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Education in public health: 2022

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Editorial: Education in public health: 2022

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Editorial on the Research Topic
Education in Public Health: 2022

Public health, by virtue of its multidisciplinary nature, presents unique challenges in the education of students, researchers, and health professionals. The requisite skills must be drawn from a diverse array of fields, taking into account the complexity of factors that influence health and the effectiveness of interventions on populations (1). This comprehensive approach necessitates an educational framework that not only imparts knowledge across various disciplines but also fosters an understanding of their interplay in addressing public health issues. Such an education system is pivotal in equipping future public health leaders with the ability to devise and implement effective strategies that are responsive to the multifaceted determinants of health.

Another crucial aspect to consider in the education of those working in the field of public health is the mitigation of health disparities and the role of diversity and inclusion, particularly for minorities or discriminated populations. To address these issues effectively in both research and practice, a range of diverse competencies and soft skills is essential. This involves not only a deep understanding of the social determinants of health but also the ability to engage with communities in a manner that respects and values their unique perspectives and experiences. Cultivating such competencies enables public health professionals to develop and implement interventions that are culturally sensitive and equitable, thereby contributing to the broader goal of reducing health inequities and enhancing the wellbeing of all segments of the population.

In recent times, the COVID-19 pandemic has highlighted gaps in education and brought to the fore new challenges that have emerged. This unprecedented health crisis has underscored the necessity for public health curricula to be agile, adaptable, and responsive to emerging global health threats. The pandemic has not only exposed vulnerabilities in public health systems but has also called for a reassessment of how we prepare health professionals to navigate complex and rapidly evolving situations (2–5). The integration of pandemic preparedness, digital health technologies, and crisis management into public health education has become imperative. Such an approach ensures that future public health professionals are better equipped with the knowledge and skills needed to effectively respond to and manage health emergencies, thereby safeguarding the health and wellbeing of populations worldwide.

The Research Topic "*Education in public health: 2022*" has received a high number of papers, indicating significant interest in this theme. It is noteworthy that many

submissions were not included in the Research Topic because they addressed health education more broadly, rather than focusing exclusively on individuals within the field of Public Health, and were therefore considered out of scope. However, this still underscores the complexity and relevance of education within the broader context of public health. The distinction between general health education and specialized education for public health professionals is crucial, yet the overwhelming response to this call for papers highlights the interconnectedness of these domains. It reflects a growing recognition of the need for comprehensive educational strategies that cater not only to public health professionals but also to the wider community, to foster a more informed and health-literate society capable of contributing to public health goals.

The Research Topic includes 17 articles, comprising nine Original Research Papers, three papers on Curriculum, Instruction, and Pedagogy, three Perspective papers, one Systematic Reviews, and one Community Case Study. The majority of the papers (13) are focused on student education, covering both the enhancement and evaluation of academic curricula and the extracurricular activities offered to students. In contrast, four papers are dedicated to the ongoing education of professionals already engaged in the workforce. This distribution underscores a predominant emphasis on shaping the foundational educational experiences of future public health professionals, while also acknowledging the importance of continuous learning and development for those actively contributing to the field. The diversity of article types reflects a comprehensive approach to exploring educational strategies, from theoretical frameworks and pedagogical innovations to empirical research and real-world applications, thereby providing a multifaceted perspective on education in public health.

An important theme is the development of what could be termed cross-disciplinary competencies or soft skills. Koh et al. discuss the integration of spirituality into public health leadership education at the Harvard Chan School. This article highlights the importance of spirituality in fostering resilience, meaning, and purpose among public health leaders, particularly in response to challenges encountered during the COVID-19 pandemic. It advocates for incorporating spiritual themes into public health leadership curricula to deepen understanding of personal motivations and enhance the ability to navigate complex public health issues. Landfried et al. examines the Master of Public Health (MPH) Capstone program at the University of North Carolina, which emphasizes community-led group projects. Utilizing a critical service-learning framework, the study assesses the program's effectiveness in benefiting students and community partners, highlighting the value of integrating service-learning into public health education. Horigian et al. research on the Learning Collaboratory at the University of Miami focuses on boosting public health students' skills through practical, community-oriented projects. The evaluation reveals enhancements in critical thinking, communication, problem-solving, collaboration, and leadership, pinpointing the strengths of a structured, collaborative approach while suggesting improvements. Dopelt et al. investigates the impact of simulation training on public health leadership skills development, employing a mixed-methods approach to evaluate how simulation scenarios enhance leadership, communication, and decision-making capabilities. The results affirm the effectiveness of simulation as a key educational tool in public health. Kedia et al. analysis of the U.S. job market for entry-level public health roles, based on a website job postings, and identifies the most sought-after skills and competencies, offering valuable insights for aligning public health education with employer expectations and workforce needs. The study of Hayes et al. presents a pedagogical framework and learning environment for the course, emphasizing public health finance and management. The population targeted includes doctoral-level students in public health. The main findings highlight the need for specialized training in public health finance and management for future leaders, addressing the gap in current academic offerings.

The theme of minority inclusion and racial issues is extensively explored in several papers. Sullivan et al. perspectivearticle discusses the "*Framing the Future 2030*" (FTF 2030) initiative by the Association for Schools and Programs of Public Health, which seeks to create a resilient educational system in public health. It emphasizes the initiative's focus on inclusive excellence through an anti-racism perspective, transformative teaching and learning methods, and broadening the field's scope. Valentim et al. evaluates a large-scale educational program's impact on prison health in Brazil, particularly its effects on the professional practices of healthcare workers in prisons. The study, through questionnaires, reveals notable improvements in professional practices and health services within prison settings, underscoring the efficacy of extensive, technology-enabled education in these contexts. Tagorda Kama leads two papers; the first examines the application of Critical Race Theory (CRT) in framing discussions around race and racism, validating experiential knowledge, and employing a social justice framework to tackle health inequities. This approach is designed to ready students for leadership roles in public health, emphasizing CRT's crucial role in addressing systemic racism and health disparities within public health education. The second paper outlines a program that engages high school students in public health education, especially those from diverse backgrounds, through various activities, coursework, and community projects. This study evaluates the program's success in sparking interest and developing public health skills among participants. Dutta and Keith investigate storytelling as a teaching method in a global health course at a Native American-Serving Non-tribal Institution, focusing on the transition from traditional to storytelling methods during the COVID-19 pandemic.

The COVID-19 pandemic has brought the issue of emergency preparedness to the forefront as a critical concern for both students and professionals in the field. Alsoukhni et al. evaluates the Public Health Empowerment Program (PHEP), focusing on its effectiveness in enhancing the skills of the public health workforce in the Eastern Mediterranean Region. The evaluation, based on Kirkpatrick's model and involving surveys of PHEP graduates and technical advisers, highlights the program's success in bolstering graduates' involvement in field epidemiology activities, especially during the COVID-19 pandemic. Fang's et al. systematic review assesses the current knowledge and skills of Chinese medical college students in managing public health emergencies and their training requirements. The findings reveal a general lack of

capability among these students to handle public health crises, despite acknowledging the importance of such skills and expressing eagerness to learn. Kaim et al. investigates the effectiveness of the TEAMS 3.0 training package designed for Emergency Medical Teams (EMTs). Utilizing a pre-post study design to evaluate self-efficacy, teamwork, and training quality among participants from diverse countries, the study reports significant improvements in self-efficacy and teamwork following the training. This research underscores the importance of specialized training programs in public health education, particularly in improving the preparedness and performance of EMTs in disaster responses. Niu et al. investigates the risk perception of COVID-19 among Chinese university students using latent profile analysis and network analysis. The study reveals two main risk perception classes among students and examines the change in their risk perception over time. The findings suggest a decline in COVID-19 risk perception, emphasizing the role of cultural influence and effective government management.

One article is about evaluation of curricula's quality: Artyukhov et al. proposes a model for the external evaluation of medical education programs' quality, integrating various indicators such as international rankings, stakeholder input, and independent agency assessments. The study focuses on assessing the quality of medical education in relation to achieving sustainable development goals. It emphasizes the importance of both internal and external quality assurance in medical education and proposes a financial model for assessing educational program quality.

Wang et al. article aims to pinpoint the challenges encountered by public health professionals in their professional development. The study employs a methodological blend of association tests and logistic regression analyses, utilizing both traditional and data screening techniques to verify the validity of the data. This rigorous approach ensures a comprehensive understanding of the obstacles that public health professional face, contributing valuable insights to the field of public health education and workforce development.

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References

1. Andrawes L, Johnson T, Coleman M. Complexity in health: Can design help support interdisciplinary Solutions? *Glob Health Sci Pract.* (2021) 9:S217–25. doi: 10.9745/GHSP-D-21-00222

2. Shelley K, Osborne NJ, Reid S, Willemsen A, Lawler S. Student reflections on an interdisciplinary pandemics course utilising systems thinking. *Health Promot J Austr.* (2022) 33:87–97. doi: 10.1002/hpja.646

3. Frenk J, Chen LC, Chandran L, Groff EOH, King R, Meleis A, et al. Challenges and opportunities for educating health professionals after the COVID-19 pandemic. *The Lancet.* (2022) 400:1539–56. doi: 10.1016/S0140-6736(22)02092-X

4. Bashkin O, Otok R, Leighton L, Czabanowska K, Barach P, Davidovitch N, et al. Emerging lessons from the COVID-19 pandemic about the decisive competencies needed for the public health workforce: a qualitative study. *Front Public Health.* (2022) 10:990353. doi: 10.3389/fpubh.2022.990353

5. Tao J, Song Z, Yang L, Huang C, Feng A, Man X. Emergency management for preventing and controlling nosocomial infection of the 2019 novel coronavirus: implications for the dermatology department. *Br J Dermatol giugno.* (2020) 182:1477–8. doi: 10.1111/bjd.19011

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Enhancing disaster response of emergency medical teams through "TEAMS 3.0" training package—Does the multidisciplinary intervention make a difference?

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Background: In the aftermath of disasters, Emergency Medical Teams (EMTs) are dispatched to help local rescue efforts. Although EMTs are recognized to be a critical component of the global health workforce, concerns have emerged over their functioning and effectiveness. For example, lack of cooperation and coordination between different EMTs has been a longstanding issue, resulting in fragmented disaster management.

Methods: To enhance the provision of EMT's field teamwork, the Training for Emergency Medical Teams and European Medical Corps (TEAMS) project was established, and later further updated with novel scenarios and exercises (i.e., adapting EMT operations to a sudden disaster; becoming a modular team; reflecting on ethical dilemmas) in the complementary "TEAMS 3.0" project where a more comprehensive training package was developed. The aim of this study was to assess the effectiveness and quality of the TEAMS 3.0 training package in four training programs in Portugal, Germany, Norway, and Turkey. Participants completed a set of questionnaires designed to assess self-efficacy, teamwork, and quality of training.

Results: The results from all the trainings suggest an improvement for both teams' self-efficacy and teamwork. The mean score among all the participants (N =100) for both the self-efficacy scale and teamwork scale was 3.217 ($\pm$0.223) prior to training and 3.484 ($\pm$0.217) following the training, and 2.512 ($\pm$1.313) prior to training and 3.281 ($\pm$0.864), respectfully, with statistically significant differences according to Wilcoxon paired samples test (p <0.05). The quality of training is regarded as high and deemed as an appropriate tool package for addressing the objectives of the project and the perceived needs of EMT disaster deployment.

Conclusion: Thus far, the TEAMS 3.0 project has demonstrated to be effective in promoting EMT teamwork capacities.

KEYWORDS

emergency medical teams, intervention, education, training program, self-efficacy, teamwork, quality of training

1. Introduction

Despite commitments and investment to better prepare for and mitigate disasters, build resilience, and address climate change, risk creation continues to outstrip risk reduction. Disasters and the underlying vulnerabilities that drive risk are increasing, with future such challenges faced only expected to magnify (1). In the event of a disaster, individuals and infrastructures are often put at unforeseen risk (2). In such contexts, the international community offers various forms of assistance, including the deployment of emergency medical teams (EMTs)—defined by the World Health Organization (WHO) as "groups of health professionals and supporting staff outside their country of origin, aiming to provide health care specifically to disaster affected populations (3).

The EMT initiative evolved in 2010, under the umbrella of the WHO with the overall objective to save lives and preserve health by enhancing surge capacity to host countries through the provision of basic and/or advanced care. EMTs include both governmental (civilian and military) as well as non-governmental teams, which as of 2022, 37 global teams have undergone complete classification (4). Synchronous to WHO efforts, in 2016 the European Union (EU) launched the European Medical Corps (EMCs) to help mobilize medical and public health teams and equipment for emergencies inside and outside the EU (5).

Despite playing a critical role in the global health workforce, previous EMT and EMC deployments have demonstrated shortcomings and concerns over their overall efficacy and functioning. Concerns have included poor preparedness and equipping to the disaster setting, failure to coordinate with response authorities and additional relief agencies, and lack of previous experience in disaster response (6). The devastating Haiti earthquake of 2010 highlighted to the global response community the adverse implications of relief that is inappropriate, uncoordinated, unsustainable, and unprepared, albeit nobly intentioned (7). Lessons have indicated that the provision of poor aid have repercussions for both the relief efforts of the affected population and may be traced among humanitarian aid workers themselves. While often overlooked, a longstanding consequence of unprepared deployment and lack of experience in the field of disaster response are the documented post-disaster rates of anxiety, depression, and trauma symptoms among humanitarian aid workers, which further diminishes the aptitude of responders to aid the community they initially intend to serve (8). To improve the quality, preparedness, and professionalism of deployed teams, it has been established that standardized guidelines and a coherent methodology to training is key.

In recognition of these elements, global health agencies have published various guidelines to improve the quality of the medical response by EMTs—most importantly the WHO's '*Classification and minimum standards for foreign medical teams in sudden onset disasters*' (9). In addition, multiple organizations and academic bodies have developed educational programs for disaster and emergency response; with a significant variation in robustness, curriculum and quality (10–14). The Training for Emergency Medical Teams and European Medical Corps (TEAMS) project is one such training program focused on operational team training for EMCs/EMTs established with the goal of enhancing the efficient provision of field team work. The projects' objective was to develop, pilot and assess a standardized, validated and cost-effective training package which was adaptable to different types of EMCs/EMTs, and was sustainable within low income countries and resource poor settings (15). The project successfully demonstrated preliminary data from two pilot training programs in Germany and Turkey in 2018, which demonstrated the effective development of a high- quality training package comprising of a set of 8 innovative blended-learning teaching materials and simulation-based exercises (see Table 1).

The TEAMS 2.O project was the simultaneous and overlapping project to that aimed to create a Training of Trainers' (ToT) program to train novice and inexperienced team leaders or training managers of EMCs/EMTs organizations on how to effectively use the TEAMS training package.

The TEAMS 3.0 project is the continuation and complementary project to the TEAMS 1.0 project, which aims to expand and revise the training package given the unceasing evolution of both the EMC and EMT initiatives. The previous TEAMS package solely addressed natural disasters (earthquake), where scenarios and exercises were lacking to train capacities to respond to outbreaks, man-made disasters and other possible cross-border risks. Additionally, only two EMT organizations had previously officially delivered the entire TEAMS training package.

Therefore, the study aimed to evaluate the follow-up TEAMS 3.0 training package involving developed new scenarios and exercises as well as new partners based on two aspects: (a) assessment of the effectiveness of the training package to increase self-efficacy and teamwork of EMT participants, and (b) assessment of the quality of the training program organized.

2. Methods

2.1. Study design

This study examined the change in 3 major constructs, i.e., team work, perceived self-efficacy, and perceived quality of training, among participants of the TEAMS Training (see following). The comparison was conducted for each participant responding to questionnaires administered before and immediately after the training.

The TEAMS 3.0 Training Package and Platform was designed to support the development and improvement of EMTs' teamwork. Through a series of three additional exercises added to the original training package (of eight exercises) which widens the scope of the package to create a more comprehensive package for personnel to train scenarios likely to be met on the field, while focusing on the importance of teamwork in achieving their goals.

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TABLE 1 Outline of TEAMS original training package consisting of 8 exercises.

#	Exercise title	Type of exercise	Phase of the humanitarian mission	Exercise scope	Learning objectives
1	Preparing for deployment	Tabletop exercise	Pre-deployment	This exercise simulates the first meeting of a group of EMT members assigned to deploy in response to an earthquake in a fictitious country. Before heading to the field, the team members introduce to each other, get information about the mission and understand what their roles will be once on the field. They will also have to work together on different preparatory tasks for the imminent deployment.	• To effectively manage the information received before deployment • To understand the different EMT staff roles within the team • To work collaboratively for the preparation of the EMT deployment
2	Arriving and setting up	Functional exercise	Arrival and set up	This exercise simulates the arrival and set up of the EMT in the field. On arrival participants will need to meet relevant authorities and organizations managing the response to the earthquake, obtain important information, and get registered to work as an EMT in the country.	• To be aware of the communication and registration procedures on arrival in the disaster area • To build up the field hospital in the target area • To get familiar with the field equipment and logistics
3	Setting priorities	Functional exercise	Operational	During this exercise the EMT members will be confronted with patients in very critical conditions and a set of resources to treat these patients. The team will have to decide how to allocate the available resources in order to save the highest number of patients. A role player will also intervene during the exercise, taking the role of a father whose child is admitted within the EMT facility in a critical state.	• To manage situations involving difficult ethical decisions • To navigate between needs and resources in a critical situation • To maximize the response to a critical event with the available resources and the network around
4	Managing operational information	Tabletop exercise	Operational	In this exercise team members will receive different sources of information related to EMT activities that they will read and consider to plan for their activities in the upcoming days. This planning will be shared with the EMT HQ office in a situation report. The team will also have to report their activities to the EMT Coordination Cell (EMTCC) using the Minimum Data Set (MDS) forms.	• To recognize the main tools for EMT data collection and reporting • To correctly analyze and interpret data related to EMT activities • To report EMT data following the established channels • To deal with emerging situations while performing other routine tasks • To work collaboratively during data collection and reporting tasks
5	Responding to a mass casualty incident	Functional exercise	Operational	In this exercise a Mass Casualty Incident (MCI) will be simulated, following an aftershock. The whole team will have to organize to deal with the high number of casualties arriving at the EMT facility, while constantly communicating with the EMTCC and other partners in the area.	• To effectively communicate with the EMTCC for situation awareness and coordination of a MCI • To appropriately organize as a team and manage a MCI
6	Adapting practice to context	Functional exercise	Operational	During this exercise EMT members will have to develop or adapt an available Standard Operating Procedure (SOP) for the management of dead bodies in the local context. Once this is ready they will be confronted with a case of a boy who arrives at the EMT facility and dies shortly after. The team will have to consider the circumstances in which the child was brought in the facility and interact pertinently with the family.	• To adapt EMT procedures to the local context • To manage a clinical emergency case of an unaccompanied minor • To show empathy and responsibility when handling sensitive cases • To understand the position of an EMT during disaster response and work collaboratively with other partners

(Continued)

TABLE 1 (Continued)

#	Exercise title	Type of exercise	Phase of the humanitarian mission	Exercise scope	Learning objectives
7	Planning the exit	Tabletop exercise	Exit	In this exercise, participants will prepare for the EMT exit by planning for the handover of medical activities, logistics, dealing with the local staff and the local community, the management of medical records and possible donations to the local facilities.	• To identify the main actions required for the EMT exit • To understand the importance of adapting the exit strategy to the local context • To effectively deal with the media during emergencies • To work collaboratively toward the exit
8	Dealing with security threats	Functional exercise	Exit	The module presents a commonly encountered case scenario in humanitarian settings and stresses the importance of both proper planning before undertaking overland road travels and adequate team/individual behavior when crossing checkpoints.	• To understand the reasons of the road movement • To plan the trip in order to reduce vulnerability during the overland road travel • To demonstrate good skills in the utilization of satellite-based navigation and other communication devices • To demonstrate good knowledge of the basic behavioral tips when crossing a checkpoint • To demonstrate good communication skills • To demonstrate good negotiation skills

CC. Disaster medicine and public health preparedness (15).

The TEAMS Training Package is comprised now of a set of eleven innovative blended-learning teaching materials and simulation-based exercises. Each exercise is a complete stand-alone module consisting of a concept note, learning objectives sheet, debriefing tool, and a variety of supplementary documents aimed at facilitating the exercise, such as injects, annexes, reading materials and gaming accessories.

The three additional exercises developed for the purpose of the TEAMS 3.0 training package include the adaptation of EMT operation to a sudden disaster (sudden outbreak or chemical incident); becoming of a modular team; and reflecting on ethical dilemmas (see Table 2).

2.2. Training of trainers course

In anticipation of the TEAMS 3.0 trainings, a Training of Trainers (ToT) Course was held in a virtual format resulting from the COVID-19 pandemic on 22–24 of November 2021. The ToT course hosted twelve trainees, training to become TEAMS trainers in the Portuguese, Norwegian, German, and Turkish trainings, which were held later throughout 2022.

The in-training trainers analyzed the eleven exercises individually to explore means to implement their purpose and intended contribution to the training EMT. They also discussed in depth gaps, challenges, and expected hardships in implementing the exercises and means to overcome them. In addition, they participated in several lectures designed to provide tools and insights to the work of a trainer, as well as to tap into experts' experience from the field.

2.3. Trainings

The trainers who underwent the ToT course eventually trained their own respective EMT trainees. These trainings were recently frontally held in all four countries (Portugal, Germany, Norway and Turkey) in the context of the TEAMS 3.0 Project. Two of the trainings (Portugal and Turkey) conducted a full training of all eleven exercises, while Germany conducted, the full training however in a modular format (where only the three new exercises were evaluated) (see Table 2), and Norway trained only the three new exercises. The training in Germany took place between 6-8th of May, 2022 and was conducted by Johanniter International Assistance, a WHO-certified Type 1 Fixed EMT. The training conducted in Portugal by Instituto Nacional De Emergência Médica- INEM, a WHO-certified Type 1 Fixed EMT took place in Lisbon, from the 26th–29th of May, 2022. The training in Turkey took place in Istanbul (Turkey) between 3rd and 6th of August 2022 and was conducted by Istanbul Medeniyet University, which overlooks the activities of a Type 2 EMT. The training in Norway was conducted from the 5th to 7th of September, 2022 in Starum, Norway by the Norwegian Directorate of Health.

2.4. Population and sample

Overall, 32 Portuguese, 18 German, 11 Norwegian, and 39 Turkish participants underwent the TEAMS 3.0 training and were included in the final analysis. In each training, there were three local trainers and the remainder of the participants were trainees (physicians, nurses, paramedics, emergency medical technicians, psychologists, logisticians, and coordinators.).There was a 100% response rate among all trainees. Among trainers, 10 out of 12 has completed the entire duration of the delivered training package, and thus two were unable to complete the post-training evaluation (and thus not included in the final dataset). All participants in the training and subsequent evaluations were EMT employees/volunteers who are expected to be deployed to disaster-affected areas upon need. All participants were invited to be included in the

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TABLE 2 Outline of three new exercises added to the original training package (See above).

Exercise #	Title	Phase of disaster response	Exercise scope	Learning objectives
A	Adapting EMT operations to a (A) sudden outbreak/(B) chemical incident	Operational Response	A. When the team has already started their activities at the EMT facility in Montyland, they will receive information about the possible outbreak of severe acute respiratory infection (SARI) in the area. With the initial data provided and others they can collect, they will have to assess emerging needs and prepare actions to install protective measures for the staff and the patients, change workflows, establish referral systems and manage suspect cases arriving at the facility. B. When the team has already started their activities at the EMT facility in Montyland, they will receive information about cluster of cases suspected to be chemical poisoning followed shortly by an explosion of chemical factory in the area. With the initial data provided and others they can collect, they will have to assess emerging needs and prepare actions to install protective measures for the staff and the patients, change workflows, establish referral systems, and manage suspect cases arriving at the facility.	A: • To perform an initial needs assessment after the suspicion of an infectious disease outbreak in the area • To plan necessary actions for the potential arrival of suspected cases to the EMT facility • To carry out the planned measures on-site (EMT temporary facility) B: • To perform an initial needs assessment after the suspicion of a chemical incident in the area • To plan necessary actions for the potential arrival of suspected cases to the EMT facility • To carry out the planned measures on-site (EMT field hospital)
B	Becoming a modular team	Operational Response	Since the work at the EMT in the facility has significantly decreased, the team will be unexpectedly requested to undertake different tasks for which they will need to split into smaller groups. Team members will need to arrange the groups and prepare to deploy in different areas for given assignments. Once deployed to new posts, they will have to deal with upcoming challenges.	• To effectively prepare for unexpected deployments • To provide respectful and targeted support to local health facilities • To reflect on possible upcoming challenges related to operational work
C	Reflecting on ethical dilemmas	Operational Response	Team members will be presented with different cases to reflect on, first individually and then as a group, and they will have to decide among different options what they think is the best way to act.	• To reflect on ethical dilemmas possibly presenting during deployments • To develop a constructive team dynamic to discuss ethical dilemmas and make decisions

evaluation's sample. Informed consent was obtained from the participants.

2.5. Variables

The TEAMS 3.0 project utilized an evaluation scheme that focused on three components: (a) Perceived teamwork, (b) Perceived self-efficacy, and (c) Training quality. The evaluation scheme was agreed upon by mutual consent and agreement of all the consortium partners. Nevertheless, given that the ToT component included within the TEAMS 3.0 Project is aimed at developing competencies and skills on an individual level the tools were adapted accordingly.

The evaluation of the TEAMS 3.0 training focused on three main constructs: *General Self-efficacy* – this index measures individual perceptions of one's capabilities to galvanize motivation, cognitive resources, and courses of action needed to meet given situational demands; *Teamwork* – this index measures individual perceptions of leadership, team dynamics, situation awareness, and effective task management; *Quality of Training* – this index measures individual perceptions of the overall efficacy, appropriateness, and contribution to the team.

2.6. Tools

Assessment of the selected variables was conducted using validated and/or original measurement tools created or adapted for the purpose of this evaluation (see complete tools in Annex 1): (a) Self-efficacy of the team was assessed using an adapted version of a scale developed by Schwarzer and Jerusalem (1995) (16); (b) Teamwork was assessed using the validated tool "Team Emergency

Assessment Measure"; (c) Quality of training was assessed using a questionnaire specifically designed for the purpose of this evaluation.

All assessment tools were based on Likert-scale measurement. Self-efficacy was assessed using a Likert-scale ranging from 1 ("Not at all true") to 4 ("Exactly true"). Teamwork was assessed with a Likert-scale ranging from 0 (Never/hardly ever) to 4 (Always/Nearly always), and Quality of Training was assessed using a Likert-scale ranging from 1 (Strongly disagree) to 5 (Strongly Agree). See Table 1 for summary of tools and evaluation methodology. See all tools in Annex 1.

In the trainings, the original English versions of the questionnaires were used (with the exception of Turkey). In Turkey, all questionnaires were translated into Turkish and were administered in Turkish. Prior to that, validation of translation accuracy was conducted by translating the Turkish version back to English by an independent translator and compared the result to the original.

2.7. Procedure

Participants were informed during the first day of the training week about the evaluation process and its purpose. Informed consent was requested from participants willing to partake in the evaluation process. The data was collected anonymously, following approval of the Ethics Committee of Sheba Medical Center (number SMC-9777-22 from October 2, 2022). Subsequently, participants were asked to complete the first round of data collection by completing the Self-efficacy and Teamwork questionnaire online *via* Google Forms platform. The information collected at this stage is considered the "pre-training" data. Upon the completion of the last day of training, participants were asked to re-take the Self-efficacy and Teamwork questionnaires, as well as to complete the Quality of Training questionnaire, once again *via* the Google Forms platform. The information collected at this stage is considered the "post-training" data. For the sake of cross-referencing the responses, participants were asked to indicate a short, designated ID tag on their questionnaire in a manner that will allow matching of the data without compromising their anonymity (see Table 3).

2.8. Statistical analysis

The statistical analysis of the results was performed using IBM's SPSS Version 27. The analysis included both descriptive and analytical methods, and the statistical tests were chosen according to variables distribution. Prior to analysis, indices were generated, and their reliability was assessed using Cronbach's Alpha.

Given the small sample size, non-parametric tests were used. Spearman correlation test (with multiple comparison correction) was used to examine correlations between continuous variables. Mann–Whitney U and Wilcoxon tests were used to compare means of independent and paired categorical variables, respectively. In all statistical analyses performed, a value of p of 0.05 or less was deemed as statistically significant. Missing data was excluded.

3. Results

Of the total sample participants (37%) were female and among trainers, 3 out of the 10. The mean participant age was 40.36 (±9.31). The average participant ages in Germany, Portugal, Turkey and Norway were 40.65 (±12.06), 41.62 (±6.82), 41.62 (±7.26), and 50.08 (±6.76), respectfully.

3.1. General self-efficacy

The Chronbach alpha of the general self-efficacy scale for before and after is $a = 0.949$ and $a = 0.920$ respectfully. In the overall sample, the mean score ($N = 100$) of the self-efficacy scale was 3.217 (±0.223) prior to training and 3.484 (±0.217) following the training. This difference is statistically significant according to Wilcoxon paired samples test ($W = 766.00$, $Z = 5.338$, $p < 0.001$). When zooming on the trainer population, the mean score for the self-efficacy scale was 3.272 (±0.13) prior to training and 3.500 (±0.01) following the training ($W = 0$, $Z = -2.803$, $p < 0.05$); while among trainees it was 3.242 (±0.10) and 3.556 (±0.08) ($W = 0$, $Z = -2.803$, $p < 0.05$) respectfully. Furthermore, differences were observed between training participants. German participants for example tended to rank their self-efficacy lower than the other participants (both before and after the training), while Turkish participants ranked their self-efficacy as highest (both before and after). The change (Δ) before and after the training in self-efficacy was highest among the Portuguese participants, whereas the Norwegian participants had mixed results in terms of self-efficacy change following the training. Although differences in participants were observed between the organization trainings, because the formats varied (full delivery of the training; only new exercises delivered; modular format), statistical significance of these differences were not computed. See complete details in Table 4.

A residual variable of the difference in self-efficacy was computed by subtracting the mean score of self-efficacy before the training from the score afterwards. Males reported higher levels of self-efficacy than women participants both before (3.275 vs. 3.218) and after the training (3.557 vs. 3.508), albeit not statistically significant ($U = 39$, $Z = 0.79373$,

TABLE 3 Summary of evaluation methodology and assessment tools used.

Assessment parameter	Participants	Proposed tool	Administration times
General self-efficacy	1. Trainees 2. Trainers	Questionnaire developed by Schwarzer and Jerusalem (1995) (16)	Before and after the training
Teamwork	1. Trainees 2. Trainers	Questionnaire based on the validated tool "Team Emergency Assessment Measure"	Before and after the training
Quality of training	1. Trainees 2. Trainers	Original questionnaire (Trainees and trainers provided their perception of training package quality in separate questionnaires)	After the training

TABLE 4 Comparison of means, and their change per item of the Self-efficacy scale between countries (N=100).

Item	Germany training (n =18)		Portugal training (n =32)		Turkey training (n =39)		Norway training (n =11)	
	Mean score after training (±SD)	Mean Change[a]	Mean score after training (±SD)	Mean Change[a]	Mean score after training (±SD)	Mean Change[a]	Mean score after training (±SD)	Mean Change[a]
1. I can always manage to solve difficult problems if I try hard enough.	3.278 (±0.46)	+0.23	3.469 (±067)	+0.12	3.667 (±0.53)	+0.18	3.4 (±0.52)	+0.23
2. If someone opposes me, I can find the means and ways to get what I want.	3.056 (±0.54)	+0.39	3.313 (±0.86)	+0.29	3.667 (±0.58)	+0.52	3.200 (±0.42)	+0.12
3. It is easy for me to stick to my aims and accomplish my goals.	3.222 (±0.55)	+0.55	3.594 (±0.56)	+0.30	3.718 (±0.51)	+0.40	3.200 (±0.42)	−0.05
4. I am confident that I could deal efficiently with unexpected events.	3.278 (±0.46)	+0.23	3.594 (±0.56)	+0.27	3.692 (±0.52)	+0.42	3.400 (±0.70)	−0.02
5. Thanks to my resourcefulness, I know how to handle unforeseen situations.	3.222 (±0.55)	+0.41	3.656 (±0.55)	+0.03	3.590 (±0.59)	+0.29	3.600 (±0.70)	+0.18
6. I can solve most problems if I invest the necessary effort.	3.389 (±0.50)	+0.29	3.742 (±0.51)	+0.41	3.821 (±0.39)	+0.36	3.400 (±0.52)	+0.10
7. I can remain calm when facing difficulties because I can rely on my coping abilities.	3.167 (±0.51)	+0.26	3.719 (±0.52)	+0.42	3.718 (±0.56)	+0.40	3.500 (±0.53)	0.003
8. When I am confronted with a problem, I can usually find several solutions.	3.278 (±0.46)	+0.33	3.719 (±0.52)	+0.34	3.692 (±0.53)	+0.18	3.400 (±0.52)	+0.07
9. If I am in trouble, I can usually think of a solution.	3.167 (±0.38)	+0.31	3.75 (±0.51)	+0.39	3.744 (±0.49)	+0.26	3.600 (±0.52)	+0.27
10. I can usually handle whatever comes my way.	3.167 (±0.62)	+0.12	3.688 (±0.54)	+0.45	3.538 (±0.64)	+0.27	3.333 (±0.50)	+0.17

[a]Change in mean score was computed by subtracting the mean score prior to training from the one after the training. [b]Scale is 1–4 for all questions.

p=0.4273) and (U=39, Z=0.793725, p=0.4240) respectfully according to the Mann–Whitney U-test.

No correlation observed between age and perception of self-efficacy was observed either before (r=0.087, p=0.364) nor after the training (r=−0.034, p=0.745), according to Spearman Correlation test.

3.2. Teamwork

The Chronbach alpha of the teamwork scale for before and after is a=0.943 and a=0.948 respectfully. In the overall sample, the mean score (N=100) of the teamwork scale was 2.512 (±1.313) prior to training and 3.281 (±0.864) following the training. This difference is statistically significant according to Wilcoxon paired samples test (W=990.0, Z=−5.777, p<0.001). When zooming on the trainer population, the mean score for the teamwork scale was 2.636 (±0.13) prior to training and 2.643 (±0.297) following the training (W=32, Z=−0.088, p=0.928); while among trainees it was 2.520 (±0.11) and 3.682 (±0.28) respectfully (W=0, Z=−2.9341, p<0.05). Furthermore, differences were observed between training participants. German participants for example tended to rank their teamwork as lower than the other participants (both before and after the training), however the change (Δ) with regard to teamwork before and after the training was highest among them. Norwegian participants tended to rate their self-efficacy as highest (both before and after the training). Although differences in participants were observed between the organization trainings, because the formats varied (full delivery of the training; only new exercises delivered; modular format), statistical significance of these differences were not computed. See complete details in Table 5.

A residual variable of the difference in teamwork was computed by subtracting the mean score of teamwork before the training from the score afterwards. Males reported higher levels of teamwork than women participants both before (2.709 vs. 2.554) and after the training (3.437 vs. 3.222). The findings were statistically significant (U=11,

TABLE 5 Comparison of means, and their change per item of the Teamwork scale between countries (N=100).

Item	Germany training (n =18)		Portugal training (n =32)		Turkey training (n =39)		Norway training (n =11)	
	Mean score after training (±SD)	Mean Change[a]	Mean score after training (±SD)	Mean Change[a]	Mean score after training (±SD)	Mean Change[a]	Mean score after training (±SD)	Mean Change[a]
1. The team leader let the team know what was expected of them through direction and command	0.333 (±0.97)	+0.29	3.625 (±0.61)	+0.49	3.538 (±0.82)	+0.07	3.909 (±0.30)	+0.49
2. The team leader maintained a global perspective	0.500 (±1.15)	+0.45	3.625 (±0.71)	+0.41	3.385 (±0.91)	+0.17	3.909 (±0.30)	+0.41
3. The team communicated effectively	2.556 (1.381)	+2.18	3.68 (±0.54)	+0.29	3.462 (±0.85)	+0.19	3.818 (±0.40)	+0.40
4. The team worked together to complete the tasks in a timely manner	2.647 (±1.498)	+2.31	3.844 (±0.45)	+0.52	3.615 (±0.67)	+0.39	3.727 (±0.47)	+0.31
5. The team acted with composure and control	2.222 (±1.396)	+1.93	3.875 (±0.34)	+0.55	3.333 (±0.74)	+0.47	3.909 (±0.30)	+0.58
6. The team morale was positive	2.111 (±1.491)	+1.77	3.875 (±0.42)	+0.44	3.667 (±0.62)	+0.28	3.909 (±0.30)	+0.33
7. The team adapted to changing situations	2.278 (±1.526)	+1.94	3.938 (±0.25)	+0.75	3.667 (±0.66)	+0.67	3.909 (±0.30)	+0.58
8. The team monitored and reassessed the situation	2.167 (±1.505)	+1.83	3.781 (±0.42)	+0.67	3.513 (±0.64)	+0.42	3.909 (±0.30)	+0.74
9. The team anticipated potential actions	1.889 (±1.568)	+1.55	3.688 (±0.47)	+0.53	3.615 (±0.67)	+0.42	3.818 (±0.40)	+0.32
10. The team prioritized tasks	2.722 (±1.364)	+2.38	3.844 (±0.45)	+0.60	3.625 (±0.54)	+0.75	3.818 (±0.40)	+0.49
11. The team followed approved standards and guidelines	2.444 (±1.294)	+2.11	3.750 (±0.44)	+0.39	3.462 (±0.68)	+0.56	3.455 (±0.52)	+0.29
12. Global rating of the team's non-technical performance (1–10 scale)	5.278 (±2.906)	+4.51	8.656 (±1.771)	+1.44	8.795 (±1.031)	+5.82	9.091 (±0.701)	+1.76

[a]Change in mean score was computed by subtracting the mean score prior to training from the one after the training; [b]Scale is 0–4 for questions 1–11. For question 12, scale is from 1–10.

Z=3.21759 p<0.001) and (U=23, Z=2.42961, p=0.0121) respectfully, according to the Mann–Whitney U-test.

In addition, item 12 on the scale prompted participants to assess the global rating of the team's non-technical performance on a scale of 1 to 10. A residual variable of the difference in responses to item 12 (global rating of the team's non-technical performance) was computed by subtracting the mean score of this item before the training from the score afterwards. The overall mean rating was 4.43 (±3.14) prior to training and 8.22 (±2.26) following the training. This difference is statistically significant according to Wilcoxon Test (W=1,605, Z=−5.771, p<0.001). For item 12, males reported a overall higher non-technical performance of the team both before (4.681 versus 3.938) after the training (8.5 versus 7.214), albeit not significant for both prior (U=958.5, Z=2.42961, p=0.2871) and after the training (U=700.5, Z=1.05842, p=0.0870). No correlation observed between age and perception of teamwork was observed either before (r=0.020, p=0.846) nor after the training (r=−0.035, p=0.737), according to Spearman Correlation test.

3.3. Quality of training

The Chronbach alpha for the quality of training index is a=0.971. The quality of training was assessed once, following the training, by all participants. Trainees (N=90) and trainers (N=10) had two different questionnaires tailored to their perspective. Within the groups of trainees, the overall mean score of the quality of training scale was 4.345 (±0.73) and among the trainers it was 4.648 (±0.16). No differences between men and women were observed. Both types of participants assess the quality of the training as equally high. The quality of training scale is not correlated with age or the self-efficacy and teamwork scales. See Tables 6, 7.

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TABLE 6 Means and percentage of top option selection per item of the quality of training questionnaire within trainees (*N*=90).

Item	Germany trainees (*n* =15)		Portugal trainees (*n*=29)		Turkey trainees (*n* =36)		Norwegian trainees (*n* =10)	
	Mean (±SD)	% of top option	Mean (±SD)	% of top option	Mean (±SD)	% of top option	Mean (±SD)	% of top option
1. The objectives of the training were clearly defined	2.70 (±1.11)	27.7%	4.78 (±0.49)	96.2%	4.55 (±0.76)	91.0%	4.55 (±0.69)	90.0%
2. Participation and interaction were encouraged in this training	3.71 (±0.99)	67.7%	5.0 (±0.00)	100%	4.58 (±0.75)	88.8%	4.82 (±0.40)	100.0%
3. The topics covered in this training were relevant to me	2.88 (±1.05)	33.3%	4.94 (±0.25)	100%	4.37 (±0.85)	94.4%	4.91 (±0.30)	100.0%
4. The structure and contents of this training were well organized and easy to follow	3.06 (±1.19)	39.9%	4.89 (±0.34)	100%	4.47 (±0.76)	94.4%	4.73 (±0.47)	100.0%
5. The training experience will be useful in my team's work	3.24 (±1.39)	50.0%	4.89 (±0.34)	100%	4.63 (±0.67)	94.4%	5.00 (±0.00)	100.0%
6. The trainer was well prepared and knowledgeable	3.41 (±1.33)	44.4%	4.91 (±0.39)	96.2%	4.68 (±0.66)	94.4%	4.91 (±0.30)	100.0%
7. The training objectives were met	3.00 (±1.17)	50%	4.78 (±0.42)	100%	4.61 (±0.68)	94.4%	4.91 (±0.30)	100.0%
8. The time allotted to the training was sufficient and appropriate	2.482 (±1.13)	50%	4.78 (±0.55)	93.1%	4.53 (±0.73)	91.6%	4.73 (±0.47)	100.0%
9. The logistics supporting this training were adequate	3.47 (±1.18)	61.1%	4.97 (±0.18)	100%	4.55 (±0.69)	94.4%	4.55 (±0.69)	90.0%
10. The training was appropriate to my level of experience and knowledge	3.35 (±1.22)	55.5%	4.78 (±0.75)	96.2%	4.55 (±0.72)	91.6%	4.82 (±0.40)	100.0%
11. Overall, this training was effective and useful to me	2.94 (±1.35)	44.4%	4.94 (±0.25)	100.0%	4.61 (±0.75)	94.4%	4.91 (±0.30)	100.0%

Note: *% of top option indicates percentage of participants that indicate a score of 4 or 5 on a 5 point Likert scale.

4. Discussion

When a disaster overwhelms the local disaster management system, emergency medical teams (alongside other agencies) are often requested to provide aid to the local community. Despite playing a critical role in the global health workforce, previous deployments of international medical teams have faced various obstacles and have documented shortcomings of the response (6, 7). For emergency medical teams to fortify its role and response to future events, it has been acknowledged that the development of guidelines and appropriate training is necessary to ensure the successful provision of medical services (17, 18).

Working with unacquainted team members of varying experience levels can prove challenging in a normal setting for any medical team—yet these challenges are exacerbated in austere environments with the need to adopt new responsibilities. To best prepare EMT members, trainings must focus on building capacities of an integrated multidisciplinary team (18). Multiple attempts to standardize the education and training of disaster and emergency responders have been made; however, the primary focus being the individual's professional development rather than competencies necessary for improved operational performance. There is a need to focus educational efforts on building capacities of EMT members to adapt their competencies to work in unfamiliar, limited resource conditions and as an integrated, close-knitted multidisciplinary team (19).

The TEAMS project development stemmed from the importance of filling the gaps in facilitating operational team training for EMTs. The TEAMS 3.0 project is the follow-up project to the previously piloted training in Germany and Turkey which found overall positive attitudes of participants toward the TEAMS Training Package. This

TABLE 7 Means and percentage of top option selection per item of the quality of training questionnaire within trainers (*N*=10).

	Mean (±SD)	% of top option
1. I have all the tools I need to train the TEAMS package	4.45 (±0.69)	90.0%
2. I feel competent in implementing a TEAMS training	4.54 (±0.68)	90.0%
3. I think my training was beneficial for the trainees	4.63 (±0.92)	90.0%
4. I think the training was beneficial for me as a trainer	4.82 (±0.41)	100.0%
5. The TEAMS training helped build trust between myself and the trainees	4.55 (±0.93)	90.0%
6. The trainees appreciated my training skills	4.55 (±0.93)	90.0%
7. I think it is important to conduct the TEAMS Training of Trainers (ToT) to improve skills and competencies of the trainers	4.91 (±0.30)	100%
8. I think the TEAMS training achieved its goals	4.73 (±0.47)	100%

Note: *% of top option indicates percentage of participants that indicate a score of 4 or 5 on a 5 point Likert scale. [a]Scale is rated as 1–5 for all questions.

project aimed to build upon the previous training package given the unceasing evolution of both the EMC and EMT initiatives through the adding of training objectives focused on building capacities to respond to outbreaks, man-made disasters and other possible cross-border risks. Additionally, the package was delivered to four additional EMTs. The data from the project indicates that participants improved their perception of self-efficacy and team work following the training, suggesting that the training has a positive effect over those perceptual constructs among participants. These findings are aligned with the previous TEAMS pilot (15) and additional studies which indicated that high fidelity simulation based training programs contribute to enhancement of teamwork (20, 21), self-efficacy (22), and leadership competencies of medical teams (23). As these components are related to the effective performance of teams throughout deployment in disaster settings, it is expected that the training package will improve the operational preparedness of EMTs.

Previous findings from training programs indicated the gender is often correlated with teamwork levels or self-efficacy, where men often exhibited higher self-efficacy, while women higher levels of team work (24–26). In contrast to previous work, gender was not found to correlate with self-efficacy or teamwork prior or following the training program.

Finally, the adapted and updated TEAMS training package appears to be similarly a high-quality product, which was considered by its users to be a useful and appropriate tool for addressing their perceived needs. While in all four trainings the assessment parameters improved following the delivery of the training package, differences were observed per each country. For example, the results suggest that German participants were more critical toward the TEAMS training compared to the other participants. It is possible that this is resulting from the format of the German training, which was conducted modularly in tandem to additional external trainings of the organization. The differences observed among all four EMTs may be resulting from the diversity of their cultural characteristics, type and size of EMT, mix of personnel, and experience in previous deployments to disasters, or resulting from the way in which the training package was delivered (in full, modularly, only three new exercises). Despite these differences, as improvements were observed among all settings, this suggests that the training programs may be beneficial among various EMTs and in varying formats that can be adapted to needs of the respective EMT. The TEAMS training may need to be adapted into the cultural and sociological context of each country prior to the implementation of the training, which may further enhance the results. The complete package including the newly developed exercises are available online, free-of-charge, to any relevant stakeholder interested in implementing it in the local EMT context. By creating a validated, cost-effective training tool for EMTs, TEAMS project further contributes to the global effort to promote a higher quality EMT system through providing a more standardized training protocol that may ultimately benefit the way in which health delivery is provisioned to affected populations, in line with the EMT WHO vision.

4.1. Limitations

The study has several limitations which must be considered. First, the study employs a questionnaire that might be subject to reporting-bias due to the fact that it measures construct through reporting, rather than objective assessment. Second, the study was performed among EMTs, primarily in Europe. Though it stands to reason that the conclusions may be generalized and applicable to other EMT organizations in different societies, this should be made with caution, preferably following further study to evaluate the applicability of the findings in additional EMT organizations outside of Europe. Third, for practical considerations, the tool used assessed only the construct reported and cannot control for possible confounders associated with these constructs. Additionally, several factors must be taken into account when considering the findings of the study including but not limited to the language in which the evaluation tool was administered (English, as a non-native language for three of the participating EMTs, while in Turkey, Turkish was utilized); differences resulting from heterogeneity (e.g., professional status/seniority levels etc.) of groups in the respective countries; as well as differences in training contexts between the varied countries.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by Sheba Medical Center (number SMC-9777-22 from October 2, 2022). The patients/participants provided their written informed consent to participate in this study.

Author contributions

AK and MB conceived the study, provided statistical advice on study design, and analyzed the data. NC, MB, KP, and LR supervised the conduct of the trial and data collection. AK undertook recruitment of participating centers and patients and managed the data, including quality control. NC chaired the data oversight committee. AK drafted the manuscript and takes responsibility for the paper as a whole. All authors contributed substantially to its revision.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2023.1150030/full#supplementary-material

References

1. Coronese M, Lamperti F, Keller K, Chiaromonte F, Roventini A. Evidence for sharp increase in the economic damages of extreme natural disasters. *Proc Natl Acad Sci*. (2019) 116:21450–5. doi: 10.1073/pnas.1907826116

2. Goldschmidt KH, Kumar S. Humanitarian operations and crisis/disaster management: a retrospective review of the literature and framework for development. *Int J Disaster Risk Reduct*. (2016) 20:1–3. doi: 10.1016/j.ijdrr.2016.10.001

3. World Health Organization. (2016). Classification and minimum standards for emergency medical teams. In *Classification and minimum standards for emergency medical teams*.

4. von Harbou K, Sawanpanyalert N, Trewin A, Brown R, Prawira J, Bhola AK, et al. Strengthening emergency preparedness through the WHO emergency medical team mentorship and verification process: experience from Thailand. *WHO South-East Asia J Public Health*. (2020) 9:32–6. doi: 10.4103/2224-3151.282993

5. Haussig JM, Severi E, Baum JH, Vanlerberghe V, Laiseca A, Defrance L, et al. The European medical corps: first public health team mission and future perspectives. *Eur Secur*. (2017) 22:30613. doi: 10.2807/1560-7917.ES.2017.22.37.30613

6. Burkle FM Jr, Lyznicki JM, James JJ. Cross-disciplinary competency and professionalization in disaster medicine and public health. In: *Handbook for Pandemic and Mass-Casualty Planning and Response*. Amsterdam: IOS Press (2012). 72–83.

7. van Hoving DJ, Wallis LA, Docrat F, De Vries S. Haiti disaster tourism—a medical shame. *Prehosp Disaster Med*. (2010) 25:201–2. doi: 10.1017/S1049023X00008001

8. Cranmer HH, Biddinger PD. Typhoon Haiyan and the professionalization of disaster response. *N Engl J Med*. (2014) 370:1185–7. doi: 10.1056/NEJMp1401820

9. World Health Organization. Registration and coordination of foreign medical teams responding to sudden onset disasters: the way forward. World Health Organization. (2013). Available at: http://www.who.int/hac/global_health_cluster/fmt_way_forward_5may13.pdf (Accessed December 1, 2022).

10. Jacquet GA, Obi CC, Chang MP, Bayram JD. Availability and diversity of training programs for responders to international disasters and complex humanitarian emergencies. *PLoS Curr*. (2014) 23:6. doi: 10.1371/currents.dis.626ae97e629eccd4756f20de04a20823

11. Burkle FM, Walls AE, Heck JP, Sorensen BS, Cranmer HH, Johnson K, et al. Academic affiliated training centers in humanitarian health, part I: program characteristics and professionalization preferences of centers in North America. *Prehosp Disaster Med*. (2013) 28:155–62. doi: 10.1017/S1049023X12001690

12. Wiesner L, Kappler S, Shuster A, DeLuca M, Ott J, Glasser E. Disaster training in 24 hours: evaluation of a novel medical student curriculum in disaster medicine. *J Emerg Med*. (2018) 54:348–53. doi: 10.1016/j.jemermed.2017.12.008

13. Ciottone GR, Biddinger PD, Darling RG, Fares S, Keim ME, Molloy MS, et al. *Ciottone's Disaster Medicine*. Amsterdam: Elsevier Health Sciences (2015).

14. Khorram-Manesh A, Ashkenazi M, Djalali A, Ingrassia PL, Friedl T, von Armin G, et al. Education in disaster management and emergencies: defining a new European course. *Disaster Med Public Health Prep*. (2015) 9:245–55. doi: 10.1017/dmp.2015.9

15. Bodas M, Peleg K, Adini B, Ragazzoni L. Training package for emergency medical TEAMS deployed to disaster stricken areas: has 'TEAMS'Achieved its goals? *Disaster Med Public Health Prep*. (2022) 16:663–9. doi: 10.1017/dmp.2020.359

16. Schwarzer R, Jerusalem M. "Generalized self-efficacy scale,"in *Measures in health psychology: A user's portfolio*. eds. J. Weinman, S. Wright, and M. Johnston (Causal and control beliefs) (1995). 35:37.

17. Djalali A, Ingrassia PL, Corte FD, Foletti M, Gallardo AR, Ragazzoni L, et al. Identifying deficiencies in national and foreign medical team responses through expert opinion surveys: implications for education and training. *Prehosp Disaster Med*. (2014) 29:364–8. doi: 10.1017/S1049023X14000600

18. Camacho NA, Hughes A, Burkle FM Jr, Ingrassia PL, Ragazzoni L, Redmond A, et al. Education and training of emergency medical teams: recommendations for a global operational learning framework. *PLoS Curr*. (2016) 21:8. doi: 10.1371/currents.dis.292033689209611ad5e4a7a3e61520d0

19. Albina A, Archer L, Boivin M, Cranmer H, Johnson K, Krishnaraj G, et al. International emergency medical teams training workshop special report. *Prehosp Disaster Med*. (2018) 33:335–8. doi: 10.1017/S1049023X18000262

20. Lateef F. Simulation-based learning: just like the real thing. *J Emerg Trauma Shock*. (2010) 3:348–52. doi: 10.4103/0974-2700.70743

21. Shapiro MJ, Morey JC, Small SD, Langford V, Kaylor CJ, Jagminas L, et al. Simulation based teamwork training for emergency department staff: does it improve clinical team performance when added to an existing didactic teamwork curriculum? *BMJ Qual Safety*. (2004) 13:417–21. doi: 10.1136/qshc.2003.005447

22. Nishisaki A, Keren R, Nadkarni V. Does simulation improve patient safety?: self-efficacy, competence, operational performance, and patient safety. *Anesthesiol Clin*. (2007) 25:225–36. doi: 10.1016/j.anclin.2007.03.009

23. Lewis R, Strachan A, Smith MM. Is high fidelity simulation the most effective method for the development of non-technical skills in nursing? A review of the current evidence. *Open Nurs J*. (2012) 6:82–9. doi: 10.2174/1874434601206010082

24. Bucholz EM, Sue GR, Yeo H, Roman SA, Bell RH, Sosa JA. Our trainees' confidence: results from a national survey of 4136 US general surgery residents. *Arch Surg*. (2011) 146:907–14. doi: 10.1001/archsurg.2011.178

25. Vajapey SP, Weber KL, Samora JB. Confidence gap between men and women in medicine: a systematic review. *Curr Orthop Prac*. (2020) 31:494–502. doi: 10.1097/BCO.0000000000000906

26. Meurling L, Hedman L, Sandahl C, Felländer-Tsai L, Wallin CJ. Systematic simulation-based team training in a Swedish intensive care unit: a diverse response among critical care professions. *BMJ Qual Safety*. (2013) 22:485–94. doi: 10.1136/bmjqs-2012-000994

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MPH Capstone experiences: promising practices and lessons learned

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To ensure workforce readiness, graduate-level public health training programs must prepare students to collaborate with communities on improving public health practice and tools. The Council on Education for Public Health (CEPH) requires Master of Public Health (MPH) students to complete an Integrative Learning Experience (ILE) at the end of their program of study that yields a high-quality written product demonstrating synthesis of competencies. CEPH suggests written products ideally be "developed and delivered in a manner that is useful to external stakeholders, such as non-profit or governmental organizations." However, there are limited examples of the ILE pedagogies and practices most likely to yield mutual benefit for students and community partners. To address this gap, we describe a community-led, year-long, group-based ILE for MPH students, called Capstone. This service-learning course aims to (1) increase capacity of students and partner organizations to address public health issues and promote health equity; (2) create new or improved public health resources, programs, services, and policies that promote health equity; (3) enhance student preparedness and marketability for careers in public health; and (4) strengthen campus-community partnerships. Since 2009, 127 Capstone teams affiliated with the Department of Health Behavior at the Gillings School of Global Public Health at The University of North Carolina at Chapel Hill have worked with seventy-nine partner organizations to provide over 103,000 h of in-kind service and produce 635 unique products or "deliverables." This paper describes key promising practices of Capstone, specifically its staffing model; approach to project recruitment, selection, and matching; course format; and assignments. Using course evaluation data, we summarize student and community partner outcomes. Next, we share lessons learned from 13 years of program implementation and future directions for continuing to maximize student and community partner benefits. Finally, we provide recommendations for other programs interested in replicating the Capstone model.

KEYWORDS

Capstone, culminating experience, service-learning, community partner, graduate public health education, MPH, accreditation, integrative learning experience

Introduction

Responding to public health crises like the COVID-19 pandemic requires a public health workforce skilled in community partnership (1, 2). Schools and programs of public health are thus charged with designing community-engaged learning experiences while also satisfying accreditation criteria (3).

The accrediting body for schools and programs of public health, the Council on Education for Public Health (CEPH), requires Master of Public Health (MPH) students to complete an Integrative Learning Experience (ILE), which represents a culminating experience near the end of their program of study. The ILE must yield a high-quality written product (e.g., "program evaluation report, training manual, policy statement, take-home comprehensive essay exam, legislative testimony with accompanying supporting research, etc.") that demonstrates synthesis of a set of competencies (2). Such products may be generated from practice-based projects, essay-based comprehensive exams, capstone programs, or integrative seminars (2). CEPH guidelines suggest ILE written products ideally be "developed and delivered in a manner that is useful to external stakeholders, such as non-profit or governmental organizations" (2).

Within this paper, we describe promising practices employed within a community-led, group-based, year-long, critical service-learning course, called Capstone, for MPH students within the Department of Health Behavior at the Gillings School of Global Public Health (Gillings) at The University of North Carolina at Chapel Hill (UNC-CH) (4). We explain the specifics of Capstone's staffing model; project recruitment, selection, and matching processes; course format; and assignments, all of which are designed to promote mutual benefit for students and community partners. Using internal and school-level course evaluations, we present findings on student and community partner outcomes. Next, we reflect on lessons learned from 13 years of implementation experience and suggest future directions for Capstone programming. Finally, we share recommendations for other programs interested in replicating Capstone. We hope the information presented in this paper will benefit other programs interested in ILEs that have mutual benefit for students and community partners.

Pedagogical framework

By design, Capstone is a critical service-learning course. Service-learning pedagogies and practices vary widely. Essential elements of service-learning include community-engaged activities tied to learning goals and ongoing reflection (5–7). The literature documents wide-ranging benefits students gain from service-learning programs such as improved critical thinking skills as well as stronger leadership, communication, and interpersonal skills (5, 8). Participation in service-learning courses promotes program satisfaction (9), academic achievement (5, 8–10), and job marketability (9, 11) among students. Finally, service-learning experiences enhance students' civic engagement (2, 4, 7), cultural awareness, and practice of cultural humility (8, 12).

Despite these benefits, service-learning implementation challenges are well documented. Service-learning courses require significant resources to cover program expenses and staffing dedicated to developing and maintaining community partner relationships (7, 12–15). In addition, the academic calendar may not align with community partners' timelines (5, 14, 16). Students and community partners have additional responsibilities and competing priorities outside coursework, thus creating variable levels of engagement across program participants (13–15, 17, 18). In cases where students have nascent project management skills and limited professional experience (9, 10, 13), it can be difficult to achieve mutual benefits among students and community partners.

A prominent debate within the field is the degree to which service-learning projects perpetuate the status quo or facilitate social change. Specifically, researchers question which elements of service-learning best create the conditions for student learning and positive community transformation (5, 19–21). To provide a framework for this debate, Mitchell (5) differentiates between "traditional service-learning" and "critical service-learning." Traditional service-learning is often critiqued for prioritizing student learning needs over benefits to the community (5, 21). In contrast, critical service-learning is explicitly committed to social justice (5). Key elements of a critical service-learning approach include: (1) redistributing power among members of the partnership; (2) building authentic relationships (i.e., those characterized by connection, mutual benefits, prolonged engagement, trust, and solidarity); and (3) working from a social change perspective (5).

Most service-learning program descriptions within public health training do not reference either a traditional or critical service-learning framework (8, 9, 11, 13, 14, 22, 23). Several published programs align with a traditional service-learning model, due to the exclusive focus on student benefits and the absence of an explicit commitment to power sharing, authentic partnerships, or social change. For example, Schober et al. (24) underscore service-learning as an effective means to train a younger workforce to address complex public health issues. Gupta et al. (8) describe the importance of self-reflection activities for personal growth and skill development, structured within a service-learning program for undergraduate students enrolled in a community nutrition course. While these courses contain many of the best practices in service-learning, including reflection, they discuss student outcomes without promoting or evaluating social change (6).

The literature also cites programs and courses that include elements of critical service-learning but do not use critical service-learning terminology. For example, a service-learning program at the University of Connecticut outlines how students contribute to structural changes and social progress through policy development and implementation as part of their applied practice experience, which culminates with a presentation to the state legislature (23). Additionally, Sabo et al. (12) describe a service-learning course at the University of Arizona oriented toward social justice, as the course is "modeled on the reduction of health disparities through exploration, reflection, and action on the social determinants of health" through strong community-academic partnerships across urban, rural, and indigenous settings. These examples highlight commitment to social progress, community impact, and equitable collaboration without overtly applying the language of critical service-learning.

A small number of service-learning practitioners define their programs explicitly as critical-service learning. Mackenzie et al. (13) document the benefits of a critical service-learning experience for undergraduate public health students, endorsing it as a "feasible, sustainable" high-impact practice. In their model, students partner with community organizations to address social determinants of health; analyze and challenge power dynamics and systems of oppression; and gain skills. As evidence of power sharing and social

change, the authors document that communities have continued their partnerships with the university due to the expansive reach and impact of their collaborations. Authentic relationships were also developed as students gained a stronger sense of commitment to communities. Derreth and Wear (25) describe the transition to an online critical service-learning course as universities grappled with changing instructional formats with the onset of the COVID-19 pandemic. In this course, public health students collaborated with Baltimore residents to create evaluation tools while participating in reflective activities. As evidence of critical service-learning, they documented students' changed perspectives, ongoing commitment to collaborate with residents after the course, and development of strong connections with faculty. These courses show the possibilities of critical service-learning ILEs. Detailed descriptions of program structures are needed for interested faculty to replicate best practices. To assist others with adopting or adapting elements of critical service-learning ILEs, this paper provides specifics about Capstone programming.

Learning environment

Program overview

Community-Led Capstone Project: Part I and II (Capstone) is a graduate-level course situated within UNC-CH's Gillings' Department of Health Behavior (Department). The Department developed Capstone in response to faculty concerns about the variable investment in and quality of master's papers (26), coupled with a desire to design a practice-based culminating experience driven by community partners' needs, interests, and concerns. Capstone satisfies CEPH ILE requirements and serves as the substitute for UNC-CH's master's thesis requirement for students in the Health Behavior (HB) and Health Equity, Social Justice, and Human Rights (EQUITY) MPH concentrations. The overwhelming majority of students in these two concentrations are full-time residential students pursuing an MPH within a two-year time frame, though there are a few students who are enrolled in a dual degree program to earn their MPH alongside a Master of Social Work (MSW) or Master of City and Regional Planning (MCRP) within 3 years.

During this year-long course, which occurs during the second year of the MPH program, students synthesize and apply their MPH training to community-designed public health projects. Supplementary material A, B include a list of HB and EQUITY required courses and their sequencing. The specific competencies applied and assessed during Capstone are listed in Supplementary material C. Each team of four to five Capstone students works with a partner organization and its constituents to produce a set of four to six deliverables (i.e., tangible products). Deliverables are based on the partner organization's self-identified needs. This community-led approach prioritizes partners' interests and gives students an opportunity to do applied public health work on a range of topics with a variety of organization types. Figure 1 details the tasks and timelines entailed in this programming. Table 1 presents information from selected projects that showcase the range of partner organizations, activities, and deliverables present in Capstone. Capstone's specific objectives are to (1) increase capacity among students and partner organizations to address public health issues and promote health equity; (2) create new or improved public health resources, programs, services, and policies that advance health equity; (3) enhance student preparedness and marketability for public health careers; and (4) strengthen campus-community partnerships.

Personnel and resources

Capstone involves numerous constituents and requires dedicated resources. Each partner organization is represented by one or two preceptors (i.e., main points of contact from the partner organization) who provide a vision for, direct, and supervise the project work. Preceptors spend 2–4 h per week meeting with students, providing guidance on the work, and reviewing deliverables. Student teams are responsible for managing Capstone relationships, processes, and tasks and producing deliverables that enhance their skillsets while meeting their partner organization's needs. They are expected to spend 6–9 h per week, outside of class time, on Capstone. One faculty adviser per project provides technical expertise and ensures that each team's project deliverables meet UNC-CH's master's thesis substitute and CEPH ILE requirements. Faculty advisers spend 30 min to an hour a week providing feedback and guidance on the project work. Advising a Capstone team every other year is a service expectation for Department faculty. The teaching team, which is comprised of course instructor(s) and teaching assistants (TAs), recruits the partner organizations and oversees and supports the Capstone experience. Each instructor manages ten to eleven teams (typically between forty and fifty students) and receives coverage equal to twenty percent full-time equivalent per semester. TAs, who are HB or EQUITY MPH alumni and/or HB doctoral students, each work with five to six teams and are expected to work 18 h a week on Capstone. TAs provide feedback on draft deliverables, direct students to resources, and help problem solve. Departmental administrative staff provide additional support to coordinate expenses associated with the program such as project-related travel, equipment, services (e.g., transcription, interpretation, translation), books, software, incentives, postage, and other costs. Capstone students pay a one-time $600 field fee to cover a portion of the expenses associated with Capstone. This fee was approved by the University and is paid when a student enrolls in the first semester of the course.

Project recruitment, selection, and matching

Recruitment

The process of setting up Capstone projects takes 9 months of advance planning (see Figure 1). The Capstone teaching team solicits project proposals in December for the upcoming academic year. They send email solicitations with Capstone overview information (Supplementary material D) and the project proposal form (Supplementary material E) to current and former Capstone partner organizations, hosts of other experiential

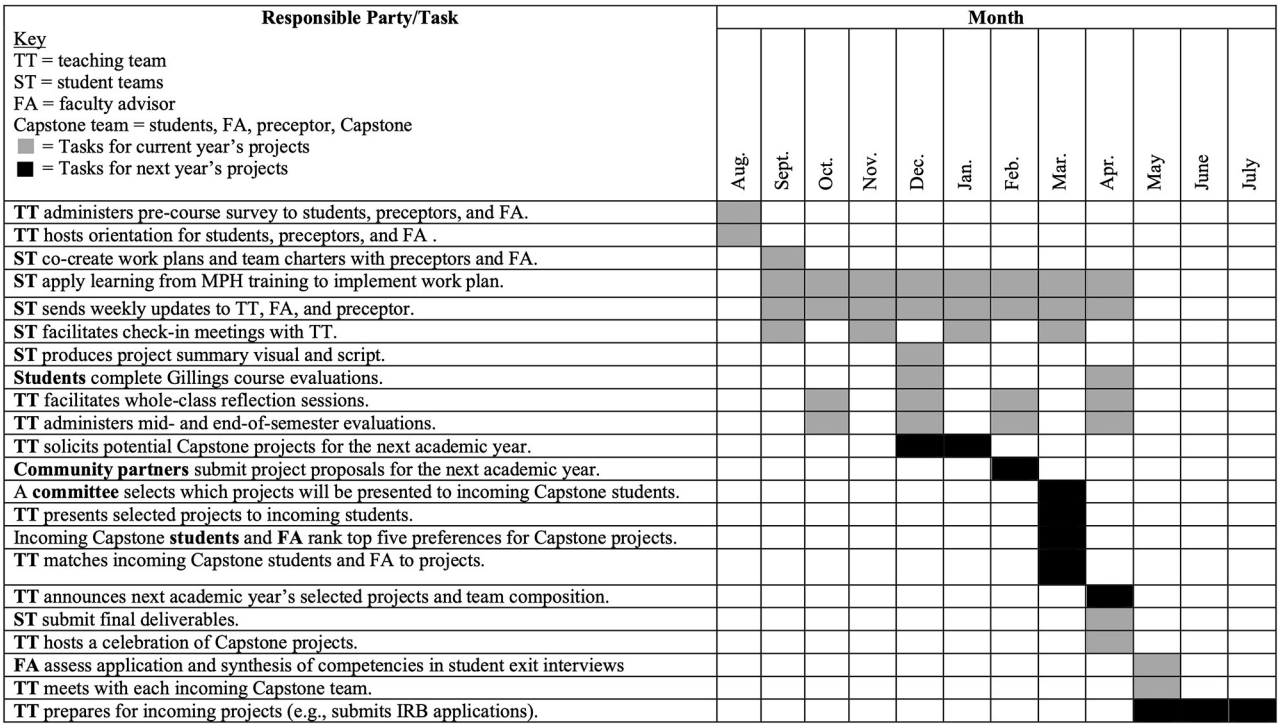

FIGURE 1
Gantt chart illustrating major Capstone activities and timeline.

education experiences, and department listservs. The Capstone teaching team encourages recipients to share the solicitation information with their networks. Prospective partners' first step is to have an informational interview with a Capstone instructor to discuss their project ideas and to receive coaching on elements of successful proposals. These interviews are also an opportunity for the teaching team to assess an organization's capacity to support a student team and gain insights on the prospective preceptors' communication, work, and leadership styles. The teaching team invites prospective partners to submit draft proposals for their review prior to the proposal deadline. Prospective partners submit their finalized project proposals and a letter of support from their leadership to the teaching team by email in early February.

Selection

The teaching team typically receives twenty project proposals. To determine which projects will be presented to incoming Capstone students, a committee consisting of the teaching team and student representatives from the current Capstone class reviews and scores proposals based on the criteria listed in Table 2. Reviewers score each criterion on a scale of one through five with one being the lowest score and five being the highest score. The fifteen community partners with the highest scoring proposals are invited to share their ideas with students via a recorded seven-minute project overview presentation.

Matching

Incoming Capstone students have 1 week in March to review the proposal materials and rank their top five project preferences. Based on student rankings, the teaching team assembles project teams using the following guiding principles: (1) give as many students as possible their top-ranked project; (2) promote diversity of concentrations and experience levels within student teams; and (3) ensure the number of students per team is appropriate for the proposed scope of work. Once the student teams are assembled, the teaching team matches faculty advisers to projects based on faculty's interests and expertise. The teaching team announces final team composition in early April. The course instructor(s) facilitates an initial meeting with each student team, their preceptor(s), and their faculty adviser in May to build community, clarify expectations, and orient the student team to their project work and partner organization. Project work formally begins in August of the following academic year.

Course format

Capstone spans the fall and spring semesters (fifteen weeks per term) and is three credits per term. To help students, preceptors, and faculty advisers become familiar with expectations for Capstone, the teaching team reserves the first 4 weeks of the fall semester for onboarding. As part of the onboarding process, each team cocreates a team charter (Supplementary material F) to promote authentic relationships between students and their community partners and to clarify

TABLE 1 Sample projects.

Partner organization	Project title	Deliverables
Campus and Community Coalition to Reduce the Negative Impacts of High Risk Drinking, Chapel Hill Downtown Partnership (2018-2019)	*Measuring and Sharing the Efforts of the Campus and Community Coalition*	1. Data analysis report 2. Communication plan 3. Qualitative analysis report 4. Evaluation recommendations report
Chapel Hill-Carrboro City Schools (2016-2017)	*Needs Assessment for Community Mental Health Among Frank Porter Graham Bilingüe Staff and Parents in Chapel Hill, North Carolina*	1. Interview and Focus Group Guides 2. Formative Research Report 3. Community Resource Guide 4. Recommendations Report
Chatham County Council on Aging* (2019-2020)	*Implementation, Evaluation, and Resource Development for Chatham County Council on Aging's Community Ambassador Program*	1. Community ambassador resources 2. Monitoring report 3. Evaluation toolkit 4. Communications workplan
El Pueblo, Inc.* (2011-2012)	*Strengthening El Pueblo's Sexual and Reproductive Health Program for Latino/a Youth in North Carolina*	1. Funding guide 2. Community Assessment Report 3. Revised Curriculum 4. Strategic Guide
North Carolina Harm Reduction Coalition* (2012-2013)	*Preventing Unintentional Drug Overdose in North Carolina by Advocating for Policies that Support Overdose Prevention*	1. Literature review summary fact sheet 2. Policy recommendations 3. Presentation 4. Legislative summit
Rural Opportunity Institute* (2021-2022)	*Evaluating an Adaptation of the Social Accelerator Model for Rural Public Institutions Focused on Healing Trauma and Building Resilience*	1. Interview guides 2. Interview codebook and summary code report 3. Manuscript
Southern Coalition for Social Justice (2021-2022)	*Analyzing and Evaluating Strategies to Decriminalize Adolescence and Developing a Participatory Research Plan to Work with Youth Impacted by the Criminal Legal System*	1. Landscape analysis 2. Interview guide and transcripts 3. Program plan 4. Partner case studies and recommendations report 5. External report

*Capstone partner organization that has hosted multiple teams.

TABLE 2 Project selection criteria.

Selection criteria	What to look for
Project Scope	1. Is there a clear scope of work with tangible outputs that have clear purposes and steps, are interrelated, and connect to one overarching project goal? 2. Is the proposed scope of work appropriate and feasible for a team of students within the academic timeline? 3. Is there sufficient time and effort allocated to onboarding students to the project work and partner organization? 4. Will the project facilitate knowledge and skill acquisition and application that will enhance students' readiness for public health careers?
Organizational Capacity	1. Does the preceptor have demonstrated time, expertise, and interest to mentor public health students? 2. Does leadership at the partner organization demonstrate support for the project?
Equity	1. Does the partner organization demonstrate commitment to promoting health equity and social justice? 2. Were the people who will be most impacted by the project work involved in the project design? 3. Will students engage with the intended beneficiaries of the work?
Impact	1. Does the project have strong potential to make a meaningful difference in the health of the beneficiary communities and populations?

expectations for working together. They also produce a workplan (Supplementary material G), which elaborates on the partner's project proposal, to outline the team's scope of work. After the onboarding weeks, the teaching team meets with each student team during class three times per semester to receive project updates and provide support. The teaching team facilitates two whole-class reflection sessions per semester to help students make meaning of their experiences. All other Capstone class sessions are protected time for student teams to meet and work on their projects.

Course assignments

Capstone assignments are designed to ensure a mutually beneficial experience for students and community partners. They are also intended to facilitate critical reflection, yield high-quality written products, assess synthesis of selected competencies, and evaluate how students steward the relationships, processes, and tasks associated with their projects. To share power and collect their unique perspectives, preceptors and faculty advisers participate in the grading

process. Tables 3, 4 summarize course assignments, their descriptions, whether they are completed and assessed at the individual or group level, and the party responsible for assessing the assignment.

Program evaluation

This study was exempted by UNC Chapel Hill's Institutional Review Board (IRB 21-0510) as it fell under the exemption category of "educational setting," which includes research on instructional approaches and their effectiveness. To abstract and analyze data on the number of students who have completed Capstone, hours they dedicated to Capstone activities, and deliverables they produced, two authors referenced course records starting in 2009. The teaching team collects students' and preceptors' perspectives on Capstone through mid- and end-of-semester evaluations using Qualtrics. Gillings administers end-of-semester course evaluations that provide additional insights into student outcomes.

Core aspects of Capstone (e.g., program aims and our staffing model) have remained constant over the past 13 years. However, a variety of lessons learned and external conditions have led to program changes. Use of class time and project recruitment, selection, and matching processes have evolved to further promote health equity and maximize mutual student and community partner benefit. The EQUITY concentration joined Capstone in 2020, which led to changes in team composition. Furthermore, the COVID-19 pandemic necessitated a transition from in-person to a remote course format in academic years 2020 and 2021, introducing the opportunity to work with organizations across the nation.

To present qualitative findings that reflect our most current programming, two authors analyzed data from academic years 2020 and 2021. Ninety-eight students and twenty-two preceptors participated in Capstone during that time. The teaching team received a 100 percent response rate to their mid and end-of semester evaluations completed by students and preceptors and a seventy-two percent response rate to the Gillings-administered student course evaluations during academic years 2020 and 2021.

To identify key outcomes for students and preceptors, two authors completed a thematic analysis of evaluation responses (27, 28). For students, they analyzed eighty-eight qualitative responses to the Gillings' course evaluation question, "What will you take away from this course?" Next, the two authors familiarized themselves with the data and inductively created a thematic codebook. To ensure consistent code use, they simultaneously coded approximately twenty-five percent of transcripts, coded remaining transcripts separately, and flagged any transcripts that required further review. To identify key preceptor outcomes, the two authors analyzed the twenty-two responses to the spring end-of-semester evaluation question, "Please describe how, if at all, your organization benefited from hosting a Capstone team." They reviewed the responses to inductively create a codebook and then worked together to apply codes to all quotations to identify thematic groups.

Results

Student outcomes

Since its inception in 2009, 574 students across 127 teams have completed the Capstone program, provided over 103,000 h of in-kind service, and produced more than 635 deliverables with our partner organizations. Between 2020–2022, ninety-eight students completed the current version of Capstone, provided 35,280 h of in-kind service, and produced eighty deliverables. Through our thematic analysis of course evaluation data, we identified two overarching themes for student outcomes: skill development and satisfaction.

Skill development, students' greatest takeaway from Capstone, was reflected in fifty-three percent ($n = 47$) of students' qualitative evaluation responses. Students directly named interpersonal skills (e.g., communication, teamwork, collaboration, conflict management, facilitation, community engagement, coalition building) the most. They also commented on acquisition of technical skills (e.g., project management; content development; and data collection, analysis, and reporting). In most cases, students named a mix of skills in their responses. For example, one student said they will take away:

> Skills developed on the project, including survey design and implementation as well as strategies for engaging with community advisory board authentically and successfully. Shared skills among team will stick with me as well – project management, inter–team communication, strategies for setting clear expectations and holding each other accountable.

Skill development helps achieve Capstone's course aims of increasing students' capacity to address public health issues and promote health equity while enhancing their preparedness and marketability for public health careers.

Twenty-four students commented on their satisfaction with the experience when sharing key takeaways. Seven students expressed dissatisfaction, primarily with course assignments, while seventeen others remarked on their satisfaction with the experience, particularly the applied format of the course. For example, one student shared,

> This Capstone project really was special. Having a community partner that demonstrated how helpful these projects would be and work with us to shape the deliverables was such a unique process. I wish we had more community–focused classes like this one.

In alignment with Capstone's objective of strengthened campus-community partnerships and CEPH ILE goals, these Capstone partnerships afford students the opportunity to see the impacts of their learning and create meaningful work that benefits external constituents.

Community partner outcomes

Over the past 13 years, we have partnered with seventy-nine organizations representing a variety of sectors including healthcare,

TABLE 3 Capstone assignments for the fall semester.

Assignment	Description	Assessment type	Assessed by	Percent of final course grade
Pre-course survey	Qualtrics survey distributed by the teaching team to students, preceptors, and faculty advisers to create a shared understanding of the team members' expectations for the Capstone experience.	Individual	TT	0%
Weekly updates	Email sent by the student team using a template prescribed by the teaching team to create communication efficiencies and systematically keep the teaching team, preceptors, and faculty advisers updated on students' project work.	Group	TT	10%
Teaching team check-in meeting facilitation	Thirty-minute meeting facilitated by the student team to build community with, update, and receive support from the teaching team.	Group	TT	10%
Team charter	Microsoft Word document following a template (Supplementary material F) provided by the teaching team used to promote authentic relationships between Capstone students, their preceptor(s), and their faculty adviser by clarifying expectations for working together.	Group	TT	10%
Work plan	Microsoft Word document following a template (Supplementary material G) provided by the teaching team that clarifies the Capstone student team's scope of work by outlining the project deliverables, their steps, and their timeline.	Group	TT	10%
Project Summary Visual and Script	Power point slide and accompanying narrative text used to explain the team's project work and its intended impacts in preparation for being on the job market.	Group	TT	5%
Mid and End-of Semester Evaluations	Qualtrics surveys administered by the teaching team to students, preceptors, and faculty advisers to reflect on accomplishments and challenges and assess roles, responsibilities, processes, and deliverables.	Individual	TT	0%
Project management	Assessment of teams' management of Capstone project relationships, processes, and tasks.	Group	TT, P, FA	35%
Project participation	Assessment of individuals' contributions to the Capstone project.	Individual	TT, P, FA	20%

TT, Teaching Team; P, Preceptor; FA, Faculty Adviser.

TABLE 4 Capstone assignments for the spring semester.

Assignment	Description	Assessment type	Assessed by	Percent of final course grade
Weekly updates	Email sent by the student team using a template (Supplementary material D) prescribed by the teaching team to create communication efficiencies and systematically keep the teaching team, preceptors, and faculty advisers updated on students' project work.	Group	TT	10%
Teaching team check-in meeting facilitation	Thirty-minute meeting facilitated by the student team to build community with, update, and receive support from the teaching team.	Group	TT	10%
Mid and end of semester evaluations	Qualtrics surveys administered by the teaching team to students, preceptors, and faculty advisers to reflect on accomplishments and challenges and assess roles, responsibilities, processes, and deliverables.	Individual	TT	0%
Deliverables	Tangible products produced by the student team that are mutually beneficial to students' professional development goals and partner organizations' needs.	Group	TT, P, FA	35%
Project management	Assessment of teams' management of Capstone project relationships, processes, and tasks.	Group	TT, P, FA	20%
Project participation	Assessment of individuals' contributions to the Capstone project.	Individual	TT, P, FA	20%
Exit interview and prep sheet	Interview between student and faculty adviser to assess the student's synthesis and demonstration of foundational and concentration competencies.	Individual	FA	5%

TT, Teaching Team; P, Preceptor; FA, Faculty Adviser.

social services, education, and government. Twenty-five (31.6%) of our partner organizations have hosted multiple Capstone teams. Based on the twenty-two preceptor responses analyzed for this paper, two authors identified four major themes within community partner benefits: deliverable utility, enhanced capacity, broad impacts, and more inclusive processes. Sixteen (72.7%) preceptors said that they benefited from the deliverables (e.g., toolkit, communication tool, datasets, evaluation plan, report, oral history products, protocols, presentation, report, curriculum, manuscript, engagement plan) produced by their team. These findings reflect Capstone's course aim of creating new or improved public health resources, programs, services, and policies.

Fifty-seven percent ($n = 12$) of preceptors noted that project outcomes would not have been possible without the support of a

Capstone team. The resources teams developed increased partner organizations' capacity to further their work. For example, a preceptor shared:

> The Capstone team provided us with SO many hours of highly skilled person power that we would not otherwise have had. We now have a draft of a thorough and high quality [toolkit], which I don't think could have been created without their labor, given the resource constraints of [our organization]. This toolkit will serve as a tool to start conversations with many [...] stakeholders in the future. I think it will also serve as a model for other states.

Not only can students' in-kind service and the work they produce help increase the capacity of our partner organizations, but also the Capstone project work can have long-term and far-reaching impacts for public health practice at large. Indeed, preceptors ($n = 8$) reported impacts that extend beyond the partner organization. For example, another preceptor noted,

> [Our organization] will use the presentation and report that the Capstone team produced for the next decade. Not only will [our organization] benefit from advancing our strategic priorities and deepening our partnerships, but we believe this report will be used by other agencies across the county to advance behavioral health priorities in need of support.

This is an example of how Capstone can yield new and improved public health resources, programs, services, and policies that have lasting impacts beyond those directly benefiting our partner organizations.

A final theme that emerged was organizations' increased ability to implement more inclusive processes. Four preceptors commented on expanded commitment to equity initiatives as illustrated by the following quote:

> The work the team did for [our organization] is work that we've talked about doing for several years - but we never had the time. The protocols are important for injured children, so we're grateful for the team's work. We also have never addressed social equity as a group. Working with this team has prompted us to take a look at our practices. The evaluation plan the students developed will provide a mechanism for us to assess and trend our implementation of the protocols and our efforts to reduce inequities in trauma care.

This example demonstrates how Capstone's commitment to working from a social change orientation can impact our partner organizations' cultures. Overall, these findings illustrate the myriad community partner benefits present within Capstone.

Discussion

These results show that Capstone mutually benefits community partners and students. Overall, students gained skills in collaborating with communities and contributed to collective capacity to improve public health practice and tools for promoting health equity. Our finding that skill development was a key student outcome aligns with Mackenzie et al.'s (13) and Gupta et al.'s (8) evaluations of similar service-learning courses. Among skills developed, both studies cited teamwork and professional development skills as key components (8, 13). Mackenzie et al. (13), Derreth and Wear (25), and Sabo et al. (12) also report additional student outcomes that were not explicitly measured in our evaluation, including a deeper commitment to work with local communities, a deeper commitment to engaged scholarship, and stronger relationships with faculty.

In our evaluation, community partners benefitted through useful deliverables, enhanced capacity to do more public health work, impacts beyond the scope of the project, and more inclusive and equitable processes. Like our study, Gregorio et al. (23) found that their students' work products were very useful. Moreover, the Mackenzie et al. (13) study cited that students were able to offer additional capacity to organizations by "extending the[ir] reach," which reinforced our main findings of enhanced capacity and impacts beyond the scope of the project. While not all service-learning course evaluation studies included data from community partners, our results aligned with those that did.

Lessons learned

After 13 years, we have identified several lessons learned about implementing a critical service-learning ILE. First, despite proactive planning efforts, the teaching team has learned to expect challenges related to project scope and relationships. The solicitation and refinement of projects and partnerships starts 9 months before the beginning of Capstone. Through extended individualized support and engagement, the teaching team hopes to build trust with community partners and collaborate in shaping and strengthening their project proposals. While there are benefits of this level of engagement, no amount of planning completely insulates projects from the unforeseen challenges of community-engaged work. For example, the COVID-19 pandemic impacted how Capstone could engage with community partners, their priorities, and their staffing. In particular, preceptor turnover creates numerous challenges for team morale and project ownership, satisfaction, and impact.

Second, Capstone course assignments are designed to maximize positive experiences for students and community partners and to uphold the principles of critical service-learning, but students are often frustrated with them. The teaching team refers to the workplan and team charter as the "guardrails" of the Capstone. They exist to clarify expectations, promote power sharing and authentic relationships, and reinforce Capstone's commitment to social change. The teaching team has observed that teams who invest deeply in these documents are the least likely to encounter significant interpersonal and logistical setbacks during the experience. Despite the teaching team's messaging about the importance of these structures for mutually beneficial experiences, students routinely assert that the start of Capstone contains too much "administrative" work. While the teaching team continues to respect and incorporate students' critical feedback, they have learned to expect a certain amount of student dissatisfaction at the start of the experience.

Third, the Department has learned that having the appropriate amount of staffing and material resources to support projects is essential to ensuring positive impacts. Limiting partners to only those with material resources is one way that funding models both within public health and the non-profit sector often exclude organizations with more explicit social change agendas. Therefore, to maximize student learning and community partner benefit while minimizing community partner burden, Capstone has a high university-staff-to-project ratio and covers project expenses. To fund Capstone, the Department uses a combination of state resources and field fees. There is an enduring tension, especially because resources are scarce, to scale back spending on courses like Capstone. For experiences like these to sustain and grow, additional resources, not fewer, are needed.

Finally, programs like Capstone must adapt to shifting social, political, economic, and educational landscapes to ensure sustained positive impacts. For example, prior to the COVID-19 pandemic, the teaching team limited the eligible pool of Capstone community partners to those within a forty-mile radius of UNC-CH. The pandemic resulted in the teaching team broadening community partner eligibility criteria and now Capstone works with community partners across the nation. Capstone's expanded reach is aligned with the new vision for Public Health 3.0 where public health professionals are expected to "engage multiple sectors and community partners to generate collective impact" while improving social determinants of health (29).

Future directions for Capstone

Public Health 3.0 (29) looks to promote health, equity, and resilience. With more community partners working on projects that explicitly tackle upstream factors like education, housing, and poverty in addition to health, Gillings will need to update its MPH training program to ensure that students enter their ILEs with the skills needed to meet these challenges. Below we describe ongoing quality improvement efforts internal to the Capstone program to strengthen outcomes for students and partner organizations.

The teaching team hopes to continue to enhance student preparedness and marketability for careers in public health. Much like other experiential learning models that report benefits to career readiness, professional leadership, and confidence (15, 18), students report a host of positive outcomes from their Capstone experience that imply preparedness and marketability. Students note the breadth and depth of technical and interpersonal skills gained, as has been reported elsewhere (13, 30). These reports of enhanced preparedness align well with findings that among undergraduate seniors seeking employment immediately after graduation, students whose course history included service-learning and capstone courses experienced greater odds of starting a new job compared with those who did not engage those high-impact practices (31). In recent years, the teaching team has offered skill-building workshops, as replicated in other programs (3), to coach students on how to present their Capstone work on résumés and how to talk about their projects during interviews using sample scripts. To simulate job applications and increase engagement with partner organizations, the teaching team will consider inviting preceptors to review and provide feedback on students' résumés and project description scripts.

The teaching team also aims to further strengthen community partnerships. One way to maximize Capstone's benefit for community partners is to adapt recruitment strategies so that the teaching team reaches more organizations for whom the Capstone experience would be most impactful. This may mean further refining the application process to lessen the time burden on potential partners and disseminating the call for Capstone projects through different channels. To enhance the experience of selected community partners, the teaching team plans to implement more preceptor-specific programming such as check-in meetings and skill-building workshops to build community and encourage collaboration among community partners.

Finally, there is a clear need for a comprehensive Capstone evaluation. The teaching team has yet to administer surveys, interviews, or focus groups that explicitly evaluate course aims and the elements of critical service learning. Furthermore, our understanding of the long-term impacts of Capstone is currently limited to anecdotal information from exchanges with former students and preceptors. By conducting a strategic evaluation, including modifications to existing course feedback opportunities and an additional alumni survey moving forward, we can better assess how Capstone is achieving course aims, operationalizing the elements of critical-service learning, and having long-term impacts.

Recommendations for program replication

Capstone's model can be adopted or adapted by individual faculty or by schools of public health. We welcome faculty members or program and school leaders to contact us to further discuss what this might look like. In general, though, we recommend that the following core components remain consistent:

1. Program staff invest effort to ensure community partners understand the overarching goals of the experience, general timelines, logistics, and roles and responsibilities of all involved parties prior to submitting a project proposal.
2. Community partners are selected using clearly defined criteria, including equity.
3. Community partners lead the development of, and direct, students' scope of work and have flexibility in determining deliverables.
4. The experience spans two semesters (vs. something shorter like one semester or a summer).
5. Students have ample time during their assigned class time to make progress on their projects.
6. Course assignments (e.g., workplan, team charter, weekly updates) provide "guardrails" for the project experience to help ensure mutual benefit.
7. There are robust staffing supports in place to recruit and maintain community partnerships, minimize community partners' burdens, and maximize student learning. Such supports are especially important when students have nascent project management skills and limited professional experience (10, 13).

As shown in Figure 1, program staff work on Capstone activities year-round and recruit new community partners while managing a current cohort of preceptors. Clear job descriptions with timelines will be helpful in negotiations and will assist with sustainability as different faculty and staff cycle through leading this kind of experience.

Strengths

Our description and analyses have many strengths. First, the detailed and transparent information contained in this paper will allow interested faculty to replicate and benefit from best practices found in Capstone. We openly share our course materials in the Supplementary material section and invite others to adopt or adapt these resources for their own use. Second, our results illustrate the benefits of Capstone and highlight mechanisms for ILEs to be transformative for students and community partners alike. Lastly, all authors on this paper have been members of the Capstone teaching team, students enrolled in the course, or both. This uniquely qualifies us to write this paper and share lessons learned with others in the field to advance public health training and practice.

Limitations

As noted above, our evaluation of Capstone has some limitations. First, we designed our evaluation and analyzed data retrospectively. Therefore, evaluation tools were not explicitly aligned to our four program objectives or the elements of critical service-learning. Second, we narrowed in on qualitative data from the past 2 years instead of the past 13 years because of changes implemented in 2020. To present reflections and feedback on the current version of Capstone, we had limited data to analyze.

Conclusion

By applying elements of critical service-learning to an ILE, Capstone is uniquely positioned to contribute to the development of public health leaders and positive community change. Community partners' project visions undergird the project selection and the course structure, which emphasizes authentic relationships, mutually beneficial processes, and practical synthesis of applied public health competencies. Through 13 years of experience, we have developed an ILE that is nimble enough to benefit community partners and rigorous enough to satisfy accreditation requirements. Capstone is a promising culminating experience practice for training skilled, collaborative public health practitioners and effecting community-driven public health change.

Data availability statement

The data analyzed in this study is subject to the following licenses/restrictions: The data were collected for internal program evaluation. We did not request permission at the time of data collection to disseminate these raw data. Requests to access these datasets should be directed to landfried@unc.edu.

Author contributions

ML developed the course and its content along with peer colleagues, wrote the abstract along with the learning environment, program evaluation, and results sections. ML and LS conducted the thematic data analysis. MC and LS completed a literature review, drafted the introduction and pedagogical framework section, and provided continual editing. EC wrote the discussion section and provided overall guidance for manuscript preparation. DE provided guidance, structural editing, and formatting. BP provided line edits. All authors contributed to the conception of the paper, manuscript revision, read, and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2023.1129330/full#supplementary-material

References

1. Core Competencies for Public Health Professionals. *Revised and Adopted by the Council on Linkages Between Academia and Public Health Practice*. (2021) Available online at: http://www.phf.org/resourcestools/pages/core_public_health_competencies.aspx (accessed February 16, 2023).

2. Council on Education for Public Health. *Accreditation Criteria: Schools of Public Health & Public Health Programs*. Silver Spring, MD (2021).

3. Minlikeeva AN, Amato KA, Przybyla SM. Modern public health problems and solutions: An undergraduate capstone course to prepare the next generation of public health practitioners to enhance health equity. *Front Public Health*. (2022) 10: 992835. doi: 10.3389/fpubh.2022.992835

4. Linnan L, Landfried M, French E, Moracco B. *Group-Based Service Learning Teaching Approaches. Teaching Public Health. 1st Edn*. London: Johns Hopkins University Press (2019), 221–34.

5. Mitchell TD. Traditional vs. critical service-learning: engaging the literature to differentiate two models. *Mich J Community Serv Learn*. (2008) 14:50–65.

6. Stith M, Anderson T, Emmerling D, Malone D, Sikes K, Clayton P, et al. Designing service-learning to enhance social justice commitments: a critical reflection tool. *Exp Learn Teaching Higher Educ*. (2021) 4:9–17. doi: 10.46787/elthe.v4i2.3438

7. Mason MR, Dunens E. Service-learning as a practical introduction to undergraduate public health: benefits for student outcomes and accreditation. *Front Public Health*. (2019) 7:63. doi: 10.3389/fpubh.2019.00063

8. Gupta K, Grove B, Mann G. Impact of service learning on personal, social, and academic development of community nutrition students. *J Commun Engage Higher Education*. (2021) 13:3.

9. Coombs C, Savoie-Roskos MR, Elnakib S. Engaging students through service-learning opportunities in public health. *J Nutr Educ Behav*. (2019) 51:1137. doi: 10.1016/j.jneb.2019.09.008

10. Pelco LE, Ball CT, Lockeman K. Student growth from service-learning: a comparison of first-generation and non-first-generation college students. *J High Educ Outreach Engagem*. (2014) 18:49–66.

11. Celio CI, Durlak J, Dymnicki A. a Meta-analysis of the impact of service-learning on students. *J Exp Educ*. (2011) 34:164–81. doi: 10.5193/JEE34.2.164

12. Sabo S, de Zapien J, Teufel-Shone N, Rosales C, Bergsma L, Taren D, et al. Service learning: a vehicle for building health equity and eliminating health disparities. *Am J Assoc*. (2015) 104:S38–43. doi: 10.2105/AJPH.2014.302364

13. Mackenzie SLC, Hinchey DM, Cornforth KP. A public health service-learning capstone: ideal for students, academia and community. *Front Public Health*. (2019) 7:10. doi: 10.3389/fpubh.2019.00010

14. Felter EM, Baumann SE. Development of a community-engaged classroom for teaching health communications: lessons learned from nine semesters of implementation. *Pedagogy Health Promot*. (20197) 5:246–53. doi: 10.1177/2373379918824353

15. Greece JA, Bangham C, Wolff J, Bryant M, Gupte G, McGrath D. The effectiveness and flexibility of practice-based teaching: a long-term, cross-disciplinary evaluation. *Public Health Rep*. (2022) 12:003335492110707. doi: 10.1177/00333549211070768

16. Tryon E, Stoecker R, Martin A, Seblonka K, Hilgendorf A, Nellis M. The Challenge of Short-Term Service-Learning. *Michigan Journal of Community Service Learning Spring*. (2008).

17. Greece JA, DeJong W, Gorenstein Schonfeld J, Sun M, McGrath D. Practice-based teaching and public health training: bringing real-world projects to the classroom to teach intervention planning and communication strategies. *Pedagogy Health Promot*. (2019) 5:55–61. doi: 10.1177/2373379918760929

18. Wrye B, Chafin C, Higginbotham C. Creating a win-win: designing and implementing mutually beneficial collaborations between community organizations and academic programs. *Educ Training*. (2019) 61:605–21. doi: 10.1108/ET-01-2018-0011

19. Kuh GD. High-impact educational practices: what they are, who has access to them, and why they matter. *Peer Review*. (2012) 14:29–30.

20. Comeau DL, Palacios N, Talley C, Walker ER, Escoffery C, Thompson WW, et al. Community-engaged learning in public health: an evaluation of utilization and value of student projects for community partners. *Pedagogy Health Promot*. (2019) 5:3–13. doi: 10.1177/2373379918772314

21. Chupp MG, Joseph ML. Getting the most out of service learning: maximizing student, university and community impact. *J Community Pract*. (2010) 18:190–212. doi: 10.1080/10705422.2010.487045

22. Samura M. Examining undergraduate student outcomes from a community-engaged and inquiry-oriented capstone experience. *Scholarsh Pract Undergrad Res*. (2018) 1:40–7. doi: 10.18833/spur/1/3/15

23. Gregorio DI, DeChello LM, Segal J. Service learning within the university of connecticut master of public health program. *Public Health Rep*. (2008) 123:44–52. doi: 10.1177/00333549081230S207

24. Schober DJ, Carlberg-Racich S, Dirkes J. Developing the public health workforce through community-based fieldwork. *J Prev Interv Community*. (2022) 50:1–7. doi: 10.1080/10852352.2021.1915736

25. Derreth RT, Wear MP. Critical online service-learning pedagogy: justice in science education. *J Microbiol Biol Educ*. (2021) 2:ev22i1–537. doi: 10.1128/jmbe.v22i1.2537

26. Linnan LA, Steckler A, Maman S, Ellenson M, French E, Blanchard L, et al. Engaging key stakeholders to assess and improve the professional preparation of MPH health educators. *Am J Public Health*. (2010) 100:1993–9. doi: 10.2105/AJPH.2009.177709

27. Braun V, Clarke V. Using thematic analysis in psychology. *Qual Res Psychol*. (2006) 3:77–101. doi: 10.1191/1478088706qp063oa

28. Kiger ME, Varpio L. Thematic analysis of qualitative data: AMEE Guide No. *131 Med Teach*. (2020) 42:846–54. doi: 10.1080/0142159X.2020.1755030

29. DeSalvo KB, Wang YC, Harris A, Auerbach J, Koo D, O'Carroll P. Peer reviewed: Public Health 3. 0: A call to action for public health to meet the challenges of the 21st century. *Prev Chronic Dis*. (2017) 5:14. doi: 10.5888/pcd14.170017

30. Durham S, Jordan H, Naccarella L, Russell M. Work-integrated learning and skill development in a master of public health program: graduate perspectives. *J Univ Teaching Learn Prac*. (2020) 17:9–26. doi: 10.53761/1.17.4.2

31. Miller AL, Rocconi LM, Dumford AD. Focus on the finish line: does high-impact practice participation influence career plans and early job attainment? *High Educ*. (2018) 75:489–506. doi: 10.1007/s10734-017-0151-z

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Developing a management and finance training for future public health leaders

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Public health leaders are increasingly being asked to address adaptive challenges in the context of finite and often limited resources. Budgets and their associated resources create the financial framework within which public health agencies and organizations must operate. Yet, many public health professionals expected to undertake roles requiring this foundational knowledge and skills are not trained in the fundamentals of public finance and are ill-equipped for managing and monitoring funds. Graduate courses in schools of public health most often are focused on health care management and finance or private sector finance. To meet the needs of future public health leaders, it is critical that academic content builds capacity in management and finance focused on public health practice. This paper describes the development of a Doctor of Public Health program management and finance course designed to prepare future public health leaders. The course aims to build the knowledge and skills of doctoral-level students to recognize the inherent challenges of public health finance and the importance of cultivating and managing resources to improve public health practice and achieve strategic public health goals.

KEYWORDS

public health, management, finance, Doctor of Public Health, workforce capacity building, management and accounting

Introduction

Public health management and finance training is critical to the preparation of public health professionals and leaders. Public health leaders are increasingly being asked to address adaptive challenges in the context of finite and often limited resources. Budgets and their associated resources create the financial framework within which public health agencies and organizations must operate. Yet, many public health professionals are expected to undertake roles requiring this foundational knowledge and skills are ill-equipped for managing and monitoring funds because they were not trained in the fundamentals of public finance (1). A 2008 analysis found that there were no U.S. graduate public health programs that required a finance course for public health non-management concentration students (1). In addition, most of those who had taken a management and finance course were trained about health care management and finance or private sector finance, neither of which prepares students for public health practice (2). Based on a 2009 national survey, Honoré and Costich detailed a list of public health finance competencies which covered three domains including financial management, analysis, and assessment; organization and program planning and policy development; and administrative skills (2). The gap between what is taught in graduate public health training programs and the requirements for effectively and

efficiently allocating and managing resources in public health practice is especially magnified for those assuming management and leadership roles. Strengthening the skills and knowledge of graduate students based on these competencies is essential preparation for public health practice.

The Doctor of Public Health (DrPH) degree was developed to provide doctoral-level training to prepare public health leaders for applied public health practice. In contrast to the Doctor of Philosophy (PhD) degree in public health, which is targeted to preparing students for careers in research, DrPH training is designed to prepare "a transformative leader with expertise in evidence-based public health practice and research who is able to convene diverse partners, communicate to affect change across a range of sectors and settings, synthesize findings, and generate practice-based evidence" (3). The development of DrPH programs grew from the acknowledgment that many leadership positions in public health are held by medical doctors and others without the necessary training or skills to lead agencies or organizations focused on population health (3). A 2014 report from the Association of Schools and Programs of Public Health (ASPPH) includes fiscal responsibility as critical content for DrPH programs to stay relevant in the 21st Century (4). Competencies closely aligned with public health management and finance comprise three of twenty foundational DrPH competencies required for Council on Education for Public Health (CEPH) accreditation, including the ability to propose human, fiscal, and other resources to achieve a strategic goal; cultivate new resources and revenue streams to achieve a strategic goal; and propose interprofessional and/or intersectoral team approaches to improving public health. Fiscal stewardship, including sustainable and flexible funding, is also a core element for Public Health 3.0, a forward-looking model for public health leadership and practice that recognizes the critical importance of cross-sector collaboration to address upstream social determinants of health (5). For public health to evolve in a way that both learns from the experiences of the COVID-19 pandemic and meaningfully prioritizes advancing health equity, practicing professionals will need to learn innovative strategies and models of funding to stabilize revenue streams and address social determinants of health (5). This will require training diverse and skilled leadership prepared to blend and braid funds to support multi-sectoral collaboration (6), advocate for sustainable public health funding, and match resources to need, targeting those communities experiencing the greatest inequities. This paper describes the development of a DrPH Public Health Finance and Management course. We provide a description of the development of the curriculum, lessons learned after the first year of implementation, and a discussion on the practical applications for the field of public health.

Pedagogical framework

We took a three-pronged approach to developing a course on public health management and finance targeted to DrPH students. This included reviewing the literature on course design and adult learning, reviewing the current literature on public health management and finance, and finally assessing other schools' doctoral-level curricula on management and finance.

We reviewed the literature on course design, learning objectives, and approaches to learning and teaching. Because of the diverse backgrounds of DrPH students, including educational backgrounds, work experience, and levels of experience in finance, the literature on higher education allowed us to bring together theory and practice to strengthen academic content for adult learners. Two theoretical constructs from Light and Cox's Learning Gap Framework and Bloom's taxonomy of educational objectives were used to inform pedagogical approaches for adult learners. The Learning Gap Framework acknowledges approaches to learning and strategies needed for adults who learn different things in different ways (7). Given the overarching goal of preparing public health leaders for applied public health practice, the class structure, activities, and assignments created the space for creativity and innovation in lecturing. Developing the interpersonal construct through peer learning embeds the Learning Gap Framework to close the gap of learning content with the intent to achieve ongoing change (8). Students are placed into groups of 3 to 5 students based on a self-assessment of their own experience and background in management and finance. Groups are made to encourage contributing and learning from others based on student's diverse exposure in management and finance and group size guarantees that all students will have a good opportunity to contribute to the lesson or activity. The learning objectives of each lesson also aim to strengthen skill sets through Bloom's learning spectrum of knowledge, comprehension, application, analysis, synthesis, and evaluation, with an emphasis on higher level application and synthesis (9). These taxonomies supported the development of the curriculum and delivery approaches to help course instructors conduct real-time assessments of students' knowledge and skill levels.

To inform course content, we conducted an online search of the literature, web sites, and presentations. Using search terms, "public health finance; public health management and finance; health finance; public policy management; nonprofit management; public health budget; government finance; government budget," we reviewed results from PubMed, Google Scholar, and Google. From this online scan, we compiled publications, presentations, roundtable discussions, and a training bootcamp specifically on public health management and finance. Many of the materials we found were products from a 2009 effort supported by the Robert Wood Johnson Foundation to optimize public health management and finance training and education (10). This work generated a significant number of resources that greatly informed this curriculum.

We also examined graduate-level management and finance courses and their descriptions in schools of public policy and public health in the United States. Schools of public policy were included because of their academic attention on public finance. We reviewed the course catalogs and syllabi for the top 20 schools of public health with DrPH programs and top 10 public policy schools in the U.S. as rated by *U.S. News and World Report* in 2020 (11). A search for management and finance courses in the schools' course catalogs was performed using the same search terms as the online search above. Of the 30 schools, four schools did not have course catalogs accessible online and an additional four schools did not yield any courses using our search terms. From the remaining 22 schools we identified 37 applicable courses. Nine of the 37 courses

reviewed were relevant to public management and finance but were not specific to public health and 13 courses contained the search terms but either a course description was not available, or the course was primarily focused on health care management and finance. The remaining 15 courses had a course description or learning objective related to public management and finance, of these 24% originating from public policy schools and 16% from schools of public health. These courses offered the fundamentals of accounting principles, an introduction to financial management and managerial accounting, examined public finance policy, and health economics theoretical concepts. While this content is an important foundation for DrPH students, it almost exclusively focused on the application in health care settings, not specifically in public health.

While acknowledging the value of accounting skills and the intersections of health care and public health, we developed a curriculum targeted to preparing practicing public health professionals and leaders across a range of settings and roles. As reflected in the foundational competencies, DrPH training should prepare public health professionals to engage in leadership-level budget discussions and provide both critical input and analysis. The course learning objectives are based on the CEPH DrPH foundational competencies and each lesson is associated with the overall course objective, including:

- #12: Propose human, fiscal and other resources to achieve a strategic goal.
- #13: Cultivate new resources and revenue streams to achieve a strategic goal.
- #17: Propose interprofessional and/or intersectoral team approaches to improving public health.

The purpose of the course is to prepare public health practitioners for real-world application of management and finance in public health agencies and organizations. This course provides an overview of basic accounting concepts to build skills in preparing, analyzing, and implementing budgets and applies management decision-making strategies to inform public health programs and policies. The intended learning outcomes are to share an array of perspectives of finance and management at the local, state, federal, and global levels, build the knowledge base on accounting principles, and critically apply team building and management skills.

The lessons and learning objectives from the draft curriculum were shared through an online survey with 16 selected experts in the field of public health management and finance to validate course content. Experts were identified by reviewing authorship of peer-reviewed publications and advocates of public health management and finance. Lastly, an online survey was completed by 20 out of 30 currently enrolled Georgia State University DrPH students to assess their backgrounds and needs relative to the content areas. Feedback was provided by both experts and students and incorporated into the curriculum.

With consensus on the lessons, a textbook or book chapter(s) on public health management and finance was not identified. We conducted a scan online using key terms from the learning objectives to identify relevant peer reviewed publications, contemporary news articles, webinars, and videos. A variety of modes and relevant or contemporary resources were selected to uphold adult learning.

Learning environment

This course was initially implemented in a remote synchronous format during the 2021–2022 academic year to 23 DrPH students. An adjunct faculty member who was a recent DrPH program graduate with an educational background in accounting and economics and over 10 years of public health experience taught this course in Georgia State University School of Public Health's DrPH program. The learning objectives across 13 lessons aimed to provide a foundation for public health management and finance with real-world application. It also intentionally integrated a health equity lens to both concepts and examples related to both allocation of resources and targeting of funds to socially, economically, and/or environmentally disadvantaged populations experiencing health inequities. The course also incorporated principles of blending and braiding funds to support cross-sector collaboration and address upstream social determinants of health. Table 1 is the list of sessions, learning objectives, and corresponding CEPH competencies. Lessons 1–4 build on foundational skills, recognizing most DrPH students do not have backgrounds in business or accounting, to learn basic principles and terminology. Lessons 5–13 were informed by the literature on public health management and finance. The full curriculum, found in Appendix A, provides the description, learning objectives, and readings.

Results

While a robust assessment and presentation of evaluation data is beyond the scope of this paper, students were provided the space and opportunity to provide feedback on the class content and materials. This allowed for valuable input that we intend to incorporate as we update and improve both course content and delivery. Feedback received to date included:

- Guest lecturers with both subject matter expertise and experience in public health finance should be engaged. Because public health finance is such a broad topic area, it is difficult for any one person to bring expertise and experiences relevant to the range of topics and public health settings. Including outside experts to provide guest lectures and/or serve as "the expert in the room" to facilitate content-related discussions provides an opportunity for students to learn from a range of experts with diverse experiences and knowledge.
- A stronger emphasis on management practices and tools should be provided. The current curriculum has a substantial amount of content on budgeting and accounting practices. Exposure to management approaches and examples on how to manage and administer funds can be a valuable contribution to the course.
- Providing additional examples from state and local context as well as illustrations from the national or federal level cultivates a more well-rounded course. An emphasis should also be given to providing examples and case studies on U.S. tribes

TABLE 1 Public health finance and management learning objectives and CEPH competency.

Lesson	Learning objectives	CEPH competency
Introduction	• Summarize fundamental theories, concepts, and definitions of public health finance. • Apply strategies for public health financing in Public Health 3.0. • Self-evaluate personal experiences and expectations to improve knowledge and skills in finance and management.	12
Planning and budgeting	• Discuss Congressional appropriation process in theory and practice. • Analyze differences in U.S. state public health funding levels. • Critique funding mechanisms and types of revenue sources for federal, state, and local public health.	12
Operating budgets	• Evaluate the overall planning process and develop an operating budget. • Design a budget using different types of costs and budget assumptions. • Analyze a planning and operating budget.	12
Financial statements	• Calculate break-even analysis and discounted cash flow analysis. • Evaluate financial statements and key players in financial statement regulation. • Design a planning budget for a public health program.	12
Taxation	• Evaluate taxation as a revenue source to support public health goals. • Compare and contrast states with different tax structures and uses of revenue. • Design an operational budget for a public health program	13
Revenue generation	• Explain social impact bonds and develop a real-world example. • Critically examine sustainability and utility of new economic models. • Design a budget that blends and braid funds to address upstream social determinant of health.	13
Spending and return on investments	• Discuss evidence-based resource allocation processes. • Examine real world resource allocation processes. • Apply equity in a resource allocation decision-making process.	17
Fiscal stewardship and transparency	• Examine public health expenditure data sources. • Assess the relationship between resource allocation and health equity goals. • Critique funding policy using the Tobacco Master Settlement Agreement as an example.	13
Partnerships	• Discuss fiscal stewardship, accountability, and transparency of public health funds. • Critique public health programming and closing the finance gap. • Compare and contrast state-level expenditures in social services and social determinants of health.	13
Decision-making strategies	• Analyze Medicaid's role in partnering with public health. • Evaluate the intersection between public health and safety net programs to improve social determinants of health. • Assess public health agencies' ability to blend funds to support people living with disabilities.	17
Ethics	• Examine the influence of philanthropic and private industry funds in public health. • Evaluate the intersection of pharmaceutical research and public health research and practice. • Critique the decision-making process in accepting funds to address a public health concern.	17
Public health emergency	• Evaluate decision-making to allocate resources during a public health emergency. • Critique public's perception of a common good during an emergency. • Integrate equity in public health emergency resource allocation.	13
Global perspective	• Apply strategies in global health finance. • Critique universal health coverage financing strategies. • Examine universal financial protection policies in LMICs.	13

and territories, given the unique contexts in which tribes and territories operate.

- Leveraging the expertise in the room should be highlighted. As adult learners and practicing professionals, DrPH students may have applicable experiences as well as examples that help highlight the relevance of the course content. Providing an open space for discussion, dialogue, and constructive debate between students helps to reinforce the content.
- Given the political nature of the funding process it is important to include news articles to stay abreast of current events and the political dialogue. This also consists of various modes of materials like news articles, podcasts, webinars to suit various types of learning styles.

Discussion

Many public health agencies do not carry out systematic financial analysis as part of their planning or review process. This threatens public health agencies' ability to quantify their fiscal condition and the sustainability and state of readiness of the public health system when an outbreak or natural disaster occurs (12). An analytical tool to measure financial performance in local health departments was recently introduced to help mainstream and apply analytical concepts to the practice of public health management (12). While measuring financial performance is not a requirement, the benefits have implications for policy and practice, including the creation of a uniform chart of accounts to help assess the financial condition of the public health system. This enables public health

managers and leaders to forecast national trends, make informed decisions for the continuation or elimination of programs, increase financial accountability, and advocate for additional funds (12).

Until public health agencies prioritize financial performance, the field will continue to experience what the World Bank penned as the "cycle of panic and neglect" (13). This term describes the reactionary response from political leaders to invest in public health systems during a time of need until the urgency fades (13). Public health professionals work and adapt in this unpredictable environment. System change will require preparing future public health leaders about these inherent challenges and innovative ways to efficiently manage funds and advocate for sustainable public health funding.

Based on our review, current academic content for doctoral-level students does not meet the practical applications public health professionals are expected to provide in the workplace. The current academic content in public health finance falls short of providing the necessary skills and strategies to effectively mobilize and manage funds in public health. Courses have content that is disproportionately health care-focused and fails to meaningfully address finance policies and management strategies unique to public health. Most current curricula are inadequate and did not properly prepare DrPH students to assume leadership and management functions, including identifying sources of public and private funds and aligning programming and allocation to meet the organization's needs and mission.

Honoré and colleagues outlined potential impediments to developing a management and finance course for public health. Those included the limited number of credit hours available in the curricula, a lack of dedicated faculty with the academic credentials, experience, and time to develop a specific public health finance course, and the lack of teaching materials dedicated to public health finance (2). When dedicated faculty are not feasible, they suggest using adjunct faculty to conserve full-time faculty resources. For DrPH students, in particular, having faculty engaged in applied practice, provides a valuable opportunity to include real-world and real-time case studies. This paper and corresponding appendix help to alleviate many of the barriers to course development and relevant teaching materials.

Based on evaluation feedback from the initial piloting of this course in Georgia State University's School of Public Health during the 2021–2022 academic year showed early signs of success in achieving course objectives. We recognize that continuous improvements to course curriculum are not only valuable but needed to keep up with the latest current events. We plan to incorporate feedback into the next iteration of the curriculum and plan to continue receiving informal and formal feedback through post-course evaluations.

Preparing and strengthening public health leadership in management and finance through a doctoral-level course will not alleviate the systemic challenges facing public health funding and infrastructure. However, aligning academic competencies and training with professional responsibilities is critical to positioning public health organizations and agencies for greater impact and improved population health outcomes. Preparing public health leaders to participate more effectively in budget, financing, and funding strategies and discussions also positions them to justify and advocate for additional public health resources with decision makers and appropriators.

Constraints

The largest constraints to development and implementation of a public health-focused doctoral-level finance and management course were finding relevant course materials, including textbooks, articles, assignments, and curricular content, like learning objectives and lesson plans that were pertinent to applied public health practice. Another practical constraint was that the course was initially administered during the 2021–2022 academic year coinciding with the COVID-19 pandemic. As a result, classes were held in a synchronous remote learning environment. While this mode helps with engagement of guest lecturers outside the geographic area, it inherently limits the faculty's ability to encourage dialogue, debate, and discussion between students. Moving forward, we plan to administer the class using a hybrid approach with half the classes meeting in-person to facilitate open dialogue and discussion and the other half using a synchronous remote environment to facilitate engagement of outside guest lecturers. Lastly, a major constraint that other schools of public health may face in adapting this curriculum is finding dedicated faculty with the academic credentials, experience, and time to teach this course. As noted above, identifying adjunct faculty with the requisite background in public health finance is challenging, but ideal for optimal course delivery.

Conclusion

Preparing the next generation of public health leaders, not only for the demands of current public health practice, but for the essential roles public health must play in collaborating to address upstream social determinants of health is a critical charge for DrPH training programs. Improving population health and advancing health equity require core competencies in both the cultivation and deployment of public health financial resources. This paper describes the development of a public health management and finance course designed to strengthen finance and management knowledge and skills for future public health leaders. The course aims to prepare doctoral-level students to recognize the inherent challenges of public health finance while also providing finance and management knowledge and skills essential for successful public health leadership and practice.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2023.1125155/full#supplementary-material

References

1. Honoré PA, Gapenski LC, Morris ME, Fos PJ, Leon J. *Advancing public health finance: closing 100-year gaps in education, training, and financial assessment methodologies. Robert Wood Johnson Foundation*. A Public Health Finance Research and Planning Report (2010).

2. Costich JF, Honoré PA, Scutchfield FD. Public health financial management needs: report of a national survey. *J Public Health Manag Pract.* (2009) 15:307–10. doi: 10.1097/PHH.0b013e31819b2c78

3. Roemer MI. The need for professional doctors of public health. *Public Health Rep.* (1986) 101:21–9.

4. Association of Schools & Programs of Public Health. Framing the Future DrPH for the 21st Century (2014).

5. DeSalvo KB. Public health 3.0: a call to action for public health to meet the challenges of the 21st century. *Prev Chronic Dis.* (2017) 14:170017. doi: 10.5888/pcd14.170017

6. DeSalvo KB, Kadakia KT. Public health 3.0 after covid-19—reboot or upgrade? *Am J Public Health.* (2021) 111:S179–81. doi: 10.2105/AJPH.2021.306501

7. Light G, Cox R. *Learning & Teaching in Higher Education the Reflective Professional*. Thousand Oaks California: Paul Chapman Publishing A SAGE Publications Company (2001).

8. Light G, Cox R, Calkins SC. *Learning and Teaching in Higher Education: The Reflective Professional*. 2nd ed. Thousand Oaks, CA: Sage Publishing.

9. Bloom BS. *Taxonomy of Educational Objectives, Handbook I: The Cognitive Domain*. New York: David McKay (1956).

10. Robert Wood Johnson Foundation. Grants. Available online at: https://www.rwjf.org/en/how-we-work/grants-explorer.html (accessed July 29, 2020).

11. The Best Public Health Programs in America, Ranked. Available online at: https://www.usnews.com/best-graduate-schools/top-health-schools/public-health-rankings (accessed July 12, 2022).

12. Honoré PA, Zometa C, Thomas C, Edmiston A. The public health uniform national data system (PHUND$): a platform for monitoring fiscal health and sustainability of the public health system. *J Public Health Manag Pract.* (2019) 25:366–72. doi: 10.1097/PHH.0000000000000838

13. International Working Group on Financing Preparedness. From Panic and Neglect to Investing in Health Security: Financing Pandemic Preparedness at a National Level. World Bank (2017).

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Evaluation of the public health empowerment program in the Eastern Mediterranean region

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Background: The Public Health Empowerment Program (PHEP) is a 3-month training program for frontline public health staff to improve surveillance quality and strengthen the early warning system capacities. Studies evaluating the program and its impact on the health systems in the Eastern Mediterranean Region (EMR) are lacking. Therefore, this study aimed to assess the level of PHEP graduates' engagement in field epidemiology activities, assess their perceived skills and capacity to perform these activities and assess the extent to which PHEP helped the graduates to perform field epidemiology activities.

Methods: A descriptive evaluation study was conducted based on levels 3 and 4 of Kirkpatrick's model for evaluating training programs to assess the change in graduates' behavior and the direct results of the program. Data were collected using two online surveys targeting PHEP graduates and programs' directors/ technical advisers.

Results: A total of 162 PHEP graduates and 8 directors/ technical advisers participated in the study. The majority of PHEP graduates reported that they are often involved in activities such as responding to disease outbreaks effectively (87.7%) and monitoring surveillance data collection (75.3%). High proportions of PHEP graduates rated their skills as good in performing most of field epidemiology activities. The majority of graduates reported that the PHEP helped them much in conducting, reviewing, and monitoring surveillance data collection (92%), responding effectively to public health events and disease outbreaks (91.4%), and communicating information effectively with agency staff and with the local community (85.2%).

Conclusion: PHEP appears to be an effective program for improving the public health workforce's skills and practices in epidemiological competencies in the EMR. PHEP strengthened the engagement of the graduates in most field epidemiology activities, especially during COVID-19.

KEYWORDS

field epidemiology, public health, outbreak, surveillance, evaluation

Background

Many countries in the Eastern Mediterranean Region (EMR) have been affected by various types of disasters including war, political conflicts and instabilities, massive forced displacement, and natural disasters (1). These emergencies have exposed many countries to increased public health threats and affected the health security of the entire region (2, 3). Furthermore, these emergencies, together with the COVID-19 pandemic, boosted the demand for training programs to provide public health professionals with a diverse range of skills required to improve global health security (4, 5).

The Public Health Empowerment Program (PHEP) is a frontline Field Epidemiology Training Program that was introduced to enhance global health security by training frontline public health staff to improve surveillance quality and strengthen the early warning system capacities in their districts (6). In 2015, the US Centers for Disease Control and Prevention (CDC) launched this three-month in-service training program in 24 countries to enhance local public health capacity (7). The program focuses on the detection and response to diseases and other public health events of national and international concerns. It is intended for Ministry of Health (MOH) staff responsible for surveillance, data collection, compilation, reporting, and response at the local health system level. The main goal of this program is to build the epidemiologic capacity, strengthen public health surveillance and promote the use of data for decision-making at sub-national levels in stable and challenging conditions (8). Through PHEP, the participants learn and practice fundamental skills used in surveillance, outbreak investigation, and basic management such as basic epidemiology, case definition, disease detection and reporting, interpretation and presentation of data, case investigation and response, surveillance monitoring and evaluation, and analysis of data for use in decision-making (8).

In the EMR, the Eastern Mediterranean Public Health Network (EMPHNET) works in partnership with MOHs to develop the training curriculum (9). The program's participants attend three workshops and complete field projects to practice, implement, and reinforce what they have learned under the supervision and support of their field mentors. By the end of the fieldwork, participants write and submit a report that describes their field experience and the newly gained and/or improved skills (8). Participants who complete the program receive a certificate of completion signed by MOH and EMPHNET.

EMPHNET has been actively working in multiple countries across the EMR, including Yemen, Oman, Iraq, Egypt, Sudan, Tunisia, Lebanon, Morocco, Jordan, Saudi Arabia, and Pakistan. The primary focus of the efforts has been to establish and implement FETPs of different modalities, while also providing frontline health workers and surveillance officers with the necessary training to prevent and respond to disease epidemics. These countries identified and expressed a need for public health professionals who possess the skills and expertise necessary to combat infectious diseases. The implementation of PHEP is crucial as it builds capacity, strengthens disease surveillance, enables early detection and response, promotes effective public health interventions, and contributes to the development of sustainable health systems. Based on the public health needs of the country, EMPHNET worked on providing one or more of the four customized designs of the program including PHEP-Basic Field Epidemiology (PHEP-BFE), PHEP-Surveillance Polio Officers (PHEP-SPO), and PHEP – Nutrition, and PHEP-Water. To date, a total of 1,303 participants graduated from the program from the 11 mentioned countries and 658 of those graduates were trained by EMPHNET.

Periodic evaluations of PHEP are necessary to maintain high-quality training, ensure that the program has achieved its aim and objectives (10), and enable countries to track the effectiveness of the programs in detecting and responding to emergencies (7). Internationally, some studies evaluated advanced FETPs and reported the experiences and lessons learned (11–13). However, only a few studies evaluated frontline PHEP (7, 14). One study was conducted to describe the process and early results of the implementation of Frontline FETP worldwide (7), which showed that FETP-Frontline can be a valuable strategy to strengthen public health capacity and enhance global health security by improving surveillance quality. Moreover, it was found that this program helped different countries to rapidly detect, respond to, and contain public health emergencies at the source. In Kenya, one study that evaluated the impact of the 3-month frontline FETP for local public health workers showed that 68% of respondents acquired new epidemiological skills and 83% applied those skills to their day-to-day work (14).

For different country programs in the EMR, there were no studies evaluating these programs. Therefore, this study aimed to assess the level of PHEP graduates' engagement in field epidemiology activities, assess their perceived skills and capacity to perform these activities and assess the extent to which PHEP helped the graduates to perform field epidemiology activities. EMPHNET conducted this evaluation as a systematic assessment to measure how well programs' goals and objectives are met as perceived by PHEP graduates in the region.

Methods

A descriptive study was conducted to evaluate the PHEP in the EMR. We used levels 3 and 4 of Kirkpatrick's model for evaluating the training (15). Level 3 of this model is about behavior "the degree to which participants apply what they learned during training when they are back on the job." Level 4 is about results "the degree to which targeted outcomes occur as a result of the training and the support and accountability package."

Two separate online questionnaires were developed using "CrowdSignal" tool. The first questionnaire (Supplementary File) was delivered to PHEP graduates from six different countries in the EMR that implemented the program including Egypt, Iraq, Jordan, Pakistan, Yemen, and Tunisia. The first section of the questionnaire collected information on the participants' demographic characteristics, highest educational degree earned, country and year of graduation. The other sections included questions to measure the perceived skills and behavior of PHEP graduates regarding the program competencies and the involvement of the graduates in key areas of field epidemiology. Each competency was assessed as an integrated set of knowledge, skills, and attitude. PHEP graduates were asked about their involvement and engagement in 16 field epidemiological activities, the extent to which PHEP helped them to perform specific field epidemiology activities, and their perceived skills and capacity to perform these activities. In each question, the participants were requested to choose an appropriate response on a 5 Likert scale. The questionnaire was developed in English and then translated to Arabic using the forward-backward translation method. The questionnaire was administered in Arabic and English languages according to the

preference of participants. The questionnaire was pilot tested on 10 graduates and minimal changes have been made. The face validity of the tool was established by having it reviewed by three persons.

The PHEP graduates' database that was developed by EMPHNET was used to select a random systematic sample of 200 PHEP graduates. The online questionnaire was sent by email to the selected graduates. Two reminders, a week apart, were sent to those who did not respond to the questionnaire.

The second questionnaire was developed to be filled by the programs' directors/ technical advisers asking them about the observed impact of the program. The questionnaire included questions on general characteristics, 5-Likert scale questions, multiple-choice questions, and a few open-ended questions. The characteristics included gender, highest educational degree earned, job title, affiliation, and country. In the second part of the survey, the questions were designed to measure the impact of the program on the health system in terms of public health priorities (disease surveillance, disease outbreaks and investigation, etc.) in addition to the COVID-19 response. The questions covered the graduates' level of engagement in field epidemiological activities, how the directors/ technical advisers evaluate the graduates' performance and the role of PHEP graduates in responding to COVID-19. The respondents were asked to make suggestions for the improvement of the PHEP.

Data were exported to IBM SPSS (IBM Corp, Released 2016, IBM SPSS Statistics for Windows, Version 24.0, Armonk, NY: IBM Corp.) for analysis. Data were described using percentages. The frequency distributions were presented for the main three outcome variables: engagement of PHEP graduates in field epidemiology activities (often, sometimes, rarely, and never), the extent to which PHEP has helped the graduates to perform field epidemiology activities (much, somewhat, little, and never), and perceived skills and capacity of the graduates (good, acceptable, and poor). Chi-square test and binary logistic regression were used to compare the three PHEP modalities in helping the graduates to perform the basic field epidemiology activities. A value of p of less than 0.05 was considered statistically significant.

Results

Participants' characteristics

Of all invitees, 162 (81%) PHEP graduates responded to the online survey. The responses were from 6 countries including Egypt, Iraq, Jordan, Pakistan, Yemen, and Tunisia. Almost two third (n = 116, 74.7%) of the respondents were enrolled in the PHEP-BFE, 13.6% (n = 22) in PHEP – Nutrition, and 11.7% (n = 19) in PHEP- SPO. The participants' characteristics are shown in Table 1. A total of 8 directors/ technical advisers from Egypt, Iraq, Jordan, and Pakistan participated in the evaluation of the program.

TABLE 1 The characteristics of 162 public health empowerment program (PHEP) graduates.

Variable	*n*	%
Gender		
Female	30	18.5
Male	132	81.5
Age (year)		
<35	74	54.7
35–40	62	38.3
>40	26	16
Country name		
Egypt	15	9.3
Iraq	93	57.4
Jordan	16	9.9
Pakistan	20	12.3
Yemen	7	4.3
Tunisia	11	6.8
PHEP modality		
Basic Field Epidemiology (BFE)	121	74.7
Nutrition	22	13.6
Surveillance Polio Officers (SPO)	19	11.7

Engagement of PHEP graduates in field epidemiology

Table 2 shows the extent of engagement of PHEP graduates in field epidemiology activities. The majority of PHEP graduates reported that they were often involved in field epidemiology activities such as reviewing and monitoring surveillance data (n = 122, 75.3%), performing descriptive data analysis (n = 105, 64.8%), communicating information effectively with agency staff and the local community (n = 129, 79.6%), and responding effectively to disease outbreaks (n = 142, 87.7%). Almost two thirds (n = 104, 64.2%) of the participants reported that they were often involved in providing support to applying isolation and infection control protocols for confirmed COVID-19 cases, and almost half of them (n = 75, 46.3%) were often involved in collecting samples and screening passengers for COVID-19. Moreover, almost two thirds (n = 111, 68.5%) of the participants were often involved in monitoring the global trends of COVID-19, managing COVID-19 surveillance data (n = 106, 65.4%), and dissemination of health education messages and promotional materials to raise awareness toward COVID-19 (n = 115, 71%). For the other activities, half of the participants were often involved in the development of national guidelines for the COVID-19 epidemic (n = 81, 50%).

Skills and capacity of PHEP graduates

Majority of the participants evaluated their skills as good in conducting most of the epidemiological activities (Table 3) such as conducting, reviewing, and monitoring surveillance data collection (n = 136, 84%), communicating information effectively with agency staff and the local community (n = 128, 79%), responding effectively to disease outbreaks (n = 138, 85.2%), performing descriptive data analysis (n = 123, 75.9%), and preparing and administering oral presentations of their fieldwork (n = 128, 79%). For the other activities that are related to the COVID-19 pandemic, PHEP graduates also evaluated their skills as good in conducting activities such as managing and reporting COVID-19 surveillance data (n = 112, 69.1%), and dissemination of health education messages and promotional

TABLE 2 The extent of engagement of public health empowerment program graduates in field epidemiology activities.

Field epidemiology activities	Often		Sometimes		Rarely	
	n	%	*n*	%	*n*	%
Conduct, review, and monitor surveillance data collection	122	75.3	26	16.1	14	8.6
Perform descriptive data analysis	105	64.8	43	26.5	14	8.6
Communicate information effectively with agency staff and with the local community	129	79.6	19	11.7	14	8.6
Respond effectively to public health events, specifically, disease outbreaks	142	87.7	13	8	7	4.3
Write a summary report on surveillance findings or an outbreak investigation	110	67.9	35	21.6	17	10.5
Use Microsoft Excel or any software to enter, analyze, and display public health surveillance data	134	82.7	15	9.3	13	8
Prepare and administer an oral presentation of their fieldwork	109	67.3	37	22.8	16	9.9
Monitor the global trends of COVID-19 and mortality through relevant websites	111	68.5	39	24.1	12	7.4
Manage COVID-19 surveillance data (data analysis and reporting)	106	65.4	23	14.2	33	20.4
Contribute to the development and distribution of a standard case definition for the COVID-19	84	51.9	37	22.8	41	25.3
Provide support applying isolation and infection control protocols for confirmed COVID-19 cases	104	64.2	29	17.9	29	17.9
Collect samples and screen passengers for testing to confirm suspected COVID-19 cases	75	46.3	27	16.7	60	37
Dissemination of health education messages and promotional materials to raise awareness towards COVID-19.	115	71	25	15.4	22	13.6
Respond to public queries about COVID-19 through the specified hotlines and develop documents with standard appropriate information.	75	46.3	44	27.2	43	26.5
Search for published scientific literature, standard operating procedures, and guidelines, and support the development of national guidelines for the COVID-19 epidemic.	81	50	47	29	34	21

materials to raise awareness toward COVID-19 ($n = 124$, 76.5%). However, only half of them thought that their skills are good in contributing to the development of a standard case definition for COVID-19 ($n = 89$, 54.9%).

The extent to which PHEP helped the graduates to perform field epidemiology activities

The level to which PHEP helped the graduates to perform field epidemiology activities is shown in Table 4. The participants reported that PHEP helped them to a considerable (much) extent in conducting, reviewing, and monitoring surveillance data collection ($n = 149$, 92%), responding effectively to disease outbreaks ($n = 148$, 91.4%), performing descriptive data analysis ($n = 143$, 88.3%), and communicating information effectively with agency staff and with the local community ($n = 138$, 85.2%). Moreover, PHEP graduates reported that the program helped them much in writing summary reports on surveillance findings or outbreak investigations ($n = 136$, 84%), using Microsoft Excel or any software to enter, analyze, and display public health surveillance data ($n = 133$, 82.1%), and preparing and administering oral presentations of their fieldwork ($n = 132$, 81.5%).

Regarding the activities that are related to the COVID-19 pandemic, almost two thirds ($n = 124$, 76.5%) of the participants reported that PHEP helped them much in managing and reporting COVID-19 surveillance data, contributing to the development and distribution of standard case definition for COVID-19 ($n = 124$, 76.5%), dissemination health education messages and promotional materials to raise awareness toward COVID-19 ($n = 126$, 77.8%), responding to public queries about COVID-19 through specified hotlines and developing documents with standard appropriate information ($n = 108$, 66.7%), and monitoring global trends of COVID-19 and mortality through relevant websites ($n = 116$, 71.6%).

The graduates from PHEP-Nutrition and PHEP-SPO were significantly less likely than the graduates from PHEP-BFE to report that the program had helped them to perform the basic field epidemiology activities related to surveillance, descriptive data analysis, communication, responding to public health threats, writing summary reports, and using Microsoft Excel. The differences were significant in univariate analysis and multivariate analysis after adjusting for age and gender (Table 5). However, the three PHEP programs did not differ significantly in the extent of helping the graduates to prepare and administer oral presentations of their fieldwork.

TABLE 3 Field epidemiology training program graduates' self-evaluation of their skills in performing field epidemiology activities.

Field epidemiology activities	Good		Acceptable		Poor	
	n	%	*n*	%	*n*	%
Conduct, review, and monitor surveillance data collection	136	84	18	11.1	8	4.9
Perform descriptive data analysis	123	75.9	28	17.3	11	6.8
Communicate information effectively with agency staff and with the local community	128	79	22	13.6	12	7.4
Respond effectively to public health events, specifically, disease outbreaks	138	85.2	19	11.7	5	3.1
Write a summary report on surveillance findings or an outbreak investigation	120	74.1	32	19.8	10	6.2
Use Microsoft Excel or any software to enter, analyze, and display public health surveillance data	130	80.2	19	11.7	13	8
Prepare and administer an oral presentation of their fieldwork	128	79	27	16.7	7	4.3
Monitor the global trends of COVID-19 and mortality through relevant websites	117	72.2	35	21.6	10	6.2
Manage COVID-19 surveillance data (data analysis and reporting)	112	69.1	37	22.8	13	8
Contribute to the development and distribution of a standard case definition for the COVID-19	89	54.9	53	32.7	20	12.3
Provide support applying isolation and infection control protocols for confirmed COVID-19 cases	106	65.4	35	21.6	21	13
Collect samples and screen passengers for testing to confirm suspected COVID-19 cases	92	56.8	37	22.8	33	20.4
Dissemination of health education messages and promotional materials to raise awareness toward COVID-19.	124	76.5	26	16	12	7.4
Respond to public queries about COVID-19 through the specified hotlines and develop documents with standard appropriate information.	103	63.6	37	22.8	22	13.6
Search for published scientific literature, standard operating procedures, and guidelines, and support the development of national guidelines for the COVID-19 epidemic.	93	57.4	46	28.4	23	14.2

The impact of PHEP from the perspectives of technical advisers

Five technical advisers (62.5%) reported that PHEP graduates contributed very often to conducting, reviewing, and monitoring surveillance data collection. Four technical advisers (50%) stated that almost all PHEP graduates were involved in performing descriptive data analysis and five advisers (62.5%) reported that almost all PHEP graduates communicated information with agency staff and with the local community effectively. For outbreak investigations, seven advisers (87.5%) reported that most PHEP graduates participated in outbreak investigations and responded effectively to such events. Furthermore, six advisers (75%) stated that PHEP graduates were involved in writing summary reports on surveillance findings and outbreak investigations. According to five advisers (62.5%), none or a few PHEP graduates participated in publishing research studies.

Regarding COVID-19, all technical advisers reported that almost all PHEP graduates were involved in the response to this pandemic, and they evaluated their performance as very good to excellent. Moreover, four advisers (50%) stated that PHEP graduates helped their countries to control COVID-19 to great extent. At the screening and isolation centers, technical advisers reported that PHEP graduates were involved in filling-in surveillance forms and contacting the arrivals in the follow-up period, and screening passengers at different points of entry. Finally, for the research activities, six advisers (75%) reported that PHEP graduates were engaged in working on different operational research and documented the readiness, knowledge, attitudes, and practices of the health workforce regarding COVID-19.

Suggestions for improvement from the perspectives of PHEP technical advisers

The technical advisers of the program provided some suggestions to improve this program in their countries. Those suggestions included training more health care providers to cope with the escalating needs in the EMR countries. They recommended increasing the number of workshops in the program to ensure the improvement of participants' epidemiological capacities and to increase the number of trainees in these programs.

Discussion

Previous studies evaluated FETPs and reported the experiences and lessons learned (11, 12, 16). The Council of State and Territorial

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TABLE 4 The extent to which field epidemiology training program helped the graduates to perform field epidemiology activities.

Field epidemiology activities	Much		Somewhat		Little	
	n	%	*n*	%	*n*	%
Conduct, review, and monitor surveillance data collection	149	92	4	2.5	9	5.5
Perform descriptive data analysis	143	88.3	9	5.5	10	6.2
Communicate information effectively with agency staff and with the local community	138	85.2	8	4.9	16	9.9
Respond effectively to public health events, specifically, disease outbreaks	148	91.4	7	4.3	7	4.3
Write a summary report on surveillance findings or an outbreak investigation	136	83.9	15	9.3	11	6.8
Use Microsoft Excel or any software to enter, analyze, and display public health surveillance data	133	82.1	20	12.3	9	5.6
Prepare and administer an oral presentation of their fieldwork	132	81.5	14	8.6	16	9.9
Monitor the global trends of COVID-19 and mortality through relevant websites	116	71.6	24	14.8	22	13.6
Manage COVID-19 surveillance data (data analysis and reporting)	124	76.5	16	9.9	22	13.6
Contribute to the development and distribution of a standard case definition for the COVID-19	119	73.5	13	8	30	18.5
Provide support in applying isolation and infection control protocols for confirmed COVID-19 cases	117	72.2	19	11.7	26	16
Collect samples and screen passengers for testing to confirm suspected COVID-19 cases	94	58	19	11.7	49	30.2
Dissemination of health education messages and promotional materials to raise awareness toward COVID-19.	126	77.8	10	6.2	26	16
Respond to public queries about COVID-19 through the specified hotlines and develop documents with standard appropriate information.	108	66.7	18	11.1	36	22.2
Search for published scientific literature, standard operating procedures, and guidelines, and support the development of national guidelines for the COVID-19 epidemic.	100	61.7	17	10.5	45	27.8

Epidemiologists (CSTE) evaluated the outcomes of the first 9 years of the Applied Epidemiology Fellowship (AEF) and reported that 67% of the alumni and 79% of the mentors indicated that the program was very essential and had a positive impact on their career (11). In India, the first 7 years of its FETP were evaluated and found that 86% of the fellows acquired the seven core competencies of the program (12). Another study reporting the role of Jordan FETP in the national and regional capacity building showed that the program contributed significantly to improvements in surveillance systems, control of infectious diseases, outbreak investigations, and availability of reliable morbidity and mortality data in Jordan (16). A study in Papua New Guinea on the lessons learned from the intervention-based FETP showed the successful public health outcomes with tangible local impacts of this program (17). Also, in the United Kingdom (UK), it was found that FETP highly contributed to the development of a skilled workforce in field epidemiology (13).

Although those different studies had evaluated FETP, PHEP evaluation had received little attention. PHEP is a competency-based training in basic public health and epidemiology. Our study assessed "the degree of applying what was learned" and "the degree to which outcomes occur as a result of the training" (15). The evaluation was based on information from two sources, PHEP graduates and program advisers who are within the healthcare system at a level where they can observe the impact of this program. Most graduates and their technical advisers reported that the program had helped them to perform field epidemiology activities, especially during the COVID-19 pandemic. Additionally, the program enabled them to be engaged more in conducting, reviewing and monitoring surveillance data collection, and in responding effectively to public health events, specifically, disease outbreaks. This was most apparent during the COVID-19 pandemic. PHEP graduates were actively participating in surveillance and screening at airports and other ports of entry and communicating information effectively with agency staff and with the local community.

Our evaluation showed the effectiveness of this training in improving the skills and capacity of public health workers. Our findings support the results from other studies regarding the impact of FETPs including Frontline FETP (PHEP). In Kenya, Frontline FETP graduates acquired practical skills that enhanced data collation, analysis and reporting (14). Another cross-sectional study was conducted to evaluate the first two cohorts of FETP-Frontline in Guinea (18). The evaluation showed high levels of self-reported involvement in key activities related to data collection, analysis, and reporting by program graduates. The program supervisors as well highlighted improvements to systematic and quality case and summary reporting as a result of the FETP-Frontline program.

Graduates from PHEP-Nutrition and PHEP-SPO programs reported significantly lower levels of perceived improvement in their

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TABLE 5 A comparison analysis of field epidemiology training programs in helping the graduates to perform the basic field epidemiology activities.

Epidemiologic activity/type of the PHEP program*	*n*	%	*p*-Value	Adjusted OR*	95% confidence interval		*P*-value
Conduct, review, and monitor surveillance data collection			<0.001				
PHEP-BFE	117	96.7		Ref			
PHEP-Nutrition	19	86.4		0.24	0.05	1.15	0.074
PHEP-SPO	13	68.4		0.07	0.02	0.28	0.000
Perform descriptive data analysis			<0.001				
PHEP-BFE	115	95.0		Ref			
PHEP-Nutrition	17	77.3		0.19	0.05	0.71	0.014
PHEP-SPO	11	57.9		0.06	0.02	0.23	0.000
Communicate information effectively with agency staff and with the local community			<0.001				
PHEP-BFE	110	90.9		Ref			
PHEP-Nutrition	14	63.6		0.16	0.05	0.52	0.002
PHEP-SPO	14	73.7		0.22	0.06	0.83	0.026
Respond effectively to public health events, specifically, disease outbreaks			<0.001				
PHEP-BFE	117	96.7		Ref			
PHEP-Nutrition	17	77.3		0.08	0.02	0.40	0.002
PHEP-SPO	14	73.7		0.07	0.01	0.34	0.001
Write a summary report on surveillance findings or an outbreak investigation			<0.001				
PHEP-BFE	107	88.4		Ref			
PHEP-Nutrition	18	81.8		0.63	0.18	2.17	0.467
PHEP-SPO	11	57.9	0.003	0.17	0.06	0.50	0.001
Use Microsoft Excel or any software to enter, analyze, and display public health surveillance data							
PHEP-BFE	108	89.3		Ref	0.06	0.52	0.001
PHEP-Nutrition	13	59.1		0.18	0.06	0.58	0.004
PHEP-SPO	12	63.2		0.19			
Prepare and administer an oral presentation of their fieldwork			0.110				
PHEP-BFE	103	85.1		Ref			
PHEP-Nutrition	15	68.2		0.38	0.13	1.06	0.064
PHEP-SPO	14	73.7		0.49	0.16	1.52	0.217

*Adjusted for the graduates' age and gender; PHEP; Public Health Empowerment Program; BFE, Basic Field Epidemiology; SPO, Surveillance Polio Officers.

ability to perform basic field epidemiology activities compared to graduates from the PHEP-BFE program. These activities include surveillance, descriptive data analysis, communication, responding to public health threats, writing summary reports, and using Microsoft Excel, which are essential competencies across all three modalities. The discrepancy in perceived improvement could potentially be explained by the fact that the field training in PHEP-Nutrition and PHEP-SPO programs is specifically focused on nutrition and polio, respectively, rather than providing a more comprehensive training in basic field epidemiology activities. It is possible that the training in these programs may not have been as directly applicable to the wider range of field epidemiology activities that the graduates may encounter in their professional roles.

Our study showed the high and effective engagement of PHEP graduates in responding to COVID-19 in the EMR which reflects the success of this program in building the epidemiologic capacity for the public health workforce, improving countries' surveillance systems, and therefore strengthening health systems. Although the technical advisers reported that PHEP graduates were engaged in working on different operational research on the readiness, knowledge, attitudes, and practices of the health workforce regarding COVID-19, none, or a few of the PHEP graduates managed to participate in publishing

research articles. This decreases the visibility of many achievements and successes in public health in the EMR. Therefore, it is very essential to invest more in this program to build the capacity of the public health workforce in this area.

Our results showed that PHEP helped in building a sustainable public health response capacity and expertise. Therefore, periodic evaluation is essential to ensure that the program is achieving its intended outcomes. Such evaluation helps to achieve and maintain high-quality training and assure the program's effectiveness in improving public health. It also allows for the exchange of experiences in managing and running the program and therefore strengthens the regional emergency response mechanism and enhances coordination between MOHs in the region.

In conclusion, PHEP appears to be an effective program for improving the public health workforce's skills and practices in epidemiological competencies. The program strengthened the engagement of the graduates in most field epidemiology activities. PHEP is essential for building the capacity in applied epidemiology. The continuity of the program should be ensured to train more people to support countries' responses to public health events and pandemics.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by the Institutional Review Board at Jordan University of Science and Technology. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

Author contributions

MAA, MA, RA, HA, and YK contributed to study design, data analysis, and writing the manuscript. MAA, RA, AAS, ZH, LA, AAK, MK, SS, NB, and IA-K contributed to data collection and revision of the manuscript. All authors have read and approved the manuscript.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2023.1180678/full#supplementary-material

References

1. The World Bank. Natural disasters in the Middle East and North Africa: a regional overview. (2014) Available at: www.worldbank.org (Accessed January 8, 2023).

2. World Health Organization (WHO). WHO EMRO | displaced populations | emergencies. (2015) Available at: http://www.emro.who.int/eha/displaced-populations/index.html (Accessed November 18, 2020).

3. Waha K, Krummenauer L, Adams S, Aich V, Baarsch F, Coumou D, et al. Climate change impacts in the Middle East and Northern Africa (MENA) region and their implications for vulnerable population groups. *Reg Environ Chang*. (2017) 17:1623–38. doi: 10.1007/S10113-017-1144-2

4. Noormal B, Eltayeb E, Al NM, Mohsni E, Khader Y, Salter M, et al. Innovative approaches to improve public health practice in the eastern Mediterranean region: findings from the sixth eastern Mediterranean public health network regional conference. *J Med Internet Res*. (2019) 5:e11382. doi: 10.2196/11382

5. Centers for Disease Control and Prevention CDC. Field epidemiology training program (FETP) fact sheet | division of Global Health protection | Global Health | CDC. (2020) Available at: https://www.cdc.gov/globalhealth/healthprotection/resources/fact-sheets/fetp-factsheet.html (Accessed June 2, 2021).

6. About FETP | Division of Global Health protection | Global Health | CDC. (2021) Available at: https://www.cdc.gov/globalhealth/healthprotection/fetp/about.html

7. André AMK, Lopez A, Perkins S, Lambert S, Chace L, Noudeke N, et al. Frontline field epidemiology training programs as a strategy to improve disease surveillance and response. *Emerg Infect Dis*. (2017) 23:S166–73. doi: 10.3201/eid2313.170803

8. Team DDicker RC, Traicoff D, Gathany N, Davidson L, Evering-Watley M, et al. *FETP-Frontline Planning Guide*. (2020) Available at: https://www.cdc.gov/globalhealth/healthprotection/fetp/pdf/FETPF_Planning_Guide_10-2020_Final-508.pdf

9. EMPHNET. The eastern Mediterranean public health network (EMPHNET). (2016) Available at: http://emphnet.net/?page_id=491 (Accessed November 23, 2020).

10. CDC. *Field epidemiology training program development handbook*. (2006) Available at: https://www.cdc.gov/globalhealth/healthprotection/fetp/pdf/fetp_development_handbook_508.pdf

11. Dick VR, Masters AE, McConnon PJ, Engel JP, Underwood VN, Harrison RJ. The CDC/council of state and territorial epidemiologists applied epidemiology fellowship program: evaluation of the first 9 years. *Am J Prev Med*. (2014) 47:S376–82. doi: 10.1016/j.amepre.2014.07.022

12. Bhatnagar T, Gupte MD, Hutin YJ, Kaur P, Kumaraswami V, Manickam P, et al. Seven years of the field epidemiology training programme (FETP) at Chennai, Tamil Nadu, India: an internal evaluation. *Hum Resour Health*. (2012) 10:36. doi: 10.1186/1478-4491-10-36

13. Dey P, Brown J, Sandars J, Young Y, Ruggles R, Bracebridge S. The United Kingdom field epidemiology training programme: meeting programme objectives. *Eur Secur*. (2019) 24:1900013. doi: 10.2807/1560-7917.ES.2019.24.36.1900013

14. Roka ZG, Githuku J, Obonyo M, Kanyina E, Oyugi EO, Boru WG, et al. Impact evaluation of the Kenya frontline field epidemiology training program (2020). 7:e18956. doi: 10.21203/rs.2.20485/v1

15. Partners Kirkpatrick. The Kirkpatrick model. (2020) Avaialble at: https://www.kirkpatrickpartners.com/Our-Philosophy/The-Kirkpatrick-Model

16. Al NM, Iblan I, Tarawneh MR. Jordan field epidemiology training program: critical role in national and regional capacity building. *J Med Internet Res*. (2018) 4:e12. doi: 10.2196/mededu.9516

17. Ropa B, Flint J, O'Reilly M, Pavlin BI, Dagina R, Peni B, et al. Lessons from the first 6 years of an intervention-based field epidemiology training programme in Papua New Guinea, 2013-2018. *BMJ Glob Heal*. (2019) 4:e001969. doi: 10.1136/bmjgh-2019-001969

18. Collins D, Diallo BI, Bah MB, Bah M, Standley CJ, Corvil S, et al. Evaluation of the first two frontline cohorts of the field epidemiology training program in Guinea, West Africa. *Hum Resour Health*. (2022) 20:1–12. doi: 10.1186/S12960-022-00729-W/FIGURES/3

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Simulation as a key training method for inculcating public health leadership skills: a mixed methods study

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Background: Successful management of public health challenges requires developing and nurturing leadership competencies. We aimed to evaluate the effectiveness of training simulations to assess public health leadership and decision-making competencies during emergencies as an effective learning and training method.

Methods: We examined the effects of two simulation scenarios on public health school students in terms of their experience (compared to face-to-face learning) and new skills acquired for dealing with similar emergent situations in the future. A mixed-methods design included developing a validated and pre-tested questionnaire with open-and closed-ended questions that examined the simulation impact and the degree of student satisfaction with the conditions in which it was conducted. Semi-structured in-depth interviews were conducted with the students after going through the simulations. The questionnaire results were evaluated using descriptive analytics. The interviews were analyzed using thematic analyses. All data were collected during June 2022.

Results: The questionnaire results indicate that students strengthened their interpersonal communication skills and learned about the importance of listening to the opinions of others before formulating their positions. Four themes emerged from 16 in-depth interviews, according to Kolb's experimental learning cycle. Students emphasized the effectiveness of experiential learning versus traditional classroom learning. The simulation scenarios were felt to realistically convey

critical issues regarding leadership, decision-making, and teamwork challenges. They effectively conveyed the importance of building a culture of conducting substantive and respectful discussions.

Conclusion: Simulation is a powerful pedagogical training tool for public health leadership competencies. Simulations were seen to be advantageous over face-to-face learning in imparting a range of leadership skills and hands-on practice. We recommend integrating simulations in all public health leadership training programs.

KEYWORDS

simulation, leadership, communication skills, Kolb's experimental learning, ethical dilemma

1. Introduction

Successful management of public health emergencies such as dealing with pandemics, earthquakes, fires, and other natural and man-made disasters, require the development and deployment of leadership competencies (1). Simulation during the COVID-19 pandemic helped refine protocols, facilitate practice changes, uncover safety gaps, improve response to crisis situations, supported team training and systems integration, and train redeployed healthcare workers in unfamiliar roles (2). Simulation helps train for essential clinical and leadership competencies using experiential learning supporting the quadruple aim (3).

Learning is the acquired behavior or potential change resulting from instruction, training, and practice or experience (4). In the context of professional training at a graduate level, learning is goal oriented and motivated by progress toward independent practice. Simulation is an effective, evidence-based learning tool that supports experiential learning and improves critical thinking (5, 6). Simulation has been shown to support the rapid acquisition of multiple skills, such as clinical skills, therapeutic procedures, time management, teamwork, and decision-making under pressure (7). Simulation based on Kolb's Experimental Learning Cycle (8) supports learners benefiting from a direct and experiential encounter with a significant phenomenon, the investigation of which requires reflective observations of knowledge and experience. Kolb's experiential learning model posits that learning includes four stages that repeat themselves: Concrete Experience, Reflective Observation, Abstract Conceptualization, and Active Experimentation, and that occur through a cycle of reflective observations of concrete experiences to gain a deeper understanding of what can be learned from each experience (9). New ideas are then applied to future experiences, renewing the cycle. Unlike traditional learning, Kolb's model enables knowledge acquired in one experience to be applied to other, new, and unfamiliar experiences. The process of reflective observations and building perceptions provides tools and supports skills that allow an encounter with a new and unfamiliar situation to succeed under ambiguity and uncertainty (10).

Simulations for the development of leadership skills are applied worldwide in all health professions and at all career stages and have been proven to be effective in developing management and leadership skills (for example, (11–14)). The skills identified as significant for healthcare leaders include communication skills, teamwork, problem and conflict resolution, interpersonal skills, ability to work under pressure, negotiation ability, ability to motivate people, and entrepreneurship (15, 16). Simulation experiences can help clinical teams strengthen their leadership self-confidence when performing professional work in fulfilling their roles as public servants (17). Simulations can effectively replicate conflict situations and strengthen communication skills and provide effective ways to resolve conflicts. They allow health system workers to translate theoretical learning into practice (18), improve communication skills (19), physician learners to improve patient handovers and develop ethical behavioral norms that support management of leadership dilemmas (20).

Hertelendy et al. (21) found that 55% of accredited Master of Public Health programs in the United States provide Leadership training courses, and only one program offered a crisis resource management leadership course. The authors state that the COVID-19 pandemic and climate change brought emergencies to the forefront for health systems, so public health curricula must emphasize leadership competencies to prepare their graduates to lead complex crisis events.

We developed and evaluated the effectiveness of simulation training of public health leadership and decision-making competencies during periods of emergency as a pedagogical and learning method. The research examined the effects of the simulation training on participants in terms of their experience (compared to traditional frontal learning), the strengthening of their skills and the new competencies acquired for dealing with similar emergent situations in the future.

2. Materials and methods

2.1. Orientation to the study

This prospective, mixed-methods study is part of a larger multinational Erasmus Plus funded project for building Capacity in Higher Education entitled "Sharing European Educational Experience in Public Health for Israel (SEEEPHI): harmonization, employability, leadership, and outreach," described in Bashkin et al. (22). Initial findings from the project point to considerable gaps between the needs of the public health labor force employers and the curriculum of Israeli Schools of Public Health, indicating a paucity of leadership training (23, 24).

2.2. Setting and participants

We developed and piloted a leadership course using training simulations designed for health professions in a recently opened learning track for healthcare management as part of a Master degree in Health Policy and Management at the Ben Gurion University School of Public Health (KD and ND academic coordinators of the program). The simulations were aimed at improving the ability to manage conflicts, strengthen teamwork, encourage collaborations with parties outside the healthcare system, and motivate a multi-disciplinary team. Eighteen students took the course and participated in the study at Ben Gurion University. The students were divided into three facilitated groups of six students (led by ND, KD, and IS).

2.3. Procedure

2.3.1. Simulation

The students were given general instructions about the training simulations followed by extensive debriefing, conducted on Friday, June 3, 2022, at the Faculty of Health Sciences Simulation Center at Ben Gurion University (Appendix 1). Each group was assigned a room with a small table, chairs, and a blackboard. Each group's facilitator provided participants with their specific role description. Students were instructed to act according to their assigned role. The simulations were filmed. The students participated in the two simulations described in Appendix 1. The questionnaires (Appendix 2), requiring about 10 min to complete, were distributed to all participants after each simulation. The simulation videos were used for debriefing by the facilitator together with the participants.

2.3.2. Structured self-reported questionnaire

We developed and piloted a questionnaire (Appendix 2) that included 22 questions, including four questions on demographics (profession, role in the simulation, age, and whether they participated in a simulation in the past), nine open-ended questions, and nine closed-ended questions using a Likert scale from 1 to 5. The open-ended questions explored whether the students had the knowledge and skills to meet the learning goals of the scenario, what gaps they identified in their knowledge base and preparation for the simulation. The closed-ended questions examined the degree of satisfaction with the conditions in which the simulation was conducted, how confident they felt in managing the situation, the contribution of the simulation to their sense of security and confidence. Ten nursing students at Ben Gurion University who participated in previous simulations pretested the questionnaire, and the final version was modified to address their feedback. All participants completed the questionnaire anonymously.

2.3.3. The interview

We interviewed 16 students (out of the 18 participants) in June 2022, during the 2 weeks following their participation in the simulations, using a pretested semi-structured individual interview tool based on our interview guides (Appendix 3). Two students were abroad at the time of the interviews and were not interviewed. The interviews were conducted in Hebrew (by IS, a lawyer with an MBA in business administration and an MA in Emergency Medicine), trained to conduct the interviews by two highly experienced qualitative researchers (by KD and ND). Two pilot joint interviews were conducted for demonstration and practice. Before the interview, each interviewee signed a new consent form agreeing to conduct the interview and to allow its recording.

The interview guide included nine questions about the participants' experience, what they derived from the experience, and how the simulation compared to traditional learning in a classroom. The Interview Guide's questions were based on a literature review of simulation evaluation and debriefing. (KD and IS compiled) Three professors at Ben Gurion University, experts in leadership, simulations, and health policy, validated the questionnaire using the content validity method. This method is based on the relevancy and coherency of a framework's elements and the degree they represent a specific goal (25). Two questions that were not clear were revised, and two new questions were added to the Interview Guide. In the second round of review, there was a consensus among the three professors regarding the suitability of the interview guide.

All students were offered face-to-face, telephone, and Zoom interview options (Zoom is a video-telephony software program), but all chose to be interviewed by phone. Each participant was given a code (interviewee number), and no identifying details of the participants were mentioned in the interview transcription or the data analysis.

2.4. Data analysis

2.4.1. The questionnaires

The questionnaire included an open and a closed section. The answers to the open-ended questions were analyzed using content analysis according to the Hickey & Kipping approach (26). The approach required three researchers (KD, IS, ND), two of whom worked together for much of the process, and a third researcher who verified the credibility of categories and the consistency of subsequent coding. In the first stage, KD entered the response data for each question into SPSS file v.29 (IBM, Armonk, NY, United States). During this process, ideas for categories were created, which highlighted the main themes emerging from the data. In the second stage, IS and KD read the answers (18 questionnaires for each simulation, for a total of 36 questionnaires for both simulations) and reached a consensus on the categories based on the dialog of the rationale underpinning each category. In the third stage, a copy of the responses was given to ND, who developed a set of categories compared with those identified by IS and KD. Disagreements were discussed until a final set of categories was agreed upon. In the fourth stage, IS and KD allocated categories and detailed codes. In the fifth stage, ND checked the coding decisions for accuracy and reliability. In the sixth stage, IS and KD merged and reallocated the details. In the seventh stage, ND checked the decisions regarding the merging and reallocating categories. Any discrepancies were discussed until a consensus was reached.

The codes can be seen in Appendix 5. Due to the small number of participants, the data analysis is descriptive. The frequency distribution for each answer is shown by comparing the results of the two scenarios.

2.4.2. The semi-structured interviews

We used assigned numbers for each interviewee to maintain confidentiality. The average time of the interview was 20 ± 4.76 min. The interviews were recorded and then transcribed by a professional

transcriber. Details that could reveal the identity of the interviewees were omitted (e.g., position, specialization, etc.).

The interviews were analyzed using a thematic analysis method based on Kolb's experiential learning model (8). A theme expresses a broad central idea that repeatedly appears in different forms of expression in the materials. The thematic analysis of the interviews was carried out in several stages according to Shkedi's method (27). In the first stage, KD and IS read all the interviews to familiarize themselves with the data. In the next step, ideas, categories, and themes related to the research questions were identified by each reader. After the themes were agreed upon and validated, the characterizations and ideas were discussed while rereading the transcripts until the final themes were formulated with exemplar quotes. The themes were sorted and distributed according to Kolb's experiential learning model and according to the research objectives (8). The themes and quotes were translated and documented in English at the final stage. We used a standardized codebook to ensure the validity of the translations from Hebrew to English.

2.5. Ethics statement

The study was approved by the ethics committee of Ben Gurion University of the Negev (approval #198–1 dated May 25, 2022). Participants gave informed consent for inclusion in the study and were informed about the procedures planned for anonymity, data protection, and privacy. A detailed explanation was provided before the simulations, and participants were given the option to opt out. The interviewees were asked to sign a consent form detailing the purpose of the study, their right to stop the interview at any stage they wished, a promise of confidentiality, and their consent to the interview was recorded. The recordings were used for transcription purposes only and then deleted.

3. Results

3.1. Sample characteristics

Eighteen students participated in the study. Table 1 illustrates the sample's characteristics. The individual sample characteristics are shown in Appendix 4.

TABLE 1 Grouped sample characteristics (n=18).

Character	Group	*N*	%
Gender	Women	10	56
	Men	8	44
Profession	Nursing	5	31
	Medicine	4	25
	Health professions	4	19
	Administration	5	25
Family status	Married	16	88
	Singles	2	12
Religion	Jews	15	88
	Muslims	3	12

3.2. Questionnaires

Eighteen students completed the questionnaire after each scenario (Table 1). Ten were women (56%), and eight were men (44%). Their ages ranged from 26 to 50 (average 38 ± 7.23). Four were doctors (22%), five were nurses (28%), four were health professionals (22%), and five had administrative positions (28%). Eleven had participated in simulations in the past (61%), in the army, in studies, or their workplace.

3.2.1. Open-ended questions

The students were interested in fruitful dialog, cooperation and appreciated the importance of hearing different opinions. In contrast, more than half of respondents felt that the second scenario was more challenging and complex than the first scenario. Most felt they had the skills to meet the learning objectives in both scenarios (78% in the first scenario compared to 50% in the second scenario).

The students indicated that they strengthened their interpersonal communication skills and learned about the importance of listening to the opinions of others before forming their position. They strengthened their self-confidence, the ability to express a position on key topics and convince others and learned how to make compromises. Strengths they identified concerning themselves were listening to others without interrupting, assertiveness to stand up for themselves, and the ability to convince others about their opinions. They identified weaknesses mainly in the first scenario: difficulty expressing oneself, leaving their comfort zone, and rapidly raising their voices.

The participants said they enjoyed the group dynamics, joint discussion, and presentation of the dilemma from the varied perspectives of others. They least enjoyed entrenching themselves in a position and lashing out at others. Some were disturbed by the feeling of being video recorded.

When asked: "Will participating in the simulation help you deal with similar situations in the future?" 89% answered yes. The ways of influence were diverse. For example: *"It increased my confidence to stand up and convince others of my position. I felt what it was like to stand in front of senior people and express myself, it helped me understand how to behave correctly to promote interests, and I learned how to compromise and reach a consensus."*

The distribution of answers for each question for both scenarios is shown in Appendix 5.

3.2.2. Close-ended questions

The questionnaire included nine closed questions in which participants were asked to indicate their agreement with each statement on a Likert scale. The participants were positive about both scenarios. Most respondents expressed satisfaction with the conditions under which the simulations were performed, felt confident in managing the simulated conflicts, identified the issues that require leadership skills, and their leadership ability. There was a slight improvement in responding to the questions in the second scenario. The distribution of answers for each question for both scenarios is shown in Appendix 6.

3.3. Interviews

Sixteen of the 18 students who participated in the simulations were interviewed (89%). Of them, 9 were women (56%), 7 were men

(44%). The data analysis resulted in four main themes according to Kolb's experiential learning stages model (8): face-to-face learning versus simulation experience; differences in experience between the two scenarios; simulation as a toolbox for the continuation of personal and professional life; and, accepting the scenario as valuable for professional training and relevant to their work.

Table 2 illustrates the themes and sub-themes according to the stages of Kolb's experiential learning model.

3.3.1. Theme I: face-to-face learning versus the simulation experience

In the first stage of the experiential learning model, an active experience in a new or familiar situation requires investigation and interpretation. Most of the BGU University degree classes are taught in a traditional face-to-face learning modality (a lecturer standing in front of a class of students). The simulations described in this study are the first experiential experience within the master's degree. The students were assigned roles and had to deal with the situations without guidance or external intervention. In the interviews, they noted the significant differences between the two learning methods according to the following sub-themes:

3.3.1.1. One-person show vs. co-play

In face-to-face learning, the lecturer determines the order of conduct in the lesson and the course. The students are more passive, compared to the simulation - in which the students are given a platform to be interactive and leading, and the instructor is more passive.

Interviewee #1 opined: *"It's much more interesting, and you want to participate and give of yourself more. In face-to-face learning, you sit in class and fiddle with the phone, talk with friends, and fiddle with the computer. Here you were all in action, a partner in the task."*

Interviewee #10 emphasized the importance of everyday discourse: *"I believe in the discourse, and I like these opportunities. I like unusual things. All these courses, where you learn all kinds of theories, are very specific and defined. When there is in between the possibility to add the discourse and the interactions, people Everyone brings with them their own beliefs and life experience. The opportunity in the simulation allows much more learning. I like listening to others, and if I have something to take from someone else–it's an opportunity in my eyes."*

3.3.1.2. Theoretical versus experiential learning

Most of the face-to-face classes are theoretical, planned, and less experiential. Although the simulation is designed, the student's behavior cannot be predicted, which makes learning an authentic experience when the student-actor reacts to each other during the scenario. The simulation experience is an opportunity to apply and practice skills that cannot be acquired theoretically in a classroom setting in front of a lecturer.

Interviewee #15 shared: *"These are exactly what I wanted, practical tools. You can sit and talk in class for hours and hours, and it does not get to you. It would be best to practice changing something inherent in you and your habits. And practice it in a safe, controlled environment - It seems much more correct to me, and it's also what later gets you used to function in real-time. So, I think this simulation taught me much more than all the classes. Because theory is nice and important, but if you do not apply it, you have not done anything with it. I would be happy for it to be more."*

Interviewee #10 added: *"I remember the ability of the one who led the discussion to let people talk, exchange opinions and criticize each other and finally bring things together. Stop and sort out the important details. I said, 'Oh, this is a point I take.' The ability to put things together. One of the participants pulled something from "under the waist," and I told myself that you are never prepared for every situation. I looked at the girl when he said it to her. She was speechless for a moment and did not know how to react. These things can always reach us one way or another; someone can catch you "below the belt," and you must deal with it. It was an empowering experience, an opportunity to deal with something, and from a place where you are a part, it was a good experience."*

TABLE 2 Themes and sub-themes according to Kolb's model.

Stages in Kolb's experiential learning model	Themes	Sub-themes
Active experience in a new or familiar situation that requires investigation and interpretation	I. Face-to-face learning versus simulation experience	■ One-person show vs. co-play ■ Theoretical versus experiential learning
Reflective observation of the situation, whether there is a match between previous understanding and experience and the situation	II. Differences in experience between the two simulation scenarios	■ Micro versus macro ■ Knowledge gaps and how best to overcome them ■ Innocence versus taking over the discussion
Building perceptions and processing information in reflective processes that lead to changing existing perceptions	III. Simulation as a toolbox for the continuation of personal and professional learning	■ Listening, inclusion, and integration skills ■ Self-confidence, a sense of higher competence ■ Meeting management, leading, striving for achievement ■ Learning about myself versus learning about colleagues' skills and competencies
Examination of the newly acquired insights	IV. Accepting the scenario as training for their professional work and organizational challenges	■ Alleviating concerns in communication with superiors and bosses ■ The culture of discussion

3.3.2. Theme II: differences in the experience between the two simulation scenarios

The second stage in the experiential learning model includes reflective observations on the simulations. The students experienced two scenarios that were not built on each other. They brought up differences in their personal experiences regarding the two scenarios in their reflective observations.

Interviewee #2 shared her feelings: *"The first was like an experience, both in my role and group dynamics. It was more relaxed. There were more requests to hear the other opinions, to let the sentences finish. The second simulation had a battle atmosphere; everyone got to say what they wanted and believed their opinion should be accepted now. There I felt less desire to listen."*

Interviewee #4 enjoyed both scenarios equally and pointed out the challenge in the second simulation: *"I enjoyed both simulations. In terms of the role, the first role was much easier on the surface. It was easier to play it than the second role, which was more demanding and complex and required rethinking this matter."* The reasons for the differences in feelings between the simulations included three sub-themes:

3.3.2.1. Micro versus macro system scenarios

The interviewees mentioned that the first scenario was written as a discussion at the local level with characters they could more easily identify with. In contrast, the second scenario simulated an ethical dilemma among senior officials at the national level, which felt less real to them.

Interviewee #10: "*The first was more convenient to operate and was something we were familiar with, material we went over and dealt with, the team members we knew, also their thoughts on the issue. The second was more challenging, issues that stand in the way of a world without solutions. Even at the level of knowing what I want to say or what I think about, it was more challenging there. But it was also more interesting because you could be in less comfortable places, but more enabling."*

3.3.2.2. Knowledge gaps and how best to overcome them

The gaps in knowledge and familiarity with the material affected the overall experience. Interviewee #14 mentioned the prior learning that helped in the first scenario, and in contrast, the challenge and the need to "get out of the box" in the second scenario: *"The first one was within the material that we studied, and then we more or less knew what we were talking. The second simulation was a bit out of the box because we got roles we had no idea how to process."*

Interviewee #6 expressed the fear she had and overcame the situation through the support she felt from her co-workers: *"Even though they had their role, they gave a feeling: do not be afraid, we are all in the same boat. They cooperated, and that's what helped me. It's an experience for life - sometimes you need good people next to you that you can trust. As soon as you do not know something, you look for someone better than you at it, and that's what I did. That's how I bridged my gaps."*

3.3.2.3. Innocence versus taking over the discussion

Some interviewees talked about innocence in the first scenario. From a "soft landing" into a situation that was more familiar, about which they had prior knowledge and were able to enter the role relatively quickly. On the other hand, in the second scenario, an ethical dilemma was presented concerning the sensitive area of the individual's right versus the common good, making the discourse aggressive, in which each character wanted to voice and impose their position.

For example, interviewee #11 shared: *"The first, I felt there was innocence. The second, everybody became more aggressive. You try to give a solution to a problem in half an hour, and everyone has their position, and everyone wants to win. It does not seem realistic, and it also turbocharges these matters. It introduced more emotions and more aggressiveness. They tried to forcefully take over the discussion and not listen to what others had to say. Ultimately, I learned that not every matter and issue you represent will be the only one that will pass, that you will win over everyone, and that your opinion will be accepted. Not realistic Every discussion you participate in, the topic you promote will be the one that will receive the full attention."*

3.3.3. Theme III: simulation as a toolbox for the continuation of personal and professional learning

The third stage of the model emphasizes the importance of information processing in the reflective processes that lead to changing existing perceptions and behaviors. Simulation has a wide variety of meanings and roles that allows participants to experience a predefined experience and practice different skills. The practice enabled the participants to investigate, learn, and reach conclusions about what was good (more or less) in their conduct with others.

An attempt was made to simulate complex situations of discussions in various dilemmas while trying to reach a consensus. The process of reaching an agreement is an essential skill that must be practiced to be effectively used in real-world situations. The participants noted in the interviews that the simulations equipped them with a toolbox of different skills that were divided into four sub-themes:

(i) Listening, inclusion, and integration skills

Listening is one of the essential tools in the ability to lead. Interviewee #8 described the importance of listening: *"I think that some of the opinions that people have around a table in one or another meeting may require listening to the end and not being fixed in your position. Sometimes a position may be mine, and I believe in it, but it is important to listen to others because they can Be that it can change a mind."*

Inclusion is an important element in listening because it is possible to listen technically, and it is also crucial to include different professional opinions. *Integration* makes it possible to connect listening and inclusion and to understand what can be derived from them. Interviewee #10 defined it from her point of view in a way that explains the importance of inclusion and integration: *"I first learned to listen, which is something that challenges us sometimes. Stop for a moment and hear all sides, integrate things. On the other hand, I was very comfortable listening to and agreeing with others, and I had to remind myself to stand by the opinion I had to present here. This is also something that I will take to life, always remembering to be both. Also, in the ability to listen, in inclusion, but on the other hand, I always have to remember who I am and what I bring. I must preserve and see how it connects."*

(ii) Self-confidence, a sense of higher competence

Self-confidence relates to the leader's ability to act, make decisions, and influence others. During a simulation, the participant can learn whether he has this feature and build on it

accordingly. Interviewee #2 authentically shared the tool added to her toolbox: *"It gives a sense of security that you are sitting in a forum and can express yourself. The experience strengthens future dealings with similar situations."*

A sense of competence relates to and is built through successful experiences. This feeling is acquired, and the individual must experience it to know her/his capabilities. Interviewee #2 shared: *"I think experimenting with the simulations increases the ability to deal with similar scenarios. Although I do not sit with the Minister of Finance, I do sit with seniors."*

(iii) Meeting management, leading, striving for achievement

Decision-making is required in all emergent situations. Decisions should be based on data, execution capabilities, and more. One of the ways to make an informed decision is to have a professional discussion of the data and to listen to various opinions. Interviewee #10 explained how the simulations contributed to her professional world: *"It's something I'm not strong at, and I'll run into it, sitting in such meetings that are more in the noise of the world. Today I'm used to doing professional things, which I've known for years. It's relatively something to sit in meetings where you talk about things from a much higher level, with a broader view of the collaborations of other factors that ultimately affect important things and all kinds of practice in the field, which is new to me. For me, it was an opportunity to dive into it and be a part of something like this in the broader view."*

Leadership in the professional world is not measured by the definition of a role but by the execution of the task and the ability to harness additional people to the task (28). This ability is not self-evident, especially in ethically complex tasks (29). Interviewee #15 shared when asked about the relationship between professional life and simulations: *"The first simulation was quite similar because I was with people who supposedly came to hear from me, and I was being led, so it felt quite similar to me. And the second one was more difficult for me because I had to deal with the fact that they were on the same level, and I had to negotiate with them. These are different strategies. It's more difficult. You do not come and give instructions. Everyone had their agenda, and I had to deal with it and try to lead the discussion."*

Although reaching the required achievement is significant, one must remember how one strives for achievement. Interviewee #9 shared his strategy: "*In the conduct of striving for contact or achievement, I learned that you need to pay attention to who is sitting next to you, to the personal complexity of the people next to you. In one of the simulations, my way offended one of the partners. But okay, in real life, I get to know the people better and know a little more."*

(iv) Learning about myself versus learning about colleagues' skills and competencies

One of the most critical tools in the toolbox required of leaders is one of self-awareness, which is routinely built through self-learning and getting to know yourself and your colleagues. The participants emphasized that a person who thinks he can act alone will not be able to promote, manage, lead, and lead for a long time. For example, interviewee #1: *"One of the girls who was with us in the group, her character and character, that's what I thought until the simulation, was arrogant and did not treat anyone and ignored the environment and was focused on herself. That's how it looked. After the simulation, I got to know a completely different person, shared more, and listened to different opinions. She consulted with us, and it was 'wow, what a completely different person,' one person in the class and someone else in the simulation."*

Interviewee #12 confirmed: *"I learned even from the first simulation to the second. I told myself that I would give my friends more space to speak and listen to their arguments. And as soon as I heard the sides and there were smart arguments, I connected. It helped me to be more open-minded. As if to listen more, to get more opinions."*

Interviewee #16 added: *"The simulation allowed me to look inward and outward. Looking inward is really from the situation I learned about myself, the points that are more or less difficult for me. And it's an amazing experience to see the extraordinary abilities of other people. Verbally as well, also in terms of group dynamics, also perceptual."*

3.3.4. Theme IV: accepting the scenario as training for their professional work and organizational challenges

The fourth stage of the experiential learning model deals with examining the new insights gained when participants face similar situations in the future. Indeed, the participants compared the simulation scenarios to their daily work life. The interviewees reported they had diverse roles in the health system, hence the variety of answers they gave, each from their perspective and personal experience. The responses were divided into two sub-themes:

(i) Alleviating concerns in communication with superiors and bosses

Interviewee #14 described the opportunity made possible by the simulation to sharpen communication skills with his superiors during discussions and to voice his opinion: *"If we put together everything, we learned about what was in the simulation, in the end I took out quite a lot of tools and quite a lot of options that I did not even think I had. Also, communication with People and communication between people from completely different worlds. Because even in the simulations, we were in all the various professions in the health systems. I used to be afraid to talk to someone in a senior position. Now I feel that I can be direct and have my opinion in front of seniors."*

(ii) The culture of discussion

When you practice a culture of discussion through simulation, you can arrive more prepared and act in a more efficient and respectful manner. Most interviewees brought up the topic of discussion culture as a key matter. Part of leadership is the ability to conduct a discussion that respects all participants and, above all, invites all opinions to be heard to help teach an informed decision. However, as in professional life and simulations, some discussions were more heated and less respectful. Interviewee #1 described her insights that everyone should be given an opportunity, including herself: *"What I take, I'm talking about the second simulation that she was a little more aggressive and more entrenched in her position, that's when you want to say something - say it and stand your ground because, in the end, they will hear you. I mean, not because several people together told you no, so what you say is wrong and unjust. You will bend down and follow their position. You can continue to try to convince and prove. And you do not have to say things aggressively. The message can be conveyed in a pleasant way."*

Interviewee #4 described the discussion culture and the importance of listening and reaching a consensus pleasantly. Despite the extensive experience that professionals have, other opinions can be valuable: *"I've been in the profession for many years. I've participated in all kinds of meetings and led all kinds of things. I have experience.*

From the simulation, I took attention. It's important not only to speak but also to hear. That's what we need to learn to do, including me. We often want to voice and decide. It's important to hear each other and reach a common denominator."

Interviewee 5 emphasized the importance of dealing with objections: *"First of all, I experienced dealing with people who seem programmed to have an opinion contrary to mine and how to deal with it respectfully on the one hand and matter-of-factly on the other. At the level of the simulation itself, I think it was an excellent simulation."*

Interviewee #11 mentioned the vital element of different opinions, which can be heard in a cultural discussion: *"Discussion management. These seem to me to be the main things. I do not think you can afford in real life to behave aggressively. Maybe I'm naive. I have not experienced politics or things like that."*

4. Discussion

The simulations demonstrated the unique importance of using simulation to train public health students in improving their leadership competencies. The results highlighted the need for innovative learning and experiential opportunities beyond providing students with theoretical knowledge. The innovation of our findings may lie in identifying strategies for inculcating and strengthening leadership skills in practice beyond traditional classroom learning. Similar simulations in Public Health Schools have not been conducted in Israel. The literature in the field of simulations in the healthcare system is traditionally concerned with strengthening clinical skills, and communication between therapists and patients and less with leadership, leading teams, and decisions making (30). Herein lies the contribution of simulation to strengthening leadership and decision-making through innovation and creativity.

All participants agreed that realistic-simulated leadership dilemmas were a valuable learning strategy and offered a powerful process beyond that occurs in face-to-face learning. The experience, dynamics, interaction, and interpersonal communication challenged the participants and their learning more than in their face-to-face teaching. Theoretical studies are essential, but they are different from the immersive experience, in which the students are empowered to develop skills that will be used in the future in their personal and professional lives (31, 32). These findings are consistent with previous studies, which found that experiential training has a positive influence on the learning process (33–36). Simulation is considered a safe method when learning to address unpredictable situations concerning non-technical skills and thus can improve management and leadership abilities (37). Students are more likely to progress in their learning and skill acquisition through simulations (38).

The quantitative and qualitative findings suggest that the simulation's lasting value may lie in provoking deep reflections and insights by the participants about their leadership and management skills. Most participants saw the simulations as a bridge to explore their confidence and learn to make their voices heard more effectively during discussions and how they can encourage others to speak up. The participants gained an understanding of moving from solo leadership to teamwork and the ability to respectfully listen to the opinions of others, as in Cooper et al. (12). The study also found, as noted by Gonen et al. (39), that the simulation increased the chances of effective learning with long-term assimilation. The participants reported that they gained many tools from participating in the simulations such as strengthening their self-confidence to voice their opinion and convince others, listening more effectively, making decisions under conditions of uncertainty, and more. Similar findings were found in a study that examined the effects of participating in a daily workshop in Israel based on simulations to strengthen communication skills among 42 medical students in their Psychiatry department rotation (19). The authors found that there was a significant increase in the interpersonal communication skills of the participants, as well as improvement in their self-confidence in communicating with patients. Peleg (40) described a process of implementing simulations within an interpersonal communication course among physical therapy students. The students found the scenarios relevant to their learning process and the simulation effective and realistic. They added that they experienced the simulation as a significant event that promoted learning. Chen et al. (41) found that in simulations carried out with the aim of examining coping strategies during an emergency, the simulations reflected flexibility in decision-making among emergency incident managers.

Cooper et al. (12) developed a training program to teach key concepts of teamwork and leadership among 108 managers of US healthcare organizations. The simulations helped the participants identify issues with self-confidence encouraging the students to acknowledge that they were afraid to speak their minds. Some commented on their failure as leaders to invite others to speak up. Others recognized the need to improve teamwork and communication. The participants in the current study raised similar points of weakness, and it became clear that there is a need to strengthen these skills during the socialization to the profession as part of the studies and in their workplaces.

4.1. Limitations

Our study has several limitations. First, we had a limited number of participants in our pilot study, and all were selected from a training course in leadership. However, the students came from various backgrounds and roles so that a multi-disciplinary team could be simulated in each simulation. Second, the study results reflect the Israeli health and education system, which may not be generalizable to other countries with their distinct health delivery and training systems, comprising unique legislative and organizational characteristics, and within diverse clinical and political settings. Third, we cannot be sure how effectively the lessons from this study are generalizable to public health leaders in real world situations. Fourth, the study did not account for the "learning style" of the participants. Fifth, the interviews were transcribed from Hebrew, the native language in Israel. This may have increased the chances for variations in the interpretation of our data. We made all efforts to ensure methodological rigor and validity of the translations from Hebrew to English by using a standardized codebook, meeting frequently, sharing and comparing our results, and performing a pilot analysis. Throughout the study, we conducted an ongoing internal quality audit during our meetings, adapted from Mays & Pope (42) and Tong et al.

(43), to determine whether the data were collected, analyzed, and reported consistently according to the study protocol.

5. Conclusions and recommendations

The results from the study demonstrate that simulation training is a powerful pedagogical tool in the leadership education of public health leaders. Simulation realistically conveys critical issues regarding leadership and decision-making, teamwork challenges, and can instill a culture of conducting substantive, reflective, and respectful discussions. Simulation has many advantages over face-to-face traditional learning in imparting skills, feedback, and practice. The simulation allows a powerful emotional experience tailored to different professional and emergency contexts essential to developing public health leaders. We recommend integrating simulations in all public health leadership courses. Further research is needed to examine the long-term effectiveness of simulations on managing meetings, reaching consensus, persuasiveness and self-expression, and decision-making skills in times of emergency and crises. This pilot study will help to further enhance our leadership programs by providing powerful scenarios for imparting essential management and leadership skills. Future work is needed to perform an objective assessment of the participant's performance in simulations and real-world situations.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by the ethics committee of Ben Gurion University of the Negev (approval #198–1 dated May 25, 2022). The participants provided their written informed consent to participate in this study.

Author contributions

KD, ND, and IS: conceptualization, analysis, and interpretation. OV and IS: project administration. KD and IS: data curation. KD and PB: writing-original draft. IS, ND, OV, KC, JN, RO, LL, OB, MD, HL, FM, MM, LO-E, SZ-S, and PB: review and editing. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2023.1202598/full#supplementary-material

References

1. Streufert S, Satish U, Barach P. Improving medical care: the use of simulation technology. *Simul Gaming*. (2001) 32:164–74. doi: 10.1177/104687810103200205

2. Pan D, Rajwani K. Implementation of simulation training during the COVID-19 pandemic: a New York hospital experience. *Simul Healthc*. (2021) 16:46–51. doi: 10.1097/SIH.0000000000000535

3. Wong AH, Ahmed RA, Ray JM, Khan H, Hughes PG, McCoy CE, et al. Supporting the quadruple aim using simulation and human factors during COVID-19 care. *Am J Med Qual*. (2021) 36:73–83. doi: 10.1097/01.JMQ.0000735432.16289.d2

4. Chaplin J. *Dictionary of psychology*. *2nd* ed. New York: Laurel (1985).

5. Forneris SG, Neal DO, Tiffany J, Kuehn MB, Meyer HM, Blazovich LM, et al. Enhancing clinical reasoning through simulation debriefing: a multisite study. *Nurs Educ Perspect*. (2015) 36:304–10. doi: 10.5480/15-1672

6. Dreifuerst KT. Using debriefing for meaningful learning to foster development of clinical reasoning in simulation. *J Nurs Educ*. (2012) 51:326–33. doi: 10.3928/01484834-20120409-02

7. Lane JL, Slavin S, Ziv A. Simulation in medical education: a review. *Simul Gaming*. (2001) 32:297–314. doi: 10.1177/104687810103200302

8. Kolb DA. *Experiential learning: Experience as the source of learning and development* Prentice-Hall (1984).

9. Cosman PH, Sirimanna P, Barach P. Building surgical expertise through the science of continuous learning and training In: J Sanchez, P Barach, J Johnson and J Jacobs, editors. *Surgical Patient Care*. Cham: Springer (2017).

10. Kothari L, Shah K, Barach P. Simulation-based medical education in graduate medical education training and assessment programs. *Prog Pediatr Cardiol*. (2017) 44:33–42. doi: 10.1016/j.ppedcard.2017.02.001

11. Adams JM, Denham D, Neumeister IR. Applying the model of the interrelationship of leadership environments and outcomes for nurse executives: a community hospital's exemplar in developing staff nurse engagement through documentation improvement initiatives. *Nurs Adm Q*. (2010) 34:201–7. doi: 10.1097/NAQ.0b013e3181e7026e

12. Cooper JB, Singer SJ, Hayes J, Sales M, Vogt JW, Raemer D, et al. Design and evaluation of simulation scenarios for a program introducing patient safety, teamwork, safety leadership, and simulation to healthcare leaders and managers. *Simul Healthc*. (2011) 6:231–8. doi: 10.1097/SIH.0b013e31821da9ec

13. Fernandez R, Rosenman ED, Olenick J, Misisco A, Brolliar SM, Chipman AK, et al. Simulation-based team leadership training improves team leadership during actual trauma resuscitations: a randomized controlled trial. *Crit Care Med*. (2020) 48:73–82. doi: 10.1097/CCM.0000000000004077

14. Labrague LJ. Use of simulation in teaching nursing leadership and management course: an integrative review. *Sultan Qaboos Univ Med J*. (2021) 21:344–53. doi: 10.18295/squmj.4.2021.007

15. Dopelt K, Levi B, Davidovitch N. Identifying distinctive traits of healthcare leaders in Israel: in-depth interviews with senior physicians - an exploratory study. *Leadersh Health Serv*. (2021) 34:263–79. doi: 10.1108/LHS-08-2020-0059

16. Levi B, Davidovitch N, Dopelt K. In Service of the Society? Medical associations as agents of social change-implications for health policy and education in Israel. *Healthcare (Basel)*. (2021) 9:1264. doi: 10.3390/healthcare9101264

17. Mitchell MJ, Newall FH, Sokol J, Williams KJ. Simulation-based education for staff managing aggression and externalizing behaviors in children with autism Spectrum disorder in the hospital setting: pilot and feasibility study protocol for a cluster randomized controlled trial. *JMIR Res Protoc*. (2020) 9:e18105. doi: 10.2196/18105

18. Orr Z, Machikawa E, Unger S, Romem A. Enhancing the structural competency of nurses through standardized patient simulation. *Clin Simul Nurs*. (2022) 62:25–30. doi: 10.1016/j.ecns.2021.09.005

19. Amsalem D, Gothelf D, Soul O, Dorman A, Ziv A, Gross R. Single-day simulation-based training improves communication and psychiatric skills of medical students. Front. *Psychiatry*. (2020) 11:221. doi: 10.3389/fpsyt.2020.00221

20. Shapira-Lishchinsky O. Simulation-based constructivist approach for education leaders. *Educ Manage Adm Leadersh*. (2015) 43:972–88. doi: 10.1177/1741143214543203

21. Hertelendy AJ, Chekijian S, McNulty E, Mitchell CL, Grimes JO, Durneva P, et al. Crisis leadership: a case for inclusion in accredited master of public health program curricula. *Public Health*. (2022) 209:14–8. doi: 10.1016/j.puhe.2022.05.012

22. Bashkin O, Dopelt K, Mor Z, Leighton L, Otok R, Duplaga M, et al. The future public health workforce in a changing world: a conceptual framework for a European-Israeli knowledge transfer project. *Int J Environ Res Public Health*. (2021) 18:9265. doi: 10.3390/ijerph18179265

23. Bashkin O, Otok R, Leighton L, Czabanowska K, Barach P, Davidovitch N, et al. Emerging lessons from the COVID-19 pandemic about the decisive competencies needed for the public health workforce: a qualitative study. *Front Public Health*. (2022) 10:990353. doi: 10.3389/fpubh.2022.990353

24. Bashkin O, Otok R, Kapra O, Czabanowska K, Barach P, Baron-Epel O, et al. Identifying the gaps between public health training and practice: a workforce competencies comparative analysis. *Int J Public Health*. (2022) 67:1605303. doi: 10.3389/ijph.2022.1605303

25. Almanasreh E, Moles R, Chen TF. Evaluation of methods used for estimating content validity. *Res Social Adm Pharm*. (2019) 15:214–21. doi: 10.1016/j.sapharm.2018.03.066

26. Hickey G, Kipping C. A multi-stage approach to the coding of data from open-ended questions. *Nurse Res*. (1996) 4:81–91. doi: 10.7748/nr.4.1.81.s9

27. Shkedi A. *Words that try to touch: qualitative research–theory and application*. Tel-Aviv: Ramot (2003).

28. Guo Y, Jin J, Yim S-H. Impact of inclusive leadership on innovative work behavior: the mediating role of job crafting. *Adm Sci*. (2023) 13:4. doi: 10.3390/admsci13010004

29. Uppathampracha R, Liu G. Leading for innovation: self-efficacy and work engagement as sequential mediation relating ethical leadership and innovative work behavior. *Behav Sci*. (2022) 12:266. doi: 10.3390/bs12080266

30. Ayaz O, Ismail FW. Healthcare simulation: a key to the future of medical education - a review. *Adv Med Educ Pract*. (2022) 13:301–8. Published 2022 Apr 5. doi: 10.2147/AMEP.S353777

31. Vural Doğru B, Zengin AL. The effects of training with simulation on knowledge, skill and anxiety levels of the nursing students in terms of cardiac auscultation: a randomized controlled study. *Nurse Educ Today*. (2020) 84:104216. doi: 10.1016/j.nedt.2019.104216

32. Samaras SA, Adkins CL, White CD. Developing critical thinking skills: simulations vs. cases. *J Educ Bus*. (2022) 97:270–6. doi: 10.1080/08832323.2021.1932703

33. Akselbo I, Olufsen V, Ingebrigtsen O, Aune I. Simulation as a learning method in public health nurse education. *Public Health Nurs*. (2019) 36:226–32. doi: 10.1111/phn.12560

34. Çelik Y, Ceylantekin Y, Kiliç İ. The evaluation of simulation market in nursing education and the determination of learning style of students. *Int J Health Sci (Qassim)*. (2017) 11:1–6.

35. Chuang YH, Lai FC, Chang CC, Wan HT. Effects of a skill demonstration video delivered by smartphone on facilitating nursing students' skill competencies and self-confidence: a randomized controlled trial study. *Nurse Educ Today*. (2018) 66:63–8. doi: 10.1016/j.nedt.2018.03.027

36. Forcina Hill JM, Woodley L, Goodwin M. Simulation to prepare graduate nursing students for clinical faculty role. *Nurs Educ Perspect*. (2018) 39:319–21. doi: 10.1097/01.NEP.0000000000000304

37. Cohen D, Vlaev I, McMahon L, Harvey S, Mitchell A, Borovoi L, et al. The crucible simulation: behavioral simulation improves clinical leadership skills and understanding of complex health policy change. *Health Care Manag Rev*. (2019) 44:246–55. doi: 10.1097/HMR.0000000000000162

38. Poore JA, Cullen DL, Schaar GL. Simulation-based interprofessional education guided by Kolb's experiential learning theory. *Clin Simul Nurs*. (2014) 10:e241–7. doi: 10.1016/j.ecns.2014.01.004

39. Gonen A, Lev-Ari L, Sharon D, Amzalag M. Situated learning: the feasibility of an experimental learning of information technology for academic nursing students. Cogent. *Education*. (2016) 3:1–8. doi: 10.1080/2331186X.2016.1154260

40. Peleg S. Experiential learning in physical therapy: the process of implementing simulations in an interpersonal communication course and faculty training. *J Physiother*. (2022) 24:5–19.

41. Chen P, Zhang J, Sun Y, Liu X. Wargame simulation theory and evaluation method for emergency evacuation of residents from urban waterlogging disaster area. *Int J Environ Res Public Health*. (2016) 13:1260. doi: 10.3390/ijerph13121260

42. Mays N, Pope C. Qualitative research in health care. Assessing quality in qualitative research. *BMJ*. (2000) 320:50–2. doi: 10.1136/bmj.320.7226.50

43. Craig P, Sainsbury A. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *Int J Qual Health Care*. (2007) 19:349–57. doi: 10.1093/intqhc/mzm042

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External assessment of medical education quality: indicative model development considering paradox of skill

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This study proposes an approach to the external evaluation of medical education programs' quality based on a combination of indicators, including international rankings, external stakeholders' input, and independent agencies' assessments. We modify the success equation with a detailed consideration of the skill component and its decomposition into internal and external quality assurance elements along with authority. We carried out a bibliometric analysis regarding the problem of medical education quality assessment in the context of achieving sustainable development goals. We described the calculation model of external quality assessment indicators through the algorithms of independent education quality assurance agencies' activity and rating indicators shown in the modified Mauboussin's equation. The model considers the economic component (the consequence of achievement) of skill, which is expressed in raising funds from external sources to implement educational and scientific activities. The proposed algorithm for assessing the educational program quality can be applied to benchmark educational program components, complete educational programs within the subject area, and the educational institution for different areas. We propose a "financial" model for educational program quality based on the analysis results. The model makes it possible to determine the need for additional focused funding of the educational program based on the individual analysis of the external evaluation criteria of the achievement level. This study analyzes the accreditation results of more than 110 educational programs in 2020 and 8 months of 2021 within the direction 22 "Medicine" (according to the national classification of fields of knowledge) (state and private Ukrainian medical universities).

KEYWORDS

medical education, education quality, education funding, education evaluation, bibliometric analysis, sustainable development goals

1. Introduction

The quality of medical education is a popular area of study by scientists in various applications:

- at the national level, with proposals for the development of strategies for improving educational programs (1);
- at the regional level, taking into account the specifics of medical programs (2, 3);
- in terms of institutional accreditation in general (4);
- communication with practitioners and employers (5, 6);
- discussions about the importance and influence of individual indicators on the quality of medical educational programs (7–9);
- the role of stakeholders in ensuring the quality of medical education (10, 11), etc.

As the analysis of the data presented above shows, assessing the quality of education (especially external, which is implemented by independent agencies) is carried out qualitatively (the presence or absence of indicators according to various criteria). The lack of a quantitative assessment complicates the evaluation process to some degree. A tool that can quantify at least some of the indicators is needed.

External accreditation of educational programs by the National Agency for Higher Education Quality Assurance is currently the only tool for assessing the quality of medical education in universities under the Ukrainian Ministry of Education and Science and the Ministry of Health.

State regulation of educational activities (12, 13) to meet the Sustainable Development Goals (14, 15) can only partially satisfy the requirements of educational services consumers. Innovation strategies (16, 17), providing leadership in the implementation of breakthrough technologies (18, 19), choosing the most effective forms of the educational process (20, 21), creating a successful socio-economic model of the university (22–24), promoting the university brand on the market of educational and scientific services (19, 25), evaluation of educational program quality by stakeholders (26, 27), and the openness of information about the educational program (28, 29)—all these characteristics are the subject of examination during the implementation of external education quality assessment.

This study demonstrates that quality assurance in education is a multifactorial "experiment". All components of the socio-economic state of the region are essential, especially the organization of training in different periods, the influence of external factors on the demand for educational programs, etc. (30–52).

The research is based on the example of data analysis in the field of "Medicine"; the research results can be further applied to other educational areas.

The data of bibliometric analysis of the keyword "medical education" states that various aspects of quality assurance are an integral part of the medical education analysis (Figure 1, tool—VOSviewer, analyzed 109,000 documents in all areas, selected the most cited 2,000 for the period 2016–2020, the minimum number of mentions of keywords: 25, excluding keywords related to specialized medical terminology). Interestingly, a significant number of keywords presented in Figure 1 are related to Sustainable Development Goals (Figure 2, tool–VOSviewer, analyzed 8,000 documents in the field of "medicine" for the period 2016–2020, the minimum number of mentions of keywords: 50, excluding keywords related to specialized medical terminology), which determines the additional relevance of this study.

Furthermore, the analysis was performed on data related to life expectancy and healthy life expectancy indices and indicators of the Universitas 21 rating leaders. The analysis involved constructing a table of relevant indicators and examining the top 10 countries in the ranking of Universitas 21 and the first 36 countries in the ranking and their respective indicators in the Life Expectancy Index 2020 and the WHO Healthy Life Expectancy Index 2018. The analysis aimed to explore the relationship between these variables and determine whether there is a significant correlation or associ ation between them. We utilized a simple linear regression model and interpretation of its coefficients to illustrate the interconnection between said indices. For the first round of analysis, we selected the Life Expectancy Index 2020 rating as the dependent variable, with the national educational Universitas 21 ranking as an independent variable. The second round of analysis accounted for data from the WHO Healthy Life Expectancy Index 2018 as a dependent variable and Universitas 21 ranking as an independent variable.

Success (S) in achieving results in any activity depends on two components: skill (M) and luck (L). This approach is reflected in Michael Mauboussin's success equation (53), which is a weighted linear function of skill and luck:

$$S = aM + bL, \tag{1}$$

where the value a reflects the relative weight of skill in the range from 0 to 1, and as a result, b = 1 – a.

Suppose we relay this approach to assessing education quality, in that case, we encounter the term "luck" as a very limited set, which is reduced to success not in achieving the quality of the educational program, but luck regarding the contingent involved in the current educational program. Furthermore, all the success, which is directly related to the educational program quality, can be measured by skill, and a value in (1) is around one. Thus, we can only talk partly about the paradox of skill in the case of the "education quality" dynamic system. For the system "education quality", the term "skill" in (1) has three components:

1. internal quality assurance of the educational program q.i.
2. mobility in improving the educational program in response to the challenges mo.
3. external evaluation by stakeholders and independent agencies q.e.

However, the success of the university's educational activities depends not only on skill and (at a minimum) luck but also on a third parameter—the authority of the university (R), which is determined, inter alia, by world rankings. Thus, the equation of Mauboussin's success can be upgraded to the following form:

$$S = aM + bL + cR \tag{2}$$

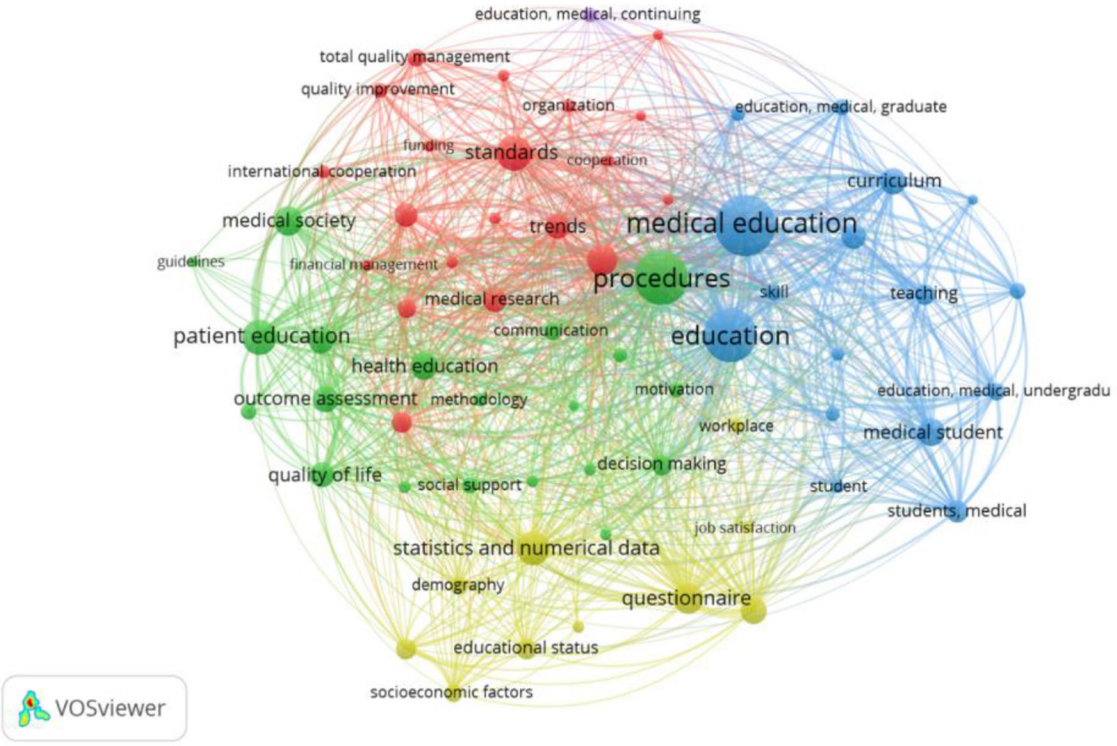

FIGURE 1
Bibliometric analysis of the key phrase "medical education".

where a + b + c = 1.

Considering components of the skill defined above, Eq. (2) will take on the form

$$S = a(QI + Mo + QE) + bL + cR. \quad (3)$$

External evaluation of the education quality by stakeholders and independent agencies is one of the most effective ways to determine the competitiveness level of an educational program. This tool is effective in cases when quality assessment indicators are clearly defined.

A multi-factor model for assessing the quality of medical education is proposed, which is based on the view from the "inside" (quality indicators of the components of the educational program and the quality assurance system) and "from the outside" (indicators of the success of the educational program according to the evaluation methods of the Ministry of Education and Science, the National Agency for Higher Education Quality Assurance).

2. Materials and methods

Since rating agencies, in addition to general university rankings, also implement university rankings by area (which actually assess educational program(s) quality within a field), additional mechanisms for educational program benchmarking are emerging.

Given the similar nature of the external and rating university evaluation, the success in Eq. (2) for the university can be interpreted as follows:

$$S = EXT + INT, \quad (4)$$

where

$$EXT = aQE + bL + cR. \quad (5)$$

$$INT = a(QI + M). \quad (6)$$

The success of the educational program is also determined by Eq. (4). However, given the insignificance of luck's contribution to educational program quality, equation (5) takes the form

$$EXT = aQE + cR. \quad (7)$$

In this study, we try to describe the component EXT in (7), considering both the rating agencies' requirements for education quality assessment by area and experience of external accreditation of educational programs by the National Agency for Higher Education Quality Assurance (Ukraine) in 2020–2021. We focus on determining the indicators QE and R because the weight factors a and c may vary for a particular evaluation period.

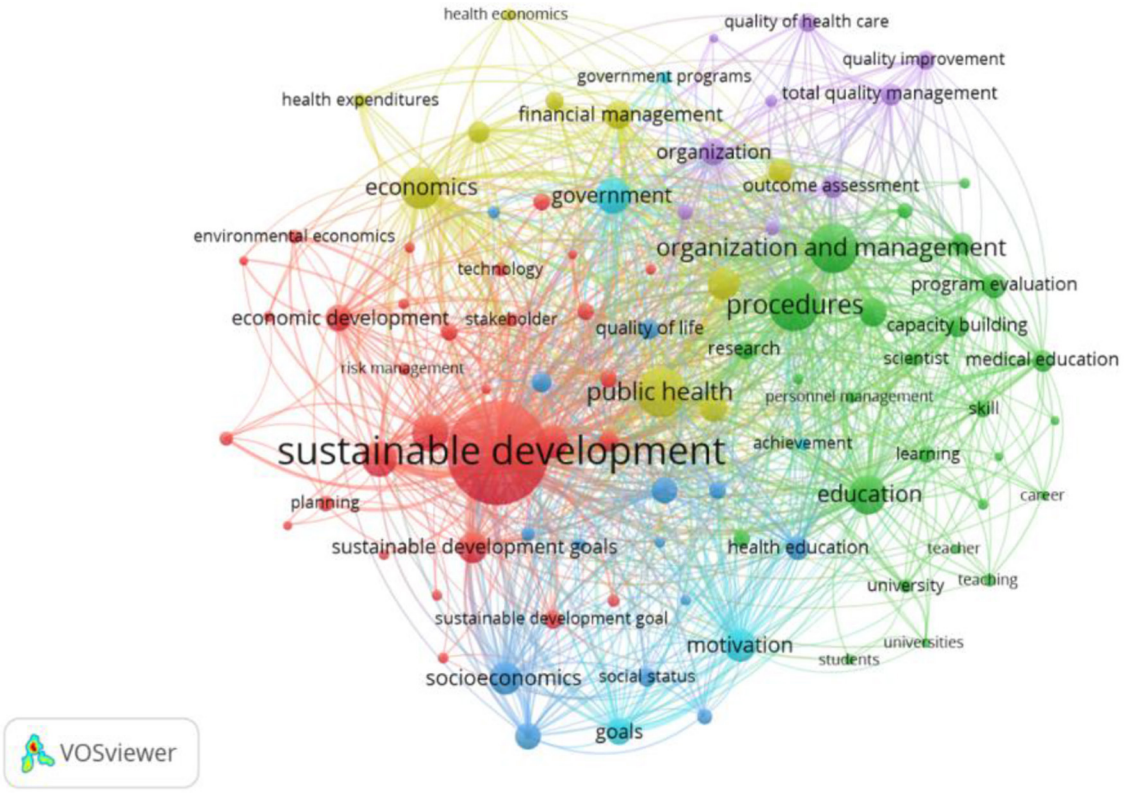

FIGURE 2
Bibliometric analysis of the key phrase "sustainable development goals".

3. Results

The presence of Ukrainian institutions providing higher medical education in the world rankings is currently a future matter. Advances on the path to the entry of Ukrainian universities to the branch medical ratings are possible due to benchmarking the main rating indicators and understanding the landscape and depth of their content. In addition, one should consider that industry rankings do not assess specific programs but the whole subject area. This fact determines the additional relevance of developing procedures aimed at the evaluation of educational programs. An attempt to evaluate medical education and the institutions that provide it was made in the ranking of the top 100 faculties of domestic universities (Top best faculties of Ukraine according to Forbes, 2021) and the ranking of the top 200 universities in Ukraine (HEI rating "TOP-200 Ukraine 2021", 2021). Indirectly, these ratings can be used to assess educational programs' quality, but they have a low level of detail in the assessment as their main drawback.

Assessment of educational institutions' quality is also carried out according to the scientific component (54). However, it is more likely to be named an outcome of quality education, expressed in the level of implementation of research results. Such attestation is currently implemented by the Ministry of Education and Science of Ukraine for subordinated universities, which does not allow us to compare the results with the indicators of universities subordinated to the Ministry of Health of Ukraine. In addition, this tool does not allow the allocation of a separate sector "medicine," as it evaluates the activities of universities in the field of "Biology and Health."

Based on the assessment of certain university performance indicators, the Ministry of Education and Science of Ukraine has developed a methodology for allocating state budget expenditures (55). Since 1 January 2021, this method is also applicable to universities subordinated to the Ministry of Health of Ukraine. Among other indicators, this technique uses the indicator of international recognition and the indicator of graduate employment, which are part of the second term of Eq. (7).

Using the data of ratings of the Life Expectancy Index 2020, the WHO Healthy Life Expectancy Index 2018, and Universitas 21: Ranking of National Higher Education Systems 2020, we constructed a table of relevant indicators of Universitas 21 rating leaders related to life expectancy and healthy life expectancy. Table 1 presents the top 10 countries in the ranking of Universitas 21 plus Ukraine. For a more detailed analysis of the relationship between the ratings, the first 36 countries of the Universitas 21 ranking and their respective indicators in the Life Expectancy Index 2020 and the WHO Healthy Life Expectancy Index 2018 were considered.

Figure 3 demonstrates the results of the life expectancy assessment depending on the national level of higher education. The coefficient at x in the linear regression equation can be interpreted as follows: with an increase of the Universitas 21 index by one unit, the value of the Life Expectancy Index increases

TABLE 1 The Life Expectancy Index 2020 and the WHO Healthy Life Expectancy Index 2018 for the first 10 countries in Universitas 21 rating plus Ukraine.

Country/rating	Universitas 21: ranking of national higher education systems 2020		Life Expectancy Index 2020		World Health Organization: Healthy Life Expectancy Index 2018			
	Rating	Index	Rating	Index (yrs)	Rating	Index(yrs)		
						Mean	Male	Female
The USA	1	100.0	37	78.9	40	68.5	66.9	70.1
Switzerland	2	90.1	3	83.8	4	73.5	72.4	74.5
Denmark	3	85.7	30	80.9	24	71.8	70.7	73.0
Singapore	4	84.5	4	83.6	1	76.2	74.7	77.6
Sweden	5	84.3	11	82.8	17	72.4	71.5	73.4
The United Kingdom	6	83.6	27	81.3	23	71.9	70.9	72.9
Canada	7	83.2	15	82.4	7	73.2	72.0	74.3
Finland	8	82.8	22	81.9	25	71.7	69.8	73.5
Australia	9	82.2	7	83.4	9	73.0	71.8	74.1
The Netherlands	10	81.6	17	82.3	20	72.1	71.3	72.8
Ukraine	36	47.8	114	72.1	100	64.0	60.3	67.6

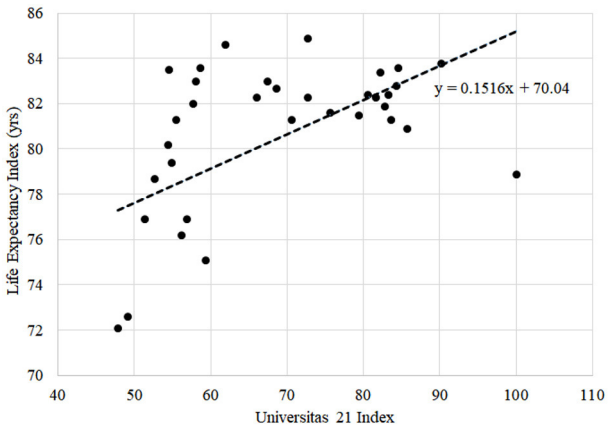

FIGURE 3
Universitas 21 index against Life Expectancy Index (in years).

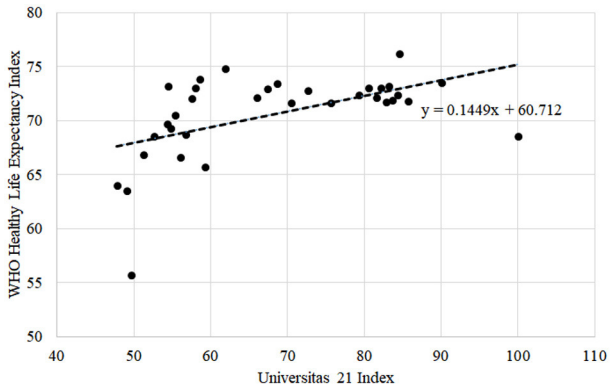

FIGURE 4
Universitas 21 index against the WHO Healthy Life Expectancy Index (in years).

by ~0.152 years. This fact allows us to conclude that education (primarily medical) quality directly impacts the parameters used in compiling the Life Expectancy Index. However, the model is limited and illustrative, as it does not consider several factors directly related to healthcare and health services.

Figure 4 is similar to Figure 3, but it estimates the life expectancy according to the WHO Healthy Life Expectancy Index 2018 relative to the Universitas 21. The coefficient at x in the linear regression equation for this case shows that by increasing Universitas 21 by one unit, the value of life expectancy according to the WHO Healthy Life Expectancy Index increases by ~0.145 years. This dependence is also not decisive but should be noted in the context of medical education analysis.

Table 2 presents European universities ranking in the "Medicine" field according to QS World University Rankings. The university's rank is determined by the value of "Overall Score". It is important to consider that the positions of compared universities in the ranking may differ significantly despite slight differences in the value of the "Overall Score." In the general case, the assessment of university performance according to the QS methodology (56) is based on six key factors:

- Academic Reputation (40%)
- Employer Reputation (10%)
- Faculty/Student Ratio (20%)
- Citations per Faculty (20%)

TABLE 2 QS rankings of Europe universities by subject "medicine".

Rank	University	Overall score	H-index citations	Citations per Paper	Academic reputation	Employer reputation
2	The University of Oxford	96.4	96.3	97.2	96.4	94.2
4	The University of Cambridge	94.1	91.4	93.9	96	94.2
6	Karolinska Institutet	92.3	94.1	92.1	96	73.2
9	UCL	91.3	94.3	94.3	88	82.3
10	Imperial College London	90.8	93.1	96.9	87.1	84.4
17	King's College London	87.6	91.6	92.8	85.2	74.5
21	The University of Edinburgh	86.4	90.3	95.2	81.7	73.6
23	London School of Hygiene & Tropical Medicine	86.2	89.3	95.9	83.3	65.7
30	Ruprecht- Karl-Universität Heidelberg	84.2	91.2	91.4	78.6	71.3
32	The University of Amsterdam	84	90.9	94.1	77.8	66.5

- International Faculty Ratio (5%)
- International Student Ratio (5%)

This study has an interest in analyzing the data related to the EXT component in (6) in the field of "Medicine". Therefore, we use QS World University Rankings by Subject, which takes into account the following indicators:

- Academic Reputation
- Employer Reputation
- Citations per paper
- H-index

Indicators "Academic Reputation" and "Employer Reputation" are based on the data obtained during surveys of academic institutions' employees and employers, respectively. Indicators "Citations per paper" and "H-index" are used to measure the scientific productivity of the university by subject. The principles and reasons for using these indicators are described in detail in (57). The weights of mentioned indicators differ by area, hence within the "Medicine" subject, the following set is used: Academic Reputation, 40%; Employer Reputation, 10%; Citations per Paper, 25%; and H-index, 25%. For universities training health professionals, one can see that priority is given to reputation in academia and scientific productivity, while reputation among employers clearly recedes into the background.

We propose using QS World University Rankings by Subject in the model discussed in this study: Academic Reputation and Employer Reputation are included in the component *cA* of Eq. (6), and Citations per Paper and H-index are accounted for by the component *aQE*. Weight factors for these indicators should be consistent with the weight factors of the other components in terms of Eq. (7). However, the QS Rankings approach provides a general idea of prioritization in university performance indicators in the "Medicine" subject framework.

The methodology for external quality assurance of educational programs incorporated by the National Agency for Higher Education Quality Assurance has the following features [the description is based on the regulatory framework of the National Agency (58)]:

Accreditation is carried out by nine (for the bachelor and master level of higher education) or 10 (for the phd level of higher education) criteria:

- Criterion 1. Project and goals of the educational program.
- Criterion 2. Structure and content of the educational program.
- Criterion 3. Access to educational programs and education results acknowledgment.
- Criterion 4. Learning and teaching within the educational program.
- Criterion 5. Control measures, student evaluation, and academic integrity.
- Criterion 6. Human resources.
- Criterion 7. The learning environment and material resources.
- Criterion 8. Internal quality assurance of the educational program.
- Criterion 9. Transparency and publicity.
- Criterion 10. Learning through research (for PhD level, not considered in the current study).

Each criterion evaluates the educational program and educational activities within the program according to the evaluation scale, which covers four levels of compliance.

- Level "A": the educational program and activities within the program fully meet the assessed criteria and have an innovative/exemplary character.
- Level "B": the educational program and educational activities within the program generally meet the assessed criterion with shortcomings that are not significant.
- Level "E": the educational program and/or educational activities within the program generally do not meet the assessed criterion, but identified shortcomings can be eliminated within 1 year;
- Level "F": the educational program and/or educational activities within the program do not meet the assessed criteria.

The identified shortcomings are fundamental and/or cannot be eliminated within 1 year.

The educational program can receive one of four grades:

- Accredited and marked as exemplary (A).
- Accredited (B).
- Conditionally accredited (E).
- Rejected in accreditation (F).

The following conditions for determining accreditation grade are proposed based on the number of corresponding criteria grades:

$$A : A \geq 5,\ E = 0,\ F = 0; \tag{8}$$

$$B : B > 5,\ E = 0,\ F = 0; \tag{9}$$

$$E : E \leq 2; \tag{10}$$

$$F : E > 2\ and/or\ F > 0. \tag{11}$$

This study analyzes the accreditation results of more than 110 educational programs in 2020 and 8 months of 2021 within the direction 22 "Medicine" (according to the national classification of fields of knowledge) (state and private medical universities).

The above evaluation criteria have been considered in previous studies (59–65) as those that have a significant impact on the quality of educational programs in the process of external expertise.

Table 3 is constructed on the basis of the abovementioned 110 programs' accreditation data. For each educational program and corresponding evaluation criteria, we present the ratio "Success/Innovation".

Success (k_s) is the percentage of grades A (n_A) and B (n_B) of the total accreditations number in the program for each area (N) and relevant criteria. Innovation (k_i) is the percentage of grades A (n_A) of the total accreditations number in the program for each area (N) and relevant criteria.

$$k_s = \frac{n_A + n_B}{N} \cdot 100\% \tag{12}$$

$$k_i = \frac{n_A}{N} \cdot 100\% \tag{13}$$

The criteria were combined into meaning-based complexes for a more effective and simple assessment of the success and innovation of educational activities within the educational program and the whole direction. "Content and Potential" (CP) complex combines criteria 1, 2, and 7; "Algorithms" (A) complex combines criteria 3 and 5; and "Personalities" complex combines criteria 4, 6, 8, and 9. Further evaluation of these complexes allows for a comprehensive assessment of both the educational program and the set of programs. Table 4 contains the Success/Innovation ratio calculations for the described criteria complexes for educational programs of 22 "Medicine" direction.

Success (k_s) and innovation (k_i) are included in the QE component of Eq. (7), as they pose a convenient and accessible tool for external quality analysis. Equation (7) in explicit form, adapted to assess educational activities quality is:

$$EXT = aQE + cR = a\left(1 + \frac{\ln \Phi_e}{\ln \Phi_b} + \sum_{j=1}^{3} \frac{k_{ij}}{k_{sj}}\right) + c\left(1 + \sum_{k=1}^{n} r_{gen_k} + \sum_{m=1}^{n} r_{loc_m}\right) \tag{14}$$

The component QE presenting an external quality evaluation of educational activities consists of the following components:

Φ_b is the component determined by the basic funding from the Ministry of Education and Science. In the case of university-level assessment, this component is formed for the whole institution.

Φ_e is the component determined by funding from external sources (except for basic funding): basic funding of science, grants, economic contracts, governmentally funded research projects, and special funds of the Ministry of Education and Science, e.g., $\Phi_1^{R\&D} + \Phi_2^{grants} + \Phi_3^{economic\ contracts} + \Phi_4^{other\ sources}$. In the case of university-level assessment, this component is formed separately for each area.

Ratio $\frac{\ln \Phi_e}{\ln \Phi_b}$ illustrates the financial independence of the educational institution. The ratio of logarithms allows effective handling of cases where funding from external sources significantly exceeds the basic funding and vice versa. Maximum value $\frac{\ln \Phi_e}{\ln \Phi_b}$ for $F_e \gg \Phi_b$ is limited by 2.

$\sum_{j=1}^{3} \frac{k_{ij}}{k_{sj}}$ is the component formed by the sum of Success/Innovation ratios for each direction and the relevant criteria complexes. In the case under consideration, the criteria are divided into three complexes, so the maximum value of the sum is 3.

University authority level R depends on two components, the first of which (r_{gen}) characterizes the university's position in the rankings (international and/or national) as a whole institution. The second component r_{loc} characterizes the direction's position in ratings by area. The maximum value for both components is 1, while the second component allows accounting for situations when the rating by area does not exist or the university is not included in such rating. In these situations, it is recommended to set an indicator $\sum_{m=1}^{n} r_{ocm}$ individually in each evaluation process for internal authority level assessment and to use the recommended parameters for external evaluations:

- $\sum_{m=1}^{n} r_{loc_m} = 0, 1$, if the university is not included in the ranking by area
- $\sum_{m=1}^{n} r_{loc_m} = 0, 3$, if the rating by direction does not exist.

4. Discussion

To improve the quality of educational activities, it is proposed to allocate contact points for the application of additional funding within each set of evaluation criteria:

1. "content and potential" complex (criteria 1, 2, and 7)

   - Bonuses for educational program project working groups.
   - Forming of additional budget for the engagement of external specialists in designated areas.

TABLE 3 Educational program accreditation results within the direction 22 "medicine".

Criterion / Program	Success/innovation								
	C1	C2	C3	C4	C5	C6	C7	C8	C9
221 ≪Stomatology≫	100/20	100/0	100/12	96/4	100/16	96/28	96/24	100/8	100/24
222 ≪Medicine≫	92/4	73/0	100/12	96/0	92/4	96/15	100/8	96/4	100/8
223 ≪Nursing≫	100/0	75/0	100/0	100/0	100/0	83/8	100/0	100/8	100/12
224 ≪Technologies of Medical Diagnostics and Treatment≫	100/0	100/0	100/0	100/0	100/0	100/0	100/0	100/25	100/0
226 ≪Pharmacy≫	86/9	86/0	100/0	86/0	100/0	86/14	90/14	95/14	95/0
227 ≪Physical Rehabilitation≫	94/13	88/0	100/0	94/0	100/0	94/6	100/6	100/6	100/19
228 ≪Pediatrics≫	100/25	100/25	100/0	100/0	100/0	100/25	100/25	100/50	100/25
229 ≪Public Health≫	100/29	100/14	100/14	100/0	100/14	86/43	100/29	100/43	100/14

TABLE 4 Evaluation of success/innovation of criteria complexes.

Program	Success (k_s)/innovation (k_i)		
	Complex CP (C1, C2, and C7)	Complex A (C3 and C5)	Complex P (C4, C6, C8, and C9)
221 Stomatology	98.7/14.7	100/14	98/16
222 Medicine	88.3/4	96/8	94/6.8
223 Nursing	91.7/0	100/0	95.8/7
224 Technologies of Medical Diagnostics and Treatment	100/0	100/0	100/6.25
226 Pharmacy	87.3/7.7	100/0	90.5/7
227 Physical Rehabilitation	94/6.3	100/0	97/15.5
228 Pediatrics	100/25	100/0	100/25
229 Public Health	100/24	100/14	96.5/25

- Constant refreshing of material assets, technical learning instruments, purchase of additional literature and/or online services subscriptions, etc.

2. "algorithms" complex (criteria 3 and 5)

- Additional funding is aimed at building a pipeline of constant communication with external stakeholders to synchronize learning results and gained competencies with the required expertise in the field.
- Funding for building and facilitating internal systems of academic integrity in accordance with the national regulatory framework and best international practices.

3. "personalities" complex (criteria 4, 6, 8, and 9)

- Allocating the budget aimed to form a bonus system for learning process stakeholders and an academic mobility system independent from international programs.
- Ensuring the "lifelong learning study" concept by funding constant professional growth of human resources associated with the learning process.
- Funding of internal quality assurance system for educational activities and synchronizing it with best practices in the field.
- Establishing open catalogs of educational offers, programs, and resources along with expenditures for creating and supporting media resources.

Funding of proposed contact points must be performed according to sources defined by the first component of Eq. (14). Each component in the numerator of the ratio $\frac{\ln F_e}{\ln F_b}$ can ensure funding distribution via separate directions requiring financial support as mentioned above.

We propose to overlook the pipeline of funding sources allocation for the university considering perspective marking of meeting criteria as exemplary for each external quality assurance of the educational program:

1. Identifying shortcomings for defined criteria.
2. Considering the possibility of increasing criterion completion level due to additional funding.
3. Selecting financial source(s) present in the university which can fund (in the framework of the current regulatory base) chosen activities aimed at criterion completion level increase.

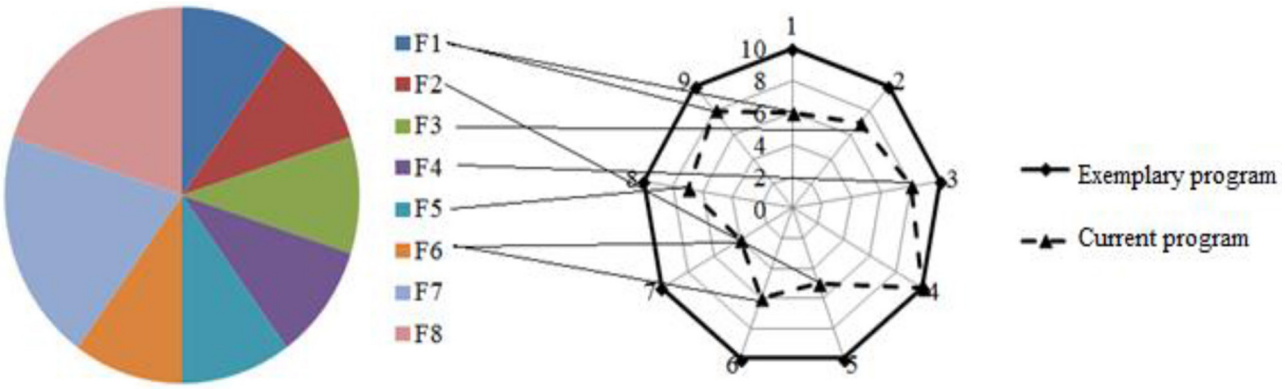

FIGURE 5
Definition of funding sources for university activity assuming perfect meeting of external quality assurance criteria.

4. Funding of certain activities or development of infrastructure through chosen financing source.

Figure 5 illustrates the definition of funding sources for university activity. In this approach, we propose to assume the perfect meeting of external quality assurance criteria considering criteria 1–9 for educational programs. Here, F1–F8 are funding sources for university activities: F1 and F2 are incomes from domestic and foreign students, F3 and F4 are incomes from scientific activities from domestic and foreign clients, F5 and F6 are incomes from grant-related activities from domestic and foreign donors, F7 is an income from additional educational offers, and F8 is an income from additional non-educational offers. Criteria grades and percentages of funding sources are presented on a pie diagram as a demonstration.

This approach not only diversifies expenditure sources but also can act as a catalyst for the diversification of university income sources through various types of educational, research, and production activities. Diversification of income sources becomes urgent since each source allows funding specific activities following the income conditions (estimates defining future expenses). Increasing revenue streams of different origins covers a broader range of tasks that need funding. For example, we propose the algorithm for selecting funding sources for the "Content and Potential" complex (criteria 1, 2, 7) as shown in Figure 6.

The proposed method of external quality assessment has advantages over analogs, which are given in the literature review:

1. the methodology takes into account independent indicators obtained by third parties.
2. the methodology can evaluate the indicators numerically.
3. the methodology allows for a retrospective analysis of progress (positive or negative) in ensuring the quality of the educational program.

5. Conclusion

External accreditation and ratings are the most effective tools for quality assessment. However, ratings often neglect the field of study with rare exceptions when the rating has a direction selection option. In addition, some rankings require data input from the university, which universities do not always want to provide and hence are dropped from the rankings. In this case, the rating cannot be considered a full and independent assessment of the university but can take part in the overall assessment tool construction. Therefore, the external assessment of education quality through accreditation expertise comes to the fore.

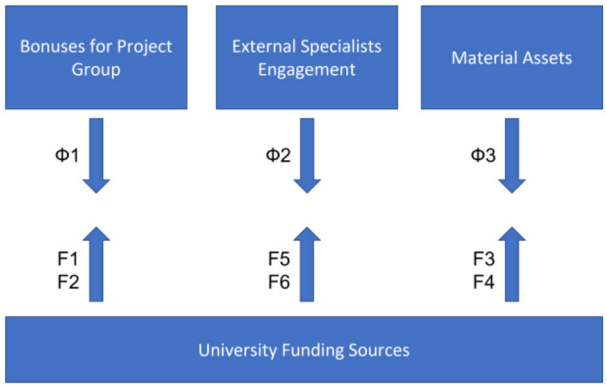

FIGURE 6
Algorithm for selecting funding source for the "Content and Potential": Φ is the necessary funding volume, and Fi is the university funding sources (number of sources corresponds to Figure 5).

Mauboussin's success equation requires modification for educational program quality assessment to evaluate the luck level at the design stage and add a component of external assessment by stakeholders that can be done through indicators of educational ratings. The paradox of skill, in which, other things being equal, the one who took advantage of the coincidence is more successful, in this case, can be interpreted as an opportunity to minimize risks. Risks here are feedback from external stakeholders and competitive or tender principles for obtaining funding from external sources.

The proposed approach to the formation of the external quality evaluation algorithm of educational activities *EXT* covers both the indicators that form the component of the external evaluation by stakeholders and independent agencies and the reputation component R formed by the university authority. We considered boundary cases for all algorithm components and provided examples of success and innovation calculation for the 22 "Medicine" subject.

The discussed analysis method of external evaluation results proposed in the study can be effectively scaled to obtain conclusions at three levels: program, university (within the benchmarking of general university components of the educational program), and national (within the benchmarking of similar programs).

The methodology presented in this study allows us to assess the educational program quality both qualitatively and quantitatively.

According to the proposed method, an important calculation result is the determination of external quality assessment criteria requiring additional funding. It is possible to establish the relationship between current financing from external sources (excluding basic funding, which is also obtained in the competition for indicators defined by the relevant formula) and the state of implementing certain external evaluation criteria and drawing conclusions about strengthening activity in specific areas.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

Conceptualization and writing—original draft preparation: AA, IV, and SL. Methodology, project administration, and software: AA and IV. Validation: AA, IV, and BG. Formal analysis: SB, AA, and SL. Investigation: AA, IV, SL, and SB. Data curation: IV and TM. Writing—review and editing: AA, IV, SL, BG, and TM. Visualization: IV and BG. Supervision: AA. Funding acquisition: TM. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

References

1. Vercellini P, Viganò P, Somigliana E. Government should monitor quality of medical education. *BMJ (Online).* (2015) 350:h2937. doi: 10.1136/bmj.h2937

2. Cook DA, Reed DA. Appraising the quality of medical education research methods: the medical education research study quality instrument and the newcastle-ottawa scale-education. *Acad Med.* (2015) 90:1067–76. doi: 10.1097/ACM.0000000000000786

3. Molano PA. Proposal of high-quality accreditation standards for undergraduate programmes in medicine with a focus on primary health care in Colombia. *Educ Medica.* (2022) 23:100731. doi: 10.1016/j.edumed.2022.100731

4. Mazroie S, Dehghani MR, Yamani N, Sabzevari S. Evaluation of medical university deputies' and managers' perspectives on the outcomes of Institutional Accreditation of Medical Universities from 2018-2019. *Stride Dev Med Educ.* (2021) 18:e10406. doi: 10.22062/sdme.2021.195647.1040

5. Taghavinia M, Maleki M, Arabshahi K. Educational leadership in education development centers: a qualitative study. *J Educ Health Promot.* (2021) 10:46. doi: 10.4103/jehp.jehp_733_20

6. Torralba KMD, Katz JD. Quality of medical care begins with quality of medical education. *Clin Rheumatol.* (2020) 39:617–8. doi: 10.1007/s10067-019-04902-w

7. Domínguez LC. Tools for the evaluation of learning climate in posgraduate training: Synthesis of evidence in the light of psychometric definitions. *Educacion Medica.* (2018) 19:335–49.

8. Blouin D, Tekian A, Kamin C, Harris IB. The impact of accreditation on medical schools' processes. *Med Educ.* (2018) 52:182–91. doi: 10.1111/medu.13461

9. Da Dalt L, Callegaro S, Mazzi A, Scipioni A, Lago P, Chiozza ML, et al. A model of quality assurance and quality improvement for post-graduate medical education in Europe. *Med Teacher.* (2010) 32:e57–e64. doi: 10.3109/0142159090 3199734

10. Hasan T. Doctors or technicians: Assessing quality of medical education. *Adv Med Educ Pract.* (2010) 1:25–9. doi: 10.2147/AMEP.S13877

11. Blouin D, Tekian A. Accreditation of medical education programs: moving from student outcomes to continuous quality improvement measures. *Acad Med.* (2018) 93:377–83. doi: 10.1097/ACM.0000000000001835

12. Nahla N. University-company collaboration: what are the obstacles in Algeria? *SocioEcon Challen.* (2023) 7:59–64. doi: 10.21272/sec.7(1).59-64.2023

13. Soltes M, Gavurova B. Quantification and comparison of avoidable mortality - causal realtions and modification of concepts. *Technol Econ Dev Econ.* (2015) 21:917–38. doi: 10.3846/20294913.2015.1106421

14. Yu Y, Xinxin W, Ruoxi, L, Tingting Y. The mediating role of human capital in the relationship between education expenditure and science and technology innovation: evidence from China. *Socio Econ Challen.* (2023) 7:129–38. doi: 10.21272/sec.7(1).129-138.2023

15. Artyukhov A, Volk I, Vasylieva T, Lyeonov S. The role of the university in achieving SDGs 4 and 7: a Ukrainian case. *E3S Web Conf.* (2021) 250:04006. doi: 10.1051/e3sconf/202125004006

16. Petrushenko Y, Vadym A, Vorontsova A, Ponomarenko O. Sustainable development goals as a tool for strategic planning in

communities: a bibliometric analysis of research. *E3S Web Conf.* (03005) 2020:202. doi: 10.1051/e3sconf/202020203005

17. Matos L, Kasztelnik K. Transformational educational leadership and the innovative strategies engaging online faculty for the excellent teaching performance in the United States. *Bus Ethics Leadersh.* (2021) 5:6–21. doi: 10.21272/bel.5(1).6-21.2021

18. Dzwigoł H. Leadership in the research: determinants of quality, standards and best practices. *Bus Ethics Leadersh.* (2021) 5:45–56. doi: 10.21272/bel.5(1).45-56.2021

19. Šoltés M, Gavurova B. Identification of the functionality level of day surgery in Slovakia. *Ekon Cas.* (2014) 62:1031—51.

20. Skrynnyk O, Vasilieva T. *Comparison of Open Learning Forms in Organizational Edu*cation. Cagliari: CEUR Workshop Proc. p. 1314–1328. Available online at: https://ceur-ws.org/Vol-2732/20201314.pdf

21. Francis C. Accreditation of Study Programs on Addictions in Nigerian Universities: Challenges, Opportunities, and the Need for Advocacy. *Adiktologie.* (2022) 22:27–33.

22. Pavlenko O, Martynets V, Dreval O, Smolennikov D. Analysis of influence of the quality of specialist training on social and economic development. *Calitatea Acces Success.* (2020) 21:81–6.

23. Lyeonov S, Liuta O. Actual problems of finance teaching in ukraine in the post-crisis period. In: Azarmi T, Amann W, editors. The Financial Crisis. Cham: Springer International Publishing. (2016) p. 145–152. doi: 10.1007/978-3-319-20588-5_8

24. Martins FP, Cezarino LO, Liboni LB, Botelho Junior AB, Hunter T. Interdisciplinarity-based sustainability framework for management education. *Sustainability.* (2022) 14:12289. doi: 10.3390/su141912289

25. Kvitka S, Starushenko G, Koval V, Deforzh H, Prokopenko O. Marketing of Ukrainian higher educational institutions representation based on modeling of webometrics ranking. *Mark Manag Innov.* (2019) 5:60–72. doi: 10.21272/mmi.2019.3-05

26. Savga L, Krykliy O, Kyrychenko K. The role of internal and external stakeholders in higher education system in Ukraine. *Bus Ethics Leadersh.* (2018) 2:32–43. doi: 10.21272/bel.2(1).32-43.2018

27. Zborník TS, Miovský M. Comprehensive evaluation of the online lifelong education course prevention and treatment of substance use disorders for physicians in the czech republic: study protocol. *Adiktologie.* (2021) 21:179–83.

28. Skliar I. Towards the assurance of transparency and quality of higher education in Ukraine: national qualification framework. *Bus Ethics Leadersh.* (2018) 2:96–105. doi: 10.21272/bel.2(1).96-105.2018

29. Miovsky M, Volfova A, Johnson K, Peters R, Koutsenok I, Heaps M, et al. New trends in education and training programs in addictions at the higher education and university levels: what kind of specialised programs are trending? *Adiktologie.* (2021) 21:201–9.

30. Zuluaga-Ortiz R, DelaHoz-Dominguez E, Camelo-Guarín A. Academic efficiency of engineering university degrees and its driving factors. *A PLS-DEA Approach J Int Stud.* (2022) 15:107–21. doi: 10.14254/2071-8330.2022/15-2/8

31. Istenič Starčič A, Lebeničnik M. Investigation of University 'students' perceptions of their educators as role models and designers of digitalized curricula. *Hum Technol.* (2020) 16:55–91. doi: 10.17011/ht/urn.202002242163

32. Costa F, Figueira-Cardoso S. University Outreach, indigenous knowledge, and education: a project with the Pataxó in Brazil. *Eur J Interdiscip Stud.* (2022) 14:39–55. doi: 10.24818/ejis.2022.03

33. Jankelová, N. Entrepreneurial orientation, trust, job autonomy and team connectivity: implications for organizational innovativeness. *Eng Econ.* (2022) 33:264–74. doi: 10.5755/j01.ee.33.3.28269

34. Gad S, Yousif NBA. Public management in the education sphere: prospects for realizing human capital in the development of knowledge management technologies. *Adm SI Manag Public.* (2021) 10:151–72. doi: 10.24818/amp/2021.37-10

35. Stuchlý P, Virágh R, Hallová M, Šilerová E. CRM and its importance for business competitiveness. *Agris -Line Pap Econ Inform.* (2020) 12:93–8. doi: 10.7160/aol.2020.120108

36. Delibasic M, Ivanis M, Pupavac D, Shilina M. Modeling citizens satisfaction with higher education: a case study of Rijeka. *Montenegrin J Econ.* (2022) 12:18. doi: 10.14254/1800-5845/2022.18-4.12

37. Draskovic V, Jovovic R, Rychlik J. Perceptions of the declining quality of higher education in the selected SEE countries. *J Int Stud.* (2020) 13:286–94. doi: 10.14254/2071-8330.2020/13-4/20

38. Dzionek-Kozlowska J, Neneman, J. Are economic majors "indoctrinated" by their education? Public good game quasi-experiment. *Econ Sociol.* (2022) 15:110–24. doi: 10.14254/2071-789X.2022/15-2/7

39. Caballero-Morales SO, Cordero-Guridi JJ, Alvarez-Tamayo RI. Cuautle-Gutiérrez L. Education 40 to support entrepreneurship, social development and education in emerging economies. *Int J Entrepreneurial Knowl.* (2020) 8:89–100. doi: 10.37335/ijek.v8i2.119

40. Vlasov M, Panikarova S, Draskovic M. Evaluating university academic efficacy: institutional approach. *Montenegrin J Econ.* (2020) 16:241–50. doi: 10.14254/1800-5845/2020.16-1.16

41. Hitka M, Štarchon P, Lorincová S, Caha Z. Education as a key in career building. *J Bus Econ Manag.* (2021) 22:1065–83. doi: 10.3846/jbem.2021.15399

42. Wach K, Bilan S. Public support and administration barriers towards entrepreneurial intentions of students in Poland. *Adm SI Manag Public.* (2021) 4:67–80. doi: 10.24818/amp/2021.36-04

43. Moreno-Carmona C, Feria-Domínguez JM, Merinero-Rodríguez R. Are University management teams strategic stakeholders within higher education institutions? A clinical study. *Econ Sociol.* (2022) 15:141–59. doi: 10.14254/2071-789X.2022/15-1/9

44. Gavurova B, Tucek D, Kovac V. Economic aspects of public procurement parameters in tertiary education sector. *Adm Si Manag Public.* (2019). doi: 10.24818/amp/2019.32-04

45. Krisnaresanti A, Julialevi KO, Naufalin LR, Dinanti A. Analysis of entrepreneurship education in creating new entrepreneurs. *Int J Entrepreneurial Knowl.* (2020) 8:67–76. doi: 10.37335/ijek.v8i2.112

46. Abdimomynova A. Entrepreneurship education prospects in the public-private partnership system. *Montenegrin J Econ.* (2021) 17:83–92. doi: 10.14254/1800-5845/2021.17-2.7

47. Barrientos-Báez A, Martínez-González JA, García-Rodríguez FJ, Gómez Galán J. Entrepreneurial competence perceived by university students: quantitative and descriptive analysis. *J Int Stud.* (2022) 15:40–9. doi: 10.14254/2071-8330.2022/15-2/3

48. Bauters M, Pejoska J, Durall E, Saarikivi K, Wikström V, Falcon M, et al. Are you there? Presence in collaborative distance. *Work Hum Technol.* (2021) 17:261–93. doi: 10.14254/1795-6889.2021.17-3.5

49. Kumar V, Nayak KP, Bhinder HS. The technology acceptance model and learning management system: a study on undergraduate tourism and hospitality students. *Eur J Interdiscip Stud.* (2021) 13:65–89.

50. Prívara A, Kiner A. Immigrant employment in the slovak hospitality industry: profiles, experience, and education. *J Tour Serv.* (2020) 20:167–82. doi: 10.29036/jots.v11i21.223

51. Tercanli H, Jongbloed B. A systematic review of the literature on living labs in higher education institutions: potentials and constraints. *Sustainability.* (2022) 14:12234. doi: 10.3390/su141912234

52. Kibrit G, Altinay F, Dagli G, Altinay Z, Sharma R, Shadiev R, et al. Evaluation of sustainability and accessibility strategies in vocational education training. *Sustainability.* (2022) 14:12061. doi: 10.3390/su141912061

53. Mauboussin MJ. *The Success Equation: Untangling Skill and Luck in Business, Sports, and Investing.* Boston: Harvard Business Review Press.

54. Order of Ministry of Education and Science About the Results of Governmental Attestation of Higher Education Institutes Regarding Their Scientific (Scientific-Technical) Activities. (2021).

55. Decree of Cabinet of Ministers of Ukraine About State Budget Expenditures Distribution amongst Higher Education Institutions Based on Educational, Scientific and International Activity Indicators. (2019).

56. Q.S. World University Rankings—Methodology. *Q.S. Top Univ. Website.*

57. Q.S. World University Rankings by Subject: Methodology. *Q.S. Top Univ. Website.*

58. Order of Ministry of Education and Science About Approval of Guidelines for Accreditation of Educational Programs Used for Student Training. (2019).

59. Yu Y. Performance analysis of public investment in chinese university education based on regional differences and influencing factors. *Busi Ethics Leader.* (2023) 7:37–49.

60. Nezai A, Ramli M, Refafa B. The relationship between the scientific activities in research laboratories with webometrics ranking of algerian universities: an empirical investigation. *Busi Ethics Leader.* (2022) 6:67–82. doi: 10.21272/bel.6(1).67-82.2022

61. Vidic F. Knowledge asset as competitive resource. *Socio Econ Challen.* (2022) 6:8–20. doi: 10.21272/sec.6(4).8-20.2022

62. Safarov Q, Sadiqova S, Urazayeva M. Methodological approach to identification of innovative determinants of human capital management. *Mark Manag Innov.* (2022) 2:255–67. doi: 10.21272/mmi.2022.2-23

63. MacNeil P, Khare A, Jugdev K. International inequity patterns in youth and young adults related to COVID-19: advancing sustainable development goals on well-being, education, and employment. *Health Econ Manag Rev.* (2022) 3:60–72. doi: 10.21272/hem.2022.3-06

64. Smiianov VA, Vasilyeva TA, Chygryn OY, Rubanov PM, Mayboroda TM. Socio-economic patterns of labor market functioning in the public health: challenges connected with covid—19. *Wiadomosci Lekarskie (Warsaw, Poland : 1960).* (2020) 73:2181–7. doi: 10.36740/WLek202010114

65. Vasylieva T, Gavurova B, Dotsenko T, Bilan S, Strzelec M, Khouri S. The behavioral and social dimension of the public health system of european countries: descriptive, canonical, and factor analysis. *Int J Envir Res Public Health.* (2023) 20:5 doi: 10.3390/ijerph20054419

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Evaluation of massive education in prison health: a perspective of health care for the person deprived of freedom in Brazil

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Education, with an emphasis on prison health, has acted as a policy inducing changes in work processes, which the Brazilian National Health System (SUS) has used, and which is present in permanent health education, which promotes health care for people deprived of liberty. This article aims to present an analysis of the impacts of the strategy of massive education on prison health in Brazil from the perspective of health professionals and other actors operating in the Brazilian prison system. The data used in the study come from a questionnaire consisting of 37 questions applied nationwide between March and June 2022. Responses were collected from students who completed the course "Health Care for People Deprived of Freedom" of the learning pathway "Prison System", available in the Virtual Learning Environment of the Brazilian Health System (AVASUS). This course was offered nationally, whose adhesion (enrollment) occurred spontaneously, i.e., the course was not a mandatory. The data collected allowed us to analyze the impacts of massive education on prison health. The study also shows that the search for the course is made by several areas of knowledge, with a higher incidence in the health area, but also in other areas, such as humanities, which also work directly with the guarantee of the rights of people deprived of liberty, which are professionals in the areas of social work, psychology, and education. The analysis based on the data suggests that the massive education mediated by technology through the courses of the learning pathway, besides disseminating knowledge–following the action plan of the 2030 Agenda of the United Nations

Educational, Scientific and Cultural Organization (UNESCO)–, are an effective tool to promote resilience in response to prison health and care demands of people deprived of liberty.

KEYWORDS

prison health, prison system, health education, health education in prison system, health massive education, evaluation of health massive education, public health

1. Introduction

Prison health is an emerging agenda in Global Health, which has been strengthened by the World Health Organization (WHO) and the Pan American Health Organization (PAHO) (1–5). In Brazil, prison health efforts are coordinated by Brazil's Ministry of Health (MoH) and the National Council of Justice (CNJ) in order to implement the National Comprehensive Health Care Policy for People Deprived of Liberty (PNAISP) and the Program of Intersectoral Actions of Health Care and Social Assistance for the Prison System (PAISA) (1, 6, 7).

Worldwide, the population deprived of liberty exceeds 10 million people, with an average growth rate of 20% per year, i.e., higher than the estimated percentage increase in the general population (18%), data observed since 2000. For every 100,000 population, there are 144 people in prison, according to United Nations (UN) data (8, 9). The growth or decline in the prison population varies by country or region. In Oceania, for instance, there was a 60% increase, while in the Americas it was 40% in contrast to Europe, which showed a 21% drop in the prison population (8).

In Brazil, the prison population exceeds 800,000, with 392 incarcerated people per 100,000 population (10, 11). With the prevalence of diseases, mainly sexually transmitted infections (STIs) and tuberculosis, health in prison settings has become a public health emergency (12–15). Therefore, several strategies and public policies directed at the prison system were adopted in order to tackle this public health crisis in the country. The Penal Execution Law (LEP) No. 7,210 of July 11, 1984, is a milestone (11). This law addresses the rights of people deprived of freedom in the Brazilian prison system, being essential for their social reintegration. However, there is still much work to be done to effectively guarantee the rights of this population, which is considered vulnerable, especially regarding health services (1, 16).

Prison health, situated as a human right, in the sense of the universal right to health, cannot be overlooked because its effects, in addition to affecting this specific population, influence the health of the community, and consequently, public health (1, 4, 11, 17). Therefore, it is essential to strengthen comprehensive and universal health, which can be developed through effective public policy interventions aimed at reducing social inequalities and promoting equity, in line with the goals of the UN's 2030 Agenda for Sustainable Development (18–22). This agenda sets forth 17 Sustainable Development Goals (SDGs) for the planet and society (1, 23, 24).

As the prison population increased, prison health became a commitment of the United Nations Educational, Scientific and Cultural Organization (UNESCO), therefore under the action plan of the UN's 2030 Agenda. Also committed to this plan are the WHO, PAHO, and Brazil's MoH, which highlight the importance of improving the prison system and health practices to fully reach incarcerated people, prison officers, and the surrounding community (1, 25–28).

Intending to face the public health crisis in the prison system, and based on legal principles, the Brazilian MoH has tailored public policies for the Brazilian Prison System. Therefore, it is always acting to insert the theme in the national health agenda.

Education, with emphasis on prison health, acts as a policy inducing changes in work processes, which SUS has used, and which is present in the permanent education of health professionals (29–31). However, in Brazil, a country with continental dimensions and great social, cultural, and regional diversity, permanent health education poses a great challenge. In this vein, the country requires health education strategies that can effectively respond to health services demands and public health crises (1, 32–35).

Brazil has 26 federative units (FUs) and one Federal District, 5,700 municipalities, 200,000 health facilities distributed throughout the country, and more than 3.5 million health professionals, who work in the most diverse areas and levels of health care–primary care, secondary/specialty care, and tertiary/hospital care (36–40). These factors are determining factors for the organization and structuring of continuing education for workers in the SUS. Especially, in scenarios of public health crisis, such as the Brazilian syphilis epidemic in 2016 and the COVID-19 pandemic in 2020 (1, 32, 41). Situations and context that require the MoH to implement strategies based on massive health education through technological mediation, which also includes the provision of courses developed from the perspective of self-learning (35, 42–46).

In the context of massive health education, one of the strategies adopted by the MoH is the Virtual Learning Environment of the Brazilian Health System (AVASUS). AVASUS is an online, free, and open knowledge educational platform in health (42, 47–50). In 2023, AVASUS recorded more than 2.6 million enrollments in more than 400 courses, which accounts for nearly 10,000 hours of online educational offerings. Recent studies show the relevance of this platform as a tool to induce public health policies. It has been an important instrument in the process of education and learning of health workers in Brazil because it has directly contributed, and in scale, to the improvement and supply of health services in the country (41, 51, 52). This massive education process, through AVASUS, has resulted in changes in work processes at various levels

of health care, which has promoted resilience in the system and timely response to health problems (32, 41, 47, 51, 53).

In 2016, the MoH declared the epidemic of syphilis due to the significant increase in the number of cases nationwide (54–56). In line with previous studies and based on the recommendations from the Brazilian Federal Court of Accounts (TCU), the MoH and PAHO have recognized that populations considered as vulnerable or key have high prevalence and incidence of STIs, in addition to other diseases, e.g., tuberculosis. In Brazil, the prison population is considered a vulnerable population, therefore, with the support of the "Syphilis No!" Project (SNP), the learning pathway "Prison System" was elaborated and made available on AVASUS, thus addresing topics related to prison health (15, 21, 57–60). Composed of four educational modules, this learning pathway has surpassed 30,000 students enrolled from the five Brazilian regions (61).

A study of an educational module of this pathway, the course "Health Care for People Deprived of Freedom", related massive education with technological mediation to the increase in syphilis testing and diagnosis in the Brazilian prison system. The results highlighted the relationship between continuing health education and work process changes (1). A limitation of the study was the use of only secondary data, lacking in this study, an analysis based on data that could observe the perception of health professionals and the relationship to the impacts of this training process on prison health.

Considering this gap, this study analyzes the impacts of the strategy of massive health education on prison health in Brazil, from the perspective of health professionals and other workers operating in the Brazilian prison system.

2. Materials and methods

Our study started with the following research question Q1: "How has massive education, mediated by technology, contributed to Brazilian prison health?" Therefore, the materials used and the methodology applied for the analysis of the impacts of massive education on prison health from the perspective of health professionals were structured and organized to subsidize the answer to this research question.

The data collected for the studies come from a questionnaire that was applied nationally, during the period from 03/23/2022 to 06/30/2022 to students who completed the course "Health Care for People Deprived of Freedom". This course was chosen as the target, for being the first to be offered in the learning pathway, and also because, at the time the questionnaire was applied, it was the only course with a significant number of students in all regions of the country (>1,000 students in all five regions), that is, able to answer the questionnaire. As the course "Health Care for People Deprived of Freedom", also, was part of the Postgraduate Program in Family Health Strategy (PEPSUS), it had already been offered since 2018 in AVASUS and had health professionals as its target audience, which was the main focus of our questionnaire. As the offer period was longer, from 06/07/2018 to 03/23/2022, this course had already reached an expressive number of enrolled students and completers, unlike the other three courses of the learning pathway, which had been launched in December 2021, i.e., a few months before the application of the questionnaire.

The AVASUS technical-administrative team applied the questionnaire to all students completing the course. Therefore, during the questionnaire application period, 6,345 students who had completed the course were eligible to answer it. Of these 6,345 students, 270 answered the questionnaire, even though it was not mandatory to do so. The expected sample size would be 184 responding graduate students (participants) so that the degree of confidence in this research would be 90% with a margin of error of 6%. In this case, the questionnaire was answered by 86 more graduating students than expected, which is 46.73% more. The sample size was determined by the model described in Equation 1.

$$n = \frac{NZ^2\, p(1-p)}{(N-1)e^2 + Z^2\, p(1-p)} \quad (1)$$

where,

n: Size of the sample to be calculated;
N: Universe size (e.g. 6,345 final-year students);
Z: Deviation from the mean value that is accepted to reach the desired confidence level. Depending on the confidence level that is sought, a certain value should be used, which is given by the shape of the Gauss distribution. The most frequent values are (in bold the value used to determine the confidence level for this research):

- 90% confidence level, $Z = 1.645$;
- 95% confidence level, $Z = 1.96$;
- 99% confidence level, $Z = 2.575$.

e: Is the maximum margin of error that you want to admit (e.g. 6%); and
p: Is the confidence proportion that is expected to be found.

The questionnaire was composed of 37 questions, in the following formats: (1) multiple choice (more than one possible answer), (2) objective (only one possible answer), and (3) open (where the student participant could answer in free text). The questionnaire can be found in the Zenodo (62) or AVASUS (63) repository. The questions were divided into six dimensions:

1. Student Profile: six questions;
2. Knowledge Sharing: eight questions;
3. Content: eleven questions;
4. Right to health of persons deprived of liberty: six issues;
5. Professional practice: two questions;
6. Workplace: four questions.

The questionnaire was composed of questions with the following characteristics: nominal categorical, ordinal categorical, Likert (64), and open (free text) questions, as described below:

I. Student profile: nominal categorical questions;
II. Knowledge sharing: nominal categorical questions;
III. Content: Ordinary questions with five items;
IV. Right to the health of persons deprived of liberty: common questions;
V. Professional practice: two Likert questions and four open questions;

TABLE 1 Profile of the experts who reviewed the questionnaire.

Specialist	Expert profile description
01	University professor, sanitarian, master in education, PhD in Clinical Psychology, and post-doctorate in Medical Anthropology. Specialist for over 30 years in Health Education.
02	University professor, nurse, master in Family Health, and doctor in Collective Health. Specialist in Public Health for over 11 years.
03	University professor, nurse, specialist in family health, Master in Public Health, and PhD in Collective Health. Develops research in the area of Prison Health for over 12 years.
04	University professor, master in Social Psychology, and doctor in Public Policies and Human Formation. Specialist in Prison System for over 18 years.

VI. Workplace: four Likert questions and two open questions.

After development, the questionnaire was reviewed and improved by a team of experts, with more than ten years of experience, as described in Table 1, in education, health education, prison health, and the prison system.

All data from the questionnaire, before being used in this research, were anonymized by a technical team responsible for AVASUS administration. Since it is a questionnaire of interest to AVASUS management, the data from its application were of public and administrative interest. The purpose of the questionnaire was to evaluate and improve the quality of the educational modules offered on AVASUS. Since it is public domain information, which can also be used for various purposes, the anonymized data were published on AVASUS and can be accessed in a free and open-access repository: In addition, a data dictionary (meta-data) and the developed questionnaire were included in this repository as a way to contribute to other analyses and studies (62). Therefore, this research used a free, open, and public domain database, whose information was aggregated without the possibility of individual identification. According to these characteristics and based on Resolution 674/2022 of the National Health Council (CNS, acronym in Portuguese) of the MoH, this research is exempt from registration with the Committee for Ethics in Research (CEP)/Brazil.

3. Results

In order to evaluate the effectiveness of health education, it should be recognized that the education-health dyad constitutes an epistemic field of significant relevance for public health policy formulation (29, 65, 66). Hence, examining and analyzing such dimensions in the context of the SUS workforce and their effects on health services and public health are indispensable steps to assess the resilience of work processes–i.e., of professional practice–and, therefore, health system resilience (1, 32, 37, 41, 67, 68). In addition to purely examining the field of health education, which considers quality aspects of training, content, course, and educational model, it is necessary to take into account its context, i.e., the impacts of this education on health services (69, 70).

In this vein, with the intention of evaluating the impacts of health education that has been massively implemented in prison health in Brazil, this section presents the data obtained from the processing and analysis of the questionnaire responses. To improve understanding and facilitate reading, the information was grouped under the questions applied. Consequently, a description was not made for each question on the questionnaire - the findings, for the most part, were described in grouped form in graphs and or tables.

The first data, presented in Figure 1, shows that 200 final-year students answered all the questions in the questionnaire and 70 answered partially. In Figure 1 it is also possible to verify the frequency of answers per question, for example, questions 1 and 6 had the highest and lowest number of answers, respectively. It is important to note that no question was answered by all students, and also no question was left unanswered, which means that there was no bias in the responses obtained, for example, students did not all mark the same question or all failed to mark a single question.

Regarding the question "When you took the course, were you a…?", which tries to find out what the professional performance of the respondent was when he/she took the course "Health Care for People Deprived of Freedom". The answers given to this question allowed us to verify that 143 respondents were already health professionals when they took the course, i.e., ∼48%. It is noteworthy in the response to this same question, that 137 (respondents) were health students when they took the course, ∼46% of all respondents. Health workers and students interested in the course topic accounted for nearly 94% of respondents. This is a significant result, as it allows us to visualize the course's reach and the massive education model adopted accordingly to the target audience. It is important to emphasize that this course is not a mandatory recommendation, so this reach occurred spontaneously and naturally.

Figure 2 displays a chart referring to the professions of the respondents. It mainly focuses on the health professions, which constitute the majority of the course's audience. It shows a predominance of physicians and nurses, with 86 and 36, respectively. These two professions added together, represent 60.09% of the professions of those who answered the questionnaire. This data draws attention because in Brazil it is common that the most significant spontaneous adhesion to open courses is usually by nurses, as they are the largest workforce in the health area (2,822,661 nurses in all levels, e.g., graduates, technicians, and aides), especially when compared to doctors (564,385 active doctors) (71, 72).

When asked "In which area of the health sector are you currently working?", 132 (42.31%) responded that they worked in primary health care. Also related to this question, more than 21% of the respondents reported that they worked in the area of training or education. One explanation for this is that in Brazil there is an incentive for educators to work in the prison system because incarcerated people can have their sentences reduced by attending classes. However, further research would be needed to better understand this phenomenon (73).

As for the respondents' performance in prison health, the data from the question "Do you work or have you worked in the prison system?" showed links to all types of Prison Primary Care Teams (eAPP), teams established in Brazilian legislation (74). However, the highest incidence is for the eAPP-I type. This means that almost 80% of the respondents informed that they work or have worked

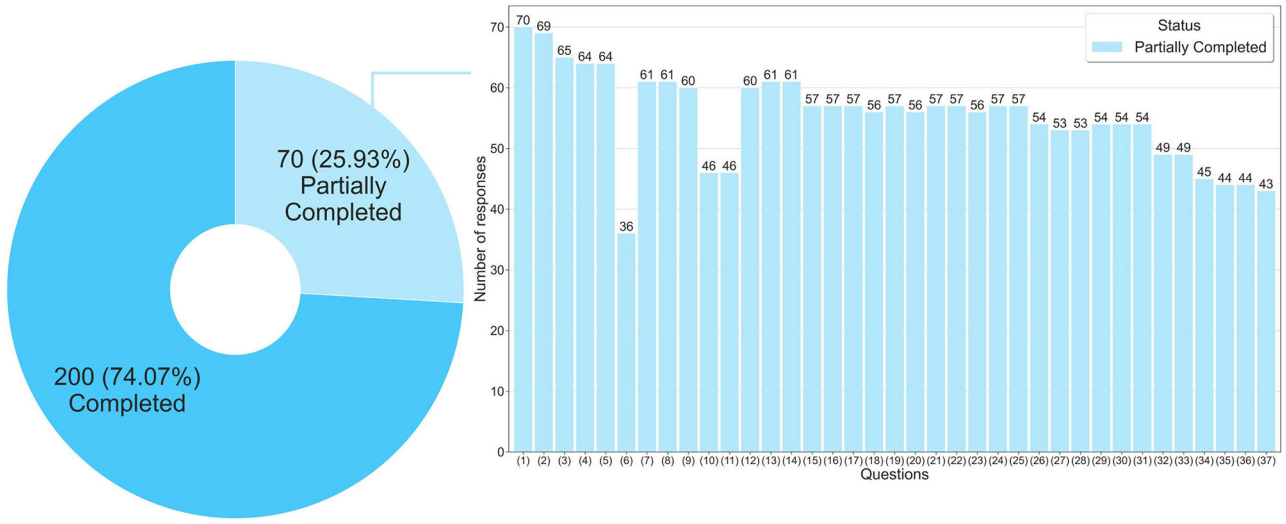

FIGURE 1
Frequency of responses per question in the questionnaire.

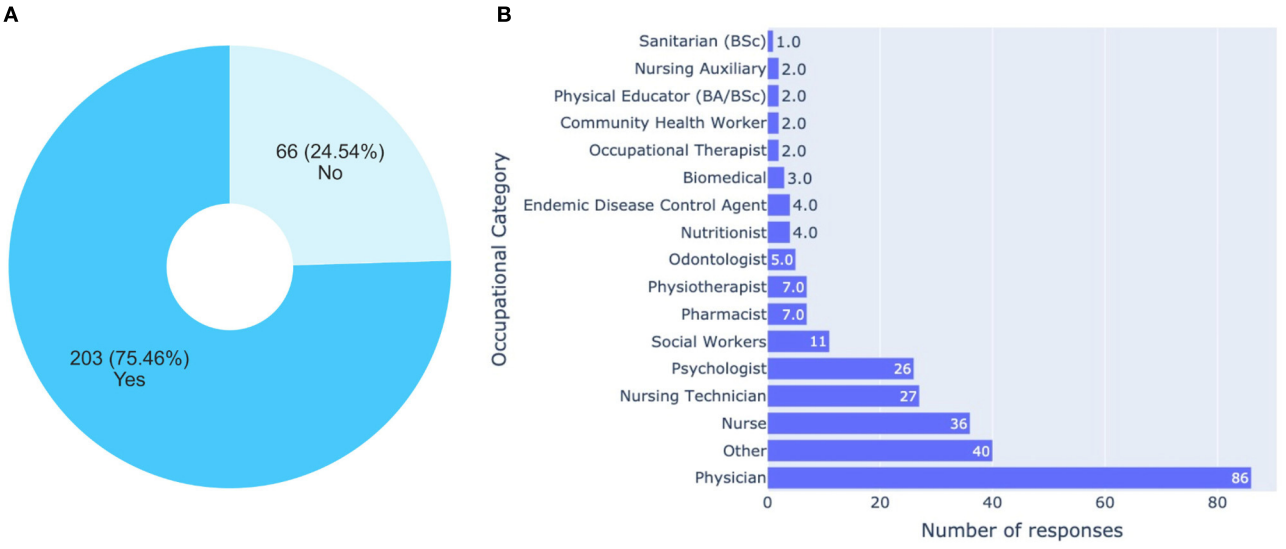

FIGURE 2
Analysis related to the occupation. **(A)** Are you currently working as healthcare professional? **(B)** If you work as a health professional, select the alternative referring to your occupational category.

in prison units that contain up to 300 (three hundred) detainees, with a health service that works six hours a week. When added to the respondents who worked or work in an eAPP-I with Mental Health (Complementary Psychosocial Team of Prison Primary Care), this percentage increases to ∼90%. Regarding the eAPP-II, 2.54% of the students answered that they had worked or work in prison units that contain from 101 (one hundred and one) to 1,700 (one thousand and seven hundred) deprived of freedom, with a health service that works 20 (twenty) hours a week. When Mental Health was included in this type of prison primary care team, this percentage increases to 3.39%. Following the eAPP-III, 5.93% of the respondents informed that they worked or work in prison units with health services in a 30 (thirty) hours a week routine, that contains from 1,201 to 2,700 people deprived of freedom. This finding enhances our perception as it shows that the course reached not only health professionals but most health professionals who work or have worked in the prison system. Regarding the prison system, a notable aspect is when we have the intention to improve and enhance health services in the prison system.

According to the answers to the question "Why did you choose the course?", 73.05% answered for the content, 20.78% for the educational model (self-learning), and 6.17% for other issues. When most of the respondents (225) stated that they chose the course for the content, they evidenced that there is a need for

training in this area and that the content was adequate to the demands of prison health. It is important to highlight that there is a shortage of qualified material for prison health training. Regarding the 64 respondents who said they chose the course because of the educational model, self-learning, this is justified by the high workload to which health professionals are submitted, therefore, many of these professionals do not have time to attend classes in the face-to-face model. Therefore, health professionals need more flexible models of permanent and continuing education. In this case, this was possible through a self-instructional course with technological mediation.

When the respondents were asked about the main reason for taking this course, 74.41% (highlighted in bold) said they did so because of the direct or indirect relationship it establishes with their work activities. This percentage reinforces the scope of the massive education among the target public of interest in the course. Among the answers, the students listed the following motivations:

1. The need to further my education (25.24%);
2. The relationship it establishes with my professional activity (19.59%);
3. For the opportunity to access unknown content (15.44%);
4. For certification (12.24%);
5. Meet the demand of the health facility where I work (9.79%);
6. For functional progression (7.91%);
7. For the duration (workload) (3.58%);
8. The referral of co-workers (2.64%);
9. Other reason (1.88%);
10. Due to publicity about the course I saw (1.69%).

Regarding referring the course to others, two questions were asked; the first is whether the respondent referred the course and the second is to whom they referred the course, represented in Figures 3A, B. Note that another 75% of the respondents stated that they referred this course to other people. Of these, 66.67% referred the course to other health professionals in the facility where they work, or in another facility. The referral of the course to co-workers helps to explain the level of capillarity and the speed of the reach of the massive open training, through technological mediation in a continental territory such as Brazil in a thorny and still little-known theme in the world that is prison health.

Besides these questions, an interesting finding was that 26.59% of the respondents indicated this course not for a health professional, but for a student. This data is relevant, as it shows that a process of improvement of future health professionals, who may work in prison health, is also taking place, something not yet observed in the traditional disciplines of health courses.

For 82% of the respondents, the main reasons they indicated the course to other people were the content (44.59%), the methodology (20.10%), and the self-instructional model (17.53%), according to the data from the answers to the question "Why did you recommend this course?" It is well known that health professionals are in great demand for the services and care of patients. Generally, these professionals have more than one employment relationship, therefore, their workload is quite compromised (75). This labor characteristic, related to health professionals, can make it unfeasible to develop their educational activities in the face-to-face format, which helps to explain these cited percentages.

According to the data presented in Figure 4, the students who answered the questionnaire said they shared what they learned with their work colleagues and also with the family and the community, respectively 85.77% in Figure 4A and 80.08% in Figure 4B. The sharing of learning with co-workers is an important finding, as it shows that the training given is reaching other health professionals who did not take the course. Therefore, it is a transversal form, which occurs through the dissemination of knowledge from the interactions at work, i.e., in the health service, an aspect that contributes to indirectly expanding the training spectrum.

Another fact that reinforces the above, still in the same Figure 4C, is that 98.47% (almost 100%) of the respondents agreed that the course content is important, and should be shared. This data shows that the contents of this course have meaning, that is, they make sense to the students, particularly to those who work in prison health. Another aspect is that natural or spontaneous sharing is also an indicator of quality.

For ∼90% of the questionnaire respondents, the course content addressed the epidemiological profile of the Brazilian prison system, according to the graph in Figure 5A. This same percentage was perceived in the graph of Figure 5B, when also, ∼90% of these respondents, considered that the contents approach assistance in sexually transmitted infections control in the prison system.

The questions related to comprehensive health care in the prison system were grouped in Figure 6, so that it was possible to observe the students' perception with the health of men and women deprived of liberty. In the three scenarios of Figures 6A–C, more than 90% of the students who answered the questionnaire consider that the course contents address effective strategies for integral care. It is observed in the graph of Figures 6B, C that, according to these same students, these contents allowed an understanding of the aspects related to the integral care of men and women deprived of liberty.

Figure 7 presents data related to the content and understanding of issues related to the mental health of detainees. In this case, when observing the responses of students who scored "extremely well" and "very well", >91% considered that the course allowed them to understand the issues related to the mental health of detainees. It is also noteworthy that mental health in the prison system is also considered a public health problem, not only in Brazil but in the world (76). Therefore, this data helps to explain the meaning of the course content for the students, which also explains the issue of knowledge sharing.

Figure 8 presents a summary of the results obtained about knowledge of National Policies. The data presented in the graph of Figure 8A show that 68.48% of the respondents did not know the national policy for comprehensive health care for people deprived of liberty before the course. The graph in Figure 8B highlights that 50% did not know about the national policy for women's health care before the course. The highest percentage of ignorance before the course was concerning the national policy for women deprived of liberty and egressed, which was 76.65%.

The findings presented in Figure 8 demonstrate the importance of this course for the training of professionals working in prison health in Brazil, since at least 50% of the respondents reported a lack of knowledge about the policies related to health care for people deprived of liberty.

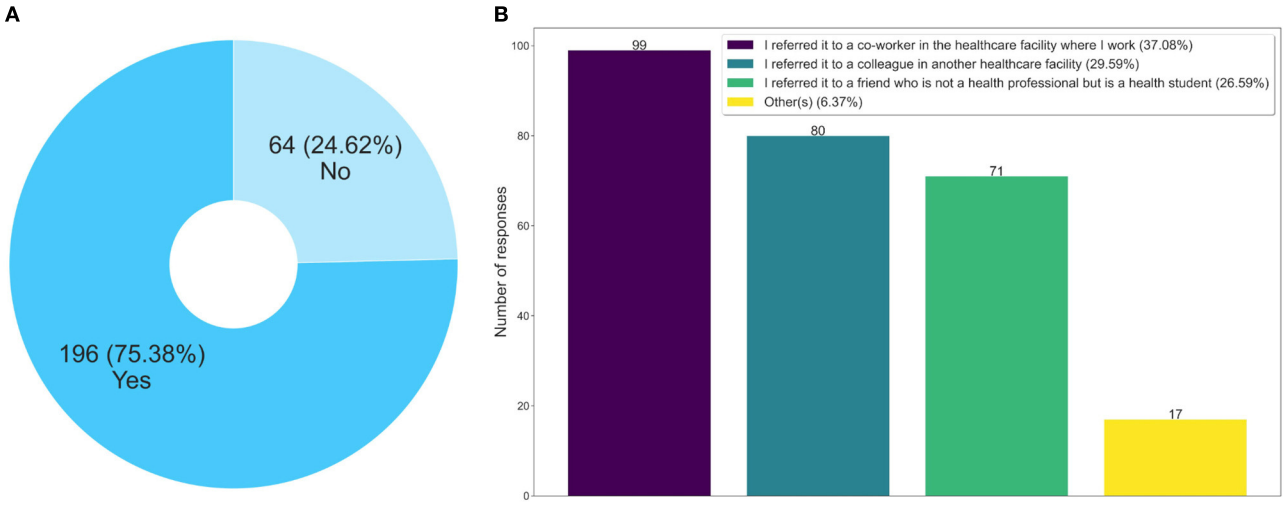

FIGURE 3
Analysis related to recommend the course to other people. **(A)** Did you recommend this course? **(B)** To whom did you recommend this course?

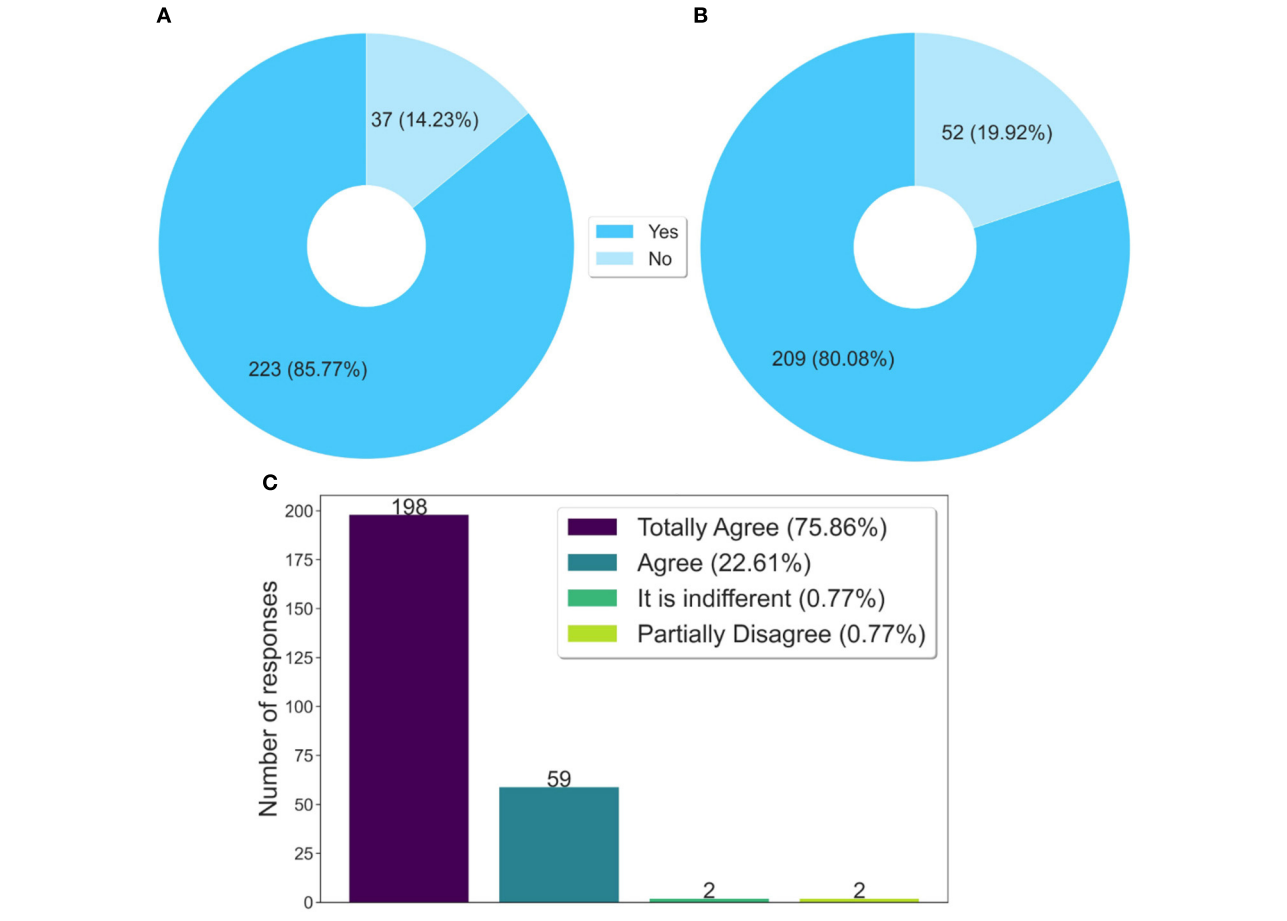

FIGURE 4
Analysis of knowledge sharing. **(A)** Have you shared what you learned in the course with your co-workers? **(B)** Did you share what you learned in the course with your family and community? **(C)** Is the course content important to be shared?

In the last question of the dimension, students were invited to answer: "Which answer best fits your level of satisfaction with the course?". The results obtained show that 99.22% are satisfied with the course, this is therefore another indicator of course quality.

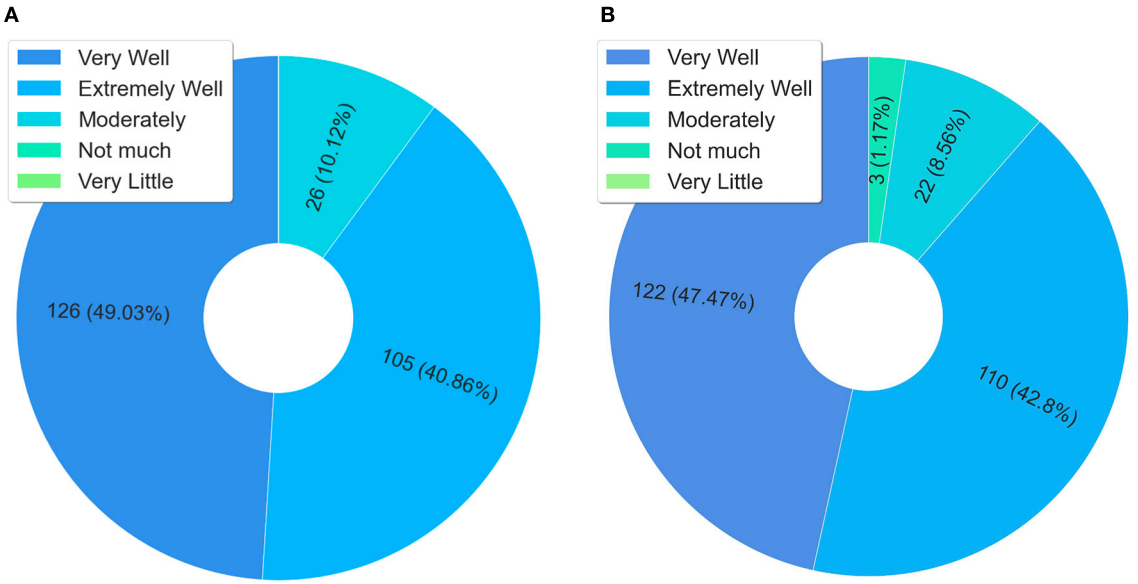

FIGURE 5
Analysis of content, epidemiological profile, and STIs. **(A)** Did the contents covered in the course discuss the epidemiological profile of the Brazilian prison system. **(B)** Did the course cover topics that help in the control of sexually transmitted infections in the prison system.

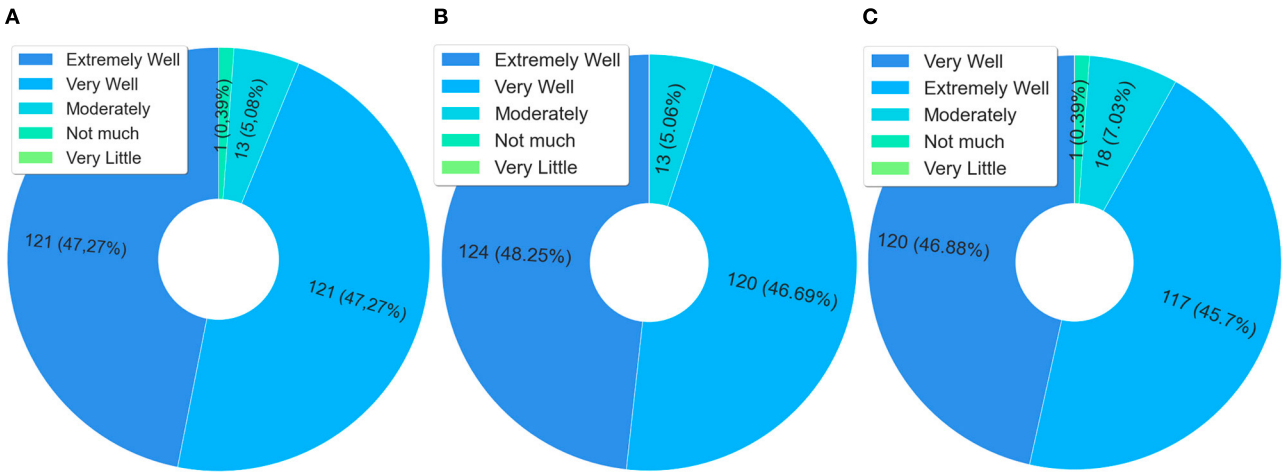

FIGURE 6
Analysis of comprehensive health care in the prison system. **(A)** Did the contents of the course cover effective strategies for comprehensive health care in the prison system? **(B)** Did the topics addressed in the course allow you to UNDERSTAND the aspects related to comprehensive care for "the health of men deprived of liberty"? **(C)** Did the topics addressed in the course allow you to UNDERSTAND the aspects related to comprehensive care for "the health of women deprived of liberty"?

The questionnaire respondents, when asked if, "Could improving health care in the prison system, observing the physical, psychological and social needs of people deprived of liberty, have a positive impact on society as a whole?" 99.21% totally agreed or agreed that yes. These data highlight the student's perception of the relevance of promoting integral care in prison health, and that this is related to society, i.e., they are inseparable in the respondents' perception - so it is possible to observe that in the respondents' general view, taking care of health in prisons is also taking care of society.

Figure 9 presents the compilation of the answers to the questions that deal with deprivation of freedom and the association with diseases, in addition to presenting the perception of the respondents of the questionnaire regarding the improvement of health care with social and humanization issues. In this case, 96.44% of the respondents (Figure 9A) agree that the deprivation of freedom and the permanence in the prison system are vulnerability factors that favor getting sick. Figure 9B shows that 96.05% of the respondents also agree that the restriction to health in the prison system is another factor that favors the onset of diseases in the prison system. Regarding the improvement of prison health,

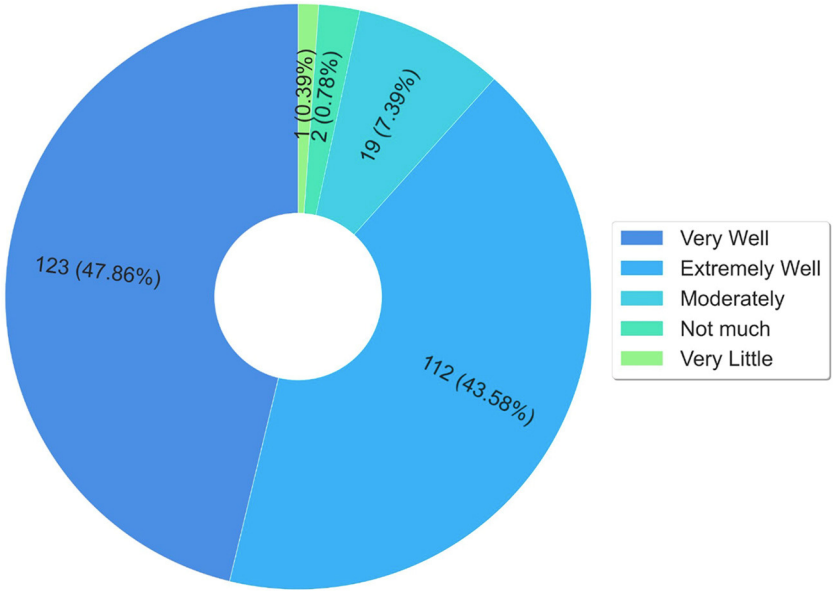

FIGURE 7
Mental health of the person deprived of liberty.

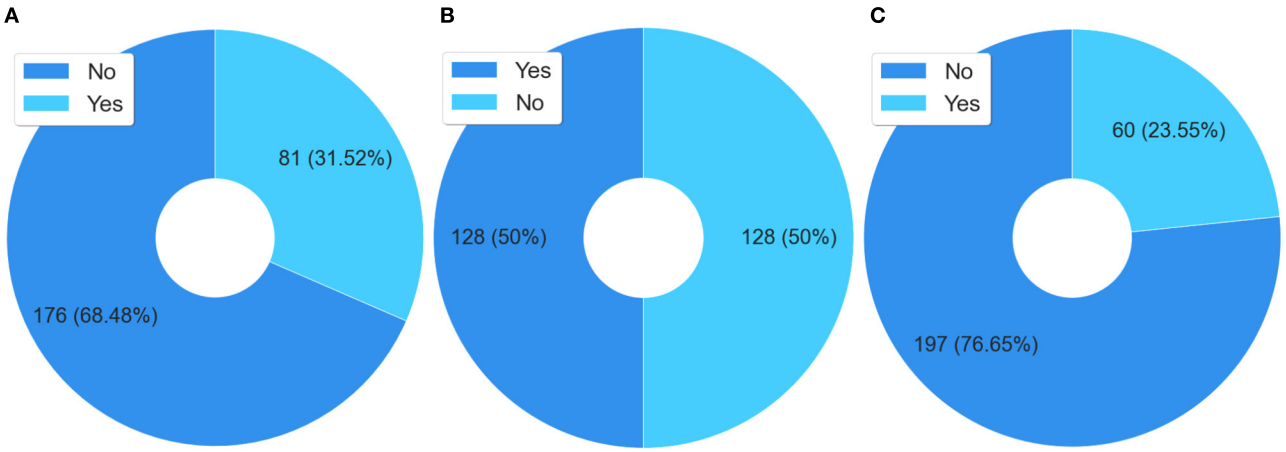

FIGURE 8
Analysis of students' previous knowledge. **(A)** Previous to the course, had you studied the content of the National Policy for Comprehensive Health Care for persons Deprived of Liberty in the Prison System (PNAISP)? **(B)** Previous to the course, had you studied the content of the National Policy for Integral Care of Women's Health (PNAISM)? **(C)** Previous to the course, had you studied the content of the National Policy for the Care of Women Deprived of Liberty and Released from the Prison System (PNAMPE)?

97.64% of respondents agree that this represents a social advance, because it means a more appropriate and humane treatment for detainees.

In the context of improving health in the prison system, 91% of the respondents totally agree or agree that it is possible to always achieve better levels of guaranteeing the right to health of the person deprived of liberty, according to the answers to the question "Is it possible to always achieve better levels of guarantee to the right to health of the person deprived of liberty?" This is positive because in their perception it is possible to develop a process of continuous improvement in prison health in Brazil.

Regarding professional practice, it is possible to observe in Figure 10A, that 98% of those who answered the questionnaire considered that the course contributed to improving their professional practice. This is an important marker of quality, as it has a direct impact on the integral health care of people deprived of liberty, that is, on prison health.

Figure 10B shows the results from the following question, "Did the course help to improve your professional practice?". For 96.38%, the course enabled a change in professional practice. This question is related to the previous one, and when observed together, can help explain changes in the behavior of professionals that can induce changes in the work processes, something desired when it is

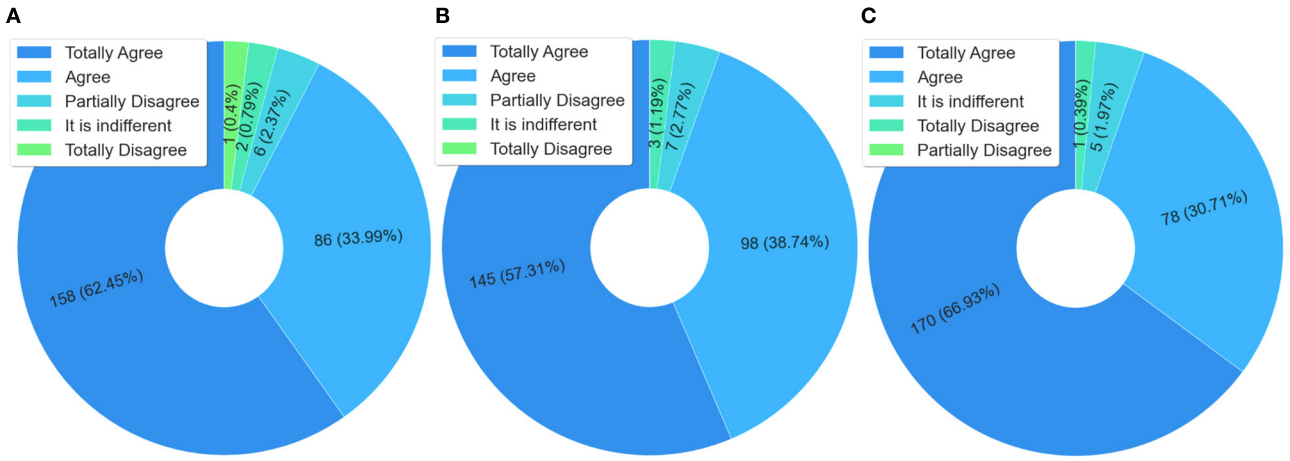

FIGURE 9
Analysis of prison health, diseases, community, and humanization. **(A)** Are deprivation of liberty and performance in the prison system vulnerability factor that intensify the appearance of various disease? **(B)** Is the restriction of comprehensive health care in the prison system a factor that intensifies the appearance of various diseases among people deprived of liberty and also in the community? **(C)** Does the improvement of health care in the prison system represent an advance toward a more adequate social and health system because it is more humanized?

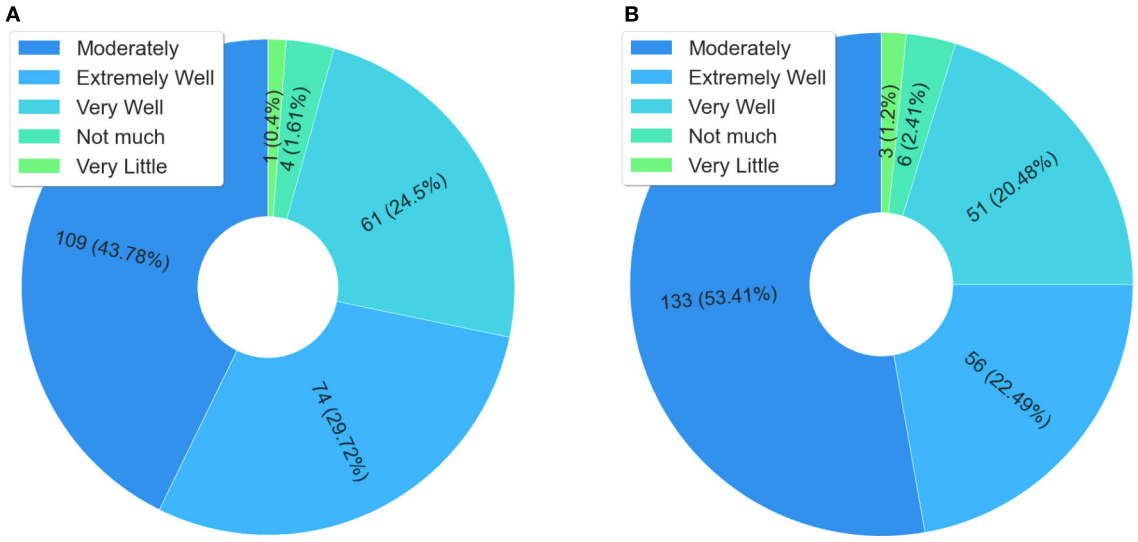

FIGURE 10
Analysis of improvements and behavioral changes in professional practice. **(A)** Did the course help to improve your professional practice? **(B)** Did the course provide change in behavior in your professional practice?

necessary to make interventions to improve health services—in this case through massive health education applied in the prison system.

Regarding the work environment, Figure 11 shows that the course allowed enhancing an existing health service and whether it provided an opportunity for changes in the workplace. Note that for 57.37% of the respondents, Figure 11A, the course allowed the improvement of an existing health service, and for 37.55%, Figure 11B, the course induced changes in the work process at the place where the health professional (who was a student in the course) works. Thus, it presents the explicit evidence that demonstrates how massive health education, through technological mediation, is a viable tool for the intervention and induction of public policies in prison health.

The data from the answers to the question "Did the course provide changes in behavior in your professional practice?" indicate that, for more than 74% of the respondents, the course contributed to improving the welcoming and health care in the prison system in Brazil. It should be noted that improving the reception of prisoners means a change of behavior in the prison system, which also implies in the humanization of care in an environment where this aspect is often neglected. Therefore, this is a finding that helps to understand the impacts of health education in the prison system, because the humanized health care of detainees is a factor that indicates and

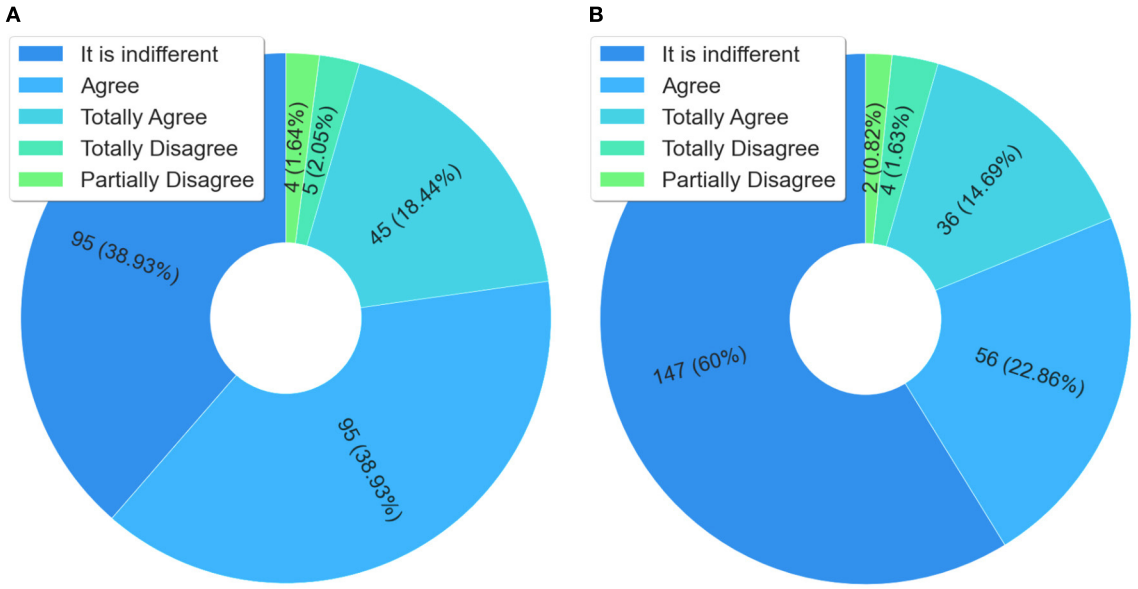

FIGURE 11
Analysis related to service improvement and work process changes. **(A)** Did the course improve an existing service? **(B)** Did the course provide change in the work process in the place where you work?

improvement and enhancement of comprehensive health care in the prison system in Brazil.

4. Discussion

The results section presented several findings, essentially, from the perspective of students of the course "Health Care for People Deprived of Freedom", who answered a questionnaire. It is noteworthy that the findings come from 246 (91.11%) of the 270 students who answered the questionnaire, showing that they work in some team of prison primary care. The data presented allowed answering the research question Q1: "How has massive education, mediated by technology, contributed to prison health in Brazil?". Furthermore, relevant information was presented for the understanding of the respondents' universe, especially, when observing their area of training at the time they took the course. The data and information described in the results section allowed: a) to validate the application phase of the questionnaire as an evaluation tool for massive education. Through it, a positive spontaneous adhesion of students to a non-mandatory open course was verified, and, b) demonstrated that the search for the course is made by several areas of knowledge. In this case, there is a higher incidence of health professionals, but also of professionals in the humanities, who work directly with the guarantee of the rights of people deprived of liberty, for example, professionals in the areas of social worker, psychology, and education.

Before deepening the discussion it is important to highlight some characteristics of Brazil, once it is a country of continental dimensions with 26 federal units and the Federal District, more than 5,700 municipalities, and more than 3.5 million health professionals working in various areas (36). Still in this context, it is worth mentioning the social inequalities, besides having one of the largest prison populations in the world, which suffer from lack of adequate structure, overcrowding, and disease (53).

It is worth noting that students enrolled in the course "Health Care for People Deprived of Freedom" hailed from all regions of Brazil. Thus, 32.59% are from the Northeast Region, 32.88% from the Southeast, 18% from the South, 8.68% from the Midwest Region, 7.49% from the North, and 0.35% from other countries. The Southeast, Northeast, and South regions have the highest number of students and correspond to the regions with the highest prison population (1).

Another aspect observed was the level of education of the students enrolled. Despite being a free and open course, the target audience was primarily health professionals. This may help to explain the higher prevalence of such a student profile among enrollees. Therefore, this profile meets the necessary digital literacy requirements for AVASUS and has an education level that aligns with the course's purpose. This is mainly because such students have experience working in public health in Brazil. Hence, these constitute basic professional requirements.

Following this context, the development of a continuing education policy focused on prison health based only on the face-to-face model may be not only insufficient but also unfeasible from the perspective of cost-effectiveness that involves programs of this type in a country with the characteristics of Brazil. As a response to this challenge, the massive education of health professionals, through models whose educational architecture is directed by technological mediation, assumes a fundamental role. Therefore, according to the results presented, and considering that the course "Health Care for People Deprived of Freedom" on AVASUS has reached more than 11,500 enrollments throughout the country and that a significant number of these enrolled students have

direct links with Primary Health Care in Prison, it is shown that this model was important to give capillarity and scalability to the course. This aspect favored the education of professionals working in prison health throughout Brazil - something that would be more difficult to achieve in the face-to-face model. However, if course enrollment were mandatory for all health professionals, particularly those working or wishing to work in Brazil's prison system, it would indeed have achieved a larger number of enrolled students.

It is worth noting that given the interfederative nature of SUS, mandatory enrollment in the course could entail a complex and very bureaucratic process, as it would require approval by a higher council of SUS. It is called the tripartite council, consisting of Brazil's Ministry of Health, the National Council of Health Secretaries (CONASS), and the National Council of Municipal Health Secretariats (CONASEMS). Notably, such a complexity becomes even more pronounced because prison health has been considered neglected, despite being something foreseen by law in Brazil. Unfortunately, this agenda has not received priority within SUS management levels. Thus, the strategy of adopting a technology-mediated model with spontaneous participation was the most viable, as in addition to accelerating the training process, it was not necessary to undergo the bureaucratic flow of the tripartite, which could take years to approve or never be on the agenda for a vote.

For a better understanding of the impacts of this course in the context of the performance and the work environment, it is also necessary to consider the PNAISP. This policy regulates the types of prison health teams and the professionals who make up these teams, which are the most diverse because the focus is the comprehensive care for people deprived of liberty. In line with the results presented, ∼90% of the health professionals who took the course work or have worked in prison primary care. This data becomes even more significant because it directly impacts all the prison health teams, especially because these students said it is important to share the knowledge acquired with co-workers, in addition to recommending the course to them. Therefore, it is possible to infer that the course analyzed, in addition to contributing toward improving prison primary care teams in Brazil, acted as an inducer to strengthen the PNAISP.

Regarding the massive education in prison health as a tool to induce changes in the work process, it is noteworthy that more than 96% of respondents said that the course contributed to promoting changes in their professional practices. And that it was also important to provide improvements in existing health services, besides creating new services. This finding is important to explain the increase in syphilis testing and diagnosis in the prison system in Brazil between the years 2018 and 2019 (1). This phenomenon of increased notifications of syphilis cases in the Brazilian prison system in this period, at first could seem something negative, however, it was actually a change in the work process, because the prison primary care began to perform more tests, and consequently to notify more cases. It is noteworthy that until 2016 syphilis in Brazil was considered a neglected disease, so it was not on the country's public health agenda. In this context, the massive education for the prison system, in addition to promoting at scale the education of thousands of health professionals throughout Brazil, was also, inducing resilience in prison health. This is because a positive correlation was observed between the increase in enrollment in the course "Health care for the person deprived of freedom" and the increase in testing, as described in Valentim et al. (1), an aspect that corroborates the answers given by the respondents.

Against this background, the main contribution of the "Health Care for People Deprived of Liberty" course to prison health was the increase in STIs screening and care. This was found through the analysis of secondary data from the epidemiological bulletin issued by Brazil's National Prison Department (DEPEN) (1). Data and analysis were confirmed through the questionnaire, especially with the responses provided, as shown in Figure 10. In this instance, respondents stated that course content contributed to STI control in prison settings. Therefore, the rise in screening after course provision indicates changes in work processes. The latter aspect was emphasized in the questionnaire responses (see Figure 10), with respondents stating that the course contributed to enhancing an existing health service and work processes.

Thus, public policymakers need to reflect on the necessity for permanent investment in public policies for health care in the prison system. The change in work processes and professional practice that has repercussions in better assistance is indeed something significant and has appeared, for example, in the increase in the diagnosis of syphilis in the prison system. However, this does not depend, exclusively, on health professionals. Therefore, it is necessary to consider not only a greater investment in the prison system but also to enhance these investments, so that greater effectiveness can be achieved. According to the answers given to the questionnaire, almost 80% of the respondents affirmed that they work in the Prison Primary Care, but in the teams that dedicate the least weekly workload, only 6 hours a week. This is explained by the low remuneration of these professionals, who accumulate more than one work bond, and therefore cannot dedicate a greater workload to prison health. Therefore, in addition to the permanent and massive education, which has proven to be effective in prison health, the formulators of public policies should also observe the wage appreciation of health professionals working in the prison system, workloads appropriate to their activities and physical and structural improvements in workplaces, which enable the implementation of best practices of health care for deprived of freedom.

Still in this context, it is valid to reinforce that it was in 2018 that the course "Health Care for People Deprived of Liberty" was made available in the Virtual Learning Environment of the Brazilian Health System, that is, one year after the beginning of the course, 2019, Brazil recorded the highest peak of syphilis testing in the prison system (1, 2, 51). Although the data do not demonstrate causality, they reinforce that continuing education can positively impact the health care and assistance services provided in the prison system (1). It is noteworthy that testing and diagnosis are premises for the treatment and cure of syphilis, and also to reduce the transmission curve of this infection in the prison system, objectives observed after the massive education process with technological mediation promoted by the course studied.

These aspects are shreds of evidence that help to demonstrate that massive health education with technological mediation is a relevant tool to be used to drive public health policies, specifically

in neglected fields such as prison health (77). This was even more apparent when we considered that the interest in the course came about spontaneously. In this respect, it is worth noting that massive health education becomes even more effective, especially in times of health crises, as was recently seen with the COVID-19 pandemic (41, 78). This is because it is necessary to upskill the workforce and health services to respond more quickly to public health emergencies, aiming to promote and instill resilience in the health system. In this regard, Henriques et al. (79) underscore the need to revisit the debates on the interactions between technology and education and the added value of digital resources to enhance educational processes.

For that reason, the biggest challenge in implementing this massive education program–mainly as it is situated in the context of prison health–is the lack of prioritization. Unfortunately, prison health continues to be overlooked in Brazil. This is an important constraint to improving health in the prison system. Therefore, it is necessary to encourage the development of public policies in the context of prison health, in addition to sustaining and fostering continuing education programs that can work toward improving the four pillars of the prison system: health professionals, people deprived of liberty, prison officers, and managers. A shortcoming of the massive education process is the need for investment in adequate infrastructure, as it is a technology-mediated process. Nonetheless, in countries with Brazil's dimensions and a very high prison population, such a model can be viable due to its cost-effectiveness and the need for a more timely response.

5. Conclusions

Evaluating massive Education in Prison Health is a strategic activity to think about the contributions and impacts of this training on the National Policy of Continuing Health Education (80, 81) and the strengthening of technology-mediated education. In the specific case, this research observed and analyzed the contributions in the context of health in the prison system in Brazil, especially, the positive impacts on the improvement of the health workforce, health services, and epidemiological indicators of prison health. However, beyond these contributions, the massive education in prison health, also contributed transversally to the social agenda of the United Nations Educational, Scientific and Cultural Organization (UNESCO). This agenda sets a new social contract for global education, a fundamental aspect, because it is a repairing agent that acts to reduce injustices and iniquities, therefore transforming the future (82).

From this perspective, the relevance of massive education for prison health crosses the improvement of the supply of health services in the prison environment and reaches the Sustainable Development Goals (SDGs) of UN's 2030 Agenda (26, 83). It is noteworthy that the main motto of this agenda is "Leave no one behind (LNOB)", based on five fundamental principles: people, planet, prosperity, peace, and partnerships, which form the five pillars of the SDGs (83–85). When analyzing the contributions, impacts and nature of the course "Health Care for People Deprived of Liberty" and based on the answers obtained through the questionnaire applied, it is possible to identify a greater emphasis on the following SDGs: 3, 4, 10, 16 and 17.

The cited goals showed that massive Education in Prison Health can be situated in an Educational Pentagon that addresses the dimensions: health, education, combating inequalities, peace and justice in institutions and partnerships toward the goals and sustainable development for all people. It is noteworthy that SDG 3 is concerned with ensuring a healthy life and promoting well-being for all, this aspect was observed in the analysis of the answers given by health professionals working in the Brazilian prison system. SDG 4, deals with inclusive, equitable, and quality education, promoting lifelong learning opportunities for all. Therefore, by using technological mediation to ensure the greatest possible access to knowledge (scalability), the course studied was able to reach all levels of health care in the Brazilian prison system. Moreover, the evaluations highlighted by the students who answered the questionnaire demonstrated the quality of the course.

Regarding SDG 10, in favor of reducing inequality within and between countries, it is observable from the analysis developed, that the promotion of prison health significantly reduces inequalities, with greater repercussion in the prison system, by ensuring both the right to health and allow continuing health education through technological mediation. For SDG 16, whose goal is to promote peaceful and inclusive societies for sustainable development, provide fair access to rights for all people. It is noticed that the massive education in prison health contributes to the improvement of a more humanized health care in the prison system, an aspect that reverberates to a more peaceful society and collaborates with the effectiveness of the institutions, in guaranteeing rights through education and health - taking care of prison health is taking care of society. Based on SDG 17, the course, "Health Care for People Deprived of Liberty", acts in the implementation and revitalization of global partnerships for sustainable development. Therefore, it is observed the contributions of massive education in prison health as an articulator of public health policies, permanent education policies, and the law of penal execution. A network of institutional cooperation, involving the Brazilian Ministry of Health, the Brazilian Ministry of Education and the Brazilian Ministry of Justice, in a pact for those deprived of freedom and with the enhanced support of professionals in the prison system.

The best expression for the analysis of massive education in prison health is the effectiveness of its open educational resources (OER), which impact on the improvement, not only of people in the context of deprivation of liberty, but also in building a society and a planet more just, peaceful and prosperous. Therefore, it is necessary to think that this Educational Pentagon can be a resilience-inducing tool, capable of reaching all of society, so that it can act in a more improved manner in the development as freedom, capable of mitigating the effects of injustices that may affect the global future (86).

6. Limitations

This research has drawn on the analysis of a questionnaire applied to participants of the course "Health Care for People Deprived of Freedom," offered through the Virtual Learning Environment of the Brazilian Health System (AVASUS). Questionnaire respondents were primarily practicing in healthcare and primary care in prisons. That represents the main limitation

of our study, as it has not been possible to verify the impacts of the health education process from the perspective of other actors included in the prison system, such as prison officers, people deprived of their liberty, and managers. Since this was not the aim of this study, future research may address this issue.

Data availability statement

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found below: https://doi.org/10.5281/zenodo.8034239.

Author contributions

JV, SD-T, MRo, EO, RM, and RV contributed to conception and design of the study. FF, PM, and KM organized the database and repository. JV, MRo, FF, AC, GF, and RV performed the analysis. JV, MRo, AC, MRo, CG, and RV wrote the first draft of the manuscript. JV, MRo, AC, and RV wrote sections of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

References

1. Valentim JLRS, Dias-Trindade S, Oliveira ESG, Moreira JAM, Fernandes F, Romão MH, et al. The relevancy of massive health education in the Brazilian prison system: the course "health care for people deprived of freedom" and its impacts. *Front Public Health*. (2022) 10:935389. doi: 10.3389/fpubh.2022.935389

2. Valentim J, Oliveira EdSG, Valentim RAdM, Dias-Trindade S, Dias AdP, Cunha-Oliveira A, et al. Data report: "health care of persons deprived of liberty" course from brazil's unified health system virtual learning environment. *FrontMed*. (2021) 8:742071. doi: 10.3389/fmed.2021.742071

3. Barbosa ML, Menezes TNd, Santos SRd, Olinda RA, Costa GMC. The quality of life of health professionals working in the prison system. Ciência & Saúde Coletiva. (2018) 23:1293–302. doi: 10.1590/1413-81232018234.09292016

4. Watson R, Stimpson A, Hostick T. Prison health care: a review of the literature. *Int J Nursing Stud*. (2004) 41:119–28. doi: 10.1016/S0020-7489(03)00128-7

5. Van Hout MC, Mhlanga-Gunda R. Prison health situation and health rights of young people incarcerated in sub-Saharan African prisons and detention centres: a scoping review of extant literature. *BMC*. (2019) 19:17. doi: 10.1186/s12914-019-0200-z

6. Dias ARP. *Atendimento á saúde no sistema prisional: controle social x parâmetros para redução carcerária*. Chapec/'o: Universidade Federal da Fronteira Sul [Programa de Pós-Graduação em Desenvolvimento e Políticas Públicas]. (2018) Available online at: https://rd.uffs.edu.br/handle/prefix/3080 (accessed April 1, 2023).

7. Cunha LCd. *Regramento internacional, encarceramento feminino e a importância da implementação das Regras de Bangkok*. Rio de Janeiro: Trabalho de Conclusío de Curso (Bacharelado em Direito), Faculdade Nacional de Direito, Universidade Federal do Rio de Janeiro. (2017) p. 1–99. Available online at: http://hdl.handle.net/11422/9178. (accessed Apr 7, 2023).

8. Stürup-Toft S, O'Moore EJ, Plugge EH. Looking behind the bars: emerging health issues for people in prison. *Br Med Bull*. (2018) 125:15–23. doi: 10.1093/bmb/ldx052

9. Walmsley R. *World Prison Population List|Eleventh Edition*. London: Institute for Criminal Policy Research. International Center for Prison Studies (ICPS). (2015). Available online at: https://nicic.gov/world-prison-population-listeleventh-edition (accessed Apr 7, 2023).

10. Brasil. *Departamento Penitenciário Nacional*. Levantamento Nacional de Informações Penitenciárias. (2022) Available online at: https://www.gov.br/depen/pt-br/servicos/sisdepen. (accessed Jan 20, 2023).

11. Monteiro FM, Cardoso GR. The selectivity of Brazilian penitentiary system and the profile of the incarcerated population: an opportune debate. *Civitas*. (2013) 13:93–117. doi: 10.15448/1984-7289.2013.1.12592

12. Dolan K, Wirtz AL, Moazen B, Ndeffo-mbah M, Galvani A, Kinner SA, et al. Global burden of HIV, viral hepatitis, and tuberculosis in prisoners and detainees. *Lancet*. (2016) 388:1089–102. doi: 10.1016/S0140-6736(16)30466-4

13. Cadamuro ACGA, Andrade RLdP, Lopes LM, Neves LAdS, Catoia EA, Monroe AA. Coordination of care for people living with HIV in the prison system. *Acta Paulista de Enfermagem*. (2020) 33:eAPE20190267. doi: 10.37689/acta-ape/2020AO02676

14. Job Neto F, Miranda RB, de Almeida Coelho R. Gonçalves CP, Zandonade E, Miranda AE. Health morbidity in Brazilian prisons: a time trends study from national databases. *BMJ Open*. (2019) 9:e026853. doi: 10.1136/bmjopen-2018-026853

15. Puga MAM, Bandeira LM, Pompilio MA, Rezende GRd, Soares LS, de Castro VdOL, et al. Screening for HBV, HCV, HIV and syphilis infections among bacteriologically confirmed tuberculosis prisoners: an urgent action required. *PLoS ONE*. (2019) 14:1–11. doi: 10.1371/journal.pone.0221265

16. Keene DE, Smoyer AB, Blankenship KM. Stigma, housing and identity after prison. The Sociological Review. (2018) 66:799-815. doi: 10.1177/0038026118777447

17. Nakitanda AO, Montanari L, Tavoschi L, Mozalevskis A, Duffell E. Hepatitis B virus infection in EU/EEA and United Kingdom prisons: a descriptive analysis. *Epidemiol Infect*. (2021) 149:e59. doi: 10.1017/S0950268821000169

18. Harris B, Dragiewicz M, Woodlock D. Technology, domestic violence advocacy and the sustainable development goals. In: Blaustein J, Fitz-Gibbon K, Pino NW, White R, editors. *The Emerald Handbook of Crime, Justice and*

Sustainable Development. Bradford: Emerald Publishing Limited. (2020) p. 295–313. doi: 10.1108/978-1-78769-355-520201017

19. Kruk ME, Gage AD, Arsenault C, Jordan K, Leslie HH, Roder-DeWan S, et al. High-quality health systems in the Sustainable Development Goals era: time for a revolution. *The Lancet Global Health*. (2018) 6:e1196–252. doi: 10.1016/S2214-109X(18)30386-3

20. Ismail N. Rolling back the prison estate: the pervasive impact of macroeconomic austerity on prisoner health in England. *J Public Health*. (2019) 42:625–32. doi: 10.1093/pubmed/fdz058

21. Engels D. Neglected tropical diseases in the Sustainable Development Goals. *Lancet*. (2016) 387:223–4. doi: 10.1016/S0140-6736(16)00043-X

22. Moazen B, Mauti J, Meireles P. Černíková T, Neuhann F, Jahn A, et al. Principles of condom provision programs in prisons from the standpoint of European prison health experts: a qualitative study. *Harm Reduct J*. (2021) 18:14. doi: 10.1186/s12954-021-00462-y

23. Ismail N, Lazaris A, O'Moore É, Plugge E, Stürup-Toft S. Leaving no one behind in prison: improving the health of people in prison as a key contributor to meeting the Sustainable Development Goals 2030. *BMJ Global Health*. (2021) 6:e004252. doi: 10.1136/bmjgh-2020-004252

24. United Nations. *Transforming our World: The 2030 Agenda for Sustainable Development*. (2015) Available online at: https://sdgs.un.org/2030agenda (accessed 10 Apr, 2023).

25. Hewitt T. *Imagining the Future of Knowledge Mobilization* : *Perspectives from UNESCO Chairs*. Ontario: Canadian Commission for UNESCO. (2021) Available online at: http://hdl.handle.net/10464/15039. (accessed 10 Apr, 2023).

26. United Nations. *Take Action for the Sustainable Development Goals*. (2015) Available online at: https://www.un.org/sustainabledevelopment/sustainable-development-goals/ (accessed 10 Apr, 2023).

27. UNESCO. *Educando para a liberdade: trajetória, debates e proposições de um projeto para a educação nas prisões brasileiras*. Brasília: UNESCO, Governo Japonês, Ministério da Educação, Ministério da Justiça. (2006) Available online at: http://www.educadores.diaadia.pr.gov.br/arquivos/File/eja_prisao/educando_liberdade_unesco.pdf. (accessed 10 Apr, 2023).

28. UNESCO. *Education in Prison: a Literature Review*. Hamburg: UNESCO Institute for Lifelong Learning (UIL). (2021). Available online at: https://unesdoc.unesco.org/ark:/48223/pf0000378059 (accessed 10 Apr, 2023).

29. Ceccim RB, Feuerwerker LCM, A. four-way approach to training in the health field: teaching, management, care, and social control. *Physis: Revista de Saúde Coletiva*. (2004) 14:41–65. doi: 10.1590/S0103-73312004000100004

30. Ceccim RB. Permanent Education in Health: decentralization and dissemination of pedagogical capacity in health. *Ciência & Saúde Coletiva*. (2005) 10:975–86. doi: 10.1590/S1413-81232005000400020

31. Campos KFC, Sena RRd, Silva KL. Permanent professional education in healthcare services. *Escola Anna Nery*. (2017) 21:e20160317. doi: 10.1590/2177-9465-ean-2016-0317

32. Caitano AR, Gusmão CMG, Dias-Trindade S, Barbalho IMP, Morais PSG, Caldeira-Silva GJP, et al. Massive health education through technological mediation: Analyses and impacts on the syphilis epidemic in Brazil. *Front Public Health*. (2022) 10:944213. doi: 10.3389/fpubh.2022.944213

33. Machado MH, Ximenes Neto FRG. Gest ao da Educação e do Trabalho em Saúde no SUS: trinta anos de avanços e desafios. *Ciência & Saúde Coletiva*. (2018) 23:1971–9. doi: 10.1590/1413-81232018236.06682018

34. Nicoletto SCS. Bueno VLRdC, Nunes EdFPdA, Cordoni Júnior L, González AD, Mendonça FdF, et al. Desafios na implantação, desenvolvimento e sustentabilidade da Política de Educação Permanente em Saúde no Paraná. *Brasil Saúde e Sociedade*. (2013) 22:1094–105. doi: 10.1590/S0104-12902013000400012

35. Brites LS, Rocha CMF. Massive open online health courses (MOOCs): Brazilian initiatives. In: Pereira Neto A, Flynn MB, editor. *The Internet and Health in Brazil: Challenges and Trends*. Cham: Springer International Publishing. (2019) p. 297–311. doi: 10.1007/978-3-319-99289-1_15

36. Santos RS, Vaz TA, Santos RP, de Oliveira JMP. Big data analytics in a public general Hospital. In: Pardalos PM, Conca P, Giuffrida G, Nicosia G, editors. *Machine Learning, Optimization, and Big Data*. Cham: Springer International Publishing (2016) p. 433–41.

37. Massuda A, Hone T, Leles FAG, de Castro MC, Atun R. The Brazilian health system at crossroads: progress, crisis and resilience. *BMJ Global Health*. (2018) 3:e000829. doi: 10.1136/bmjgh-2018-000829

38. Castro MC, Massuda A, Almeida G, Menezes-Filho NA, Andrade MV, de Souza Noronha KVM, et al. Brazil's unified health system: the first 30 years and prospects for the future. *The Lancet*. (2019) 394:345–356. doi: 10.1016/S0140-6736(19)31243-7

39. Paim J, Travassos C, Almeida C, Bahia L, Macinko J. The Brazilian health system: history, advances, and challenges. *Lancet*. (2011) 377:1778–97. doi: 10.1016/S0140-6736(11)60054-8

40. Harzheim E, Felipe Pinto L, D'Avila OP, Hauser L. Following the legacy of professors Barbara Starfield and Leiyu Shi in Brazil as health policy: the National Health Survey (PNS), led by the Brazilian National Institute of Geography and Statistics (IBGE) and the Primary Care Assessment Tool (PCAT). *Int J Equity in Health*. (2019) 18:176. doi: 10.1186/s12939-019-1083-2

41. Valentim RAdM, Lima TS, Cortez LR, Barros DMdS, Silva RDd, Paiva JCd, et al. The relevance a technology ecosystem in the Brazilian National Health Service's Covid-19 response: the case of Rio Grande do Norte, Brazil. *Ciência & Saúde Coletiva*. (2021) 26:2035–52. doi: 10.1590/1413-81232021266.44122020

42. de Lima Pessoa T, da Silva Gama ZA, de Medeiros PJ, de Freitas MR. Massive online open course as a strategy for teaching medication safety. *Revista Brasileira de Educação Médica*. (2021) 45:e047. doi: 10.1590/1981-5271v45.1-20190302

43. Floss M, Vieira Ilgenfritz CA, Rodrigues YE, Cláudia Dilda A, Borngräber Corrêa AP, Azevedo Conte de. Melo D, et al. Development and assessment of a brazilian pilot massive open online course in planetary health education: an innovative model for primary care professionals and community training. *Front Public Health*. (2021) 9:663783. doi: 10.3389/fpubh.2021.663783

44. Monteiro EP, Gomide HP, Remor E. Massive open online course for Brazilian healthcare providers working with substance use disorders: curriculum design. *BMC Med Educ*. (2020) 20:240. doi: 10.1186/s12909-020-02162-w

45. Floss M, Abelsohn A, Kirk A, Khoo SM, Saldiva PHN, Umpierre RN, et al. An international planetary health for primary care massive open online course. *Lancet Planetary Health*. (2023) 7:e172–e178. doi: 10.1016/S2542-5196(22)00307-2

46. Parulla CD, Galdino DM, Dal Pai D, Azzolin KdO, Cogo ALP. Nursing assessment: the elaboration and development of a massive open online course. Revista Gaúcha de Enfermagem. (2020) 41:e20190199. doi: 10.1590/1983-1447.2020.20190199

47. Araújo K. Innovation in health: using the resources of distance education to teach basic life support to the Brazilian population. In: *ICERI2017 Proceedings. 10th annual International Conference of Education, Research and Innovation*. Valencia: IATED. (2017) p. 6573-6579.

48. da Rocha MA, de Morais PSG, da Silva Barros DM, dos Santos JPQ, Dias-Trindade S, de Medeiros Valentim RA. A text as unique as a fingerprint: Text analysis and authorship recognition in a Virtual Learning Environment of the Unified Health System in Brazil. *Expert Syst Appl*. (2022) 203:117280. doi: 10.1016/j.eswa.2022.117280

49. de Oliveira MTD, de Freitas Alvarenga K, da Costa KTL, Regini VBG, Balen SA, Jacob-Corteletti LCB, et al. Effectiveness of an online continuing education course in infant hearing health for primary care professionals. *Int J Audiol*. (2022) 0:1–9. doi: 10.1080/14992027.2022.2050821

50. Pinto RdM, Valentim RAdM, Fernandes da Silva L, Góis Farias de Moura Santos Lima T, Kumar V, Pereira de Oliveira CA, et al. Analyzing the reach of public health campaigns based on multidimensional aspects: the case of the syphilis epidemic in Brazil. *BMC Public Health*. (2021) 21:1632. doi: 10.1186/s12889-021-11588-w

51. Miranda AE, Rosadas C, Assone T, Pereira GFM, Vallinoto ACR, Ishak R. Strengths, weaknesses, opportunities and threats (SWOT) analysis of the implementation of public health policies on HTLV-1 in Brazil. *Front Med*. (2022) 9:859115. doi: 10.3389/fmed.2022.859115

52. Amancio AdM, Sousa LCd, Viana JCM, Cunha RIMd, Silva EGCd, Medeiros RGd, et al. Teleservice to the population of Rio Grande do Norte during the COVID-19 pandemic. *Res Society Dev*. (2020) 9:e90996636. doi: 10.33448/rsd-v9i9.6636

53. Valentim RAdM, de Oliveira CAP, da S de Oliveira E, Ribeiro EL, da Costa SM, Morais IR, et al. Virtual Learning Environment of the Brazilian Health System (AVASUS): Efficiency of Results, Impacts, and Contributions. *Front Med*. (2022) 9:896208. doi: 10.3389/fmed.2022.896208

54. de Souza Mareco TC, de Moura Santos TGF, dos Santos MM, Horta APCBO, Orrico Horta APCB. Prevention of vertical transmission in the "Syphilis No!" project: a study on the specificities of the investigation committees/space in the North Region of Brazil. *Braz J Infect Dis*. (2021) 33:e213323. doi: 10.5327/DST-2177-8264-20213323

55. Bezerra M, Fernandes F, de Oliveira Nunes J, de Araújo Baltar S, Randau K. Congenital syphilis as a measure of maternal and child healthcare, Brazil. *Emerg Infect Dis*. (2019) 25:1469–76. doi: 10.3201/eid2508.180298

56. Valentim RAM, Caldeira-Silva GJP, da Silva RD, Albuquerque GA, de Andrade IGM, Sales-Moioli AIL, et al. Stochastic Petri net model describing the relationship between reported maternal and congenital syphilis cases in Brazil. *BMC Med Infor Decision Mak*. (2022) 22:40. doi: 10.1186/s12911-022-01773-1

57. Paiva JCdL, Dias-Trindade S, Gonzalez MOA, Barros DMdS, Cardoso PH, Bezerra PHC, et al. Analysis of the impact of communication campaigns under the project "syphilis no": a national tool for inducing and promoting health. *Int J Environm Res Public Health*. (2022) 19:15884. doi: 10.3390/ijerph192315884

58. Domingues RMSM. Leal MdC, Pereira APE, Ayres B, Sánchez AR, Larouzé B. Prevalence of syphilis and HIV infection during pregnancy in incarcerated women and the incidence of congenital syphilis in births in prison in Brazil. *Cadernos de Saúde Pública*. (2017) 33:e00183616. doi: 10.1590/0102-311x00183616

59. da Silva Santana R, Kerr L, Mota RS, Kendall C, Rutherford G, McFarland W. Lifetime syphilis prevalence and associated risk factors among female prisoners in Brazil. *Sex Transm Dis*. (2020) 47:105–10. doi: 10.1097/OLQ.0000000000001113

60. Brasil. *Learning Path: Prison System. Virtual Learning Environment of the Brazil's Unified Health System. Brazilian Ministry of Health. Project "Without*

Syphilis". Natal: Federal University of Rio Grande do Norte (UFRN) Laboratory of Technological Innovation in Health. (2023) Available online at: https://avasus.ufrn.br/local/avasplugin/cursos/prisional.php (accessed Apr 8, 2023).

61. Valentim RAdM, Oliveira AC, Dias AdP, Oliveira EdSG, Valentim JLRdS, Moreira JAM, et al. Educommunication as a strategy to face syphilis: an analysis of the open educational resources available at AVASUS. *Brazilian J Sexually Transm Dis*. (2021) 33. doi: 10.5327/DST-2177-8264-20213310

62. Valentim JLRS, Dias-Trindade S, Romão MH, Fernandes F, Caitano AR, Bonfim MAA, et al. *Evaluation of Massive Education in Prison Health: a Perspective of Health Care for the Person Deprived of Freedom in Brazil*. Zenodo. (2023) l

63. Brasil. *Ambiente virtual de aprendizagem do SUS. Dados Públicos. Avaliação do curso de "Atenção á Saúde da Pessoa Privada de Liberdade"*; (2023) Available online at: https://avasus.ufrn.br/local/avasplugin/dashboard/publicinfo.php (accessed Jun 13, 2023).

64. Likert R, A technique for the measurement of attitudes. In: *Archives of psychology*. New York, NY: New York University (1932).

65. Merhy EE, Feuerwerker LCM, Ceccim RB. Educación permanente en salud: una estrategia para intervenir en la micropolítica del trabajo en salud. *Salud Colect*. (2006) 2:147–60. doi: 10.18294/sc.2006.62

66. Rangel M. Education and health: a human political and educational relation. *Educação*. (2009) 32:59–64.

67. Blasi F, Caiani EG, Cereda MG, Donetti D, Montorsi M, Panella V, et al. Six drivers to face the XXI century challenges and build the new healthcare system: "la salute in movimento" manifesto. *Front Public Health*. (2022) 10:876625. doi: 10.3389/fpubh.2022.876625

68. Nuzzo JB, Meyer D, Snyder M, Ravi SJ, Lapascu A, Souleles J, et al. What makes health systems resilient against infectious disease outbreaks and natural hazards? Results from a scoping review. *BMC Public Health*. (2019) 19:1310. doi: 10.1186/s12889-019-7707-z

69. Allen LM, Hay M, Palermo C. Evaluation in health professions education–is measuring outcomes enough? *Med Educ*. (2022) 56:127–36. doi: 10.1111/medu.14654

70. Allen LM, Palermo C, Armstrong E, Hay M. Categorising the broad impacts of continuing professional development: a scoping review. *Med Educ*. (2019) 53:1087–99. doi: 10.1111/medu.13922

71. Cofen. *Conselho Federal de Enfermagem (Cofen) - Enfermagem em Números*. (2023). Available online at: http://www.cofen.gov.br/enfermagem-em-numeros (accessed May 25, 2023).

72. CFM. *Conselho Federal de Medicina (CFM) Demografia Médica*. (2023). Available online at: https://demografia.cfm.org.br/dashboard/ (accessed May 14, 2023).

73. Brasil. *LEI N° 12.433, DE 29 DE JUNHO DE* 2011. (2011). Available online at: https://www.planalto.gov.br/ccivil_03/_ato2011-2014/2011/lei/l12433.htm (accessed May 14, 2023).

74. Brasil. *Ministério da Saúde. PORTARIA INTERMINISTERIAL N° 1, DE 2 DE JANEIRO DE (2014) Política Nacional de Atenção á Saúde das Pessoas Privadas de Liberdade no Sistema Prisional (PNAISP)*. (2014) Available online at: https://bvsms.saude.gov.br/bvs/saudelegis/gm/2014/pri0001_02_01_2014.html (accessed May 14, 2023).

75. Esperidião E, Saidel MGB, Rodrigues J. Mental health: focusing on health professionals. *Revista Brasileira de Enfermagem*. (2020) 73:e73. doi: 10.1590/0034-7167.202073supl01

76. Fazel S, Hayes AJ, Bartellas K, Clerici M, Trestman R. Mental health of prisoners: prevalence, adverse outcomes, and interventions. *Lancet Psychiat*. (2016) 3:871–81. doi: 10.1016/S2215-0366(16)30142-0

77. Machado NO, Guimar aes IS. A realidade do sistema prisional brasileiro e o princípio da dignidade da pessoa humana. *Revista Eletrônica de Iniciação Científica Itajaí, Centro de Ciências Sociais e Jurídicas da UNIVALI*. (2014) 5:566–81.

78. Dias-Trindade S, Correia JD, Henriques S. Ensino remoto emergencial na educação básica brasileira e portuguesa: a perspectiva dos docentes. *Revista Tempos e Espaços em Educação*. (2020) 13:1–23. doi: 10.20952/revtee.v13i32.14426

79. Henriques S, Correia JD, Dias-Trindade S. Portuguese primary and secondary education in times of COVID-19 pandemic: an exploratory study on teacher training and challenges. *Educ Sci*. (2021) 11:9. doi: 10.3390/educsci11090542

80. Brasil. *Ministério da Saúde. Secretaria de Gestão do Trabalho e da Educação na Saúde. Departamento de Gestão da Educação na Saúde. Política Nacional de Educação Permanente em Saúde: o que se tem produzido para o seu fortalecimento? / Ministério da Saúde, Secretaria de Gestão do Trabalho e da Educação na Saúde, Departamento de Gestão da Educação na Saúde – 1. ed. rev*. Brasília : Ministério da Saúde; (2018) p. 73. Available online at: https://bvsms.saude.gov.br/bvs/publicacoes/politica_nacional_educacao_permanente_saude_fortalecimento.pdf (accessed May 10, 2023).

81. Ely KZ, Schwarzbold P, Ely GZ, Vendrusculo VG, Dotta RM. Rosa LRd, et al. Permanent Education in Health and prison system actors in the pandemic scenario Trabalho. *Educação e Saúde*. (2023) 21:e01224207. doi: 10.1590/1981-7746-ojs1224

82. UNESCO. Reimagining our Futures Together: a New Social Contract for Education. Paris: United Nations Educational, Scientific and Cultural Organization. (2021) p. 1-188. Available online at: https://unesdoc.unesco.org/ark:/48223/pf0000378059 (accessed 10 Apr, 2023].

83. Pradhan P, Costa L, Rybski D, Lucht W, Kropp JP. A systematic study of sustainable development goal (SDG) interactions. *Earth's Future*. (2017) 5:1169–79. doi: 10.1002/2017EF000632

84. Colglazier EW. The sustainable development goals: roadmaps to progress'. *Sci Diplom*. (2018) 7:1–10.

85. World Health Organization. *Regional Office for Europe. Leaving no One Behind in Prison Health: the Helsinki Conclusions*. World Health Organization. (2020) Available online at: https://apps.who.int/iris/handle/10665/352128 (accessed May 14, 2022).

86. Sen A. *Development as freedom. vol. 1 of 1. 1st ed*. Rua Bandeira Paulista: Companhia da Letras. (1999).

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Shaping undergraduate public health education through critical race theory: a case study

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In 2020, the American Public Health Association declared structural racism a public health crisis acknowledging the long-lasting and harmful effects of prejudice, including relatively high rates of morbidity and mortality in many communities of color. Critical Race Theory (CRT) has become an essential lens to view and reconsider education's role in perpetuating racial and ethnic discrimination. Debates over integrating CRT in higher education with the intent to acknowledge and address racial equality and justice are more present than ever, and the discussions held in public health classrooms are no different. We present a case study of CRT integration into the Bachelor of Arts in Public Health (BAPH) program at the University of Hawai'i at Mānoa. In line with Solorzano's framework of CRT in education, initial goals of integrating CRT in instruction and advising included fostering discussions of race and racism, using a social justice framework to highlight opportunities to reduce health inequities, and validating the experiential knowledge of people of color. By engaging in active discussions with community leaders and participating in experiential learning throughout the program, students develop empathy and many underrepresented and marginalized students engage actively in their home communities. Specific examples of CRT integrated in the curriculum and examples of student projects that integrate a CRT lens are provided for educators and researchers.

KEYWORDS

public health education, health professionals, critical race theory, racism, undergraduate education, underrepresented minority

1. Introduction

A bold statement by the American Public Health Association declared structural racism a public health crisis, worthy of immediate attention and research by public health practitioners and institutions (1). This 2020 policy was formed within the context of nationwide protests of racist law enforcement and criminal justice systems (2), an unprecedented presidential election mired in racist and xenophobic allegations (3, 4), and the heights of a pandemic which disproportionately affected people of color (5–9). These issues have been subsumed into an impassioned examination of Critical Race Theory (CRT) and its application.

Besides a robust body of scholarship examining American law and legal systems through a lens of historic and structural racism (10, 11), CRT has been used to reinterpret "colorblind" laws, policies, and systems that have paradoxically contributed to more discriminatory outcomes (12, 13). Fiery debates over integrating CRT in higher education with the intent to acknowledge and address racial equality and justice—particularly for Black, Indigenous, and People of Color

(BIPOC) communities—are more present than ever (10, 14). Various opponents contend that shaping general education around the social construct of race and concepts of intersectionality creates a revisionist history hyper-focused on racial strife and unbalanced power structures (10, 15). In 17 states, laws restricting discussions of race and racism in primary and secondary school classrooms have been passed mainly to limit the discomfort of students (16). Others argue that the application of CRT is more important than ever in higher education as faculty seek to empower students with a more critical lens to examine the structures that continue to create social, health, and economic disparities across the country. Regardless, conversations on race continue to occur in academic spaces, the media, and everyday encounters.

The discussions held in medical and public health classrooms are no different (14, 17, 18). Since public health is grounded in the ethos of social justice and the collective stories of how people have survived and thrived, it is important to acknowledge those who have not thrived, often the disadvantaged and marginalized. Health inequalities remain rampant in this golden age of medical science (19). Racial and ethnic minority groups, throughout the US, are disproportionately more likely to suffer and die from a wide range of health conditions, including diabetes, hypertension, obesity, asthma, and heart disease, when compared to White counterparts. The life expectancy of non-Hispanic/Black Americans is 4 years lower than that of White Americans (20). The COVID-19 pandemic has exacerbated these disparities; racial and ethnic minority populations are disproportionately more likely to contract and die from the illness (6, 9). Public health pedagogy has integrated the social determinants of health (SDOH) model to highlight where, when, and among whom do inequalities arise.

The SDOH are the "conditions in the environments where people are born, live, learn, work, play, worship, and age." (21) Communities of color are more likely to be born and live in unhealthy conditions. For example, there is a growing number of studies that confirm that unhealthy food outlets are more likely to be in Black and Native communities, while healthy food outlets are more likely to be available in predominantly white communities (22–24). But SDOH misses the larger historical context that continues to reinforce these inequitable conditions, thus requiring distillation through a framework grounded in socio-political realities, such as CRT (10, 14, 17, 25, 26).

Critical race theory provides students the tools to examine why these inequities are extant and perpetuated—and, subsequently, how they can address such inequities to improve community health. For example, CRT equips students to understand the historical policies and practices that have led to the conditions where Black and Native communities are more likely to live in communities with poor access to healthy foods and viable economic opportunities, quality schools, and safe neighborhoods. CRT allows us to understand how the US history of redlining and racially based mortgage loans have led to these inequitable conditions that have produced today's health and socioeconomic disparities (27, 28).

The stories of the oppressed also serve as records of forced but invaluable contributions to the field of population health. For centuries, researchers have unethically experimented upon minoritized populations to discern the devastating effects of diseases—and yet these communities are woefully underrepresented in modern clinical trials of lifesaving pharmaceuticals (29, 30). CRT provides students with the capacity to question how these unethical breaches have occurred and why minorities are underrepresented in clinical research. Using the lens of CRT, students can investigate how research and science have been used to justify racist beliefs and policies, including justifying slavery, genocide, and colonization (31–33).

Baseless race-based myths regarding pain tolerance to disease transmission are still prevalent in medical education and among practicing clinicians (34, 35). Minority communities continue to be targeted and susceptible to misinformation and disinformation campaigns. Patients and providers are susceptible to myths perpetuating suboptimal population health (8). Only by confronting these uncomfortable truths about trenchant prejudice in healthcare access, delivery, and utilization can we start to build an institution worthy of training the next generation of public health practitioners.

Hawai'i is one of the most racially and ethnically diverse states in the US. In 2019, 24.2% of Hawai'i's population reported being multiracial compared to only 2.8% of the US population. Hawai'i is the ancestral home to the Indigenous population of Native Hawaiians or Kānaka Maoli, who comprise slightly over 10% of the population, including other Pacific Islanders who have migrated to Hawai'i (e.g., Samoans, Tongans, Micronesians). Asians, such as Japanese, Chinese, Korean, Filipinos, compose approximately 38% of the population. Hawai'i's Hispanic and Black or African American populations are proportionally smaller than the continental United States (36). Although Hawai'i is often portrayed as one of the healthiest states in the United States, pervasive health disparities exist across these racial and ethnic groups. Factors such as colonization, structural racism, and assimilation contribute to inequitable access to housing, healthcare, education, and occupation. For example, Native Hawaiians and other Pacific Islanders have one of the highest rates of diabetes and hypertension compared with other major racial groups (37). Native Hawaiians have the shortest life expectancy—only 62 years—in their own homeland (38).

Training the next generation of Hawai'i public health leaders to address these social and health disparities will require a dynamic curriculum grounded in CRT's social justice principles. We need to cultivate an increasingly diverse student body that reflects the communities who are most affected by these disparities. While the SDOH model does much to support curricula, it misses elements to identify rooted inequities that determine health. The addition of CRT tools is essential in any undergraduate public health program, even though the discipline claims to see and address inequity. Here we present a perspective of such a merger between philosophies in the Bachelor of Arts in Public Health (BAPH) program at the Office of Public Health Studies (OPHS) at the University of Hawai'i at Mānoa (UHM).

2. Program background

The University of Hawai'i at Mānoa was established in 1907 as a land-grant university on the island of O'ahu. A part of UHM's strategic plan is to become a Hawaiian place of learning. The university is also classified as an Asian-American, Native-American, and Pacific Islander-Serving Institution (AANAPISI) (39). Among the undergraduate student body, about 33% are Asian and 18% are Native Hawaiian and Pacific Islander (40).

Office of Public Health Studies, under the Thompson School of Social Work and Public Health, offers specializations in epidemiology, health policy and management, Native Hawaiian and Indigenous health, and social and behavioral health sciences (41). Degrees offered include the Bachelor of Arts (BA), Master of Public Health (MPH), Master of Science (MS), and Doctor of Philosophy (PhD). Proactive academic advising serves to promote the enrollment and retention of diverse students, while targeted recruitment and outreach efforts to underrepresented communities have been fruitful.

The BAPH program started in 2014, in response to a nationwide expansion in demand for undergraduate education (42–44), with inclusion in mind and using culturally relevant curriculum, aids, models, and examples taught by diverse faculty and staff. This curriculum, rooted in SDOH, has always included diverse perspectives, valued student lived experiences, and featured a range of locally relevant cultural examples. Beginning in the Fall 2020 semester, the curriculum expanded and scaled its previously fragmented application of CRT tools more intentionally and purposefully to respond to the need for anti-racist education. Since its inception, enrollment has grown from 35 students in 2015 to over 150 students in 2022. Our undergraduate student semester hours have been increasing since 2018, and enrollment in the public health minor has also grown since its launch in Fall 2018 to a consistent cohort size of roughly 30 students per academic year, demonstrating our department's interdisciplinary reach. Approximately 50% of the BAPH student body is Native Hawaiian, other Pacific Islander, Indigenous, and/or Filipino ancestries, and 65% are Hawai'i residents (45).

3. Critical race theory in public health education

Solórzano provides five themes that guide CRT in education: (a) centering discussions of race and racism, (b) recognizing the dominant ideologies and challenging the claims toward a more just educational system, (c) using a social justice framework to end oppression, (d) validating the experiential knowledge of people of color, and (e) utilizing the interdisciplinary nature of CRT to frame racism within historical and contemporary contexts of people of color (46). As listed in Table 1, numerous examples in the BAPH program incorporate CRT within the courses and in advising and support. By centering race and racism in discussions throughout the BAPH curriculum, students begin to think critically about the systems of oppression that disproportionately impact people of color.

The introductory core series at the BAPH program provides students a broad-based foundation of public health knowledge and skills (83). These courses also offer an opportunity to introduce fundamental concepts that allow students to build their character and discover their whole selves, empowering them to engage in anti-racist critical thinking in public health through community work and advocacy.

For example, in PH 201: Introduction to Public Health course, CRT frameworks are utilized while introducing topics such as health disparities, ethical research, climate change, and the built environment. The course highlights the impact of colonization on the health of Native Hawaiian people through facilitated discussions on health disparities and Native Hawaiian health. Examples of ethical violations center on the marginalization of BIPOC communities and women. The lived experiences of Pacific Island communities allow students to connect the injustices these populations face. The historical experiences of Black communities—where U.S. redlining policies and lack of community investment continue to prevent economic mobility—are discussed within conversations about inequities found in Hawai'i.

PH 202 is a course focused on Public Health Issues in Hawai'i. With UHM committed as an Indigenous-serving institution (39), it is important to have a course that ties together the lived experiences and historical context of the Native Hawaiian people as it relates to public health. The course covers key historical events of Hawai'i, including pre-western contact, impact of land tenureship as a result of external forces such as the arrival of missionaries, plantation culture, and the illegal overthrow of the Hawaiian kingdom, and how these events impact Indigenous peoples and their land (58). In more recent history, increased attention is paid to inequities among Pacific Island communities of migrants from Compact of Free Association (COFA) countries, who participate in the labor force and have waning access to federal healthcare and assistance programs yet face harsh discrimination from other groups (84, 85). Guest speakers from these communities are intentionally invited to share their stories, research, and expertise that centers their experiential knowledge.

The course weaves the topic of colonial impact throughout PH 203: Introduction to Global Health Issues. By providing the historical and contemporary impacts of colonization on BIPOC communities, students learn to identify and associate systemic oppressions as the direct consequences of colonization and historical trauma. These consequences include dietary shifts from traditional food systems contributing to rises in non-communicable diseases; impacts of climate change disproportionately impacting people of color, especially island communities; internalized racism as illustrated by shifts towards western beauty standards driven by colonization; and losing cultural practices that once maintained community wellness.

Throughout the semester, students engage in active discussions and experiential learning activities such as water-carrying exercises to illustrate negative consequences of water access on BIPOC communities and the disproportionate burden of water-carrying on women and girls. Women and girls are overwhelmingly responsible for unpaid domestic work including water collection. In fact, globally, women spend a large proportion of their time and energy waiting for, securing, and transporting water (86). Students also develop written policy and role-play policy-making discussions through a modified Model United Nations process. These activities help empower students to identify examples of systemic racism and associated health disparities, then locate or develop policy proposals to dismantle existing systems. The course also shares documentaries portraying lived experiences of BIPOC communities to spur continual student reflection. Students also learn about the impacts of climate change that led to migration of climate change refugees.

With a strong foundation in the introductory core, students are well-positioned and prepared for the applied learning experience (APLE). Students in the BAPH program complete a three-course capstone series where they apply classroom knowledge and associated skills to real-world applications in the public health field (87). The first course of the APLE series allows students to reflect on their own experiences and complete a literature review in an area of public health of their choice. The instructors introduce key research skills using a

TABLE 1 Applications of critical race theory in public health classroom settings.

Course	Core curricular content	CRT application and select examples used
PH 201: Introduction to public health	Ethical violations in research and practice	• Oral contraceptive experimentation among Puerto Rican women (47) • Kalaupapa and mistreatment of Hansen's Disease patients in Hawai'i (48) • Tuskegee Syphilis Study (49, 50)
PH 201: Introduction to public health	Built environment	• Inequities in the built environment (51) • Discussion of red-lining and both short and long-term consequences among BIPOC communities (28, 52) • Discussion of built environment interventions in low-income neighborhoods (53)
PH 202: Public health issues in Hawai'i	Food insecurity	• Environmental impact of food importation and dependence (54) • Sustainability of historical and cultural practices (e.g., ahupua'a system) (55) • History of farming and community connections (56)
PH 202: Public health issues in Hawai'i	History of public health in Hawai'i	• Hawaiian monarchy's role in developing health department prior to US occupation (57) • Hawaiian monarchy investment and development of preeminent Queen's Medical Center (57)
PH 202: Public health issues in Hawai'i	Plantation history	• Unionization of plantation workers (i.e., primarily immigrant communities) (58) • Health disparities in plantation communities (59)
PH 202: Public health issues in Hawai'i	Epidemiology in Hawai'i	• Disproportionate impacts of COVID-19 infection and mortality on Native Hawaiians and Pacific Islanders (60)
PH 203: Introduction to global health	Global health history, geography, and colonization	• Use of geographical maps depicting Indigenous communities pre-colonization (61) • Student viewing and reflection of "High on the Hog" documentary (62)
PH 203: Introduction to global health	Vaccination distribution and vaccine hesitancy	• Genocide in present-day Namibia, early 1900s by German officials (63) • Drug companies conducted research trials without consent, e.g., Pfizer in Nigeria (64) • HIV treatment research in southern Africa (65–69)
PH 203: Introduction to global health	Women and girls' education	• Cultural barriers to education for women (70, 71) • Barriers to education associated with limited access to feminine hygiene products, sanitation, and bathrooms (72–74)
PH 203: Introduction to global health	Maternal health	• Systemic barriers to accessing healthcare among women (75) • Lack of prenatal care and limited access to skilled birth attendants among people of color (76) • Cultural and religious barriers to contraception (77) • Impacts of obstetric fistula in Namibia (Africa) (78) • Labor and delivery challenges in Manila (Philippines) (79), both highlighting firsthand, lived experience accounts
PH 203: Introduction to global health	Conflict and refugees	• Bias and racism in media coverage of war and conflict (e.g., Ukrainian refugee coverage compared to Tigray and Yemen humanitarian crises) (80–82)

social justice framework, with the intent of helping students identify selection and publication biases in literature, and the dangers of misclassifying underrepresented minorities in academic studies. In the second course, students complete a 100-h field experience with a community or faculty mentor, then in the third and final course, reflect on and finalize a written paper and academic poster. All three courses are centered on a public health issue of the student's selection (87).

The power of choice and supporting theories of student self-authorship empower students to think critically about different communities' issues and explore public health solutions to address them. Baxter Magolda defines self-authorship as the ability to control and orient one's beliefs and identity through concurrent membership in multiple communities like families, workforces, and student bodies (88). Encouraging underrepresented and marginalized students to engage actively in their home communities is a validating experience that raises their consciousness of the cultural capitals they bring as leaders. Table 2 highlights various student APLE projects integrating a CRT lens.

4. Critical race theory in advising and student support

Many factors can impact a student's sense of belonging and success in higher education. Advisors play a crucial role for students, especially those of underrepresented backgrounds, by providing a relationship and environment to help affirm, support, and advocate for students' needs (89). Advisors are gatekeepers of information and opportunities that can provide equitable experiences for students of marginalized backgrounds. The BAPH program focuses on recruiting and supporting students from underrepresented populations in higher education, including Native Hawaiian, Pacific Islander, Filipino, and other Indigenous backgrounds

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TABLE 2 Examples of bachelors of public health student-developed capstone projects, 2021–2022: applying themes of critical race theory.

Public health student-developed capstone project titles	Solórzano framework (98) of critical race theory in education				
	Centrality and intersectionality of race and racism	Challenge to dominant ideology	Commitment to social justice	Centrality of experiential knowledge	Interdisciplinary perspective
Reducing racial disparities in maternal mortality among black women in the United States	x		x	x	
Improving access to quality care among Filipino women in the Philippines to reduce maternal mortality			x	x	
Addressing type II Diabetes among native Americans by promoting a cultural diet	x	x	x	x	x
Preventing type II Diabetes among native Hawaiians by increasing access to produce in Hawai'i	x			x	x
Increasing breast cancer screening through culturally appropriate programs among native Hawaiian women in Hawai'i	x	x	x		x
Raising COVID-19 vaccination rates among pacific islander populations within Hawai'i through outreach and education programs	x				x
Decreasing COVID-19 infection among native Hawaiians and Pacific islanders in rural communities by promoting use of testing in school settings	x			x	
Preventing obesity among native Hawaiian adults in Hawai'i through the promotion of a cultural diet	x	x	x		x
preventing hypertension among Filipinos in Hawai'i by increasing access to healthy foods	x			x	x
Decreasing chlamydia in black, indigenous, people of color teens in Hawai'i through early screening and treatment	x		x	x	x
Promoting early detection of breast cancer among Filipino adult women in Hawai'i through screenings and health literacy	x			x	x

who are more likely to be first-generation college students. The advisor and faculty members who support the BAPH program are from underrepresented backgrounds themselves (e.g., first-generation college graduates, and ethnic or religious minorities) and possess a deep understanding of the structural barriers these populations face in accessing and pursuing higher education. These faculty members are able to contribute their own lived experiences and, by doing so, are better equipped to support students in finding their own voice and language to share their stories. By centering students' lived experiences, a CRT approach in advising encourages dialogue that highlights students' strengths rooted in their cultural capitals (90).

Advising public health students with a CRT approach includes honoring students' narratives and histories while providing a space to discuss altruistic, prosocial sociocultural goals. Conversations in the classroom provide rich opportunities during advising sessions to reflect on key public health topics. Within a CRT approach, advisors affirm students' experiences and any injustices suffered while focusing on students' strengths and commitments to serving the community and contributing to the greater good. The overall goal of advising is to ensure students' academic, emotional, familial, and economic needs are addressed and supported through trust built on advisor-student rapport.

5. Discussion

Centering the lived experiences of the oppressed and marginalized is essential to address the public health issues that exist due to injustices and inequities throughout history and those in the present day. The levels of racism that contribute to the race-associated differences in health outcomes is a recognized practice in health equity work (91). Public health research and practice continue integrating CRT to develop programs and interventions (92, 93). Undergraduate public health education is well-positioned to integrate the frameworks of CRT into the curriculum. In turn, programs will develop future public health leaders equipped to recognize the impact of dominant racist ideologies and powers that lead to systemic racism and health disparities.

Curriculum reform through a CRT lens can support the development of students' global identities and skills to communicate, respect, and understand others (94). A special issue of the *Australian Journal of Indigenous Education* highlights higher education's role in building an Indigenous health workforce (95), including addressing curriculum gaps in Indigenous public health (96). Our case study contributes to the growing literature on social justice and antiracism pedagogy in public health education (97).

The following are recommendations for integrating CRT in a public health curriculum. Normalizing conversations about race is essential in public health work. Beyond competencies needed to fulfill accreditation, faculty should include anti-racism training as a learning outcome in various courses. Providing students with these experiences in introductory courses can help to prepare them for deeper, more critical applications of the theory in later courses and in practice. Furthermore, the curriculum should be intentional about the examples in lectures and assignments. Faculty should also invite guest speakers to share voices and stories from underrepresented communities. Holding our faculty, staff, and students to an anti-racist ideal will normalize the practice of addressing racism as a fundamental public health issue.

6. Conclusion

Students study public health at the undergraduate level to become public health professionals but also as a complement to other health professional pathways. Many students will study public health and then engage in direct community service; others will continue on in allied health fields, such as nursing, medicine, and pharmacy. In any event, applications of critical race and related educational theories are essential to surround students with the indispensable context of historical and current systemic barriers to the principles of community health, equity, and social justice. Integrating CRT frameworks into undergraduate public health education creates a more anti-racist, socially aware, and empowered public health workforce vital to addressing ongoing community challenges and promoting health equity.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

MT-K, UP, and DN-H contributed conception and design of the project. UP and MT-K wrote the first draft of the manuscript. MT-K, UP, JC-D, LK, MA, and DN-H wrote sections of the manuscript. All authors contributed to the manuscript revision, read, and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

References

1. American Public Health Association. *Structural Racism is a Public Health Crisis: Impact on the Black Community [internet]*. Washington, DC: American Public Health Association (2020).

2. American Public Health Association. *Violence is a Public Health Issue: Public Health is Essential to Understanding and Treating Violence in the U.S. [internet]*. Washington, D.C.: American Public Health Association (2018).

3. Anderson-Nathe B, Gharabaghi K. Trending rightward: nationalism, xenophobia, and the 2016 politics of fear. *Child Youth Serv*. (2017) 38:1–3. doi: 10.1080/0145935X.2017.1277125

4. Darling-Hammond L. Teaching for social justice: resources, relationships, and anti-racist practice. *Multicult Perspect*. (2017) 19:133–8. doi: 10.1080/15210960.2017.1335039

5. Büyüm AM, Kenney C, Koris A, Mkumba L, Raveendran Y. Decolonising global health: if not now, when? *BMJ Glob Health*. (2020) 5:e003394. doi: 10.1136/bmjgh-2020-003394

6. Centers for Disease Control and Prevention. Introduction to COVID-19 racial and ethnic health disparities [internet]. *Ctr Dis Control Prev*. (2020)

7. Kendi IX. We still Don't know who the Coronavirus's victims were. *The Atlantic [Internet]*. (2021)

8. Quint JJ, Van Dyke ME, Maeda H, Worthington JK, Dela Cruz MR, Kaholokula JK, et al. Disaggregating data to measure racial disparities in COVID-19 outcomes and guide community response—Hawaii, March 1, 2020–February 28, 2021. *MMWR Morb Mortal Wkly Rep*. (2021) 70:1267–73. doi: 10.15585/mmwr.mm7037a1

9. The Atlantic Monthly Group. About the racial data tracker [internet]. *The COVID Tracking Project*. (2022)

10. Delgado R, Stefancic J, Harris A. *Critical Race Theory: An Introduction [internet]. Third*. New York, NY: New York University Press (2017).

11. Crenshaw KW. Twenty years of critical race theory: looking Back to move forward. *Conn Law Rev*. (2011) 43:103.

12. Johnson TR. How conservatives turned the 'color-blind constitution' against racial Progress. *The Atlantic [Internet]*. (2019)

13. Annamma SA, Jackson DD, Morrison D. Conceptualizing color-evasiveness: using dis/ability critical race theory to expand a color-blind racial ideology in education and society. *Race Ethn Educ*. (2017) 20:147–62. doi: 10.1080/13613324.2016.1248837

14. Lightfoot AF, Efird CR, Redding EM. Developing an antiracist Lens: using photography to facilitate public health critical race praxis in a foundational MPH course. *Pedagogy Health Promot*. (2021) 7:317–26. doi: 10.1177/23733799211045712

15. Neville HA, Gallardo ME, Sue DW eds. Introduction: Has the United States Really Moved Beyond Race? In: *The Myth of Racial Color Blindness: Manifestations, Dynamics, and Impact [internet]*. Washington, DC: American Psychological Association (2016). 3–21.

16. Pendharkar E. A school openly discusses race in a state that bans it. *Education Week [Internet]*. (2022)

17. Zaidi Z, Young M, Balmer DF, Park YS. Endarkening the Epistemé: critical race theory and medical education scholarship. *Acad Med*. (2021) 96:Si–v. doi: 10.1097/ACM.0000000000004373

18. Fletcher FE, Jiang W, Best AL. Antiracist praxis in public health: a call for ethical reflections. *Hast Cent Rep*. (2021) 51:6–9. doi: 10.1002/hast.1240

19. Walensky RP. *Director's Commentary [internet]*. Bethesda, MD: Centers for Disease Control and Prevention (2021).

20. Centers for Disease Control and Prevention. *Racism and Health [Internet]*. Bethesda, MD: Centers for Disease Control and Prevention (2021).

21. Office of Disease Prevention and Health Promotion. *Social Determinants of Health - Healthy People 2030 [Internet]*. (n.d.). [cited 2022 Jan 14]. Available from: https://health.gov/healthypeople/objectives-and-data/social-determinants-health

22. Cooksey Stowers K, Jiang Q, Atoloye AT, Lucan S, Gans K. Racial differences in perceived food swamp and Food Desert exposure and disparities in self-reported dietary habits. *Int J Environ Res Public Health*. (2020) 17:7143. doi: 10.3390/ijerph17197143

23. Fleischhacker SE, Evenson KR, Rodriguez DA, Ammerman AS. A systematic review of fast food access studies. *Obes Rev*. (2011) 12:e460–71. doi: 10.1111/j.1467-789X.2010.00715.x

24. Lee S, Oshiro M, Hsu L, Buchthal OV, Sentell T. Neighborhoods and health in Hawai'i: considering food accessibility and affordability. *Hawaii J Med Public Health*. (2012) 71:232–7.

25. Tsai J, Lindo E, Bridges K. Seeing the window, finding the spider: applying critical race theory to medical education to make up where biomedical models and social determinants of health curricula fall short. *Front Public Health [Internet]*. (2021) 9. doi: 10.3389/fpubh.2021.653643/full

26. Carroll SR, Suina M, Jäger MB, Black J, Cornell S, Gonzales AA, et al. Reclaiming indigenous health in the US: moving beyond the social determinants of health. *Int J Environ Res Public Health*. (2022) 19:7495. doi: 10.3390/ijerph19127495

27. Yearby R. Racial disparities in health status and access to healthcare: the continuation of inequality in the United States due to structural racism. *Am J Econ Sociol*. (2018) 77:1113–52. doi: 10.1111/ajes.12230

28. Nardone A, Chiang J, Corburn J. Historic redlining and urban health today in U.S. *Cities Environ Justice*. (2020) 13:109–19. doi: 10.1089/env.2020.0011

29. Lefor AT. Scientific misconduct and unethical human experimentation: historic parallels and moral implications. *Nutrition*. (2005) 21:878–82. doi: 10.1016/j.nut.2004.10.011

30. Hussain-Gambles M. Ethnic minority under-representation in clinical trials. Whose responsibility is it anyway? *J Health Organ Manag*. (2003) 17:138–43. doi: 10.1108/14777260310476177

31. Harvard Library. Scientific racism [internet]. Harvard Library (2022). Available at: https://library.harvard.edu/confronting-anti-black-racism/scientific-racism

32. Weigmann K. In the name of science. *EMBO Rep*. (2001) 2:871–5. doi: 10.1093/embo-reports/kve217

33. Brave Heart MYH, Chase J, Elkins J, Altschul DB. Historical trauma among indigenous peoples of the Americas: concepts, research, and clinical considerations. *J Psychoactive Drugs*. (2011) 43:282–90. doi: 10.1080/02791072.2011.628913

34. Chapman EN, Kaatz A, Carnes M. Physicians and implicit Bias: how doctors may unwittingly perpetuate health care disparities. *J Gen Intern Med*. (2013) 28:1504–10. doi: 10.1007/s11606-013-2441-1

35. Hall WJ, Chapman MV, Lee KM, Merino YM, Thomas TW, Payne BK, et al. Implicit racial/ethnic Bias among health care professionals and its influence on health care outcomes: a systematic review. *Am J Public Health*. (2015) 105:e60–76. doi: 10.2105/AJPH.2015.302903

36. Research Economic Analysis Division. Hawaii Population Characteristics 2019 [Internet]. (2020). Available at: https://census.hawaii.gov/wp-content/uploads/2020/06/Hawaii-Population-Characteristics-2019.pdf

37. Look MA, Soong S, Kaholokula JK. *Assessment and Priorities for Health and Well-being in Native Hawaiians and Pacific Islanders [internet]*. Honolulu, HI, US: Department of Native Hawaiian Health, John A. Burns School of Medicine, University of Hawai'i (2020).

38. Wu Y, Braun K, Onaka AT, Horiuchi BY, Tottori CJ, Wilkens L. Life expectancies in Hawai'i: a multi-ethnic analysis of 2010 life tables. *Hawaii J Med Public Health*. (2017) 76:9–14.

39. University of Hawai'i at Mānoa. *About UH Mānoa [Internet]*. (2023). Available from: https://manoa.hawaii.edu/about/

40. University of Hawai'i at Mānoa, Office of Student Equity, Excellence and Diversity. *Mānoa's Racial and Ethnic Diversity Profile [internet]*. Honolulu, HI: University of Hawai'i at Mānoa (2016). 7 p.

41. Office of Public Health Studies. About [internet]. University of Hawai'i at Mānoa. (2022). Available at: http://manoa.hawaii.edu/publichealth/about

42. Leider JP, Castrucci BC, Plepys CM, Blakely C, Burke E, Sprague JB. On academics: characterizing the growth of the undergraduate public health major: U.S., 1992–2012. *Public Health Rep*. (2015) 130:104–13. doi: 10.1177/003335491513000114

43. Resnick B, Leider JP, Riegelman R. The landscape of US undergraduate public health education. *Public Health Rep*. (2018) 133:619–28. doi: 10.1177/0033354918784911

44. Riegelman RK. *2022 Update On Undergraduate Public Health [internet]*. Burlington, MA: Jones & Bartlett Learning (2022).

45. Mānoa Institutional Research Office. University of Hawai'i at Mānoa enrollment trend report [internet]. (2022). Available at: https://manoa.hawaii.edu/miro

46. Solorzano DG. Critical race theory, race and gender microaggressions, and the experience of Chicana and Chicano scholars. *Int J Qual Stud Educ*. (1998) 11:121–36. doi: 10.1080/095183998236926

47. Vargas T. Guinea pigs or pioneers? How Puerto Rican women were used to test the birth control pill. *Washington Post [Internet]*. (2017); Available at: https://www.washingtonpost.com/news/retropolis/wp/2017/05/09/guinea-pigs-or-pioneers-how-puerto-rican-women-were-used-to-test-the-birth-control-pill/

48. Wong A. People with leprosy were exiled there—Should it be a tourist destination? The Atlantic [internet]. (2015); Available at: https://www.theatlantic.com/health/archive/2015/05/when-the-last-patient-dies/394163/

49. Centers for Disease Control and Prevention. Tuskegee Study [Internet] (2021). Available at: https://www.cdc.gov/tuskegee/timeline.htm

50. Lombardo PA, Dorr GM. Eugenics, medical education, and the public health service: another perspective on the Tuskegee syphilis experiment. *Bull Hist Med*. (2006) 80:291–316. doi: 10.1353/bhm.2006.0066

51. Hutch DJ, Bouye KE, Skillen E, Lee C, Whitehead L, Rashid JR. Potential strategies to eliminate built environment disparities for disadvantaged and vulnerable communities. *Am J Public Health*. (2011) 101:587–95. doi: 10.2105/AJPH.2009.173872

52. Jackson C. What is redlining? *The New York Times [Internet]* (2021); Available at: https://www.nytimes.com/2021/08/17/realestate/what-is-redlining.html

53. Branas CC, South E, Kondo MC, Hohl BC, Bourgois P, Wiebe DJ, et al. Citywide cluster randomized trial to restore blighted vacant land and its effects on violence, crime, and fear. *Proc Natl Acad Sci*. (2018) 115:2946–51. doi: 10.1073/pnas.1718503115

54. Ritchie H, Roser M. Environmental impacts of food production. *Our World Data [Internet]*. (2020); Available at: https://ourworldindata.org/environmental-impacts-of-food

55. Gon S, Winter K. A Hawaiian renaissance that could save the world. *American Scientist [Internet]*. (2019) 107:232. doi: 10.1511/2019.107.4.232

56. University of Northern Iowa. Farming for public health | evidence-based farming! [internet]. (2022). Available at: https://farmingforpublichealth.org/

57. Anonymous. History of Hawaii's public health [internet]. (2015). Available at: https://www.youtube.com/watch?v=rJEIqGMaasw

58. McDermott JF, Andrade NN eds. *People and Cultures of Hawai'i: The Evolution of Culture and Ethnicity [internet]*. Honolulu: University of Hawai'i Press (2011). 347 p.

59. Wikipedia Authors. Picture Bride (film). In: Wikipedia [internet]. (2022). Available at: https://en.wikipedia.org/w/index.php?title=Picture_Bride_(film)&oldid=1096673329

60. Hofschneider A. Pacific islanders, Filipinos have highest COVID-19 rates in Hawaii. *Honolulu Civil Beat [Internet]*. (2020); Available at: https://www.civilbeat.org/2020/06/pacific-islanders-filipinos-have-highest-covid-19-rates-in-hawaii/

61. Fields S. Decolonizing the map: Creating the indigenous mapping… [internet]. PBS Education. (2022). Available at: https://www.pbs.org/education/blog/decolonizing-the-map-creating-the-indigenous-mapping-collective

62. Anonymous.High on the hog: how African American cuisine transformed America [internet] (2021). Available at: https://www.netflix.com/title/81034518

63. United States Holocaust Memorial Museum. Herero and Nama Genocide [Internet] (2022). Available at: https://www.ushmm.org/collections/bibliography/herero-and-nama-genocide

64. Lenzer J. Secret report surfaces showing that Pfizer was at fault in Nigerian drug tests. *BMJ*. (2006) 332:1233. doi: 10.1136/bmj.332.7552.1233-a

65. McNeil DG. A failed trial in Africa raises questions about how to test H.I.V. *Drugs The New York Times [Internet]* (2015); Available at: https://www.nytimes.com/2015/02/05/health/failed-trial-in-africa-raises-questions-about-how-to-test-hiv-drugs.html

66. Clark K. Clinical trials in developing countries: the new "Tuskegee.". *WR J Arts Sci Writ Program [Internet]*. (2011) 4

67. Annas GJ, Grodin MA. Human rights and maternal-fetal HIV transmission prevention trials in Africa. *Am J Public Health*. (1998) 88:560–3. doi: 10.2105/AJPH.88.4.560

68. Brewster D. Science and ethics of human immunodeficiency virus/acquired immunodeficiency syndrome controversies in Africa. *J Paediatr Child Health*. (2011) 47:646–55. doi: 10.1111/j.1440-1754.2011.02179.x

69. Cunningham B. *Partially treated: AIDS, inequality and ethics: The controversy over the short course AZT trials [Internet] [Dissertation]*. [Ann Arbor, MI, US]: University of Michigan. (2006). Available from: https://www.proquest.com/dissertations-theses/partially-treated-aids-inequality-ethics/docview/305278829/se-2

70. Yousafzai M. *I Am Malala*. Boston, MA: Little, Brown (2013). 352 p.

71. Singmaster H. The legacy of Michelle Obama and the let girls learn initiative. *Education Week [Internet]* (2017); Available at: https://www.edweek.org/leadership/opinion-the-legacy-of-michelle-obama-and-the-let-girls-learn-initiative/2017/01

72. Sanchez E, Rodriguez L. Period poverty: everything you need to know [internet]. *Global Citizen* (2019). Available at: https://www.globalcitizen.org/en/content/period-poverty-everything-you-need-to-know/

73. UNESCO. *Puberty Education and Menstrual Hygiene Management [internet]*. Paris, FR: UNESCO (2014). 58 p.

74. Lusk-Stover O, Rop R, Tinsley E, Rabie TS. Globally, periods are causing girls to be absent from school [internet]. (2016). Available at: https://blogs.worldbank.org/education/globally-periods-are-causing-girls-be-absent-school

75. Alexander LL, LaRosa JH, Bader H, Garfield S. *New Dimensions in Women's Health* Jones & Bartlett Learning (2020). 504 p.

76. Artiga S, Orgera K, Pham O, Corallo B. Growing data underscore that communities of color are being harder hit by COVID-19 [internet]. *Kaiser Family Foundation*; (2020). (Disparities Policy Brief). Available at: https://www.kff.org/coronavirus-policy-watch/growing-data-underscore-communities-color-harder-hit-covid-19/

77. Srikanthan A, Reid RL. Religious and cultural influences on contraception. *J Obstet Gynaecol Can*. (2008) 30:129–37. doi: 10.1016/S1701-2163(16)32736-0

78. Anonymous. Shout Gladi Gladi [Internet]. (2015). Available at: https://www.shoutgladigladi.com/

79. Motherland [Internet]. *CineDiaz*. (2017) [cited 2023 Aug 13]. Available from: https://www.imdb.com/title/tt6333078/

80. Ryder M. The media's racial bias is also happening off screen. Fortune [internet]. (2022); Available at: https://fortune.com/2022/03/10/racial-bias-ukraine-war-reporting-media-diversity-trust-marcus-ryder/

81. Ali L. In Ukraine reporting, Western press reveals grim bias toward "people like us." *Los Angeles Times [Internet]* (2022); Available at: https://www.latimes.com/entertainment-arts/tv/story/2022-03-02/ukraine-russia-war-racism-media-middle-east

82. Mba Abogo CA. Racism in Western reporting of the Ukraine war. How should we respond? *New African Magazine [Internet]* (2022); Available at: https://newafricanmagazine.com/27904/

83. Nelson-Hurwitz DC, Tagorda M, Kehl L, Buchthal OV, Braun KL. Developing an undergraduate public health introductory Core course series. *Front Public Health*. (2018) 6:155. doi: 10.3389/fpubh.2018.00155

84. Blair C. Micronesian immigration an "important civil rights issue" facing Hawaii—Honolulu civil beat. (2015); Available at: https://www.civilbeat.org/2015/08/micronesian-immigration-an-important-civil-rights-issue-facing-hawaii/

85. Hofschneider A. Report: battling discrimination against Micronesians requires policy changes. *Honolulu Civil Beat [Internet]*. (2019)

86. Adams EA, Adams YJ, Koki C. Water, sanitation, and hygiene (WASH) insecurity will exacerbate the toll of COVID-19 on women and girls in low-income countries. *Sustain Sci Pract Policy*. (2021) 17:85–9. doi: 10.1080/15487733.2021.1875682

87. Nelson-Hurwitz DC, Tagorda M. Developing an undergraduate applied learning experience. *Front Public Health [Internet]*. (2015). doi: 10.3389/fpubh.2015.00002/abstract

88. Baxter Magolda MB. Self-authorship. *New Dir High Educ*. (2014) 2014:25–33. doi: 10.1002/he.20092

89. Lee JA. Affirmation, support, and advocacy: critical race theory and academic advising. *NACADA J*. (2018) 38:77–87. doi: 10.12930/NACADA-17-028

90. Puroway A. Critical advising: a Freirian-inspired approach. *NACADA J*. (2016) 36:4–10. doi: 10.12930/NACADA-15-015

91. Camara PJ. Levels of racism: a theoretic framework and a gardener's tale. *Am J Public Health*. (2000) 90:1212–5. doi: 10.2105/AJPH.90.8.1212

92. Petteway RJ, González LA. Engaging public health critical race praxis in local social determinants of Health Research: the youth health equity and action research training program in Portland, OR—yHEARTPDX. *Int J Environ Res Public Health*. (2022) 19:8187. doi: 10.3390/ijerph19138187

93. Amani B, Cabral A, Sharif MZ, Huỳnh J, Skrine Jeffers K, Baptista SA, et al. Integrated methods for applying critical race theory to qualitative COVID-19 equity research. *Ethn Dis*. (2022) 32:243–56. doi: 10.18865/ed.32.3.243

94. Azzahrawi R. A Look at the approaches to multicultural and anti-racist education through the lenses of critical race theory: the reported benefits and failures. *J Adv Res Educ*. (2023) 2:1–9. doi: 10.56397/JARE.2023.01.01

95. Bond C, Kajlich H. Introduction to the special issue: critical conversations on higher education as an enabler to building an indigenous health workforce. *Aust J Indig Educ*. (2020) 49:108–9. doi: 10.1017/jie.2020.12

96. Lee N. Addressing the knowledge gap of indigenous public health: reflections from an indigenous public health graduate. *Aust J Indig Educ*. (2020) 49:110–8. doi: 10.1017/jie.2020.15

97. Bentley KM, Fortune D, Rooks R, Walter G. Antiracism and the pursuit of social justice. *Pedagogy Health Promot*. (2021) 7:296–8. doi: 10.1177/23733799211054402

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Understanding professional development challenges of Chinese public health professionals: association and prediction analyses with data validity screening

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Background: Little is known about the public health professionals engaged in educating and training new or future researchers in public health. Research in this direction identifies their issues, concerns, challenges, and needs. This study focused on the professional development challenges of Chinese public health professionals.

Methods: Snowball sampling was utilized. A total of 265 public health professionals participated. An instrument of 6 dimensions (burnout, sleep issue, mood issue, friends' support, exercise, and challenges) was developed, revised, and administered online. Two different approaches, the conventional and data screening approaches, were applied. The former started with item quality analyses, whereas the latter began with data quality checks. The chi-square tests of associations and logistic regressions were performed on both approaches.

Results and discussion: 19.25% of the participants were detected and deleted as careless respondents. Using both approaches, six professional development challenges except one ("Multidisciplinary learning") were significantly associated with various demographic features. The two approaches produced different models though they converged sometimes. The latent variables of exercise predicted professional development challenges more frequently than other latent variables. Regarding correct classification rates, results from the data screening approach were comparable to those from the conventional approach.

Conclusion: The latent variables of exercise, such as "Exercise effects," "Expectations of exercise," and "Belief in exercise," might be understudied. More research is necessary for professional development challenges using exercise as a multidimensional construct. Based on the current study, screening and deleting careless responses in survey research is necessary.

KEYWORDS

professional development challenge, Chinese public health professional, chi-square test of association, logistic regression, Rasch model, careless responses, survey data quality

1. Introduction

Public health professionals prevent and cure diseases and promote the public's well-being. Their research refreshes our understanding of health-related issues, discovers more scientific ways to treat and prevent diseases, and builds various frameworks to understand our health. Their research impacts policy, our longevity, and quality of life. However, more is needed to know about the professional development of public health professionals engaged in training and educating new and future researchers (hereafter referred to as public health professionals). Research in this line is vital to understanding their professional issues, needs, and well-being, promoting their professional growth, and maximizing general welfare.

Chinese public health professionals have contributed tremendously to the Chinese people's well-being. According to Chen et al. (1), life expectancy in mainland China increased by 9.44 years from 1990 to 76.3 years in 2016, and infant mortality dropped remarkably from 1990 to 2002. Behind these simple statistics are the efforts of numerous public health workforce at different levels in various disciplines. Their research plays a vital role in preventing diseases, prolonging the life of the Chinese people, and reducing mortality and morbidity. It is of practical significance that we understand the professional development of Chinese public health professionals for their well-being and the public benefits. However, there is a dearth of research on this topic.

The current research aimed to understand the professional development challenges of public health professionals in mainland China. For this purpose, snowball sampling was utilized to recruit public health professionals from hospitals and universities. A total of 265 filled out the online survey. First, tests of associations were conducted on their demographic variables and self-reported challenges in professional development. Next, logistic regressions were performed to examine the significant predictors for the self-reported challenges in professional development. More importantly, the current research applied data screening techniques in survey research to identify careless responses and remove these invalid data for high-quality research. The conventional approach and the data screening approach were used simultaneously.

2. Literature review

The current research incorporated the professional development framework with burnout, a common occupational phenomenon, to investigate the challenges of Chinese public health professionals. Furthermore, screening for data quality in survey research was introduced into the study. This section elaborated on professional development and the relationship between burnout (including its related consequences) and professional development.

2.1. Professional development

2.2.1. Definition and importance

Professional development (PD) is a well-designed, systematic process to assist people in learning, retaining, and applying knowledge and skills related to their jobs (2). Professional development aims to teach new skills, knowledge, and strategies to bring positive career outcomes. It ensures quality improvement in public health care delivery and maintenance of public health (2). It can happen in different formats and levels. As such, professional development plays a vital role in enhancing the competencies of public health professionals in various disciplines. Thus, the PD program is popular in the public health sector. For instance, American Public Health Association established the Center for Public Health Practice and Professional Development.[1]

2.2.2. Impacts of professional development

The literature consistently documents the positive impacts of PD. It was related to career satisfaction and quality patient care among nurses (3). Teachers who experienced PD programs had higher job satisfaction (4). Higher job satisfaction was associated with higher productivity and a lower turnover rate. Rouleau et al. (5) synthesized that the nurses participating in a PD program reported the most outcomes in learning and that participants perceived positive outcomes for older patients. Forsetlund et al. (6) reported that PD meetings improved the professional practices of health personnel and patient outcomes. To conclude, PD is essential in assisting health professionals to advance their skills and expertise and improve their professional practices.

2.2.3. Exercise, friend influences, and professional development

Learning is central to PD. In education, theory and empirical evidence support the pivotal role of self-efficacy, which is an individual's belief in their ability to succeed (7). People with a higher sense of self-efficacy can recover from setbacks more quickly, are more likely to take on challenges, and persist in difficulty. One of the sources of self-efficacy is vicarious influences, alternatively known as the role model from friends. The role model plays an important in the development of self-efficacy (8). Research demonstrated that exercise behaviors had strong predictive power on self-efficacy (9). Exercises improve psychological well-being, thus elevating the self-efficacy level of individuals (10, 11). Exercise positively affects the body, mind, and memory, improving learning (12). The national research report confirmed that exercise and support from friends could decrease burnout, facilitating professional development (13).

2.2.4. Professional development challenge and the role of challenge

"Challenge" refers to something difficult or a task stimulating participants to reach some learning objectives or meet some criteria (14). In chess, sports, and leisure activities, researchers reported a positive association between challenges and enjoyment and between challenges and intrinsic goal orientations (15). In higher education, the challenge-based learning approach has been proven useful in fostering learning and learning outcomes (16–18). In some workplace training, challenge-based teaching was superior to lecture-based teaching, with more participant interaction and better learning outcomes (19). A challenge can stimulate an individual's motivation to engage and pave the way to accumulate more expertise and

1 https://www.apha.org/about-apha/centers-and-programs/center-for-professional-development

knowledge, preparing an individual for the future. Therefore, it is meaningful to understand the self-perceived challenges of public health professionals.

2.2. Burnout and professional development

2.2.1. Burnout definition and prevalence

Burnout is work-related stress characterized by physical and mental exhaustion, cynicism, and reduced professional efficacy (13). Burnout is common among public health sectors. The national report summarized that the burnout prevalence rate was 35% and 54% for American nurses and physicians and 45% and 60% for medical students and residents (13). In a Chinese cross-sectional study of mental health professionals, 38.1% of the participants suffered from burnout (20). Stone et al. (21) reported 66% of burnout in a sample of about 200 frontline public healthcare workers during the pandemic. Its prevalence differs by gender, cultural background, and age (13, 22).

2.2.2. Burnout as a barrier to professional development

Research has consistently documented that occupational burnout was associated with sleep issues, suicide risks, higher rates of alcohol use, higher risks of depression, and sub-optimal professional outcomes among the healthcare workforce (13). A meta-analysis showed that, among health workers, the pooled prevalences of anxiety, depression, and sleep problems were 300%, 311%, and 440% during the pandemic (23).

Individuals with burnout were likely to decrease their professional engagement. Burnout was significantly associated with self-reported medical errors (24). Physicians with burnout syndrome were likely to have decreased motivation, a reduced sense of control over their practices, and experience suboptimal professional behaviors with patients and colleagues (25). Sleep disorders were also positively associated with medication errors and significantly impacted depression scores (26). Depressive physicians had a significantly higher risk of making medical errors (27). Chronic burnout strengthens emotional exhaustion and undermines daily functioning (28). The consequences of burnout differed by gender and background (13, 22).

2.2.3. Professional development to alleviate burnout

The national report suggested positive learning environments to promote PD and reduce burnout (13). The research found that attitudes toward PD had a positive relationship with professional efficacy, a negative association with cynicism, and that attitudes differed by gender and participant experience (29). Professional development significantly predicts the burnout of healthcare workers (30). Attitudes toward professional development were positively related to the dimensions of burnout (31). Existing research supports the effectiveness of PD programs in reducing burnout. For example, the PD intervention decreased burnout and increased job satisfaction (32). Another PD program significantly reduced the perceived stress and burnout of the participating professionals (33).

2.3. Careless responses in survey research

Educational, sociology, psychology, and public health researchers utilize surveys as an essential vehicle for collecting and analyzing data. Survey data quality depends on how honestly the participants follow the instructions and complete the survey. The recent two decades have witnessed careless response (CR) research growth.

2.3.1. Definition and prevalence of careless responses

CR is present when participants are not motivated to provide accurate or correct choices. CR can be either random or non-random. Random CR is a response pattern in which participants randomly fill out the survey (34). Non-random CR is the behavior of choosing the same options in a highly consistent manner (34). CR prevails in survey research. Hong et al. (35) reported that the CR rates ranged from 20% to 50% in the reviewed articles. Their research had about 33% of CR. Ward et al. (36) reported CR as a common source of bias in online surveys. With technological innovations, online surveys are becoming popular. It is vital to examine the data quality of our online survey.

2.3.2. Consequences of careless responses

When CR is present, it compromises data quality and distorts statistical results and research conclusions. Huang et al. (37) found that CR increased the correlation among variables and inflated the Type I error rate. Goldammer et al. (38) reported that CR increased item variance and pulled item means toward midpoints. Some research reported that CR obscured the significance of treatment (39). Kam (40) detected that CR distorted factor loadings and threatened construct validity. CR produced bias in item parameter estimates and spuriously decreased the standard error estimates (41). Scholars recommend removing CRs to ensure high-quality data (38, 42, 43).

2.3.3. Growing practices

Some researchers have used data screening techniques to improve data quality. Osborne and Blanchard (39) removed the CR. The intervention in their study became significant. Kam (40) reported that the sample of careful respondents showed more substantial evidence of data validity than the sample with careless responses. For some research, removing CR increased the credibility of the findings (44). However, data screening and removal have yet to catch enough attention (40, 45).

Following this trend, the current study adopted two different approaches to data analysis. First was the conventional method. We conducted item quality analyses before other statistical analyses. Second was the data screening approach with data quality checks and item quality research before performing any analyses. The specific questions were as follows.

2.4. Research questions:

1) What demographic characteristics were associated with Chinese public health professionals' professional development challenges? The chi-square test of association was used to answer the question.
2) What predicted the self-perceived challenges of professional development? The logistic regression was applied to examine the predictive power of the predictors.

The results from the two different approaches were discussed in section 4. Section 3 presents the details of the research methodology.

3. Materials and methods

3.1. Instrument and sample

Institutional research board (IRB) approval was obtained from the university. At the very beginning of the survey, the participants were informed of the aims and uses of the data and the researchers' promise of confidentiality. The directions at the beginning of the study emphasized that only the public health professionals engaged in educating, administering, and training new and future researchers were eligible to participate and that each individual needed to fill out the survey once. The initial survey had 70 items. Some participants in the pilot test suggested reducing the number of items to recruit more people. Thus, the ten items on general self-efficacy were removed.

The administered version had 60 items with six dimensions—burnout, sleep issues, mood issues, professional development challenges, support from friends, and physical exercise. The six dimensions were developed based on the literature related to PD and burnout. The research pinpoints sleep and mood issues as expected outcomes of burnout. It confirms that support from friends and exercises are instrumental for self-efficacy development. Demographic items were at the end of the survey. The burnout items were based on the Chinese version of the Maslach Burnout Inventory General Survey (MBI-GS) (46) and Likert-scaled, addressing emotional exhaustion (5 items), cynicism (4 items), and professional efficacy (9 items). The options ranged from 1 ("Very few, several times a year") to 6 ("Every day"). Questions for sleep, mood, and professional development challenges were dichotomous ("No"/"Yes"). Support from friends and exercise comprised six items and 16 items, respectively. Each item for "Friends" had a 4-point scale, including "Very few," "Sometimes," "Often," and "Always." Exercise items were further conceptualized to include the exercise effects (6 items), the expectations of exercise (5 items), and belief in exercise (5 items). Each item had five options, including "Strongly Disagree" to "Strongly Agree".

The survey was administered on Wenjuanxing (a Chinese survey website). Snowball sampling was used to recruit participants from hospitals and universities in different regions. The co-authors distributed the survey among their co-workers and friends, who forwarded it to other professionals who met the inclusion criteria. The final sample size was 265.

3.2. Variables

The dependent variables were PD challenges in various aspects. They included the challenges of peer cooperation, multidisciplinary cooperation, physical and mental exhaustion, learning new knowledge and skills in one's major, multidisciplinary learning, improving individual jobs, professional communication with peers, and helping students' academic growth. The rest variables were independent.

MBI-GS had 15 items. For emotional exhaustion, some items were "My job makes me exhausted" and "I feel burnout at the end of the day." Cynicism included four items, such as "I doubt the significance of my job." There were six items for professional efficacy, such as "I have done much valuable work".

Sleep and mood items investigated if the participants had any disorders in the related area(s). The sleep questions included insomnia, easiness of waking up, drowsiness, fatigue after waking up, and early wakening. Mood questions examined the tendency to become irritable, angry, lose emotional control, and unhappy or low spirit over 15 days.

Items for support from friends asked participants to answer how many friends they had, how frequently they met, how involved their communications were over work-related issues, and how frequent conversations were over other topics such as personal issues and their feelings.

As mentioned previously, there were three different sub-dimensions with exercise. The exercise effects dealt with the frequency of exercise, the time length of each time they exercised, and the feelings after exercise. Two of the items were negatively worded. Thus, reverse coding was done after data collection. The expectations of exercise focused on participants' subjective expectations when they exercised. For example, "I expect myself to burn a certain amount of calories each time I excise." Each question in the exercise belief dimension emphasized belief. For example, "I believe that exercise can strengthen my stamina".

Demographic variables included (1) gender, (2) job types (doctoral or master advisor, not an academic advisor but teaches doctoral or master courses, lab manager, administrative personnel, director or deputy chief physician/nurse, intermediate-level physicians/nurse, elementary-level physician or nurse), (3) institution (hospital versus university), (4) education (doctoral, master, bachelor, two-year college degree, below two-year college degree), (5) marital status (married, divorced, or single), and (6) the number of years in the profession. Due to the low frequency in the "Divorced" category, it was combined with "Single," forming the "Unmarried" category. For the same reason, "Below two-year college degree" was combined with "Two-year college degree".

3.3. Statistical analyses

Figure 1 presents the analytical procedures for the two approaches. The data screening approach started with the data quality check, i.e., CR analyses. The conventional approach skipped CR analyses, began with the item quality analyses, and did the analyses on the data after poor-quality items were removed (hereafter referred to as the conventional dataset). The following paragraphs elaborate on the details of the data screening approach.

3.3.1. Step 1 for data quality check—CR analyses

In this step, we conducted CR analyses to detect and remove CR. Multiple techniques exist for detecting careless responses. Curran (34) and Hong et al. (35) proposed using at least two techniques. Thus, we selected long string and Rasch outlier analyses. The former detects non-random CR, and the latter random CR. Additionally, the stopping criterion exists for the Rasch analysis (see 3.3.5). For the screening approach, the data quality analyses were performed on MBI-GS for several reasons. First, careless responses occur in Likert-scale surveys. There were six different dimensions in our instrument. The number of options varied with each dimension, and some were dichotomous. Conducting the long string analysis on the total items was not feasible. Second, our instrument was brief. The participants' attitudes should remain unchanged from the beginning to the end. Details for each screening technique were as follows.

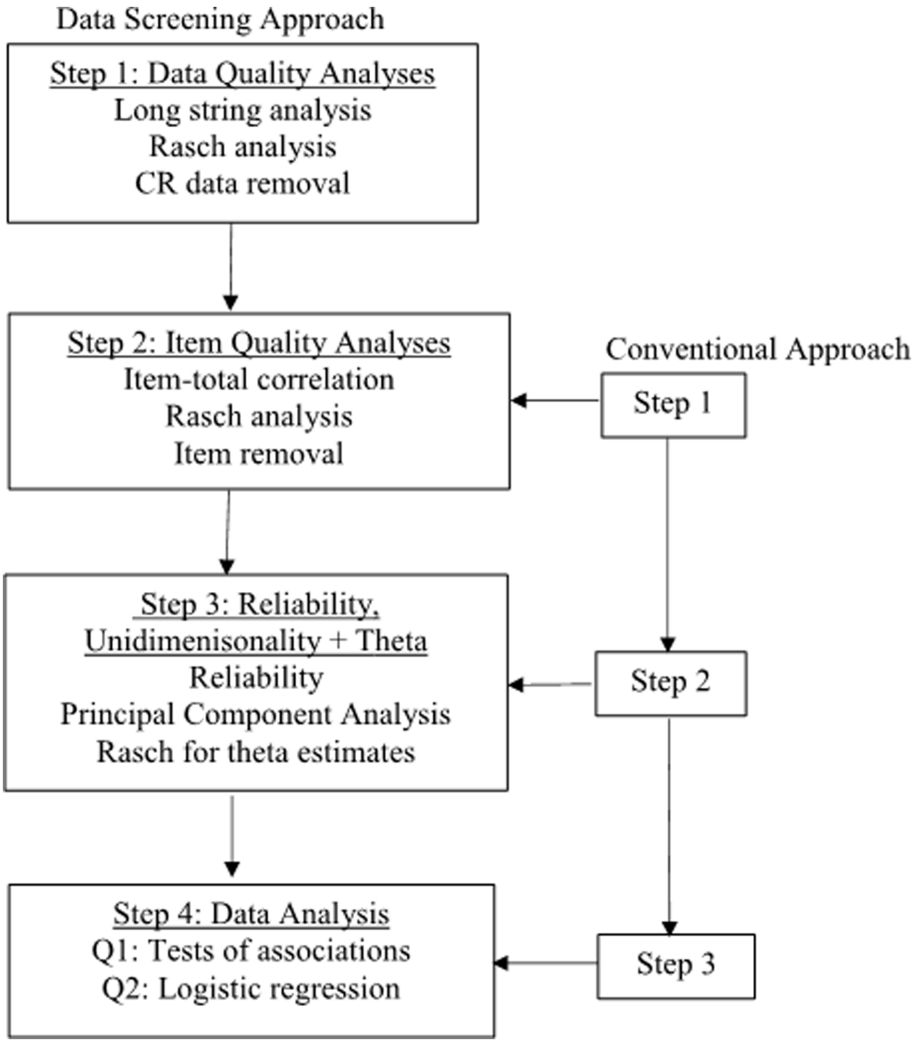

FIGURE 1
Flow chart for analytical procedures. Each step in the conventional approach is one step behind the data screening approach.

(1) Longstring for non-random CR. Non-random CR is the overly consistent response pattern (34, 35, 47). Respondents fail to give enough attention to the survey content. Longstring analysis helps to identify some severely careless responses (28). A long string of consistent options for at least half the total scale length can be considered careless responses (28). Johnson (47) and Niessen et al. (43) chose the maximum long string as cutoff values. We determined that when respondents chose ten same consecutive options out of the 15 MBI-GS items, they were careless respondents (Figure 2 in 4.1.1).
(2) Rasch outlier analysis for random CR. Random careless responses are random selections, like flipping a coin. Osborne and Blanchard (39) proved that the Rasch outfit index was as sensitive to random responses as another statistic. To perform Rasch analysis, several steps were necessary.

First, the number of response options for some items was combined, reducing the categories from six to five to ensure that each response category had enough respondents. According to Linacre's (48) guideline, there should be a minimum of 10 respondents per category for the Likert-scaled items. This size guarantees that the precision of item and person parameter estimation falls within a ± logit confidence interval.

Second, random CR analyses were performed using Rasch outfit fit statistics. Rasch fit statistics on MBI-GS were obtained using jMetrik (49). jMetrik is a free computer program for classical and modern psychological model analyses. Meyer and Hailey (50) verified that jMetrik and WINSTEPS yielded similar results with different sample sizes and items. For sample size <300, standardized outfit statistics > |3.0| indicate outliers (personal communications with M. Linacre, Ph.D., Research Director, mike@winsteps.com, on March 09, 2023) and were applied to detect random CR. The participants detected as careless respondents using longstring or outlier analyses were removed from research in the screening approach.

3.3.2. Step 2 for item quality check—item analyses

Two different statistics were utilized. First was the item-total correlation. A negative item-total correlation means that the item measures another trait from the remaining items and should

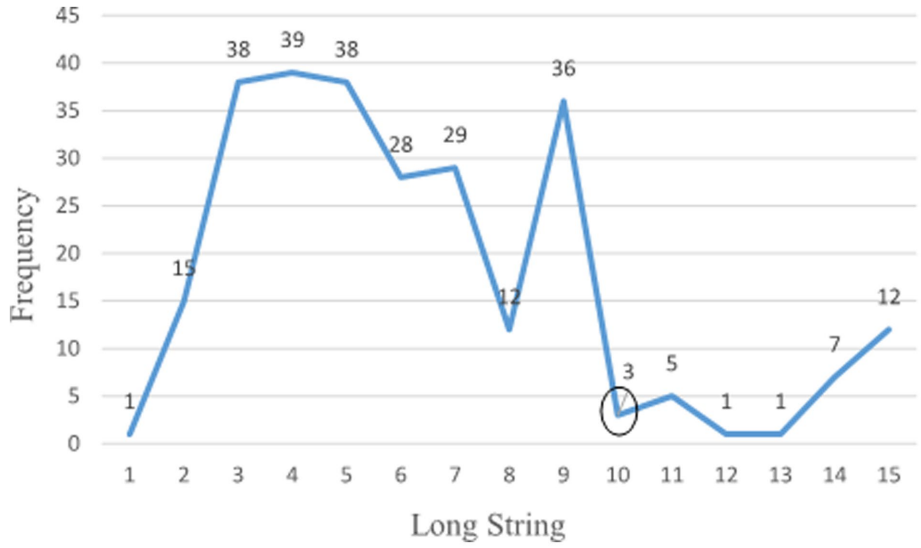

FIGURE 2
Long string frequency.

be removed. The results revealed that all item-total correlations were positive. Second, Rasch infit and outfit statistics were obtained after merging adjacent categories of some items to retain enough respondents. After CR was removed, the sample size decreased. Thus, further combinations of adjacent categories for some items were performed. jMetrik was re-run on the screened data to get item fit statistics. Items with standardized outfit statistics > |3.0| were removed from the analyses. Due to the multi-dimensionality nature of the dataset, item-total correlation and Rasch model were run separately on each dimension.

3.3.3. Step 3 for reliability, unidimensionality, and theta (i.e., estimated ability)

Two public health experts discussed the instrument's content validity, covering each item's validity, dimension validity, and other potential issues. After removing misfit items or CR, Cronbach alpha for each dimension was calculated for both data types. These dimensions included all burnout items, sleep, mood, friend, and all exercise items. Principal component analysis (PCA) was performed on each dimension to investigate the unidimensionality of related dimensions. The fundamental assumption of the Rasch model is that the data is unidimensional.

When unidimensionality was confirmed, jMetrik was performed on each dimension or sub-dimension to obtain each individual's estimated theta for prediction analysis. These thetas included sleep issues, mood issues, support of friends, the three sub-dimensions of burnout, and the three sub-dimensions of exercise. The estimates from the Rasch model have several advantages over the observed data. First, the observed data were ordinal and might run into small frequencies with some items; thus, the results might be biased with low power. In contrast, the Rasch model produces continuous estimated ability, thus avoiding the small frequency issue with ordinal data. Second, the Rasch models are well-known for their robustness in the case of the small sample (51, 52).

3.3.4. Step 4 for association and logistic regression analyses

Chi-square tests examined the associations between the challenges and the demographic variables. For question 2, four sets of variables were hierarchically entered into the model, and the forward stepwise selection method was utilized to investigate which variable(s) in each set contributed significantly to predicting the perceived challenges of Chinese public health professionals. The entry level in our study was set at 0.10, and the removal level at 0.15. The first set was demographic features. The second set was sleep, mood, and support from friends. The third set was the exercise effects, the expectations for doing exercise, and the belief in the benefits of exercise. The last set was the three subdimensions of burnout. The 2nd to fourth set variables were the estimated thetas from the Rasch model. Tests of associations and logistic regression analyses were performed using SPSS 22.0.

3.3.5. Stopping and evaluation criteria for analyses

Linacre (53, 54) provided a guideline for removing items. His suggestions are to start deleting the item with the worst fit. The next step is to rerun the analysis and cross-plot the thetas from this step with those in the previous step. If the scatter plot reveals no noticeable changes, we should accept the items in the last step. If the plot shows noticeable changes, we should remove the item and perform Rasch analysis again. In the coming phase, if there are any misfit items, remove the worst, and do the persons' estimates. Then, we cross-plot again and repeat what we have done in the preceding steps. When the differences in the person's estimates between the current and previous stages are small, we can stop. Linacre (53, 54) suggested the same guideline for removing misfit persons.

For dimensionality analysis in 2.3.3, two indexes were used simultaneously to evaluate the dimensionality of the PCA results. The first was the number of components exacted. The second index was utilized when the number of extracted components exceeded 1.0. It

was the ratio of the first-to-second eigenvalue. A ratio > 3.0 suggests multi-dimensionality.

For association analyses, two significance levels, 0.05 and 0.10, were chosen to compare the analytical results from the conventional approach against those from the data screening approach. The purpose was to highlight which approach yielded more significant results.

For logistic regression, only the indexes for the final selected model in each logistic regression were reported. Specific evaluation criteria included:

(1) Which predictors were significant? What were the odds ratio (OR) and the confidence interval (CI) for the significant preditors? When CI for the odds ratio includes 1.0, it suggests non-significance. When CI excludes 1.0, it indicates significance.
(2) What were the sizes of Nagelkerke R-square (hereafter referred to as the R-square) and Hosmer and Lemeshow goodness-of-fit test (hereafter referred to as GOF test) results? The former is about the amount of variability the model explains, and the nonsignificant value of the latter suggests model fit.
(3) Last, we examined the percentage of correctly classified participants for each logistic regression. If the two approaches produce comparable results, it indicates that the data screening approach removed invalid data.

4. Results

4.1. Preliminary results and descriptive statistics

4.1.1. Data screening results

22 (8.30%) participants were identified as random respondents or outliers, using the standardized outfit value > |3.0|. Figure 2 presents the longstring frequency. 29 (10.94%) respondents were flagged as non-random respondents. The two screening techniques excluded 51 (19.25%) participants. Table 1 compares demographics for the conventional and screened datasets. After data screening and removal, the sample size decreased from 265 to 214. For the original data, the frequency ranged from 178 to 14. For the screened dataset, the frequency ranged from 154 to 12.

4.1.2. Item quality analytical results

The Rasch model was run on the conventional dataset for item quality purposes. According to the stopping criteria (3.3.5 Stopping and Evaluation Criteria for Analyses), an item was removed if the scatterplot of thetas demonstrated any noticeable changes. The four items were removed: (1) "It is easy for me to become angry." (2) "It is challenging to deal with physical and mental exhaustion."; (3) "I can communicate with my friends about nonwork-related problems (such as family, spouse, children, etc.)."; and (4) "Each time I exercise, I expect myself to burn a certain amount of calories".

After cleaning the invalid data, jMetrik was rerun on the cleaned dataset. The five items were removed. The first three were the same as the three in the conventional dataset. One challenge item ("Across-department cooperation is a challenge") was deleted. One exercise item ("How long do you exercise each time") was deleted.

4.1.3. Reliability and unidimensionality

Reliability and validity are essential indexes of data quality. Except for the reliability of mood (0.576) with the screening approach, all other reliability indexes were acceptable, ranging from 0.615 to 0.894. With burnout as one dimension, the reliability for the conventional dataset was 0.831 and 0.726 for the screened dataset. The reliability index for sleep was 0.67 for the conventional dataset and 0.615 for the screened dataset. The reliability index for mood was 0.649 for the conventional dataset. For the friends, the index changed from 0.712 for the conventional data to 0.657 for the screened data. Last, the reliability was 0.894 and 0.893 for all exercise items. In general, the screened data exhibited lower reliability than the unscreened data. For the lowest reliability, only three items were available for Cronbach's alpha. Increasing the number of items will increase the reliability.

Two subject experts examined the survey items and confirmed the content validity of each item and dimension. In addition, we conducted principal component analyses (PCA) for the original and the screened datasets. The PCA produced only one component for "Emotional exhaustion," "Cynicism," "Professional efficacy," "Mood," "Support from friends," "Expectations of exercise," and "Belief in exercise." PCA on sleep and exercise effects produced two extracted principal components for both data types. However, the ratios of the first-to-second eigenvalue were all <3.0. Thus, the unidimensionality assumption was met.

4.1.4. Descriptive statistics for the estimated thetas

The descriptive statistics in Table 2 present the means and standard deviations of the thetas from the Rasch model. Comparing the two data types, the screened data exhibited higher means of "Emotional exhaustion" and "Cynicism" and a lower mean of "Professional efficacy," indicating more problems with burnout. The screening lowered the means for sleep disorders and mood issues and a slightly higher mean for support from friends. Higher values suggest more sleep and mood problems and more support from friends. Lower means suggest fewer sleep and mood issues and less help from friends. The screening lowered the means of the three different dimensions of exercise. Lower values in these three dimensions suggest less impact of exercise on individual life.

4.2. Association tests

Table 3 displays the *p*-values for the tests of associations for both data types. "Improving my job" was significantly associated with job type, education level, and years of work for the conventional dataset. It was significantly associated with job type and years of work for the screened dataset. "Professional communication with coworkers" was significantly related to marital status and years of work for the conventional dataset. It was significantly associated with education level, marital status, and years of work for the screened dataset. These two challenges were associated with more demographic variables. Next came "Peer cooperation." It was significantly associated with gender and years of work in the two analytical approaches. "Learning new knowledge or skills in my major" was significantly related to institutions for both data types. Last, "Helping students' academic growth" was significantly associated with the institution variable.

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TABLE 1 Demographic characteristics.

Variable	Level	Conventional data (*N*=265)		Screened data (*N*=214)	
		Frequency	Percentage	Frequency	Percentage
Sex	Male	93	35.1%	65	30.4%
	Female	172	64.9%	149	69.6%
Institution	Hospital	133	50.2%	116	54.2%
	University	132	49.8%	98	45.8%
Job type	Doctoral/master advisor	36	13.6%	29	13.6%
	Teaches doctoral or master's courses	24	9.1%	21	9.8%
	Laboratory manager	14	5.3%	12	5.6%
	Administrative personnel	19	7.2%	15	7.0%
	Director or deputy chief physician/nurse	60	22.6%	52	24.3%
	Intermediate-level physicians or nurses	55	20.8%	41	19.2%
	Elementary-level physicians or nurses	57	21.5%	44	20.6%
Education	At or below 2-year college degree	59	22.3%	37	17.3%
	Bachelor degree	65	24.5%	57	26.6%
	Master degree	78	29.4%	71	33.2%
	Doctoral degree	63	23.8%	49	22.9%
Marital status	Unmarried	87	32.8%	60	28.0%
	Married	178	67.2%	154	72.0%
Years of work	<1 Year	44	16.6%	27	12.6%
	1–3 Years	27	10.2%	23	10.7%
	3–5 Years	28	10.6%	20	9.3%
	5–7 Years	16	6.0%	13	6.1%
	7–10 Years	24	9.1%	19	8.9%
	>10 Years	126	47.5%	112	52.3%

TABLE 2 Descriptive statistics for estimated thetas.

Statistics estimates	Conventional data (*N*=265)				Screened data (*N*=214)			
	Mean	SD	Mini	Maxi	Mean	SD	Mini	Maxi
Emotional exhaustion	−2.702	3.679	−7.968	8.309	−1.649	2.975	−6.443	5.344
Cynicism	−3.101	3.221	−6.372	5.049	−2.112	2.353	−4.588	3.953
Professional efficacy	1.120	3.401	−6.457	6.573	0.683	2.840	−5.766	5.781
Sleep	−0.661	1.752	−2.900	2.911	−0.753	1.644	−2.885	2.901
Mood	−0.926	2.001	−2.785	2.950	−1.049	1.898	−2.815	2.986
Friend		1.453	−4.016	3.841	−0.670	1.311	−4.023	2.621
Effects of exercise	0.198	1.288	−4.430	4.621	0.171	1.347	−4.517	4.602
Expectations of exercise	−0.481	2.393	−4.165	5.262	−0.574	2.800	−4.587	5.885
Belief of exercise	2.471	5.165	−9.412	9.186	1.629	4.943	−10.026	7.976

SD, standard deviation.

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TABLE 3 *P*-values for tests of associations.

Variables	Challenge 1	Challenge 4	Challenge 5	Challenge 6	Challenge 7	Challenge 8
Conventional data						
Sex	**0.012**					
Institution		**0.042**				**0.002**
Job type				**0.036**		
Education				**0.019**		
Marriage					**0.023**	
Years of work	**0.026**			*0.097*	*0.058*	
Screened data						
Sex	*0.053***					
Institution		*0.069***				**0.001***
Job type				*0.068***		
Education				***	*0.064**	
Marriage					**0.001***	
Years of work	**0.022***			**0.024***	**0.018***	

Bolded numbers indicated significance at 0.05 level and *italicized* numbers at 0.10 level. * indicate that either the *p*-values became smaller or became significant at 0.05 or 0.10 level with the screened data. ** indicate the *p*-values became bigger with the screened data. *** indicate the test became insignificant with the screened data. Challenge 1: peer cooperation. Challenge 4: learning new knowledge or skills in my major. Challenge 5: multidisciplinary learning. Challenge 6: improving my own job. Challenge 7: professional communication with peers. Challenge 8: helping students' academic growth.

4.3. Logistic regression

Based on the item analytical results, two challenge items were removed from the screened dataset and one from the conventional dataset. Logistic regression was run on the remaining six challenge items for comparison purposes. SPSS modeled "Yes" as the event. All the demographic variables were dummy coded with the last category as the reference group. In this section, OR was interpreted, holding all other variables in the model constant.

4.3.1. Prediction for peer cooperation

The results are presented in Table 4. For the *conventional dataset*, compared with those working more than ten years, those with 1–3 years had 4.781 times the odds of selecting peer cooperation as a challenge (CI: 1.882, 12.141). For each unit increase in "Sleep," we expected about a 39% increase in selecting "Yes" for peer cooperation. CI for this odds ratio excluded 1.0. For each unit increase in "Expectations of exercise," there would be about a 12% increase in endorsing peer cooperation as a challenge. Its CI included 1.0. For every unit increase in support from friends, we expected about an 82% decrease in selecting this challenge (CI: 0.670, 0.996). The R-square was 0.195, and the GOF was 0.667.

For the *screened dataset*, years of work significantly predicted the challenge of peer cooperation. Compared with those working more than ten years, those with 1–3 years of experience had 5.079 times the odds of selecting "Yes" for peer cooperation. For every unit increase in "Sleep," the odds of choosing "Yes" increased by 1.347 (CI: 1.113 and 1.629). The R-square was 0.140, and the GOF was 0.437.

4.3.2. Prediction for learning new knowledge or skills in my major

For the *conventional dataset* (the top part of Table 5), three variables, institution, "Mood," and "Professional efficacy," were all non-significant with CI including 1.0. The bottom part of Table 5 shows the results for the *screened data*. For every unit increase in "Professional efficacy," we expected about a 0.87% decrease in selecting this challenge (CI: 0.786 and 0.966). The R-square for the conventional dataset was 0.056, and the GOF was 0.39. The R-square for the screened data was 0.073, and the GOF was 0.400.

4.3.3. Prediction for multidisciplinary learning

Table 6 reveals the results of multidisciplinary learning. For the *conventional data*, "Sleep" and "Effects of exercise" were in the model with CI including 1.0. For every unit increase in "Exercise expectations," there would be about a 19% increase in selecting "Yes" for this challenge (CI: 1.066 and 1.338). In the *screened data*, for every unit increase in "Expectations of exercise," we expected an 11% increase in choosing "Yes" for this challenge (CI: 1.003 and 1.222). The R-square was 0.079, and the GOF was 0.489 for the conventional approach. These indexes were 0.026 and 0.433 for the screened dataset.

4.3.4. Prediction for improving my job

For the *conventional data* (the top part of Table 7), intermediate-level physicians and nurses had 2.603 times the odds of choosing "Improving my job" as a challenge compared with those elementary positions. Compared with professionals with doctoral degrees, those with master's degrees had 2.815 times the odds of considering "Improving my job" as a challenge. CI for both odds ratios excluded 1.0. For every unit increase in "Exercise effects," the odds for the predicted event decreased by 0.697 (CI: 0.530, 0.916). "Sleep" and "Belief in exercise" were nonsignificant. The R-square for the final model was 0.158, and the GOF was 0.447 for the original data.

For the *screened data*, compared with those having >10 years of experience, those with 5–7 years of experience has 0.128 times the odds of choosing this challenge (CI: 0.027, 0.613). Compared with those with >10 years of experience, the odds of selecting this challenge

TABLE 4 Logistic regression for peer cooperation.

Block	Variable	*B*	S.E.	Wald	OR	95% CI for OR	
						Lower	Upper
Conventional data							
Final model	Sex (1)	*0.570*	0.299	3.629	1.769	0.984	3.181
	Years of work			**13.222**			
	Years of work (1)	0.126	0.413	0.093	1.135	0.505	2.551
	Years of work (2)	**1.565**	0.476	10.826	4.781	1.882	12.141
	Years of work (3)	0.246	0.477	0.266	1.279	0.502	3.258
	Years of work (4)	−0.307	0.652	0.223	0.735	0.205	2.637
	Years of work (5)	*0.813*	0.495	2.705	2.256	0.856	5.946
	Sleep	**0.331**	0.083	15.764	1.392	1.183	1.640
	Friend	**−0.202**	0.101	4.010	0.817	0.670	0.996
	Expectations of exercise	*0.114*	0.061	3.498	1.121	0.995	1.264
	Intercept	**−1.031**	0.242	18.201	0.357		
Screened data							
Final model	Years of work			**13.453**			
	Years of work (1)	0.227	0.463	0.240	1.255	0.506	3.112
	Years of work (2)	**1.625**	0.507	10.275	5.079	1.880	13.719
	Years of work (3)	−0.011	0.539	0.000	0.989	0.344	2.845
	Years of work (4)	−0.714	0.808	0.781	0.490	0.101	2.385
	Years of work (5)	0.864	0.535	2.610	2.372	0.832	6.762
	Sleep	**0.298**	0.097	9.378	1.347	1.113	1.629
	Intercept	**−0.683**	0.213	10.297	0.505		

Bolded parameter estimates or Wald statistics indicated significance at 0.05 level and *italicized* numbers at 0.10 level.

TABLE 5 Logistic regression for learning new knowledge/skills in my major.

Block	Variable	*B*	S.E.	Wald	OR	95% CI for OR	
						Lower	Upper
Conventional data							
Final Model	Institution (1)	−0.284	0.274	1.076	0.752	0.440	1.288
	Mood	*0.114*	0.064	3.161	1.121	0.988	1.271
	Professional efficacy	*−0.071*	0.041	2.929	0.932	0.859	1.010
	Intercept	**0.414**	0.188	4.862	1.513		
Screened data							
Final Model	Mood	0.111	0.077	2.039	1.117	0.960	1.300
	Professional efficacy	**−0.138**	0.053	6.805	0.871	0.786	0.966
	Intercept	*0.268*	0.163	2.705	1.307		

Bolded numbers indicated significance at 0.05 level and *italicized* numbers at 0.10 level.

decreased by 0.379 for professionals with <1 year of experience (CI: 0.154 and 0.929). Compared with those with >10 years of experience, the odds of this event for those with 3–5 years of experience decreased by 0.320 (CI: 0.115 and 0.886). Every unit increase in "Cynicism" increased the odds of selecting this challenge by 1.152 (CI: 1.016 and 1.307). The R-square for the final model was 0.111, and the GOF was 0.183.

4.3.5. Prediction for communication with peers

Table 8 displays the results of the challenge of professional communication with peers. For the *conventional data*, for every unit increase in "Expectations of exercise," we expected about a 25% increase in selecting "Yes" for this challenge (CI: 1.103 and 1.419). For every unit increase in "Emotional exhaustion," we expected about an 11% increase in selecting "Yes" for this challenge (CI: 1.013, 1.210).

TABLE 6 Logistic regression for multidisciplinary learning.

Block	Variable	*B*	S.E.	Wald	OR	95% CI for OR	
						Lower	Upper
Conventional data							
Final model	Sleep	*0.136*	0.077	3.101	1.145	0.985	1.332
	Effects of exercise	*−0.194*	0.113	2.986	0.823	0.660	1.026
	Expectations of exercise	**0.178**	0.058	9.381	1.194	1.066	1.338
	Intercept	**0.363**	0.142	6.579	1.438		
Screened data							
Final model	Expectations of exercise	**0.102**	0.050	4.068	1.107	1.003	1.222
	Intercept	0.173	0.142	1.494	1.189		

Bolded numbers indicated significance at 0.05 level and *italicized* numbers at 0.10 level.

TABLE 7 Logistic regression for improving my job.

Block	Variable	*B*	S.E.	Wald	OR	95% CI for OR	
						Lower	Upper
Conventional data							
Final model	Job type			**13.577**			
	Job type (1)	0.346	0.497	0.484	1.413	0.534	3.744
	Job type (2)	*1.066*	0.570	3.500	2.905	0.951	8.877
	Job type (3)	−0.758	0.681	1.241	0.468	0.123	1.778
	Job type (4)	−0.579	0.602	0.923	0.561	0.172	1.826
	Job type (5)	**0.957**	0.434	4.867	2.603	1.113	6.090
	Job type (6)	0.205	0.423	0.234	1.227	0.535	2.813
	Education			**8.788**			
	Education (1)	0.077	0.438	0.031	1.080	0.458	2.548
	Education (2)	0.490	0.424	1.332	1.632	0.710	3.749
	Education (3)	**1.035**	0.396	6.842	2.815	1.296	6.113
	Sleep	0.100	0.080	1.582	1.105	0.946	1.292
	Effects of exercise	**−0.361**	0.139	6.713	0.697	0.530	0.916
	Belief of exercise	*0.055*	0.032	2.921	1.056	0.992	1.125
	Intercept	*−0.785*	0.456	2.968	0.456		
Screened data							
Final model	Years of work			**12.976**			
	Years of work (1)	**−0.971**	0.458	4.502	0.379	0.154	0.929
	Years of work (2)	−0.185	0.471	0.154	0.831	0.331	2.090
	Years of work (3)	**−1.141**	0.521	4.803	0.320	0.115	0.886
	Years of work (4)	**−2.054**	0.798	6.622	0.128	0.027	0.613
	Years of work (5)	−0.443	0.503	0.777	0.642	0.239	1.720
	Cynicism	**0.142**	0.064	4.887	1.152	1.016	1.307
	Intercept	**0.713**	0.254	7.849	2.040		

Bolded parameter estimates or Wald statistics indicated significance at 0.05 level and *italicized* numbers at 0.10 level.

Other variables in the model were non-significant. The R-square was 0.165, and the GOF was 0.552.

For the *screened data*, compared with the married professionals, those without marriages had 2.326 times the odds of choosing this challenge (CI: 1.220, 4.435). For every unit increase in "Expectations of exercise," the odds of choosing "Yes" for this challenge increased by 1.131 (CI: 1:019, 1.257). For every unit increase in "Cynicism," the odds of choosing "Yes" for this

TABLE 8 Logistic regression for professional communication with peers.

Block	Variable	*B*	S.E.	Wald	OR	95% CI for OR	
						Lower	Upper
Conventional data							
Final model	Marital status (1)	0.470	0.295	2.525	1.599	0.896	2.854
	Mood	0.029	0.079	0.138	1.030	0.883	1.201
	Friend	−0.166	0.103	2.609	0.847	0.693	1.036
	Effects of exercise	−0.191	0.135	1.992	0.826	0.634	1.077
	Expectations of exercise	**0.224**	0.064	12.082	1.251	1.103	1.419
	Emotional exhaustion	**0.102**	0.045	5.072	1.107	1.013	1.210
	Intercept	−0.254	0.223	1.290	0.776		
Screened data							
Final model	Marital status (1)	**0.844**	0.329	6.572	2.326	1.220	4.435
	Expectations of exercise	**0.123**	0.054	5.299	1.131	1.019	1.257
	Cynicism	**0.154**	0.064	5.692	1.166	1.028	1.323
	Constant	−0.274	0.230	1.419	0.761		

Bolded numbers indicated significance at 0.05 level and *italicized* numbers at 0.10 level.

challenge increased by 1.166 (CI: 1.028 and 1.323). The R-square was 0.137, and the GOF was 0.178.

4.3.6. Prediction for helping students' academic growth

For the *conventional data* (the top part of Table 9), compared with the university professionals, the hospital professionals had 0.322 times the odds of choosing this challenge (CI: 0.165 and 0.629). Compared with those in elementary positions, director or deputy chief professionals had 6.238 times the odds of selecting this event (CI: 2.383, 16.329). With the same reference group, those teaching doctoral or master courses had 4.553 times the odds of endorsing this challenge (CI: 1.421, 14.594). For every unit increase in "Effects of exercise," there was about a 46% decrease in selecting "Helping students' academic growth" as a challenge (CI: 0.322, 0.649). For every unit increase in "Expectations of exercise," there was about a 29% increase in choosing "Yes" (CI: 1.112, 1.493). For every unit increase in "Belief of exercise," there was about an 11% increase in choosing "Yes" for this question (CI: 1.029, 1.196). The R-square was 0.30, and the GOF was 0.962.

For the *screened data*, compared with the university professionals, the hospital professionals had 0.410 times the odds of selecting this challenge (CI: 0.225, 0.747). For every unit increase in "Exercise effects," there was about a 58% decrease in selecting this challenge (CI: 0.418, 0.791). For every unit increase in "Belief in exercise," there was about an 11% increase in the event (CI: 1.027, 1.209). The R-square was 0.214, and the GOF was 0.577.

5. Discussion

This section started with the discussions on which groups were more likely to be flagged as careless respondents. The rest of the discussion evolved around the tests of associations and logistic regressions.

5.1. Demographic variables in careless responses

A series of chi-square tests were performed. The chi-square test on the contingency table for gender and deleted group (1 = deleted and 0 = not deleted) produced a significant test statistic (test statistic = 10.878 with $df = 1$, a p-value of 0.001). The male was more likely to fill out the survey carelessly. The chi-square test for the institution × deleted group was also significant (test statistic = 7.177 with $df = 1$, a p-value of 0.007). Those at universities were more likely to produce CR. Similarly, those with less experience (i.e., less number of years working in the profession) and those with lower levels of education were significantly more likely to behave carelessly (p-value <0.000 and p-value of 0.003 respectively).

5.2. What did we understand from tests of associations?

There were some similarities between both approaches in Table 3. The challenge of "Helping students' academic growth" was significantly associated with institutions in both approaches. Compared with hospital professionals, more university professionals consider it challenging to help students grow academically. This association was significant for both approaches. The job of university professionals was to help students grow. Their experiences with students' academic development were substantively more than those at hospitals. For both approaches,

TABLE 9 Logistic regression for helping student academic growth.

Block	Variable	*B*	S.E.	Wald	OR	95% CI for OR	
						Lower	Upper
Conventional data							
Final model	Institution (1)	**−1.132**	0.341	11.035	0.322	0.165	0.629
	Job type			**18.933**			
	Job type (1)	0.728	0.510	2.038	2.071	0.762	5.630
	Job type (2)	**1.516**	0.594	6.507	4.553	1.421	14.594
	Job type (3)	−0.054	0.714	0.006	0.948	0.234	3.843
	Job type (4)	0.558	0.625	0.797	1.747	0.513	5.948
	Job type (5)	**1.831**	0.491	13.901	6.238	2.383	16.329
	Job type (6)	0.569	0.465	1.496	1.766	0.710	4.395
	Mood	0.101	0.074	1.842	1.106	0.956	1.280
	Effects of exercise	**−0.782**	0.178	19.265	0.457	0.322	0.649
	Expectations of exercise	**0.254**	−0.782	11.402	1.289	1.112	1.493
	Belief of exercise	**0.104**	0.254	7.375	1.110	1.029	1.196
	Intercept	−0.576	0.104	2.487	0.562		
Screened data							
Final model	Institution (1)	**−0.891**	0.306	8.505	0.410	0.225	0.747
	Sleep	0.148	0.098	2.270	1.159	0.956	1.405
	Effects of exercise	**−0.553**	0.162	11.599	0.575	0.418	0.791
	Expectations of exercise	0.155	0.063	6.142	1.168	1.033	1.320
	Belief of exercise	**0.108**	0.041	6.820	1.114	1.027	1.209
	Intercept	0.216	0.232	0.861	1.241		

Bolded parameter estimates or Wald statistics indicated significance at 0.05 level and *italicized* numbers at 0.10 level.

gender and years of experience were significantly associated with the challenge of "Peer Cooperation." For both approaches, marital status was significantly associated with "Professional communication with peers".

"Challenge of multidisciplinary learning" was not significantly associated with demographic variables in both approaches. Several explanations exist. First, our sample size was not enough to produce a significant relationship. More participants might solve the issue. Second, the relationship between this challenge and demographic variables was suppressed by a mediator. Third, Chinese public health professionals might understand "multidisciplinary" differently. If knowledge, skills, and strategies from multiple disciplines are related to their career or job, they might classify these into their majors instead of understanding them as multidisciplinary.

Differences existed. More tests yielded smaller *p*-values with the screened dataset, as indicated by * signs in Table 3. Those marked by ** signs in Table 3 indicated larger *p*-values for the screened data. Education level was significantly associated with "Improving my job" for the conventional data but insignificant for the screened data. Comparing the results for the two approaches, there were more tests with smaller *p*-values in the screened data. Thus, the significance levels of the uncleaned data were obscured in many cases.

5.3. What did we understand from logistic regression?

In the discussion of logistic regression, only the variables at 0.05 levels were presented in 4.31 and 4.3.2.

5.3.1. Which demographic features were more important?

In the current study, years of experience and job type mattered. The professionals in directors or deputy chief positions and those with master's degrees had significantly higher odds of choosing "Improving my job" as a challenge. For the conventional data, teaching doctoral or master courses and professionals in directors or deputy chief positions were more likely to endorse "Helping students' academic growth" as a challenge. With the nature of their job, they encountered more student issues. The significance varied with demographic variables.

5.3.2. Which variable had stronger predictive power?

In the current literature, exercise has been conceptualized as uni-dimensional. For example, exercise was some workout each time in the national report (13). In our study, exercise was multi-dimensional.

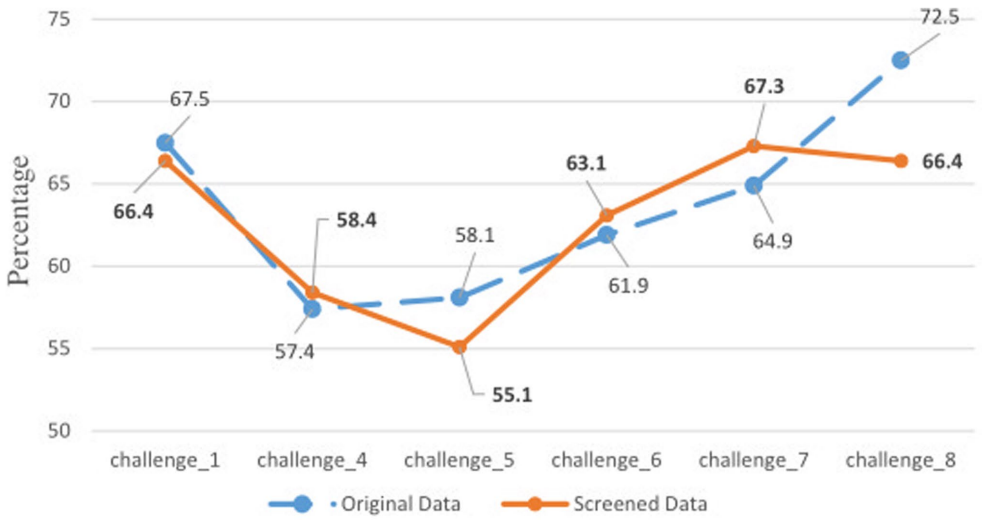

FIGURE 3
Percentages of correct classification for two approaches. **Bolded** numbers were from the screened data. See the bottom of Table 3 for challenge information.

"Expectations of exercise" was a frequent predictor for PD challenges. "Expectations of exercise" impacted the professionals' realization of their professional challenges. The coefficients of "Exercise Effects" were negative, suggesting more desirable effects health professionals had from exercise, the more likely they were to rate PD challenges as easy. "Belief in exercise" was also predictive.

"Sleep" predicted "Peer cooperation" in both approaches. Cynicism predicted "Improving my job" and "Professional communication with peers" for the screened data. The negative coefficient associated with professional efficacy suggested that those with higher professional efficacy considered this challenge easy. This aligns with existing research on the positive impact of professional efficacy on PD (29–31). "Friends" predicted "Peer cooperation" negatively at 0.05 for the conventional approach. Burnout did not predict PD as much as exercise did.

5.3.3. Correctly classified participants

Figure 3 presents the percentages of correct classification for the selected models of the two approaches. For "Helping students' academic growth," the conventional approach outperformed the data screening approach (72.55% versus 66.4%). For "Multidisciplinary learning," the conventional approach was better than the data screening approach (58.1% versus 55.1%). Apart from these two conditions, the percentages of correct classifications were very close for the two approaches. This confirmed that the removed data were invalid.

5.3.4. Implications

First, exercise can enhance PD. The findings on exercise were consistent with the literature, which supports the positive role of exercise on learning or learning-related motivation (12, 55, 56). Clinically, professionals should develop good exercise habits and proper expectations toward exercise results to facilitate their PD and develop self-efficacy. Those with burnout syndrome should also have adequate exercise to reduce burnout (13). Institutions should have policies to encourage employees to exercise.

Second, the findings on burnout and burnout-related issues suggest that professionals should build a network of supportive friends who can positively influence them to enhance their professional self-efficacy. Individuals and institutions should create an environment to foster PD and professional efficacy (13).

Lastly, the findings in 4.3.3 were consistent with the survey literature, which proves the uselessness of removed CR (e.g., 39–41). Public health researchers should examine the data quality before conducting any research.

6. Conclusion

The current research provided an understanding of Chinese public health professionals and their perceived PD challenges. For both approaches, the sub-dimensions of burnout did not significantly predict the challenges frequently as the sub-dimensions of exercise. Some variables did not enter the models. Some mediators might exist, suppressing the relationship between the independent and dependent variables. The correct classification rates with both approaches were close.

Future research may follow several directions. First, the instrument in the current study was of mixed scales. It can be revised such that all items are on the same scale, enabling researchers to check the data quality of all items. Second, the current research only applied two CR detection techniques. Other CR techniques can be used. Third, our sample size was 265 and 214 for the conventional and data screening approaches. It is possible for future research to recruit more participants.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving humans were approved by Research Office, Shandong Youth University of Political Science, Jinan, Shandong, China. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

YW participated in every research step (instrument development and revision, data collection and cleaning, data analysis, manuscript writing, and revision). HZ provided insight concerning the research design and participated in the instrument development and validation, data collection, and data cleaning. XK participated in the instrument development and validation, and data collection. FL participated in the instrument development and data collection. YW, XK, FL, and HZ listed meet the authorship criteria according to the latest guidelines of the International Committee of Medical Journal Editors. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2023.1250606/full#supplementary-material

References

1. Chen H, Qian Y, Dong Y, Yang Z, Guo L, Liu J, et al. Patterns and changes in life expectancy in China, 1990-2016. *PLoS One*. (2020) 15:e0231007. doi: 10.1371/journal.pone.0231007

2. Training and Professional Development. Atlanta (GA). (2019). Center for Disease Control and Prevention (US). Available at: https://www.cdc.gov/healthyschools/trainingtools.htm (Accessed June 15, 2023)

3. Price S, Reichert C. The importance of continuing professional development to career satisfaction and patient care: meeting the needs of novice to mid- to late-career nurses throughout their career span. Administrative. *Science*. (2017) 7:17. doi: 10.3390/admsci7020017

4. Robinson OP, Bridges SA, Rollins LH, Schumacker RE. A study of the relation between special education burnout and job satisfaction. *J Res Spec Educ Needs*. (2019) 19:295–303. doi: 10.1111/1471-3802.12448

5. Rouleau G, Gagnon MP, Côté J, Payne-Gagnon J, Hudson E, Dubois CA, et al. Effects of E-learning in a continuing education context on nursing care: systematic review of systematic qualitative, quantitative, and mixed-studies reviews. *J Med Internet Res*. (2019) 21:e15118. doi: 10.2196/15118

6. Forsetlund L, O'Brien MA, Forsén L, Mwai L, Reinar LM, Okwen MP, et al. Continuing education meetings and workshops: effects on professional practice and healthcare outcomes. *Cochrane Database Syst Rev*. (2021) CD003030. doi: 10.1002/14651858.CD003030

7. Bandura A. *Self-efficacy: the exercise of control*. New York, NY: Freeman (1997).

8. Usher EL, Pajares F. Sources of self-efficacy in school: critical review of the literature and future directions. *Rev Educ Res*. (2008) 78:751–96. doi: 10.3102/0034654308321456

9. Shan H-S, Li B, Xu WG, Zhi KY, Qiao MS, Xing LY, et al. Physical fitness, exercise Behaviors, and sense of self-efficacy among college students: a descriptive correlational study. *Front Psychol*. (2022) 13:932014. doi: 10.3389/fpsyg.2022.932014

10. McAuley E, Blissmer B. Fefof physical activity. *Exerc Sport Sci Rev*. (2000) 28:85–8.

11. Tikac G, Unal A, Altug F. Regular exercise improves the levels of self-efficacy, self-esteem and body awareness of young adults. *J Sports Med Phys Fitness*. (2022) 62:157–61. doi: 10.23736/S0022-4707.21.12143-7

12. Mind-blowing Benefits of Exercise. US News & World Report (US); (2023), Available at: https://health.usnews.com/wellness/fitness/slideshows/mind-blowing-benefits-of-exercise (Accessed July 31, 2023)

13. Committee on Systems Approaches to Improve Patient Care by Supporting Clinician Well-Being, National Academy of Medicine, National Academies of Sciences, Engineering, and Medicine. *Taking action against clinician burnout: a systems approach to professional well-being [internet]*. Washington, D.C.: National Academies Press (2019).

14. Gibson D, Irving L, Scott K. Technology-enabled, challenge-based learning in a global context In: M Shonfeld and D Gibson, editors. *Collaborative learning in a global world*. Charlotte: Information Age Publishing-Iap (2019). 32–42.

15. Abuhamdeh S, Csikszentmihalyi M. The importance of challenge for the enjoyment of intrinsically motivated, Goal-Directed Activities. *Pers Soc Psychol Bull*. (2012) 38:317–30. doi: 10.1177/0146167211427147

16. Gallagher SE, Savage T. Challenge-based learning in higher education: an exploratory literature review. *Teach High Educ*. (2020) 26:1–23. doi: 10.1080/13562517.2020.1863354

17. Hamari J, Shernoff DJ, Rowe E, Coller B, Asbell-Clarke J, Edwards T. Challenging games help students learn: an empirical study on engagement, flow and immersion in game-based learning. *Comput Hum Behav*. (2016) 54:170–9. doi: 10.1016/j.chb.2015.07.045

18. Legaki NZ, Xi N, Hamari J, Karpouzis K, Assimakopoulos V. The effect of challenge-based gamification on learning: an experiment in the context of statistics education. *Int J Hum Comput Stud*. (2020) 144:102496. doi: 10.1016/j.ijhcs.2020.102496

19. O'Mahony TK, Vye NJ, Bransford JD, Sanders EA, Stevens R, Stephens RD, et al. A comparison of lecture-based and challenge-based learning in a workplace setting: course designs, patterns of interactivity, and learning outcomes. *J Learn Sci*. (2012) 21:182–206. doi: 10.1080/10508406.2011.611775

20. Xia L, Jiang F, Rakofsky J, Zhang Y, Zhang K, Liu T, et al. Cigarette smoking, health-related Behaviors, and burnout among mental health professionals in China: a Nationwide survey. *Front Psych*. (2020) 11:706. doi: 10.3389/fpsyt.2020.00706

21. Stone KW, Kintziger KW, Jagger MA, Horney JA. Public health workforce burnout in the COVID-19 response in the U.S. *Int J Environ Res Public Health*. (2021) 18:4369. doi: 10.3390/ijerph18084369

22. Templeton K, Bernstein CA, Sukhera J, Nora LM, Newman C, Burstin H, et al. Gender-based differences in burnout: issues faced by women physicians. NAM Perspectives. (2019); Available at: http://nam.edu/gender-based-differences-in-burnout-issues-faced-by-women-physicians

23. Marvaldi M, Mallet J, Dubertret C, Moro MR, Guessoum SB. Anxiety, depression, trauma-related, and sleep disorders among healthcare workers during the COVID-19 pandemic: a systematic review and meta-analysis. *Neurosci Biobehav Rev*. (2021) 126:252–64. doi: 10.1016/j.neubiorev.2021.03.024

24. Menon NK, Shanafelt TD, Sinsky CA, Linzer M, Carlasare L, Brady KJS, et al. Association of Physician Burnout with Suicidal Ideation and Medical Errors. Occupational health. *JAMA Netw Open*. (2020) 3:e2028780. doi: 10.1001/jamanetworkopen.2020.28780

25. Arnsten AFT, Shanafelt T. Physician distress and burnout: the neurobiological perspective. *Mayo Clin Proc*. (2021) 96:763–9. doi: 10.1016/j.mayocp.2020.12.027

26. Saleh AM, Awadalla NJ, El-masri YM, Sleem WF. Impacts of nurses' circadian rhythm sleep disorders, fatigue, and depression on medication administration errors. *Egypt J Chest Dis Tuberc*. (2014) 63:145–53. doi: 10.1016/j.ejcdt.2013.10.001

27. Pereira-Lima K, Mata DA, Loureiro SR, Crippa JA, Bolsoni LM, Sen S. Association between physician depressive symptoms and medical errors: a systematic review and meta-analysis. *JAMA Netw Open*. (2019) 2:e1916097. doi: 10.1001/jamanetworkopen.2019.16097

28. Bakker AB, Costa PL. Chronic job burnout and daily functioning: a theoretical analysis. *Burn Res*. (2014) 1:112–9. doi: 10.1016/j.burn.2014.04.003

29. Özer N, Beycioglu K. The relationship between teacher professional development and burnout. *PRO*. (2010) 2:4928–32. doi: 10.1016/j.sbspro.2010.03.797

30. Cotel A, Golu F, Pantea Stoian A, Dimitriu M, Socea B, Cirstoveanu C, et al. Predictors of burnout in healthcare workers during the COVID-19 pandemic. *Healthcare*. (2021) 9:304. doi: 10.3390/healthcare9030304

31. Khan F, Rasli A, Khan S, Yasir M, Malik MF. Job burnout and professional development among universities academicians. *Sci Int Lahore*. (2014) 26:1693–6.

32. Soper K. Reducing burnout and promoting professional development in the palliative care service. *J Hosp Palliat Nurs*. (2022) 24:181–5. doi: 10.1097/NJH.0000000000000847

33. Couarraze S, Saint Jean M, Decormeille G, Houze Cerfon CH, Minville V, Fourcade O, et al. Short-term effects of simulation training on stress, anxiety and burnout in critical care health professionals: before and after study. *Clin Simul Nurs*. (2023) 75:25–32. doi: 10.1016/j.ecns.2022.12.001

34. Curran PG. Methods for the detection of carelessly invalid responses in survey data. *J Exp Soc Psychol*. (2016) 66:4–19. doi: 10.1016/j.jesp.2015.07.006

35. Hong M, Steedle JT, Cheng Y. Methods of detecting insufficient effort responding: comparisons and practical recommendations. *Educ Psychol Meas*. (2020) 80:312–45. doi: 10.1177/0013164419865316

36. Ward MK, Meade AW, Allred CM, Pappalardo G, Stoughton JW. Careless response and attrition as sources of bias in online survey assessments of personality traits and performance. *Comput Hum Behav*. (2017) 76:417–30. doi: 10.1016/j.chb.2017.06.032

37. Huang JL, Liu M, Bowling NA. Insufficient effort responding: examining an insidious confound in survey data. *J Appl Psychol*. (2015) 100:828–45. doi: 10.1037/a0038510

38. Goldammer P, Annen H, Stöckli PL, Jonas K. Careless responding in questionnaire measures: detection, impact, and remedies. *Leadersh Q*. (2020) 31:101384. doi: 10.1016/j.leaqua.2020.101384

39. Osborne JW, Blanchard MR. Random responding from participants is a threat to the validity of social science research results. *Front Psychol*. (2011) 1:220. doi: 10.3389/fpsyg.2010.00220

40. Kam CCS. Careless responding threatens factorial analytic results and construct validity of personality measure. *Front Psychol*. (2019) 10:1258. doi: 10.3389/fpsyg.2019.01258

41. Patton JM, Cheng Y, Hong M, Diao Q. Detection and treatment of careless responses to improve item parameter estimation. *J Educ Behav Stat*. (2019) 44:309–41. doi: 10.3102/1076998618825116

42. Huang JL, Curran PG, Keeney J, Poposki EM, DeShon RP. Detecting and deterring insufficient effort responding to surveys. *J Bus Psychol*. (2012) 27:99–114. doi: 10.1007/s10869-011-9231-8

43. Niessen ASM, Meijer RR, Tendeiro JN. Detecting careless respondents in web-based questionnaires: which method to use? *J Res Pers*. (2016) 63:1–11. doi: 10.1016/j.jrp.2016.04.010

44. Arias VB, Garrido LE, Jenaro C, Martínez-Molina A, Arias B. A little garbage in, lots of garbage out: assessing the impact of careless responding in personality survey data. *Behav Res*. (2020) 52:2489–505. doi: 10.3758/s13428-020-01401-8

45. McGonagle AK, Huang JL, Walsh BM. Insufficient effort survey responding: an under-appreciated problem in work and organisational Health Psychology research. *Appl Psychol*. (2016) 65:287–321. doi: 10.1111/apps.12058

46. Maslach C, Jackson SE, Leiter MP. *Maslach burnout inventory manual. 3rd* ed. Palo Alto, CA: Consulting Psychologists Press (1997).

47. Johnson JA. Ascertaining the validity of individual protocols from web-based personality inventories. *J Res Pers*. (2005) 39:103–29. doi: 10.1016/j.jrp.2004.09.009

48. Linacre JM. Sample size and item calibration stability. *Rasch Meas Trans*. (1994) 7:328.

49. Meyer JP. *jMetrik (version 4.1.1) (computer software)*. Charlottesville, VA: Pyschomeasurement System (2018).

50. Meyer JP, Hailey E. A study of Rasch, partial credit, and rating scale model parameter recovery in WINSTEPS and jMetrik. *J Appl Meas*. (2012) 13:248–58.

51. Lunz ME. *Comparison of item performance with large and small samples*. Chicago, IL: Measurement Research Associates.

52. Wright BD, Stone MA. *Best test design*. Chicago: MESA Press (1979).

53. Linacre JM. When to stop removing items and persons in Rasch misfit analysis? *Rasch Meas Trans*. (2010) 23:1241.

54. Linacre JM. Removing Rasch misfit and cleaning windows. *Rasch Meas Trans*. (2010) 23:1241.

55. Fu W, Li Y, Liu Y, Li D, Wang G, Liu Y, et al. The influence of different physical exercise amounts on learning burnout in adolescents: the mediating effect of self-efficacy. *Front Psychol*. (2023) 14:1089570. doi: 10.3389/fpsyg.2023.1089570

56. Sudeck G, Schmid J, Conzelmann A. Exercise experiences and changes in affective attitude: direct and indirect effects of in situ measurements of experiences. *Front Psychol*. (2016) 7:900. doi: 10.3389/fpsyg.2016.00900

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Evolution of storytelling pedagogy in global health course at a U.S. Native American-Serving Nontribal Institution from Fall 2019 to Spring 2023

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Background and purpose: Responding to COVID-19-induced disruptions to traditional teaching methodologies, and considering the relevance of narratives among indigenous populations, "storytelling as pedagogy" was developed and implemented in the undergraduate Global Health course in a Native American-Serving Nontribal Institution (NASNTI) in Colorado.

Methods: We describe the evolving pedagogic adjustments and storytelling strategies incorporated into the global health course from Fall 2019 to Spring 2023. This entailed before the COVID-19 in-person format, online digital storytelling during the pandemic emergency, the HyFlex and hybrid classes with the emergence of "new normals," and finally the gradual move to in-person classes. The story arc in the course included the following: (1) Course learning outcomes revisited and the course syllabus language framed based on the native philosophies of empowerment education and experiential learning, (2) students' inputs sought to incorporate socioculturally responsive topics in the course syllabus (e.g., dental health disparities among indigenous populations), (3) strategic and non-threatening shifts such as "no textbooks" and "no finals" introduced, (4) global health thought partners invited by the course instructor and coached to use story-based teaching methods, (5) use of first-person trauma-informed storytelling methods to teach specific global health topics, and (6) students undertook gratitude journaling, a scaffolding exercise of writing letters on global health topics to global health thought partners.

Results: Storytelling as pedagogy was most effective in the in-person format, while digital storytelling during the COVID-19-induced online classes was extremely challenging considering the stark digital divide in the Navajo Nation. First-person, trauma-informed storytelling is a helpful approach to discuss insider–outsider perspectives and can potentially establish sustainable trustworthy relationships among the students, instructor, and global health thought leaders. Gratitude journaling and photovoice can be tweaked as powerful storytelling methods to build students' interaction-based critical thinking, intercultural humility, and professional networking.

Conclusion: Mapping storytelling pedagogies' best practices can be useful in developing a granulated understanding of this strategy and utilizing them across diverse disciplines in higher education. Faculty capacity building is recommended to enable the former to conceptualize culturally responsive storytelling pedagogies and create assessment plans to assess students' learning outcomes through the utilization of this method.

KEYWORDS

storytelling, global health course, pedagogy, COVID-19, Native American-Serving Nontribal Institution (NASNTI)

Introduction

The power of storytelling as a pedagogic strategy is increasingly being acknowledged by general, scientific, and technical courses because of their deep appeal, ability to validate experiences, transcend cultural, mythical, personal, and sacred knowledge, and enable students to construct their life narratives (1, 2). Furthermore, storytelling in public health and allied disciplines facilitates exploring, reflecting on the realities of clinical practices, and developing empathy (3, 4). There are several examples of successful usage of storytelling as an effective active learning and high-impact pedagogical strategy. For example, a three-part storytelling approach assisted students to construct life narratives in which they were able to internalize, evolve, and integrate their stories with each other (5), or an instance of English as Foreign Language classrooms in Indonesia used narrative texts that facilitated students become aware of the moral lessons of the story, aroused students' imagination, and increased student's literacy interest (6). Existing scholarship also showcases this method being used as a research and intervention tool to examine health risks and experiences, understand and influence public opinion on prevention issues, inform public health practice, and engage populations, clinical professionals, and organizations (7).

That said, there could be four key issues that prevent storytelling from being the learning paradigm, especially in majority–minority institutions of higher education in the United States. First, active learning and storytelling methods need to be planned and implemented in an inclusive way, especially among ethnic minorities and first-generation students (8). Second, narrative models of teaching might reflect a tendency toward a transactional approach—an action-orientated comprehensive approach of teaching and learning with elements of mutuality, reciprocity, and giving back to the community—and thus could be "distanced" from the students and generate superficial sensitivities when infrequently used as a tool (9). Third, there are rare instances with minority-serving academic institutions where teaching–learning is co-developed as an interactional process—for example, designing the course or teaching some of the issues raised by students or periodically undertaking 'how is this class going' with students —rather than as an instructional deliberation that can subsequently fail to link students' agency to racial, feminist, or minority tensions (10). In addition, there is a dearth of professional folklorists (in the US sense of the term) practicing storytelling pedagogy, which invariably results in very uneven quality accounts of this methodology (11).

This study summarizes how storytelling was devised as pedagogy and practiced as an integral strategy in the global health course in a Native American-Serving Nontribal Institution (NASNTI) during the changing COVID-19 scenarios, from before the coronavirus disease 2019 (COVID-19) period (Fall 2019), during the first 2 years of the pandemic (Spring 2020–Fall 2021), and with the emergence of "new normals." (Spring–Spring 2023). We further advocate that story-based teaching methods can potentially develop a strong feeling of connection and sense of belonging among the students, course instructor, external thought partners, and, most importantly, the community, who are protagonists in several case stories that are discussed in this course.

Learning environment

This NASNTI is in southwestern Colorado and noted by the 2021 US News & World Report as the ninth most diverse liberal arts college in the nation, defined by its rural and multiethnic composition (12). The college offers 59 undergraduate majors and enrolls approximately 3,000 undergraduate and 200 graduate students annually. With representation from 17 countries, 48 states in the United States, and 185 Native American tribes and Alaska Native villages, the college has 58% students of color and 46% first-generation students (13).

The global health course taught in this college is an upper level (PH300-level) undergraduate Public Health course capped at 25 students. It is one of the public health major electives, and since Fall 2019 has been taught every semester by one of the authors (TD). Most students who take this course are majoring in disciplines such as Public Health, Health Sciences, and Psychology, while others are from backgrounds such as Business, Management, Engineering, Native American Studies, Sociology, and Biochemistry. Students in the class are mostly Native American, first-generation graduate aspirants, and especially during the pandemic showcased deep interest and commitment in studying the topic and investing their acumen to improve the health of vulnerable communities (14, 15).

Pedagogical philosophies

The unique mix of indigeneity and intersectionalities of NASNTI including a range of sociocultural diversities makes it crucial to acknowledge the relevance of broader narrative contexts when developing and teaching public health courses in this college. Furthermore, the complex history of the college as an "American Indian" boarding school resonated with the narratives of health disparities, untold stories of uncounted numbers, and power asymmetries in global health (16). The combination of the residents and history of the college, the philosophies of narrative medicine and oral traditions practiced among indigenous communities (17, 18), plus the pandemic exposing the need for a more sensitive and empathetic future public health workforce illustrated the possibilities of using storytelling pedagogy in the global health course. Additionally, the course instructor's personal and professional experience with vulnerable communities (19), training in health education (20), participatory planning, monitoring evaluation, and managing for impact (21), and digital storytelling from StoryCenter® (22) were deep influencers to her praxis-oriented teaching that are incumbent to

agentic skills such as respectful listening, empathy, and classroom community building.

Pedagogical format: building the story arc

In addition to the course instructor's own background of experiential learning, her knack for storytelling processes, and foreseeing storytelling as an effective pedagogic strategy in this course, as a new employee to the college in Fall 2019, she leaned heavily on the previous existing course materials to develop the course modules. In doing this, she observed that the previous materials highlighted the binaries of haves versus have-nots, developed versus developing, communicable and non-communicable. These materials also reflected a stark lack of ongoing social, institutional, and political overlaps such as intersectionalities, acknowledging that everyone has their own unique experiences of discrimination, which is a complex interplay and function of identity factors such as race, gender, class, disability, and sexuality; glo-cal that juxtaposes 'global' and 'local' and emphasizes a constant influence of globalization on the local and, on the other hand highlights local, nuanced reinterpretation that gets a voice on the global diaspora (23) and relative deprivation in health discussing dimensions of health inequalities and inequities by geography, race, ethnicity, gender, education, class, income, and occupation (24). Teaching from this biomedical perspective was often evident in the reductionist and pessimistic framing, such as the "developing" countries and communities thereof being mentioned as third-world countries and uneducated communities.

Simultaneously, the course instructor reviewed the Course Learning Outcomes (CLOs) of the college that are guided by the Council on Education for Public Health (CEPH) guidelines (page 26), which has an impetus on curriculum that focuses on "the socioeconomic, behavioral, biological, environmental, and other factors that impact human health and contribute to health disparities" (25). Keeping the CLOs in mind, the course instructor started conceptualizing story-based teaching methods that resonated advancing the college's "graduates ready to promote and advance the health of communities." By this means, student-centric skills of critical thinking, professionalism, information literacy in issues pertaining to global health, and intercultural humility, "a lifelong process of self-reflection and self-critique whereby the individual not only learns about another culture but also one starts with an examination of her/his own beliefs, cultural identities, and explicit and implicit biases," were also underpinned (26).

Thereafter, the instructor applied for and received a faculty development Learning Circle grant (US$500) in Spring 2020 that proposed to collaborate with two other faculties in the college (MC and DG) and use story-based techniques in this course. However, because of the COVID-19 pandemic at the beginning of Spring 2020 and subsequent school closure, the course was rushed to a completely online format. Adding to the turmoil of the pandemic was the formidable digital divide in this region; the in-person planned activities through the grant could not be carried out. The grant was rather utilized in exploring and revising pandemic suited culturally responsive teaching pedagogies, brainstorming with the Teaching Learning Services department to devise a NASNTI tailored definition of hybrid, HyFlex and online, and making all efforts during those almost incommunicado times to identify potential guest speakers who would be interested to share their high-impact stories of practice and research online with students.

Following this, in the latter part of Spring 2020 and continuing through 2021 as COVID-19 disruptions and shutdowns continued, the college adopted diverse teaching methods. They were (i) in-person classes with a hybrid element (synchronous classes that used hybrid elements, such as meeting in outdoor spaces, namely, in tents on certain days and virtually on other days of the week), (ii) completely online classes (asynchronous, taught 100% virtually), (iii) remote access classes, and (iv) HyFlex (hybrid and flexible) classes where the course was "delivered with fully remote option(s)—synchronous or asynchronous—along with regularly scheduled face-to-face classes, allowing students to transition seamlessly between the two learning environments." (27). At that time, the global health course was delivered in the HyFlex format by utilizing the new e-learning infrastructure that was installed in the college and technology bundles that were made available to students for free or at affordable prices. HyFlex formats allowed capitalizing on technology and offered students greater flexibility to choose the learning modality that suited them best. Because the pandemic amplified academic inequalities that, in turn, affected the psychological wellbeing of both the students and teachers, narratives, vignettes, case stories, and short audiovisuals were incorporated into the course with the expectation to make the classes more interesting and interactive. This marked the budding phases of the story arc. In the HyFlex format, global health classes were delivered synchronously to in-person students and via Zoom (Zoom Inc.). Additionally, each Zoom session and chat were recorded and shared with students who would access the class materials asynchronously.

COVID-19-induced turmoil continued through the Spring 2022 and Fall 2022 semesters. This resulted in the extension of HyFlex teaching of the global health course with nimble transitioning to in-person formats during Spring 2023. This phase was the hallmark of initiating students' involvement and seeking their input to inform and enrich the course syllabus.

The next step noted the gradual incorporation of interaction between students, academics, and community members. In this case, the course instructor first utilized her professional network and purposefully selected 12 "global health thought partners." Most of these thought partners are from minority backgrounds themselves or have served minority communities, trained in medicine, public health, psychology, community health ethics, and vaccine trust science, and have illustrative experience of more than 15 years, typified by multi-country program leadership and grant management. All were involved in evidence-based policymaking and influencing roles. Thus, these individuals, by virtue of their knowledge, experience, and positions, were able to provide a unique big-picture perspective of a global health topic. Evites were sent to all 12 thought partners, requesting them to contribute to this class, of whom 8 responded in affirmation (Table 1). The eight thought partners were then inducted by the instructor about the NASNTI and coached to use first-person, trauma-informed storytelling to co-teach sessions elucidating history, evolution, and turning points in global health. Both the thought partners and the instructor were mindful in using trauma-informed sensitivities to teach topics because they were occurring in real time and impacted the Native populations disproportionately (i.e., vaccination equity and gender-based violence) (28).

The final expression of the story arc transpired as students engaged in more interactive and contemplative activities including think-pair-share groups, role plays, simulations, and reflective gratitude journaling to the global health thought leaders. Figure 1 presents the evolution of storytelling methodologies into the global health course across all eight semesters from Fall 2019 to Spring 2023.

TABLE 1 Global health thought partners by their qualification specialization and their global health leadership focus areas.

Global health thought partners	Qualification specialization	Global health leadership focus areas
1.	Public Health Administration	Playing a strategic leadership and advocacy role in the Public Health Service and Implementation Science/Division and Office of Tribal Affairs and Strategic Alliances in a federal public health agency.
2.	Medicine, Public Health	Prolific global health contribution in coordinating India's exemplar polio elimination and leading a donor organization's global polio vaccine research, product development initiatives and polio-related policymaking across multiple countries and geographies.
3.	Social work, Public Policy	Global strategy formulation, landscapes analysis, and project and partnership management in an international non-profit agency entrusted with addressing micronutrient deficiencies in developing countries.
4.	Dentistry	A dental surgeon with expertise in general dentistry services as well as dental anesthesia in the 4-Corners area, and deeply passionate about pediatric dental health and dental health issues and disparities among NA AI populations.
5.	Medicine, Public health, Health Promotion	Global health expertise in the National Smallpox Eradication Programme in India, the Global Programme on AIDS in Switzerland, and international HIV/AIDS prevention and control, child survival, and reproductive health programs, plus scholarly contribution in the arena of sexual health and sport.
6.	Medicine, Clinical Psychology	Globally acclaimed research practitioner on multi-faceted behavioral and social science research programs focusing on attitudes about and determinants of vaccination with a particular focus on human papillomavirus (HPV) vaccination. Also, one of the core developers of the Multidimensional Scale of Perceived Social Support (MSPSS).
7.	Epidemiology, Public Health	An epidemiologist at a federal public health agency focusing on behaviors associated with the transmission of sexually transmitted infections (STIs), sexual health promotion, social justice, health equity, and dismantling institutional racism.
8.	Medicine, Public Administration	Leading and managing non-profit organizations' health-related projects internationally, in the times of coups, military rule, and ethnic conflict.

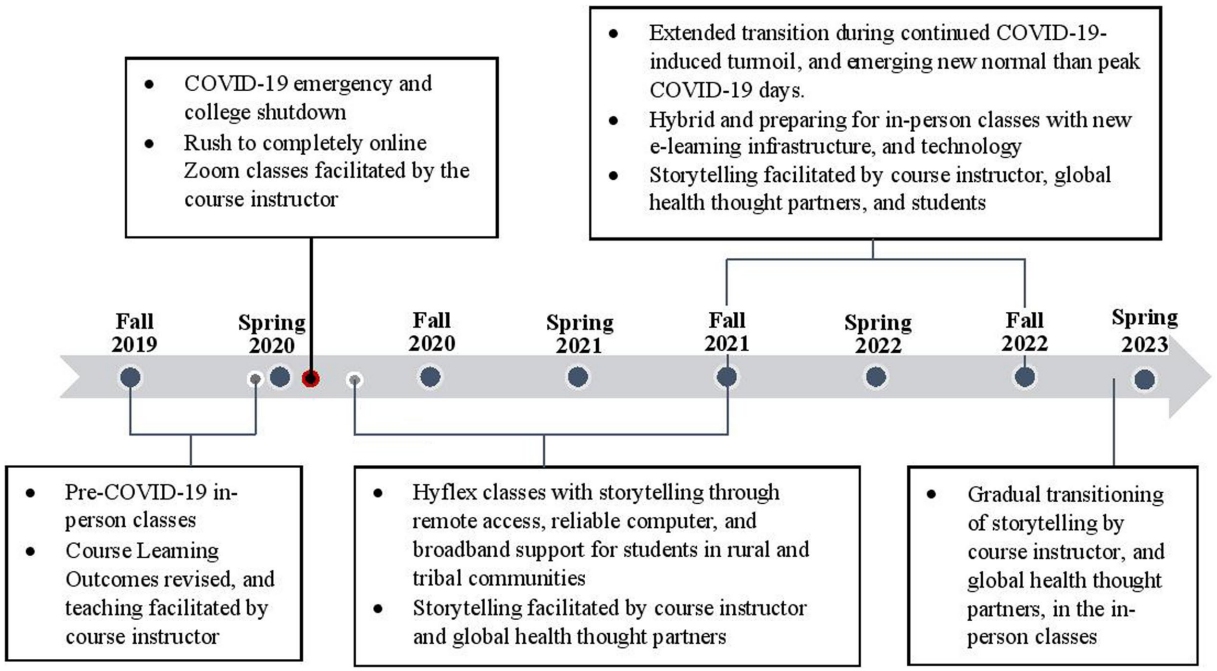

FIGURE 1
Evolution of storytelling as pedagogy in the global health course in accordance with the college's COVID-19 response phases, from Fall 2019 to Spring 2023.

Results

Overall, the storytelling approach resonated with the diverse traditional storytelling practices and cultures among students in a NASNTI. In addition, the non-threatening story-delivery mood in a classroom was set through the application-based language of the revised Course Learning Outcomes (CLOs) and strategic shifts such as "no textbooks" and "no finals" approaches. The earlier and revised descriptive language of the CLOs is presented in Table 2.

The course instructor's teaching philosophy as an inclusion strategist, in turn, led to the agentic engagement of students. Instances of this ranged from students' recommendations and inclusion of topics, such as Community-Based Participatory Research, health disparities among indigenous populations in the United States, dental health among indigenous people in the Four Corners Region, and global health volunteering, to the course.

Attention was given to small things. For example, using the term "thought partners" manifested a sense of collegiality as opposed to the hegemonic term "global health leaders" or "guest speakers" that would convey being external to the classroom community. Storytelling pedagogies included the diverse conceptualizations of health and the varied construct of "global" in global health. This required that everyone involved in the classroom community (instructor, students, and global health thought partners who served as co-teachers in the class) were aware of the emic-etic (insider-outsider) positionalities of each other. Table 3 describes the emic-etic positionalities by classroom stakeholders. Narrative storytelling was effectively used to teach uncomfortable topics, initiate difficult conversations, and enhance student's critical thinking while exciting them in a way that made room for self-discovery and intercultural humility.

The first-person storytelling tools and props that were used by the course instructor and thought partners included narrations of eyewitness accounts, professional journeys, field and lived experiences, excerpts from speeches, and trigger photographs from the field. Stories ranged from folk to scientific domains which made them more relatable as opposed to reading information from a text. These pedagogic processes facilitated linking the past events and the current scenarios (e.g., how experiences from previous pandemics, such as Spanish flu, informed during COVID-19 times) to instill foundational concepts of health policies, disparities, and communication that are not commonly discoursed and critiqued through traditional pedagogy. Trauma-informed storytelling helped to destigmatize public and institutional narratives about poverty and contemplate a holistic definition of health that considered "spiritual dimensions" [of health] beyond the popular definitions that encompass physical, mental, and social wellbeing (29).

TABLE 2 Comparison of the earlier (prior to Fall 2019) and revised Global Health Course Learning Outcomes (CLOs) (from Spring 2020).

CLOs prior to Fall 2019	Redesigned CLOs from Spring 2020
1. Define and describe the key principles and goals of global health 2. Compare and contrast the traditional biomedical approach with a biopsychosocial approach to global health 3. Compare and contrast how health system structures vary globally 4. Identify key determinants and describe disparities in health outcomes 5. Describe and assess the current global health agenda and prospects for the future	1. Develop an empathy-based epistemological understanding of select global health issues by region and subpopulations 2. Invigorate critical understanding of the evolving field of global health politics: before and during the coronavirus disease 2019 period 3. Enhance knowledgeability of global health stakeholders and improve learning the complex linkages between global and community health 4. Build intercultural humility while identifying key social and political determinants of health and describing health disparities 5. Appreciate implementation science and initiate professional networking with global health stakeholders that will enhance students' confidence and preparedness to enter the professional workforce

TABLE 3 Classroom community stakeholders' respective insider and outsider positionalities.

Classroom community stakeholder	Emic (Insider) positionality	Etic (Outsider) positionality
Course instructor	Her global experience influenced her being an inclusion strategist in public health. Her own indigeneity and traditional culture of using narrative storytelling.	Being a first-generation graduate, person of color, and having an international background initially took her more time to build the classroom community.
Students	The resonance of the storytelling with the students' traditional culture of narrative storytelling methods and (most) students' exposure and experience of witnessing health disparities helped them make a connection with the latter seamlessly.	Being from small towns and villages often posed as a barrier to visualize themselves as stakeholders in the big picture of global health.
Global health thought partners	Their illustrative journey and experience influenced their passion on global health issues and perspectives thereof that were shared in the class.	Most of them were accustomed to making high-level presentations using traditional methods. For most thought partners it was one of the first experiences to "coteach" in a majority-minority undergraduate class. It took time for some of them to understand the "contemplative spaces and silences" that several students preferred.

Similarly, the usage of audio visuals and still photographs was enlightening in many ways. For example, viewing the documentary series "*The Most Dangerous Ways to School*" (citing example of Bolivia, (30)) helped to elicit shared experiences of risk, resilience, and relative deprivations with the affected communities. Viewing trigger pictures such as seeing 'happy' photographs of vaccinators with their family members was a strong tool to deconstruct emotions and experiences while listening to the dreadful stories of the vaccinators being subjected to community backlash and brutally murdered by anti-vaxxers (31).

Stories also entailed exemplification of the thought partners' and course instructor's collaborative research that, in turn, encouraged students to consider similar internships/projects in future (32). For example, one thought partner is a clinical psychologist and professor from a public research university who described the development of his *Multidimensional Scale of Perceived Social Support* and acknowledged the course instructor's translation of the scale into an Indian language. This motivated a few students to undertake language translations of COVID-19 vaccination FAQs retrieved from the Centers for Disease Control and Prevention (CDC) and World Health Organization (WHO) websites into Braille, podcast, and Navajo language–*Diné bizaad* (33). Moreover, one of the students presented this project as the first author at the 50th Annual Symposium on the American Indian organized by the Northeastern State University (34).

In addition to including sessions co-facilitated by global health thought partners in the course, interactive and immersive student activities included role plays, simulations, photovoice, and reflective writings. Box 1 describes an exemplary global health course syllabus in 2022, highlighting each module, the corresponding story-based method that was used to teach each module and the diverse student activities that were undertaken aiming to build classroom community. Two story-based assignments, namely, gratitude journaling and photovoice, are explained here.

(1) Gratitude journaling was a think-pair-share scaffolding exercise undertaken by students in a span of 3–4 weeks. In this exercise, students first chose a peer, formed a pair, and consultatively drafted a letter jointly addressing any one of the global health thought leaders who presented in their class. A typical letter to the thought partner included the following 10 sections: (1) The students thanked the thought partner and gave a brief introduction about themselves to her/him, (2) used five appreciative action words to summarize her/his presentation, (3) described the global health topic that the speaker highlighted and the teaching methods that were used, (4) summarized some of the key aspects that students were grateful for and learned from and related to the presentation (the gratitude condition), (5) cited the Sustainable Development Goals connected to the topic presented, (6) recommended policy-level issues to address the scenario pertaining to this global health issue, (7) suggested programmatic interventions to improve the global scenario (these are very similar to the "hassle condition as defined in gratitude journaling"), (8) opined why this topic is relevant and needed to be learned by global/public health students, (9) described strategic skills that public health students need to address this issue, and (10) suggested ideas for professional networking with the thought leader or their organization in imagining a future research/internship with the thought partner or her/his organization or allied organization. The journaling process was progressive. It required students to express their content knowledge, deliberate structural and systematic factors linked to a global health issue, and ideate professional networking steps with the global health thought leader who had presented on that issue. One such example was students in this class who participated and interacted with the CDC personnel at the 2022 American Indian, Alaska Native, and Native Hawaiian (AIANNH) Career Expo that was organized by the CDC. Accountability was established as each student needed to confirm their respective roles in the completion of this exercise. Gratitude journaling that took shape through almost a month of collaborative working between peers helped (1) students to express their gratitude to the thought partner *via* letters, (2) provided a unique opportunity to thank and acknowledge their peers in the letters, thus expressing one's own gratitude and enhancing classroom community relationships, and (3) illustrated the complex interplay of emic (insider) and etic (outsider) perspectives of the instructor, thought partners, and themselves. A preliminary version of this method was presented at the 73rd Annual Conference Society for Public Health Education, and components of this study also appeared in the associated abstract for that conference (35).

The potential of this methodology in deepening students' content understanding, invigorating their empathy, and rekindling our hopes in future graduate ready professionals was evident in excerpts from the gratitude journaling.

> Excerpt 1 Responding to the presentation on Impact on health and wellbeing during coups, military rule, and ethnic conflict: The Context of Myanmar, "*Your presentation highlighted the organized, large scaled, and sustained civil war in Myanmar. By becoming emotionally vulnerable, you allowed us as a class, a brief glimpse into health disparities in Myanmar. Students need to be more creative, illustrate adaptive qualities while being present in a humanitarian crisis. There are many forces working to control the people of Myanmar and they will not like the idea of outside help… Students should also be patient, as this issue will likely not get turned around in one or two years.*"
>
> Excerpt 2 Responding to the presentation on Dental health among indigenous populations, "*…Another thing we learned about was the lack of dental knowledge as well as the lack of dentists on Indian reservations. One of the statistics that really stood out was American Indian/Alaska Native had a 400% higher chance of an early childhood dental caries than the general US population… Public health students could learn about these issues and then provide advocacy for these issues through partnership with local governments as well as local dentists on the reservations.*"
>
> Excerpt 3 Responding to the presentation on the overview of COVID-19 health disparities in developing countries. "*Your presentation taught us about COVID-19 challenges in each country … such as income inequality, gender inequality, and inequality of opportunities in India, political challenges in Brazil and gender-based violence in South Africa. Learning more about an issue helps students to figure out what they can do to improve it …and be grateful for all the things that are provided such as clean water, consistent food, health care, quality education, and an overall well-structured life.*"

BOX 1 An example of the global health course syllabus in Fall 2022 and story-based teaching methods and student activities used.

Global Health Course Modules, Fall 2022	Storytelling methods used	Student activities for agentic engagement and building classroom communities
Module 1 Millennium Development Goals and Sustainable Development Goals	- World Health Organization documentaries, and interpretation of SDG scores by country	Presurvey of students to understand their contexts better and design student-centered classes and increase students' relatability to an applied course.
Module 2 Social Determinants of Health (SDoH) in a Socio-Ecological Framework and key global health organizations	- Case studies, vignettes, and infographics	Students participate in a 'Digital Storytelling in Health' webinar by StoryCenter® and described unique conceptual learnings, emotional realizations, technological approaches imbibed and how they plan to utilize these learnings in their future public health work.
Module 3 Violation of ethical principles, formation of international instruments dealing with public health ethics, human rights, and informed consent	- Timeline-based case studies	Students and instructor used Hypothesis® e-learning tool to read, socially annotate and have conversations on the paper 'Politics of disease control in Africa and the critical role of global health diplomacy A systematic review'.
Module 4 Health Disparities among indigenous populations	- Emic perspectives of indigenous health policymaker explaining Native American health policies and programs - Emic-etic narratives of a dental surgeon working in the reservation area describing dental health disparities among indigenous populations	Students watched and had discursive comments on TEDx talk *'Life Lessons via Cannibals, Sex Workers & Marginalized People'*, to improve emotional intelligence, and build a sense of connectedness and empathy with the instructor and glo-cal communities.
Module 5 The global health endemics-Cancer, HIV and Polio	- Ethnographic journey and mapping comparing HIV and cervical cancer prevention, control, and treatment in developed and developing country - Field stories, and trigger photos explaining the polio outbreak control to eradication	Students answered infographic-based reflection and critical thinking questions.
Module 6 Implementation science, global health volunteering and community engagement	- Success stories, and collective advocacy in the context of abortion rights - Addressing malnutrition in developing countries through examples of food fortification policies and programs	Students' mid-course assessment addressing aspects of relevance, relatedness, and reciprocity. Students watched the movie *'The song of sparrows'* to identify visual moments when 'boundaries of comforts were pushed' to watch global health/ public health disparities.
Module 7 Behavior Change Communication and social media misinformation and disinformation in global health	- Use Photovoice® to discuss on 'endemics and resilience'	Each student had a choice of watching one spectacular documentary from the series- *'The Most dangerous Ways to School'*, simulated interning with that community and writing a letter to [the student's] grandma/ parents, mindfully depicting the issues of health disparity in that place and stressing on the haves, rather than regretting the downsides, and utilizing 'Appreciative Inquiry' to describe a hypothetical internship plan.
Module 8 Emerging issues in Global Health	- Health emergencies explained using narratives of global health personnel in the military and government healthcare	Student pair-up and undertook gratitude journaling to one global health thought partner highlighting: the key aspects that they learned on the topic, the topic's relevance in public health, strategic public health skills required to address this issue, and recommendations to improve this scenario.

Excerpt 4 Responding to the presentation on STIs in the USA, "*We appreciate your and TD's [course instructor's] commitment to sharing knowledge and being a role model. Growing up on a tribal reservation, STI's or STD's are not talked about and are considered a 'taboo' topic because of the culture. Fortunately, there has been a rise in conversations and awareness about syphilis among the Navajo people. You are an inspiration to students who have big dreams of working towards reducing health inequities for all. We ask you to continue to advocate and provide opportunities that will open doors (e.g., speaking to Global Health students). Thank you & ahéhee.*"

(2) In the photovoice-based synchronous exercise, students participated in the art exhibition of the college titled "Resilience" and reflected on the exhibited pieces. The experience was unique and offered something new for everyone. It was complex for the course instructor to manage this hybrid exercise with most students participating in-person and a few remote learners *via* Zoom. A professor at the Art & Design department debriefed the students on the art pieces and acknowledged that this was her first time explaining art to non-art students. This exercise allowed interdepartmental synergistic collaboration and showcased three dimensions of learning empowerment as follows: (1) development of new knowledge relating to the pedagogic utility of photovoice as a storytelling approach, otherwise and mostly used as a qualitative research method, (2) stories of resilience embedded in the exhibited pictures instilled respectful perception of vulnerable and marginalized communities, and (3) students were able to build new networks with professors beyond the comfort zones of their academic disciplines. Components of this were published in the college's magazine, such as FLC voices (36).

Discussion

This study reports the evolution of storytelling methods in a NASNTI and is not an evaluation of the said methods in the global health course. Numerous disruptions in 2020, the most critical being the protracted COVID-19 pandemic, and the murder of George Floyd, that led to a paradigm shift in global health education (37, 38). All these called for using 'stories' to teach global health methodologies that have been known to disrupt class-, color-, race-, and gender-based stereotypes, diminish stigma, improve addiction-related practices, and reduce fatalistic (e.g., suicidal) ideas (39–42). Using storytelling as a teaching method especially resonated with the student-centric, high-impact experiential, and interdisciplinary learning of the college, invigorated through academia-non-profit and regional partnerships and equity-driven teaching methodologies (43). In addition, storytelling as pedagogy gave students the space to question the dominance of medical frames of reference and discuss the topics of global health as social processes (such as vaccination equity) and aspects that are not readily discussed and critiqued through traditional pedagogy (44).

Reflexivity (intersecting relationships between the course instructor and students) and positionality (ontological and epistemological understanding of issues) were pertinent aspects in integrating storytelling pedagogy into this course. Scholarships on the experience of storytelling as pedagogy explain that such aspects ensure rigor and creditability and deepen understanding of the issues and scientific validity (45). Reflexivity and positionality were also vital because the course instructor, students, and thought partners had diverse ethnic and pedagogic backgrounds and thus held differing orientations about storytelling. Therefore, developing a shared understanding was an evolving process. The global health course was presumably used as the main research and implementation space and thus as cultural insiders or outsiders, that is, emic and etic, necessitating the course instructor's attention to and exploration of the local cultures while connecting the students with global health themes (46).

The pandemic happening in real time required being sensitive in teaching topics such as social determinants of health because they affected each one of us directly and the Native populations more disparately (47, 48). Using Arundhati Roy's concept of Pandemic is a Portal (49), storytelling method facilitated to viscerally reveal how identities and socioeconomic status intersected and led to differential outcomes of COVID-19 across individuals, regions, and communities.

In summary, the philosophies of "storytelling pedagogy" can provide with knowledge about intrapersonal, interpersonal, and institutional dimensions that influence everyday classroom practice. This resonated with other research studies reiterating that a well-designed praxis-oriented course can maximize student's empathetic and egalitarian realization of global health goals, engage students as active participants in metacognition, and lead to an attitude shift invigorating students' behavioral, emotional, cognitive, and agentic engagement (50).

Promoting students' involvement made learning in this course real, meaningful, and enjoyable both for the teacher and the taught (51). This intuitive feeling resonated with another longitudinal study in the context of Irish curriculum reform that described the process of negotiation between teachers and students to promote learners' agency around the decision-making of pedagogical activities (52).

The course importantly introduced the use of first-person trauma-informed storytelling as a continuum to contribute to the circle of care that, at one end, significantly impacts pedagogical effectiveness while also nurturing the best learning among students. It also facilitated to activate, transform, shift, trigger, and contradict critical insights that transformed a broader and deeper meaning-making of "classroom community" beyond merely a classroom space (53). Stories were not used as fixed or measurable information but as interpretable frames of meaning-making for teaching–learning that occurred through narrative co-constructions. Studies show that this is particularly important in the context of a NASNTI where students' self-exploration and creating an engaging and exciting learning environment are deeply tied to their retention (54–56).

Photovoice, photo elicitation, and gratitude journaling made the instructor realize that these methods can set the stage for learners to share knowledge and experiences that can excite them about learning in a way that can make room for self-discovery, sensitize them to alternative voices, make them aware of individual, and can potentially create collective resilience in relation to a specific public health topic that can eventually foster connectedness between the students, professors, and external stakeholders (57, 58).

Acknowledgment of constraints

We note several constraints in the storytelling pedagogic method, particularly during COVID-19. First, this pedagogic methodology was largely generative and "figured out" (59) during the COVID-19 pandemic, with several changes that occurred in critical college policies, teaching–learning modalities, and campus access procedures. The generalizability of practicing storytelling as a pedagogic strategy in institutions of higher education, especially in STEM courses, needs further affirmation. Delivering the course in a HyFlex format was seemingly useful for Native students who were unable to commute to school when COVID-19-induced curfews were in place in the reservation areas. This format also gave several quarantining students,

those sharing one laptop for the whole household and those who needed to be in the reservation areas and take care of their families or work on the farm, the opportunity to listen to the Zoom recordings asynchronously. Digital storytelling as a strategic pedagogic approach was challenging during the COVID-19 pandemic for three main reasons. First, it required tremendous flexibility and dexterity of the instructor to separately design reflection and group exercises for in-class students and those using Zoom breakout rooms synchronously and those taking the class asynchronously for every single class. Second, the digital divide in this area impacted students' class participation with some students from the Navajo Nation who had to drive miles to access the internet from a commercial parking lot and who had to climb to the top of hills near their homes to access Wi-Fi and others who were simply unable to access the internet. Last but not least, storytelling strategies relied heavily on synchronous, in-person, and consistent personal interaction between students, academics, and community members, to develop rapport. Thus, it was almost impossible to practice storytelling effectively during the peak of the COVID-19 pandemic (60).

Conclusion

Summing up, using storytelling pedagogy in the Global Health course was in a way a contribution to the indigenous tradition of storytelling that provided an opportunity to 'listen' and 'share' perspectives and discover the layers of meaning-making of 'reconciliation' and 'resilience' among several marginalized communities across the world. Considering that such transformations are holistic, ongoing assessment and evaluation of expected outcomes are proposed to cultivate an interest in storytelling for teacher education candidates and students. Careful planning in the curriculum design measured, preferably through pre-post studies to evaluate personal and teaching benefits that arise from implementing storytelling in the classroom curriculum, and 360-degree assessments are proposed. More systematic reviews are recommended to identify and document gold standards and analyze interests, challenges, and applicability of storytelling pedagogic strategies in both humanities and natural and applied science courses. Capacity building of instructors and apportioned resources is recommended to develop and use story-based teaching tools in the class and assess students' learning outcomes beyond the pandemic-induced application of this method (61, 62).

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

TD: conceptualization, formal analysis, project administration, writing – original draft , review, editing, and finalization. CK and TD: literature review, investigation, methodology and reflections, and writing – review and editing. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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References

1. Aronowitz, S. *Postmodern education: politics, culture, and social criticism*. Minneapolis: University of Minnesota Press (1991).

2. Iseke, J. Indigenous storytelling as research. *Int Rev Qualit Res*. (2013) 6:559–77. doi: 10.1525/irqr.2013.6.4.559

3. Haigh, C, and Hardy, P. Tell me a story—a conceptual exploration of storytelling in healthcare education. *Nurse Educ Today*. (2011) 31:408–11. doi: 10.1016/j.nedt.2010.08.001

4. McAllister, M, John, T, Gray, M, Williams, L, Barnes, M, Allan, J, et al. Adopting narrative pedagogy to improve the student learning experience in a regional Australian university. *Contemp Nurse*. (2009) 32:156–65. doi: 10.5172/conu.32.1-2.156

5. Landrum, RE, Brakke, K, and McCarthy, MA. The pedagogical power of storytelling. *Scholarsh Teach Learn Psychol*. (2019) 5:247. doi: 10.1037/stl0000152

6. Satriani, I. Storytelling in teaching literacy: Benefits and challenges. *Engl Rev J Engl Educ*. (2019) 8:113–20. doi: 10.25134/erjee.v8i1.1924

7. Tsui, EK, and Starecheski, A. Uses of oral history and digital storytelling in public health research and practice. *Public Health*. (2018) 154:24–30. doi: 10.1016/j.puhe.2017.10.008

8. Harris, BN, McCarthy, PC, Wright, AM, Schutz, H, Boersma, KS, Shepherd, SL, et al. From panic to pedagogy: Using online active learning to promote inclusive instruction in ecology and evolutionary biology courses and beyond. *Ecol Evol*. (2020) 10:12581–612. doi: 10.1002/ece3.6915

9. Matias, CE, and Grosland, TJ. Digital storytelling as racial justice: digital hopes for deconstructing whiteness in teacher education. *J Teach Educ*. (2016) 67:152–64. doi: 10.1177/0022487115624493

10. Wortham, SE. Interactional positioning and narrative self-construction. *Narrat Inq*. (2000) 10:157–84. doi: 10.1075/ni.10.1.11wor

11. Ross, MC. Australian Aboriginal oral traditions. *Oral Tradit*. (1986) 1/2:231–71.

12. Fort Lewis College *2021 U.S. News & World Report ranks FLC 9th in Campus Ethnic Diversity; FLC News and Updates* (2020) Available at: https://www.fortlewis.edu/fort-lewis-college-news/news-detail/2021-us-news-world-report-ranks-flc-9th-in-campus-ethnic-diversity (Accessed April 29, 2023)

13. Fort Lewis College. *Fort Lewis College History, About FLC*. (2023). Available at: https://www.fortlewis.edu/about-flc/fast-facts (Accessed April 29, 2023)

14. Shinn, M. Fort Lewis College public health program is growing fast. *Journal*. (2018). Available at: https://www.the-journal.com/articles/fort-lewis-college-public-health-program-is-growing-fast/on) Accessed August 20, 2023

15. Brown, T, Fort Lewis College offers scholarships to those majoring in public health, Durango Herald (2022). Available at: https://www.durangoherald.com/articles/fort-lewis-college-offers-scholarships-to-those-majoring-in-public-health/on (Accessed August 20, 2023)

16. Moats, D. Of stories and numbers: rethinking the settlement between anthropology and metrics in global health. *Sci Cult*. (2016) 25:1–6. doi: 10.1080/09505431.2016.1222362

17. Goyal, R, and Hegele, A. *Culture and medicine: critical readings in the health and medical humanities*. London: Bloomsbury Publishing (2022).

18. Mehl-Madrona, L. *Narrative medicine: The use of history and story in the healing process*. New York: Simon & Schuster Inc. (2007).

19. Dutta, T. Life lessons via cannibals, sex workers & marginalized people; TEDx Indianapolis women (2019). Available at: https://www.youtube.com/watch?v=DOyfpNH_LrY&t=4s (Accessed April 29, 2023)

20. Dutta, T. Spotlight on COVID-19: an interview with Dr. Tapati Dutta, MCHES®, Fort Lewis College; National Commission for Health Education Credentialing News. (2020). Available at: https://www.nchec.org/news/posts/covid-19-spotlight-dutta (Accessed April 29, 2023)

21. Wageningen University. *Managing for sustainable development impact*. Wageningen: Wageningen University. (2017). Available at: https://library.wur.nl/WebQuery/wurpubs/524334

22. StoryCenter. *Storycenter webpage detailing curriculum announcements*. Available at: https://www.storycenter.org/public-workshops/dsocp (Accessed April 29, 2023).

23. Shaw, J. 'Glocalization'? What is that? The global, the local, and health policy research. *BMC Blog Network on Health* (2014). Available at: https://blogs.biomedcentral.com/on-health/2014/06/19/glocalization-what-is-that-the-global-the-local-and-health-policy-research/ (Accessed May 23, 2023).

24. Arcaya, MC, Arcaya, AL, and Subramanian, SV. Inequalities in health: definitions, concepts, and theories. *Glob Health Action*. (2015) 8:27106. doi: 10.3402/gha.v8.27106

25. Council on Education for Public Health. *Accreditation criteria: schools of public health and public health programs* (2016). Available at: https://media.ceph.org/wp_assets/2016.Criteria.pdf

26. Murray, SA, Hinton, A, and Spencer, EC. Developing cultural humility in immunology and STEMM mentoring. *Trends Immunol*. (2022). doi: 10.1016/j.it.2022.01.010

27. Stritikus, T. Your options for a flexible Fall. Fort Lewis College News and Events. (2020). Available at: https://www.fortlewis.edu/fort-lewis-college-news/news-detail/your-options-for-a-flexible-fall

28. Dutta, T. A Tale of Tales: Using Story-Based Techniques for Health Education, An Interview with Dr. Tapati Dutta, MCHES®, National Commission for Health Education Credentialing News (2021). Available at: https://www.nchec.org/news/posts/a-tale-of-tales-using-story-based-techniques-for-health-education (Accessed April 29, 2023).

29. Megan, R. Tapati Dutta brings storytelling into teaching. Fort Lewis College News and Events. (2021). Available at: https://www.fortlewis.edu/fort-lewis-college-news/people/faculty-staff/tapati-dutta-brings-storytelling-into-teaching (Accessed April 29, 2023).

30. The Most Dangerous Ways to School, Bolivia. (2019). Available at: https://www.youtube.com/watch?v=iGRnd8WlcIU

31. Coffee With Polio Experts Part 1 & 2. Global Polio Eradication Initiative. (2022). Available at: https://polioeradication.org/countries/india/ (Accessed April 29, 2023).

32. Zimet, GD, Meyerson, BE, Dutta, T, Forster, A, Corcoran, B, and Hanley, S. Political and public responses to human papillomavirus vaccination In: *Human papillomavirus*. Cambridge: Academic Press (2020). 363–77.

33. Dutta T. Fort Lewis College. Giving language a shot FLC Voices. (2023). Available at: https://www.fortlewis.edu/fort-lewis-college-news/news/flc-voices/article-detail/giving-language-a-shot (Accessed April 29, 2023).

34. Keith C, Dutta T. Northeastern State University. Socio-Culturally Inclusive COVID-19 Vaccine Communication Translation in Navajo (Diné) Language, Braille, and Podcast at a Native American Serving Nontribal Institution. 50th Annual Symposium on the American Indian, CRN 31253, Northeastern State University, Tahlequah (2023)

35. Dutta, T, and Meeker, E. Partnerships: An Effective Health Education Method for Diverse Students, 73rd Annual Conference Society for Public Health Education. *St. Louis Abstract*. (2022) 65624:22–5.

36. Dutta, T. Finding light through story-public health students explore art., FLC Voices. (2023) Available at: https://www.fortlewis.edu/fort-lewis-college-news/news/flc-voices/article-detail/finding-light-through-story (Accessed May 23, 2023).

37. Vickers, R, Field, J, and Thayne, M. Collaborative and participatory learning: the co_LAB model. In Proceedings of the 20th International Academic Mindtrek Conference (2016) (pp. 137–143).

38. Phillips, L. Storytelling as pedagogy. *Lit Learn*. (2013) 21.

39. Wallerstein, N, and Bernstein, E. Empowerment education: Freire's ideas adapted to health education. *Health Educ Q*. (1988) 15:379–94. doi: 10.1177/109019818801500402

40. Riley, T. Boys are like puppies, girls aim to please: how teachers' gender stereotypes may influence student placement decisions and classroom teaching. *Alberta J Educ Res*. (2014) 60:1–21. doi: 10.11575/ajer.v60i1.55729

41. White, J, and Stoneman, L. Thinking and doing prevention: a critical analysis of contemporary youth crime and suicide prevention discourses. *Child Youth Serv*. (2012) 33:104–26. doi: 10.1080/0145935X.2012.704784

42. Wallerstein, N. Empowerment to reduce health disparities. *Scand J Public Health*. (2002) 30:72–7. doi: 10.1177/14034948020300031201

43. Adomaitis, C. Building community in the classroom. KSJD Community Radio. (2023). Available at: https://www.ksjd.org/2023-05-08/building-community-in-the-classroom (Accessed May 23, 2023).

44. Schrecker, T. What is critical about critical public health? Focus on health inequalities. *Crit Public Health*. (2022) 32:139–44. doi: 10.1080/09581596.2021.1905776

45. Eagle Woman, A, Terry, DJ, Petrulo, L, Clarkson, G, Levasseur, A, Sixkiller, LR, et al. Storytelling and truth-telling: personal reflections on the native American Experience in Law Schools. *Mitchell Hamline L Rev*. (2022) 48:704.

46. Tripp-Reimer, T. Reconceptualizing the construct of health: Integrating emic and etic perspectives. *Res Nurs Health*. (1984) 7:101–9. doi: 10.1002/nur.4770070206

47. Gubrium, A, and Gubrium, E. Narrative complexity in the time of COVID-19. *Lancet*. (2021) 397:2244–5. doi: 10.1016/S0140-6736(21)01287-3

48. Romeo, J. *From India to Durango, FLC professor seeks to understand, help others, Durango Herald*. (2021) Available at: https://www.durangoherald.com/articles/from-india-to-durango-flc-professor-seeks-to-understand-help-others/ (Accessed April 29, 2023)

49. Roy, A. The pandemic is a portal. *Financ Times*. (2020) 3:45.

50. Lohr, AM, Raygoza Tapia, JP, Valdez, ES, Hassett, LC, Gubrium, AC, Fiddian-Green, A, et al. The use of digital stories as a health promotion intervention: a scoping review. *BMC Public Health*. (2022) 22:1–6. doi: 10.1186/s12889-022-13595

51. Dutta, T, and Agley, J. Making sure students are at the center: case study of a Native American-Serving Non-Tribal Institution's collegiate leadership during COVID-19. The American Academy of Health Behavior 2022 Annual Scientific Meeting; Key Largo, FL. (2022). 50.

52. Fitzpatrick, J, O'Grady, E, and O'Reilly, J. Promoting student agentic engagement through curriculum: Exploring the negotiated integrated curriculum initiative. *Irish Educat Stud*. (2018) 37:453–73. doi: 10.1080/03323315.2018.1512882

53. Basov, N, and Brennecke, J. Duality beyond dyads: multiplex patterning of social ties and cultural meanings In: *Structure, content and meaning of organizational networks 2017*, vol. *53*. Bingley: Emerald Publishing Limited. 87–112.

54. Oldani, MJ, and Prosen, D. Trauma-informed caring for Native American patients and communities prioritizes healing, not management. *AMA J Ethics*. (2021) 23:446–55. doi: 10.1001/amajethics.2021.446

55. Chávez, V, Turalba, RA, and Malik, S. Teaching public health through a pedagogy of collegiality. *Am J Public Health*. (2006) 96:1175–80. doi: 10.2105/AJPH.2005.062950

56. Lipsey, AF, Waterman, AD, Wood, EH, and Balliet, W. Evaluation of first-person storytelling on changing health-related attitudes, knowledge, behaviors, and outcomes: a scoping review. *Patient Educ Couns*. (2020) 103:1922–34. doi: 10.1016/j.pec.2020.04.014

57. Hopkins, L, and Wort, E. Photo elicitation and photovoice: how visual research enables empowerment, articulation and dis-articulation. *Ecclesial Pract*. (2020) 7:163–86. doi: 10.1163/22144471-BJA10017

58. Budig, K, Diez, J, Conde, P, Sastre, M, Hernán, M, and Franco, M. Photovoice and empowerment: Evaluating the transformative potential of a participatory action research project. *BMC Public Health*. (2018) 18:1–9.

59. Maragh-Bass, A, Comello, ML, Tolley, EE, Stevens, D Jr, Wilson, J, Toval, C, et al. Digital storytelling methods to empower young black adults in COVID-19 vaccination decision-making: feasibility study and demonstration. *JMIR Format Res*. (2022) 6:e38070. doi: 10.2196/38070

60. Rider, J, and Moore, A. Scaling HyFlex for the Post-Pandemic Campus, *Educ Rev* (2021), Available at: https://er.educause.edu/articles/2021/8/scaling-hyflex-for-the-post-pandemic-campus (Accessed April 29, 2023)

61. Torabi, M, Jayawardene, W, Daniels, D, Dutta, T, Bragazzi, N, and Lohrmann, DK. Global perspectives for strengthening health education: a mixed-methods study. *Health Behav Res*. (2022) 5:9.

62. Yazan, B. Toward identity-oriented teacher education: Critical autoethnographic narrative. *TESOL J*. (2019) 10:e00388. doi: 10.1002/tesj.388

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Expectations of employers in the United States for entry-level public health job skills with a bachelor's degree: an analysis of the positions advertised in an online job portal

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Objectives: To analyze the current public health labor market for bachelor's-level graduates.

Methods: Public health-related job postings ($N = 365$) from across the United States were collected from an online job portal, Indeed.com, from November 7–14, 2022. Job titles, organization type, degree requirements, work experience, job location, and preferred skills for bachelor's-level public health positions were analyzed.

Results: Thirty-one job titles were identified. Approximately one-third (32.33%) of postings were from the Northeastern US; 23.56% were from the Southeastern region. Thirty-five job skill categories were identified. Most jobs (92.33%) required oral and written communication skills, and 85.21% specified educational skills for public health promotion. Cultural competency, project management, and case management abilities were also highly sought.

Conclusion: This study revealed the needs of the public health workforce and bolstered the case that public health degree-seekers should be equipped with a set of strategic skills applicable to a range of multisectoral and multidisciplinary public health jobs.

Policy implications: Given the rapid changes in the field of public health, ongoing analysis of the labor market benefits educators, employers, and policymakers alike.

KEYWORDS

public health, education, employment, job skills, entry-level, bachelor's degree

1. Introduction

Even before the COVID-19 pandemic, demands for public health interventions were on the rise (1). The aging of the baby boomer generation (2), the looming threats of climate change (3), and the COVID-19 pandemic-related need for immunizations, testing, and reliable public health information have accentuated the demand for a well-trained public health workforce (4–6).

Moreover, the pandemic led to elevated levels of professional burnout in many health- and public health-related jobs (7). Given the evolving conditions of community health, it behooves public health educators to consider workforce demands and synchronize public health higher education curricula with current and projected employer and community needs.

The World Health Organization (WHO) predicts a global healthcare worker shortage in the coming decade (8). Similarly, the U.S. Bureau of Labor Statistics projects that the nation's healthcare and social assistance sectors will add approximately 2.6 million new jobs between 2021 and 2031, a rate of increase that exceeds any other workforce sector (2). Enrollments in public health degree programs at the undergraduate level are also currently on the rise. Over 36% of conferred public health degrees were undergraduate, and 57% were master's degrees in the 2019–2020 academic year (9). Plepys et al.'s (10) study of over 53,000 graduates of Council on Education of Public Health (CEPH) accredited schools and programs showed that 73% of all graduates were employed, 15% had gone for further education, and 5% were engaged in internships within a year of graduation. However, while a higher number of individuals are being trained in public health, the question remains as to whether their training is adequate for current and future workforce demands.

Scholars have observed the shifting trends in public health and strive to identify the skills necessary for the public health workforce to meet the changing needs of our time (11–15). A report from the National Consortium for Public Health Workforce Development (13) compiled a list of specialized and strategic skills needed by public health workers. The six specialized skills were: communicable disease control, chronic disease and injury prevention, environmental public health, epidemiology, specific population focus (i.e., maternal, child, and family health, or LGBTQ populations), and health education. The report also identified eight strategic skills that are necessary regardless of any specialized focus: systems thinking, change management, persuasive communication, data analytics, problem solving, diversity and inclusion, resource management, and policy engagement (13). Most studies, as well as the Consortium report, acknowledge that training and education for public health have focused largely on specialized skills, leaving many workers with gaps in strategic skills (11, 13, 16).

An examination of deficits in the current public health workforce indicates that many public health workers who are not trained in public health informatics (PHI) feel underprepared to work with health informatics data (17). Similarly, McCullough's (18) analysis of the 2017 Public Health Workforce Interest and Needs Survey (PH WINS) data showed skill gaps in financial proficiency among non-supervisory employees, especially in county-level health departments. Finally, health equity and social determinants of health (SDH) are being recognized locally and globally as critical components of effective public health services (19, 20). However, the focus on health equity and knowledge of SDHs, including health informatics, framed in terms of health equity, are not being translated into actionable efforts (21, 22).

The relationship between public health workforce skill demands and educational needs has been the focus of several surveys and studies, many of which are derived from either the 2017 or 2021 PH WINS data collected from government public health employees (23–25). Taylor and Yeager's (16) study reported that public health workers without formal public health education experienced more core competency gaps than their co-workers with public health degrees. In addition, Treviño-Reyna et al. (6), who gathered European public health graduate and employee data, found that even highly educated and motivated public health workers faced poor working conditions and unacceptably low compensation, which created instability in appropriate crisis response, such as experienced during the COVID-19 pandemic. Krasna et al.'s (8) analysis focused specifically on workforce demand for public health graduates at the MPH level and determined that labor market demand outside the public health field may be compounding the shortage of public health workers. Other published studies had a sub-disciplinary focus, such as McLane et al.'s (12) or Joshi et al.'s (26) examination of health informatics employment, which identified the growing need for informatics training in the public health workplace. Our study has uniquely focused on entry-level job postings across public and private workforce sectors in the US, requiring a bachelor's degree. This focus will allow educators and policymakers to make informed choices about the undergraduate curricula needed to meet the skill demands of the public health workforce.

2. Methods

For our current study, data on all public health jobs advertised on Indeed.com were collected from November 7–14, 2022. Indeed.com is a common job portal in the U.S. and was chosen because it is the most trafficked online job portal in the country. Indeed.com aggregates millions of job postings across company career sites, job boards, staffing firms, and other online sources (26) and provides options for job posting search criteria. We restricted our search terms to "public health," "last 7 days," "full-time," "entry-level," and/or "bachelor's degree" for better selection. The search was limited to jobs in the United States. The postings were reviewed by the first three co-authors, screening independently using the defined search term and criteria. The initial search for jobs in public health between November 7–14, 2022, returned 668 matches. After removing duplicates not meeting the criteria (i.e., lower than bachelor's degree preferred, part-time jobs), and not public health-related positions (e.g., a driver in a community health center, a housekeeper in a health facility), 437 job postings remained. Excluding postings that required other degrees or licenses (e.g., nursing, nutrition, social work, etc.), the final selection resulted in 365 job postings (Figure 1).

The job postings that met the consensus of reviewers were extracted into an Excel spreadsheet. After finalizing the list, the first author double-checked all postings based on the search term, search criteria, and consensus rules. The data extraction included the following:

- Job title: Job titles from the postings were recorded and re-coded into similar job categories. For example, COVID-19 community health equity navigator, community health outreach, harm reduction outreach specialist, or youth outreach coordinator were categorized into the "Community Health Outreach Specialist."
- Organization type: The types of organizations making the job postings were recorded and coded into 12 categories: (1) government, (2) non-profit organizations (NPO), (3) educational

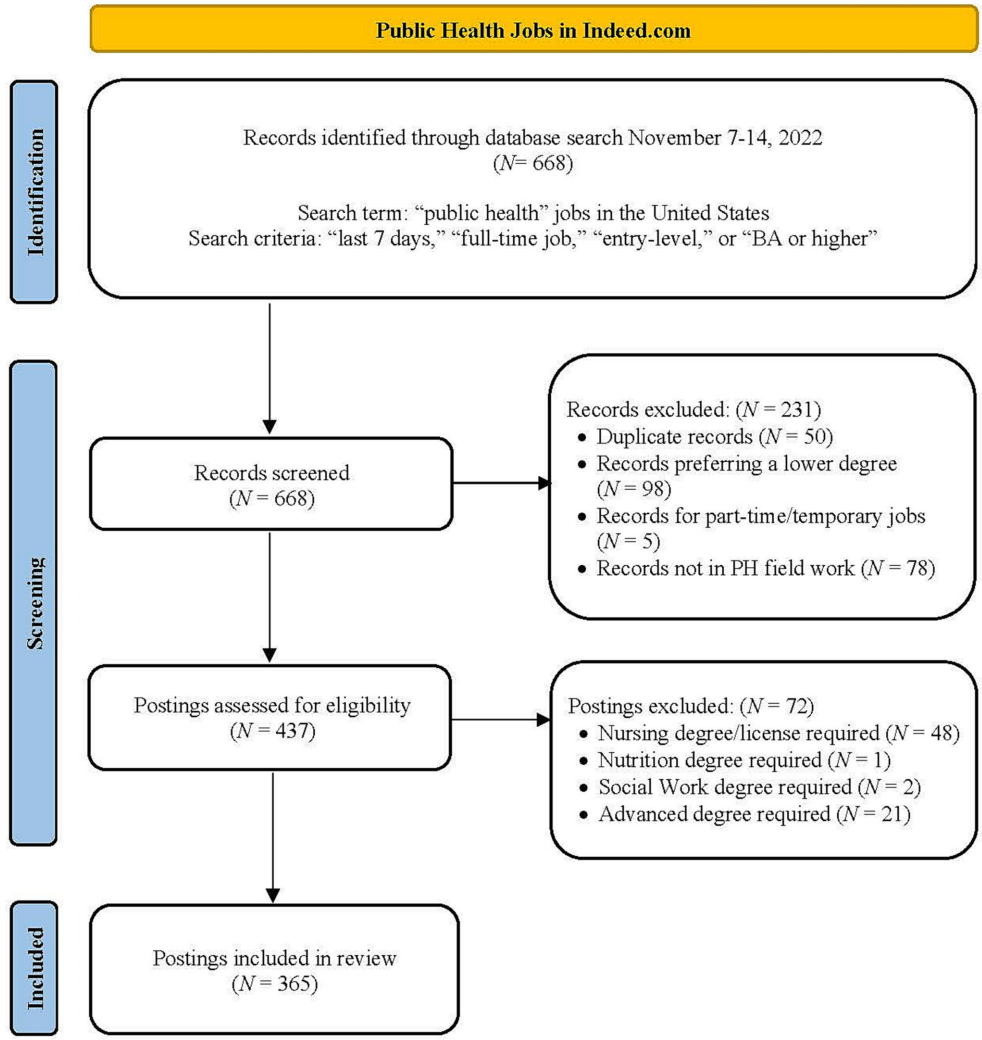

FIGURE 1
Search flow chart.

institution, (4) hospital, (5) healthcare provider, (6) medical center, (7) community center, (8) insurance company, (9) patient portal, (10) nursing home, (11) staffing agency, and (12) others.

- Educational degree required: Data was sorted for degree required; categories included (1) High school Diploma, (2) Associate Degree, and (3) Bachelor's Degree.
- Work experience expected: Information was extracted on how much work experience was expected to apply for the various available jobs.
- Location: Using the common way of referring to regions in the US, (27) the location of the vacancies across the US states was also recorded as (1) Northeast, (2) Southeast, (3) Midwest, (4) West, (5) Southwest, (6) Alaska, and (7) remote (anywhere).
- Preferred skills or competencies: Skills and competencies from each job description were coded into 35 categories.

Descriptive analysis on 365 postings was performed to report the most common job titles and requirements for the field by frequency and percentage distribution (Tables 1, 2) using Microsoft Excel v.2209 and SPSS v.28. Desired skills listed in job descriptions were extracted from the original spreadsheet and condensed into 35 categories (see Table 3 and Figure 2).

3. Results

3.1. Sample descriptive statistics

3.1.1. Job titles and organization types

In this study's sample of 365 job postings, 31 job titles were mentioned at notable frequencies. The most frequently posted position (15.07%) was for a Community Health Educator. The second-ranking job title was Community Health Worker (8.22%), followed by Prevention Specialist (5.48%). All other specific job titles were represented by less than 5% of the total postings (see Table 1 and Figure 3). Of the types of organizations posting bachelor-level public health jobs, government organizations were the most represented (34.45%), followed by NPOs at 25.48% (see Table 2). Educational institutions, which accounted for 8.77% of the organization postings, were responsible for most research-related postings (i.e., Research

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TABLE 1 Job titles ($N = 365$).

Job titles	*n*	%
Community Health Educator	55	15.07
Community Health Worker	30	8.22
Prevention Specialist	20	5.48
Nutritionist	18	4.93
Program Coordinator	17	4.66
Research Assistant/Associate	17	4.66
Infection Preventionist	13	3.56
Public Health Officer	13	3.56
Community Health Outreach Specialist	10	2.74
Population Health Coordinator	10	2.74
Program Manager	10	2.74
Public Health Analyst	10	2.74
Environmental Health Specialist	9	2.47
Research Analyst	8	2.19
Public Health Specialist	7	1.92
Research Coordinator	7	1.92
Data Analyst	6	1.64
Case Manager	5	1.37
Epidemiologist	5	1.37
Health Education Specialist	5	1.37
Prevention Educator	5	1.37
Program Specialist	5	1.37
Public Health Coordinator	5	1.37
Research Scientist	5	1.37
Bilingual Community Health Navigator	4	1.10
Dietitian	4	1.10
Disease Intervention Specialist	4	1.10
Nursing Home Administrator	4	1.10
Grant Coordinator	3	0.82
Health Counsellor	3	0.82
Prevention Coordinator	3	0.82
Other	45	12.33

TABLE 2 Sample descriptive statistics ($N = 365$).

Organization type	*n*	%
Government	125	34.25
Non-Profit Organization	93	25.48
Educational Institution	32	8.77
Hospital	29	7.95
Healthcare Provider	23	6.30
Staffing Agency	17	4.66
Medical Center	17	4.66
Community Center	14	3.84
Insurance Company	3	0.82
Patient Portal	3	0.82
Nursing Home	3	0.82
Others	6	1.64
Degree required		
High school Diploma	50	13.70
Associate Degree	29	7.95
Bachelor's Degree	286	78.36
Work experience required		
Less than 1 year	5	1.37
1 year	76	20.82
1–3 years	85	23.29
4 years and above	12	3.29
Some Experience	119	32.60
Intermediate Experience	1	0.27
Extensive Experience	2	0.55
Not Listed	65	17.81
Location		
Northeast	118	32.33
Southeast	86	23.56
Midwest	66	18.08
West	57	15.62
Southwest	27	7.40
Alaska	5	1.37
Remote	6	1.64

Assistant/Associate, Research Scientist, Research Analyst, and Data Analyst). Though entries that required medical degrees were excluded, 7.95% of public health job postings were at hospitals, 6.30% at healthcare providers, and 4.66% at other medical centers.

3.1.2. Degrees and work experience required

Since a bachelor's level education was one of the inclusion criteria, the majority of job postings required a bachelor's degree (78.36%). Some postings requiring only a high school diploma (13.70%) or an associate degree (7.95%) were not screened out because those posts also listed a bachelor's degree as "preferred." Nearly one third (32.60%) of job postings required "some experience," 23.29% sought workers with 1–3 years of experience, and 20.82% required 1 year of experience. Employers did not expect lengthy experience for the positions, as only 3.29% required 4 or more years of experience, and less than 1% each required either "intermediate experience" (0.27%) or "extensive experience" (0.55%) (see Table 2).

3.1.3. Job locations

The geographic distribution of job postings was consistent with regional population densities. For instance, the more densely populated Northeastern region of the US accounted for 32.33% of job posts (118 out of 365). The Southeastern region, with large population centers and rural areas, accounted for 23.56% of postings, followed by the Midwest (18.08%), which is similarly disparately populated. The West and Southwestern portions of the country represented 15.62 and 7.40% of

TABLE 3 Preferred skills and competencies ($N = 365$).

Skills	*n*	%
Public health communication and campaigns - outreach/intervention	337	92.33%
Public health education and promotion	311	85.21%
Cultural competency - sensitivity to population-specific issues	275	75.34%
Project development, implementation, management, and compliance	244	66.85%
Case management skills – referrals and assessments	208	56.99%
Administrative and organizational skills	204	55.89%
Technical writing, grant writing, reports, and manuscripts	167	45.75%
Data collection and analysis	148	40.55%
Software competency – MS Office and data analysis software	134	36.71%
Documentation and reporting of project activities	130	35.62%
Multi-agency/cross-sectoral communication	124	33.97%
Health Program evaluation and improvement	120	32.88%
Collaboration and partnerships	118	32.33%
Behavioral and mental health issues	95	26.03%
Infectious and chronic disease prevention and control	95	26.03%
Health informatics – data management and visualization	72	19.73%
Environmental – health planning, investigation, and assessment	59	16.16%
Health policy development, implementation, and analysis	58	15.89%
Environmental – industrial hygiene and occupational safety	56	15.34%
Epidemiology and disease surveillance	56	15.34%
Public health leadership	46	12.60%
Work with at-risk populations	46	12.60%
Problem solving and critical thinking	43	11.78%
Financial management, budget, grant management	37	10.14%
Literature review and reporting	35	9.59%
Develop and conduct surveys	31	8.49%
Quantitative research methods and statistical analysis	24	6.58%
Disaster preparedness and emergency management	23	6.30%
Develop and implement behavior change intervention plan	19	5.21%
Communication - using media for health promotion	18	4.93%
Food and water safety concerns	18	4.93%
Evidence-based intervention and best practices	18	4.93%
Experience with electronic health records	15	4.11%
Needs assessment	8	2.19%
Qualitative research methods and analysis	7	1.92%

postings, respectively. Five (1.37%) job postings were in Alaska, and six (1.64%) were remote positions (see Table 2).

3.2. Preferred skills and competencies

3.2.1. Skills mentioned in more than 50% of job postings

Almost all (92.33%) of job postings required strong communication skills, both oral and written, especially pertaining to public health outreach and intervention. Of nearly equal importance, with 85.21% of postings represented, were community health education and promotion skills. This included the creation and evaluation of educational material to be shared in both broad interventions and for at-risk population groups, as determined by the nature of the organization or project. Cultural competency and sensitivity to population-specific needs were also foremost concerns, as seen in 75.34% of the postings. Some demands of this category of skill included bi- or multi-lingual capabilities and specific knowledge of populations, stage-of-life, and developmental needs, such as maternal-child health

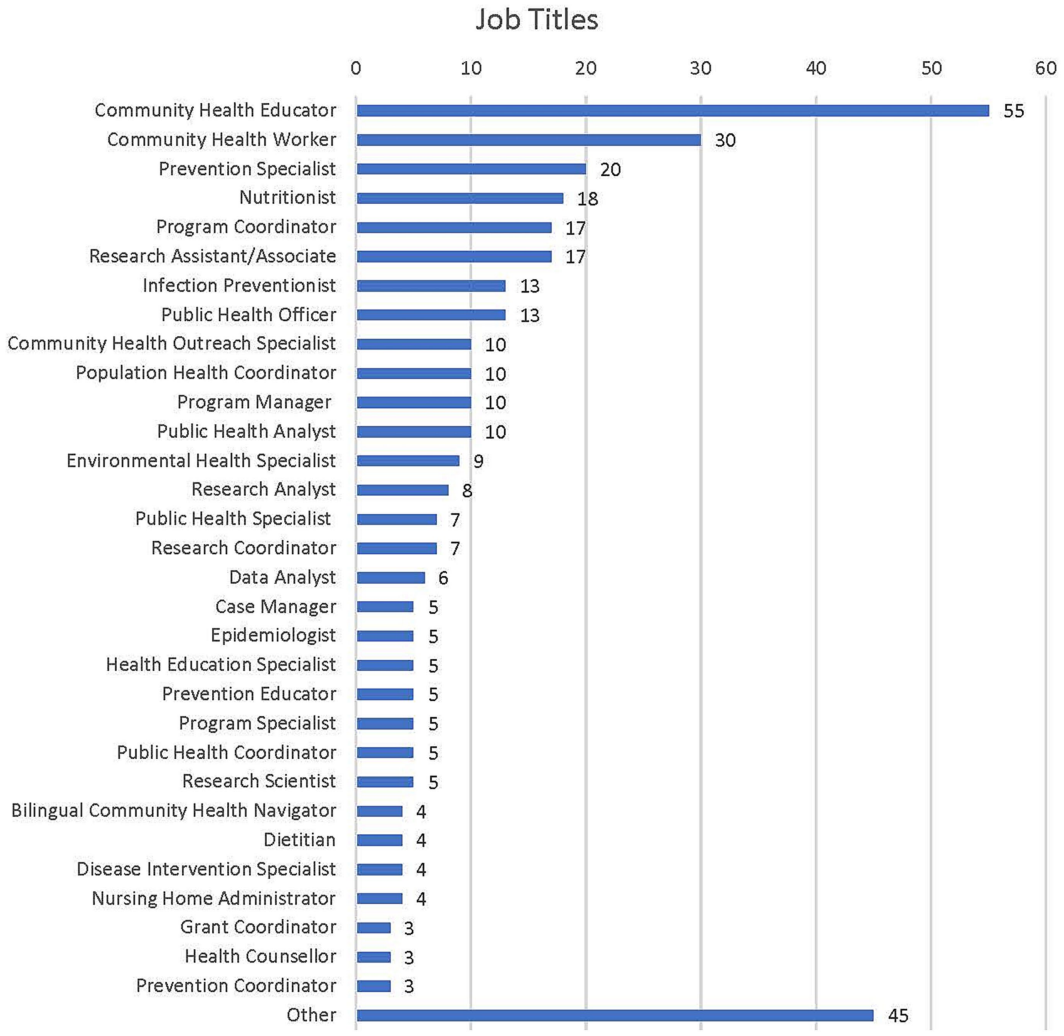

FIGURE 2
Job titles, frequency (*N* = 365).

and geriatric issues. The capacity to administer a project from development through evaluation was also a highly sought-after skill (66.85%). Mentions of administrative and organizational aptitude were also prevalent (55.89%) outside of the context of project management.

3.2.2. Skills mentioned in between 25 and 50% of postings

Nine skills and competencies were listed by 25–50% of all employers. Technical writing skills, with 167 mentions in the data (45.75%), refer to a higher level of written communication skills, including grant writing as well as the development of project reports and manuscripts. Data collection and analysis were listed in 40.55% of job postings, with data analysis software capability and computer competency close behind (36.71%). The ability to document and report project activities was specified by 35.62% of employers. Cross-sectoral team communication (33.97%) and the capacity to work in multi-agency relationships and collaborations (32.33%) were also listed in this data segment. Health program evaluation was listed in 32.88% of the job postings. Also included were two public health specializations: behavioral and mental health and infectious and chronic disease prevention and control; both were specified in 26.03% of the postings.

3.2.3. Skills listed in between 10 and 25% of job postings

Skills in health informatics, including data management and visualization, were sought in 72 postings (19.73%). Related competencies in epidemiology and disease surveillance were mentioned by 15.34% of employers. Skills in health planning and investigation, as well as industrial hygiene and occupational safety, were included in 16.16 and 15.34% of posts, respectively. Knowledge about policy implementation and analysis was mentioned by 15.89% of employers. Leadership and supervisory competency were noted by 12.60% of employers, as was skill with specific at-risk populations (for instance, incarcerated populations and domestic violence survivors). The phrases "problem solving" and/or "critical thinking" were noted 43 times. Skills related to budgeting, grant management, or other financial competencies were listed in 10.14% of posts.

3.2.4. Skills listed in less than 10% of postings

The ability to conduct a literature review and report findings was explicitly mentioned by 9.59% of employers. This category also included the capacity to develop and conduct surveys (8.49%), quantitative research methods (6.58%), and qualitative research

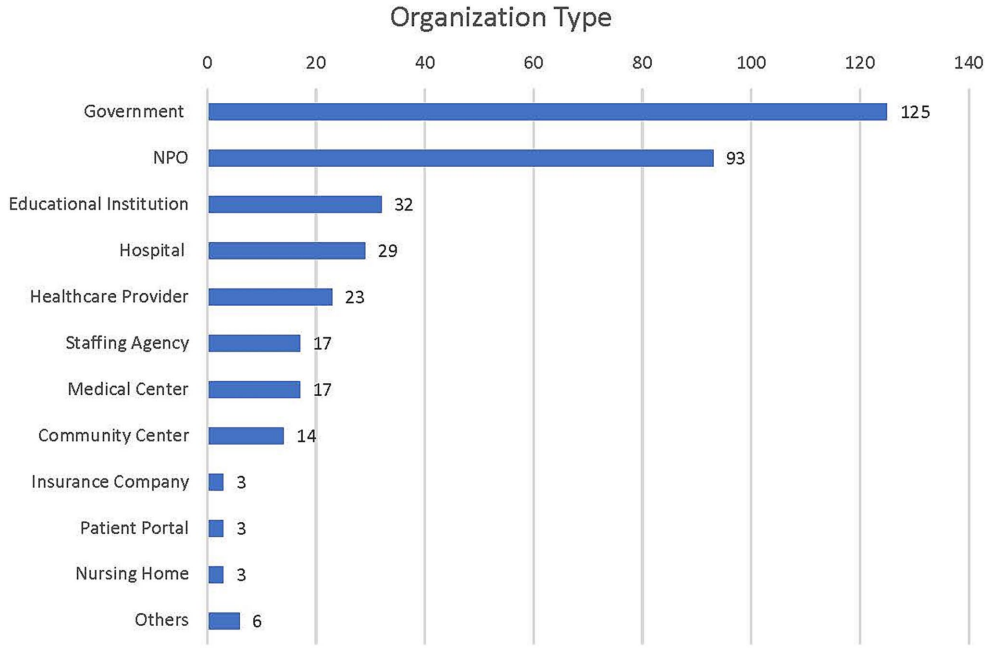

FIGURE 3
Organization type, frequency (N = 365).

methods (1.92%). Training in disaster preparedness and emergency management was mentioned 23 times (6.30%); there were 19 references (5.21%) to behavior change intervention planning. Experience with mass media for public health promotion was required by 4.93%, as was knowledge of food and/or water safety and competencies with evidence-based interventions and best practices. Fifteen postings mentioned experience with electronic health records (4.11%), and eight (2.19%) referred to "needs assessment."

4. Discussion

In this study, we examined the job skills required at the bachelor's level by public health employers in the US over the course of 1 week in 2022. This study provides a snapshot of public health workplace skill demands for those with an undergraduate education. The field of public health is constantly evolving, and changes in the field need to be evaluated regularly to track progress in public health trends and ensure that education for public health efforts meets the demands of the workforce.

Results of the study indicate that the WHO's projection of a healthcare workforce shortage is well-founded (8). More than one third (34.45%) of job postings were from government employers, yet Plepys et al.'s (10) study of first-destination employment for public health graduates found that just 17% of the study participants were going to work for the government. Our study is reflective of late or post-pandemic trends, which may account for a greater demand as many health workers have dealt with various degrees of "burnout" from the stress of the pandemic (7). As Plepys et al.'s (10) data were gathered pre-pandemic, additional research is needed on the nature of this discrepancy. The analysis of PH WINS data, which solely examines data from the governmental public health workforce, indicates that while about 37% of public health workers have only a bachelor's-level degree, only 14% have a degree at any level with a public health focus (28). Thus, governmental public health employers are hiring individuals without public health training. Identifying the cause of this discrepancy and ascertaining a plan to remedy it is outside the realm of this study, but Locke's et al.'s (29) examination indicates that dissatisfaction with pay and a lack of opportunity for advancement were the top two reasons workers listed for intending to leave governmental public health positions. Both of these were indicated by more than half of the younger generations of workers (29). A closer examination of economic implications of the governmental public health workplace may be in order to explore this issue further.

Data from our study reinforces the understanding of public health as a multidisciplinary field. As there is no clear majority of job titles represented in the data, we can ascertain that the field of public health includes a broad spectrum of potential employment opportunities. The challenge for universities is to provide the competencies needed in an undergraduate setting for a wide array of jobs. The three skills listed in 75% or more postings were: (1) communication and campaigns (92.33%), (2) education and promotion (85.21%), and (3) cultural competency (75.34%), align with Zemmel et al.'s (22) qualitative study of public health workforce development needs, which found that communication skills were perceived to be the most important in the field. Cultural competency is another important skill that receives attention from many researchers investigating gaps in public health worker training (16, 30), thus, verifying the need for cultural competency and population-specific sensitivity.

Job skill results positively reflect on the National Consortium for Public Health Workforce Development's specialized and

strategic skills model (13). Even if specific terms, such as "systems thinking" and "change management," were not used in job descriptions, investigation reveals that many of the qualities sought are components of larger skills sets. For instance, "systems thinking" – a set of methodologies that recognizes complexity and interconnectivity and seeks solutions from a variety of perspectives (31) – could be found in data categories such as collaboration and partnerships (listed by 32.33% of employers), multi-agency/cross-sectoral communication (33.97%), public health leadership (12.60%), and project development, implementation, and management (66.85%). Similarly, "change management," the skills necessary to facilitate organizational change, including leadership, communication, and organizational skills (32), include many of the same categories as "systems thinking" skills.

Other strategic competencies, such as "persuasive communication," "data analytics," and "diversity and inclusion" are more easily recognized in the preferred skillset and demanded in over 40% of the job postings. Apart from "health education," which is listed in 85.21% of job postings, the specialized skills (communicable disease control, chronic disease and injury prevention, environmental public health, epidemiology, and maternal, child, and family health) are narrowly but evenly distributed within the range of preferred skills data. For instance, "epidemiology and disease surveillance" was listed in 15.34% of postings, and the skill category of "infectious and chronic disease prevention and control" was required in 26.03% of postings. Our analysis validates the National Consortium for Public Health Workforce Development's conclusion that certain skills are useful, regardless of a specific public health focus. We echo the consortium's call for an increased focus on "strategic skill" competencies in public health education (13).

Two other trends in public health employment met with surprising results in our data analysis. First, studies indicate that public health workers have skill gaps pertaining to financial management (16, 18, 23), with one study finding that up to 55% of public health employees self-report skill gaps pertaining to budgeting (23). Interestingly, financial management and budgeting (including grant management) were only listed in 10.14% of postings at the bachelor's level. This may indicate that financial skills are being underestimated by employers as they assemble job descriptions, or are not a skill expected at the undergraduate level of public health training (18). Second, while none of the four skill categories related to environmental health or climate change ("food and water safety," "disaster preparedness and emergency management," "industrial hygiene and occupational safety," and "health planning and investigation") were listed by more than 20% of employers, their representation in the preferred skill list totals 42.73%. Krasna et al.'s (3) study of public health job postings over a span of 16 years posits that this niche is valued, expanding, and could grow rapidly in the coming decade.

Similarly, many recent studies have examined the growing role of health informatics in public health applications (12, 25, 33). Three job titles related to data analysis ("Public Health Analyst," "Research Analyst," and "Data Analyst") accounted for 24 positions. "Health Informatics: data management and visualization" was listed as a required skill in 19.7% of postings, and 40.55% of postings included "data collection and analysis." Like climate-related public health, informatics is another rapidly-evolving field of study that demands our attention as we anticipate future public health needs (4, 26).

4.1. Limitations

As we sought to investigate current public health workforce demands, this study is limited to a small window of time. Therefore, our results are reflective only of the time period for the postings included in this study. Also, just one employment website was used to collect job postings for this study. It is possible that other web postings would have provided a slightly different profile of results. Thus, future studies should expand our search criteria by using multiple sources and a broader data collection period to develop a better understanding of employers' expectations. Our study was also restricted to job postings within the US, which may limit the relevance of our study for international scholars. This study is of national scope and does not address regional differences in workplace demand. We acknowledge that there could be different skill demands in different regions of the US and hope that this study may inspire further investigation. In addition, this analysis is an exploratory component of an effort to revise our undergraduate public health curriculum to align with the skillset desirable in the current workforce. Therefore, we do not have the outcomes of our curriculum revisions available at this point.

4.2. Public health implications

Our goal in this study was to examine the skill demands of the current public health workplace for those with a bachelor's degree and to ascertain the desired skills and competencies sought by public health employers in the US. Results revealed the most sought-after skillset required in the current public health job market and may give higher education administrators additional evidence necessary to align their curricula to adequately prepare students for the public health workforce. In the multidisciplinary field of public health, it remains critical for educators to consider real-world workplace demands (34). An honest evaluation of the industry requirements and training gaps will fuel critical changes in the undergraduate curricula and important updates in the competencies to train the future public health workforce. This detailed evaluation of a slice of the public health labor marketplace for undergraduate-level jobs, with a focus on the skills and competencies most demanded by employers, will contribute to on-going efforts to reform public health education at the undergraduate level and lead to a healthier future for our communities, nation, and world.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

AJ and SK conceived and designed this study. GL collected and collated the data. SK and CE sorted and coded the data, then wrote the

first draft of the manuscript. AJ, LM, and EB contributed to further thematic development of the manuscript. All authors made substantial contributions to the revision of the manuscript, read and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

References

1. ASPPH. (2019) Annual Report 2019. Available at: https://aspph.org/about/annual-report-pages/annual-report-2019/

2. U.S. Bureau of Labor Statistics. Employment projections: 2021-2031 summary - 2021 A01 results. (2022). Available at: https://www.bls.gov/news.release/ecopro.nr0.htm

3. Krasna H, Czabanowska K, Jiang S, Khadka S, Morita H, Kornfeld J, et al. The future of careers at the intersection of climate change and public health: what can job postings and an employer survey tell us? *Int J Environ Res Public Health*. (2020) 17:1310. doi: 10.3390/ijerph17041310

4. Bashier H, Ikram A, Khan MA, Baig M, Gunaid MA, Nsour MA, et al. The anticipated future of public health services post COVID-19: viewpoint. *JMIR Public Health Surveill*. (2021) 7:e26267. doi: 10.2196/26267

5. Morabia A. The public health we need. *Am J Public Health*. (2020) 110:923–4. doi: 10.2105/AJPH.2020.305731

6. Treviño-Reyna G, Czabanowska K, Haque S, Plepys CM, Magaña L, Middleton J. Employment outcomes and job satisfaction of international public health professionals: what lessons for public health and COVID-19 pandemic preparedness? Employment outcomes of public health graduates. *Int J Health Plann Manag*. (2021) 36:124–50. doi: 10.1002/hpm.3140

7. Stone KW, Kintziger KW, Jagger MA, Horney JA. Public health workforce burnout in the COVID-19 response in the U.S. *Int J Environ Res Public Health*. (2021) 18:4369. doi: 10.3390/ijerph18084369

8. Krasna H, Czabanowska K, Beck A, Cushman LF, Leider JP. Labour market competition for public health graduates in the United States: a comparison of workforce taxonomies with job postings before and during the COVID-19 pandemic. *Int J Health Plann Manag*. (2021) 36:151–67. doi: 10.1002/hpm.3128

9. ASPPH. (2021) Annual Repor 2021. Available at: https://aspph.org/about/annual-report-pages/annual-report-2021/

10. Plepys CM, Krasna H, Leider JP, Burke EM, Blakely CH, Magaña L. First-destination outcomes for 2015-2018 public health graduates: focus on employment. *Am J Public Health*. (2021) 111:475–84. doi: 10.2105/AJPH.2020.306038

11. Amos K, Levy NA, Bialek R, Arana M, Murrman M. Developing complex, cross-cutting skills in the public health workforce: using a crosswalk analysis to map public health competencies to strategic skills for the governmental public health workforce. *J Public Health Manag Pract JPHMP*. (2022) 28:536–40. doi: 10.1097/PHH.0000000000001532

12. McLane TM, Hoyt R, Hodge C, Weinfurter E, Reardon EE, Monsen KA. What industry wants: an empirical analysis of health informatics job postings. *Appl Clin Inform*. (2021) 12:285–92. doi: 10.1055/s-0041-1726423

13. National Consortium for Public Health Workforce Development. *Building skills for a more strategic public health workforce: A call to action*. Bethesda, Maryland: de Beaumont Foundation (2019).

14. Pearsol JAssociation of State and Territorial Health Officials. (2022). Seven trends will shape the future public health workforce. Available at: https://www.astho.org/communications/blog/seven-trends-will-shape-the-future-public-health-workforce/

15. Ye J, Leep C, Robin N, Newman S. Perception of workforce skills needed among public health professionals in local health departments: staff versus top executives. *J Public Health Manag Pract JPHMP*. (2015) 21:S151–8. doi: 10.1097/PHH.0000000000000299

16. Taylor HL, Yeager VA. Core competency gaps among governmental public health employees with and without a formal public health degree. *J Public Health Manag Pract JPHMP*. (2021) 27:20–9. doi: 10.1097/PHH.0000000000001071

17. Martin LT, Chandra A, Nelson C, Yeung D, Acosta JD, Qureshi N, et al. Technology and data implications for the public health workforce. *Big Data*. (2022) 10:S25–9. doi: 10.1089/big.2022.0208

18. McCullough JM. The financial and business analysis capacities of the state and local public health workforce. *J Public Health Manag Pract*. (2019) 25:S145–56. doi: 10.1097/PHH.0000000000000913

19. DeSalvo KB, Wang YC, Harris A, Auerbach J, Koo D, O'Carroll P. Public health 3.0: a call to action for public health to meet the challenges of the 21st century. *Prev Chronic Dis*. (2017) 14:14. doi: 10.5888/pcd14.170017

20. WHO. Social determinants of health. (2023). Available at: https://www.who.int/health-topics/social-determinants-of-health

21. Shah GH. Public health education and changing public health realities in the public health 3.0 era. *Am J Public Health*. (2021) 111:336–8. doi: 10.2105/AJPH.2020.306100

22. Zemmel DJ, Kulik PKG, Leider JP, Power LE. Public health workforce development during and beyond the COVID-19 pandemic: findings from a qualitative training needs assessment. *J Public Health Manag Pract*. (2022) 28:S263–70. doi: 10.1097/PHH.0000000000001524

23. Bogaert K, Castrucci BC, Gould E, Rider N, Whang C, Corcoran E. Top training needs of the governmental public health workforce. *J Public Health Manag Pract JPHMP*. (2019) 25:S134–44. doi: 10.1097/PHH.0000000000000936

24. Bogaert K, Papillon G, Wyche Etheridge K, Plescia M, Gambatese M, Pearsol JL, et al. Seven years, 3 surveys, a changed world: the state public health workforce 2014-2021. *J Public Health Manag Pract*. (2023) 29:S14–21. doi: 10.1097/PHH.0000000000001645

25. McFarlane TD, Dixon BE, Grannis SJ, Gibson PJ. Public health informatics in local and state health agencies: an update from the public health workforce interests and needs survey. *J Public Health Manag Pract*. (2019) 25:S67–77. doi: 10.1097/PHH.0000000000000918

26. Joshi A, Bruce I, Amadi C, Amatya J. Developing evidence-based population health informatics curriculum: integrating competency based model and job analysis. *Online J Public Health Inform*. (2021) 13. doi: 10.5210/ojphi.v13i1.11517

27. National Geographic Society. United States Regions (2022). Available at: https://education.nationalgeographic.org/resource/united-states-regions

28. de Beaumont Foundation. *PH WINS 2021 Findings*. Bethesda, Maryland: de Beaumont Foundation and Association of State and Territorial Health Officials (2022).

29. Locke R, Gambatese M, Sellers K, Corcoran E, Castrucci BC. Building a sustainable governmental public health workforce: a look at the millennial generation. *J Public Health Manag Pract JPHMP*. (2022) 28:E198–210. doi: 10.1097/PHH.0000000000001247

30. McKeever J, Leider JP, Alford AA, Evans D. Regional training needs assessment: a first look at high-priority training needs across the United States by region. *J Public Health Manag Pract*. (2019) 25:S166–76. doi: 10.1097/PHH.0000000000000946

31. Khalil H, Lakhani A. Using systems thinking methodologies to address health care complexities and evidence implementation. *JBI Evid Implement*. (2021) 20:3–9. doi: 10.1097/XEB.0000000000000303

32. Phillips J, Klein JD. Change management: from theory to practice. *TechTrends*. (2022) 67:189–97. doi: 10.1007/s11528-022-00775-0

33. Joshi A. Population health informatics opportunities and challenges. Ashish Joshi Website (2019). Available at: https://ashishjoshi.me/population-health-informatics-opportunities-and-challenges/

34. Joshi A, Gertner R, Roberts L, El-Mohandes A. An evidence-based approach on academic Management in a School of public health using SMAART model. *Sustainability*. (2021) 13:12256. doi: 10.3390/su132112256

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Exploring the spiritual foundations of public health leadership

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The Covid-19 pandemic has laid bare the challenges of public health leadership. Faced with criticism, threats, and even violence, many public health leaders have left the field. A healthier future for the nation may well rest on training aspiring public health leaders to build deeper capacity for perseverance, healing, and resilience. Reflecting the growing experience of a team of public health educators at the Harvard T.H. Chan School of Public Health (Harvard Chan), this article offers recommendations for public health schools to recognize, and incorporate into leadership education, themes of spirituality—ie, the way people seek ultimate meaning and purpose and deep connectedness to something larger than themselves. Doing so can serve as a foundation for the lifelong journey of leadership. Over the past decade, Harvard Chan has incorporated meaning, purpose, and connectedness themes to complement more traditional coursework addressing research and translation. While many established leadership frameworks address the "what" and "how" of career development, the spirituality framework can support aspiring leaders to more fully understand their "why" and its alignment with challenging work. Such a deeply personal topic, traditionally kept private, has been shared and nurtured in Harvard Chan classrooms through a range of pedagogical strategies including personal reflection, one-on- one coaching, experiential learning, case discussions, and candid conversations with public health leaders. By encouraging a values-based foundation for decision-making in crises and difficult leadership moments, such grounding can help aspiring leaders navigate the challenges of public health leadership that inevitably lie ahead.

KEYWORDS

spirituality, leadership, public health, education, meaning, purpose, resilience

Introduction

Covid-19 has laid bare the challenges of public health leadership. Through the pandemic, leaders struggling to provide health guidance to an anxious public have endured searing experiences involving harassment, threats, and even violence (1). Such unsettling and even traumatic episodes have contributed to a steady exodus from the field (2, 3). According to some estimates, at least 500 top national and local public health leaders had, just a year into the pandemic, resigned or been fired (4). Moreover, almost half of the state and local public health workers left their jobs (4).

The nation's ability to not only weather such health crises but also build better systems for the future may well rest on explicit training to build motivation, stamina, and resilience for aspiring leaders (5). In this article, we describe how one public health school has attempted to achieve such goals by steadily incorporating themes of meaning, purpose, and connectedness into leadership education. Such themes can be broadly captured under the term "spirituality,"

defined in an international consensus conference as "a dynamic and intrinsic aspect of humanity through which persons seek ultimate meaning, purpose, and transcendence, and experience relationship to self, family, others, community, society, nature, and the significant or sacred" (6). For some, spirituality involves connection to organized faith traditions. For others, it involves connection with a cause or some significant entity that is greater than themselves. People can be spiritual but not religious; indeed, those who identify as atheists and agnostics can be, according to this definition, highly spiritual. But for all people, such themes are deeply personal, often rooted in cultural upbringing, and/or associated with major life experiences that shape values and beliefs (7).

To date, public health leadership educators have largely overlooked these themes. A review of the literature shows virtually no attention to the spirituality theme as part of public health leadership education. Over the past decade, however, our teaching team at the Harvard T.H. Chan School of Public Health (Harvard Chan) has steadily curated a curriculum that explicitly calls out meaning, purpose, and connectedness as fundamental to leadership. In this article we briefly describe this approach and its rationale, together with reflections on ways such spiritual dimensions might complement other leadership competencies more frequently noted in the published literature (8).

Public health leadership education and spirituality

Leadership poses extraordinary challenges for public health, a field in which highly complex and seemingly unsolvable problems characteristically abound. Often enormous in scale and impacting populations broadly, public health challenges usually, if not inevitably, fall outside the control of a single authority in volatile and politicized setting that involve passionate stakeholders, powerful vested interests (9) and controversies about how best to distribute finite resources to address infinite needs (10). Moreover, the field, by definition, requires performing "on stage," with leaders subjected to intense scrutiny and where everything is "fair game for comment, criticism, and interpretation (or misinterpretation)" (11).

Despite these challenges, only 55% of accredited public health schools offer any kind of course on public health leadership (12). Even when they do, the emphasis is more often, as noted by Ganz, on external strategy ("head") and action ("hands"), and less often on the personal narrative of motivation ("heart") (13). However, Sinek advocates "starting with why"— ie, "working from the inside out"—as a way for aspiring leaders to ground their work and actions in a foundation of meaning, purpose, and connectedness (14). Guiding one's work in this way also equips students to better connect with the "who," ie, the "Ps" of public health— that include policymakers, purchasers, and the press, not to mention passionate advocates and penurious budget officials (5, 9, 15). In this way, leaders can better recognize the source of both their motivations and biases, persevere through crises (9), include other voices in collective action, navigate uncertainty, and ultimately find renewed and deeper meaning and purpose. Solidifying this foundation readies them, in a way current training systems may not, to lead teams, organizations, and systems in whatever the future befalls them.

A recent national expert panel has similarly urged more integration of the worlds of spirituality and health, given growing evidence of their strong links (16). One relevant meta- analysis of 10 prospective studies of ~136,000 participants associated a high sense of purpose in life with a reduced risk for all-cause mortality and cardiovascular events (adjusted pooled relative risk = 0.83) (17). Another recent comprehensive study by Balboni et al. (16) analyzed the century's nearly 600 highest-quality related studies (2000–2022) on the subject and associated spirituality with greater years of life and health-related quality of life.

Public health can also learn from other sectors that have demonstrated the value of incorporating spirituality themes in enhancing leadership. In business, for example, Fry and colleagues have found their model of spiritual leadership in the workplace linked to greater organizational commitment and productivity (18) through a heightened sense of "engagement of the whole person," belonging, and life satisfaction (19). In medical education, the concept of finding a sense of professional belonging has been called "socialization into profession" (20). The field of public health may be particularly amenable to such themes, as it inherently features a sense of mission and calling, especially through difficult times like a pandemic.

Encouraging public health students to share the origins of their "why" in classroom discussion may free them to let down their guard, "bring their whole self" to discussions, and convey authenticity and transparency. It can also provide a means to connect to a shared sense of purpose, promote empathy, build genuine curiosity and appreciation for others' motivations, and cultivate the sense of interdependence so elusive in the vitriol of the pandemic (21). This approach has the potential to advance for students the overarching educational goal of fostering "confidence in their authentic self rather than trying to adhere to a prescribed definition of leadership" (22).

Addressing the "why" in the classroom to understand diverse views and belief may lead some students to share strong personal beliefs of faith and religion. For some listeners, that may trigger discomfort and concerns about inclusivity and vulnerability; indeed, explicit expressions of religion may be helpful for many while hurtful for many others. However, it can be argued that such sharing in a student-centered approach can offer healing in the midst of difficult conversations regarding issues of pain and even trauma. Frankl has noted, that "life is never made unbearable by circumstances, but only by lack of meaning and purpose" (23) and as noted by Miller, Gupta, and others, many religions highlight themes common in public health, regardless of specific faith (24, 25). From his personal teaching experience, the lead author of this paper regularly asks students to reflect on if, and how, spirituality has impacted their public health leadership journey. In general, students appreciate direct conversations about spirituality, although some have also been explicit about how religion has negatively impacted their lives. Meanwhile, theologians from different denominations regularly emphasize themes of human interconnectedness, service to others, and discovering deeper meaning in difficult times. Thich Nhat Hanh noted "our own life has to be our message" (26). Martin Luther King noted that we are all a part of "…an inescapable network of mutuality, tied in a single garment of destiny. Whatever affects one directly, affects all indirectly" (27) and William Sloane Coffin urged that we should "care most for those society counted least and put last" (28).

Integrating spirituality themes into public health leadership education at Harvard Chan

Over the past decade, Harvard Chan has encouraged students to clarify their meaning, purpose, and sense of connectedness as a foundation for their professional journey.

Introduction to the topic starts on the opening day of orientation, where faculty note that a sense of vocation and mission can be integral to the profession. In fact, in an orientation poll, when students are asked to choose between "I never thought I would be attending a public health school but here I am" versus "I always knew I wanted to attend a public health school," the results, routinely 2:1 in favor of the former, regularly spark discussions about calling and vocation as part of a public health career. Students can dig deeper in the related orientation workshop "Calling to Public Health," where they share values and beliefs that fuel their professional aspirations.

Harvard Chan also offers additional optional opportunities for students to explore their leadership "why." The non-credit Public Health Leadership Lab, a semester-long co- curricular program with weekly workshops, provides students a venue to develop a greater understanding of their motivations through shared reflection. Such workshops focus on attentive listening to self and others as a basis for understanding organizations and systems. Faculty model how listening can serve as a powerful method of staying connected to one's purpose and that of others. Interested students can also seek peer coaching as well as executive coaching by seasoned mentors. Moreover, several elective leadership courses allow students to pose questions about motivation, meaning and purpose to guest speakers with storied public health careers captured in case studies. Qualitative program evaluation through classroom feedback surveys and course evaluations are used for continuous curriculum revision.

In addition, the Doctor of Public Health (DrPH) program starts each cohort with a year-long development course on "personal mastery," one of five disciplines identified by organizational leadership expert Peter Senge as essential to leading large-scale systems change (29). Personal mastery emphasizes clarifying one's vision, values, strengths, and weaknesses through the lens of connection to purpose, self, and others. Other DrPH courses focus on leading teams and addressing systems change. And the culminating doctoral project requires a leadership development statement grounded in students' purpose and values.

In such educational efforts, students can then integrate inquiry and reflection about meaning, purpose, and connectedness into learning from established leadership theories. Pedagogical methods, which include regular contemplative practices that encourage mindfulness (awareness and attention), journaling, listening, and structured dialog are drawn from a diverse and expansive collection of contemplative practices from wisdom traditions, adult development research, leadership development pedagogy, and social movement organizing practices; works included are by experts such as Barry (30), Brown (31), Freire (32), Hemphill (33), Kabat-Zinn (34), Kegan and Lahey (35, 36), Kolb (37), Palmer (38), and Scharmer (39). Many established leadership development frameworks lend themselves to such integration, such as Goleman's Emotional Intelligence (40), George's Authentic Leadership Framework (41), Heifetz's and Linsky's Adaptive Leadership Framework (42), Edmondson's work on teaming and psychological safety (43), and Bennis' "Crucibles of Leadership" (44).

Bennis, for example, emphasizes that the best leaders are ones that can reframe crucible experiences—i.e., intense, unplanned and traumatic experiences that make one deeply question one's values and identity—to emerge stronger than before. Such themes reinforce writings by Nouwen who celebrated that the search for deeper meaning during tough life experiences can motivate wounded people to serve as "wounded healers" (11, 45). Such reframing additionally allows leaders to stay grounded in mission while developing the "existential flexibility" (46) essential for the challenges ahead. Such skills can complement the updated 2022 Lancet Commission Report on the future of public health education, which underscores the need for leaders who can leverage a range of competencies as part of their "education for life" (8).

Discussion and recommendations

> *"I used to think that leadership just required learning about leadership skills, but now I think that leadership development is a lifelong process that requires active and ongoing reflection."* (47)
>
> *-Harvard T.H. Chan Student Feedback, May 2022 Program Evaluation.*

Harvard Chan's leadership curriculum, while evolving over a decade, is still embryonic. To our knowledge, few, if any, published articles explore the link between public health leadership and spirituality. We hope that sharing our perspectives will prompt national dialog on how to further explore and support such fundamental and deeply personal themes for future public health leaders.

To promote future dialog, we propose that schools of public health consider the following recommendations to prepare leaders:

- Provide more opportunities for self- and systems- awareness practices in public health leadership education.
- Build a classroom culture of belonging where students can comfortably share their inner selves and listen respectfully to others share theirs as a way of building empathy, respecting differences, and even managing difficult conversations.
- Offer experiential learning opportunities in which exploration of self, purpose, and relationships are prioritized as much as traditional instruction in research methods and theories.
- Invite public health leaders to speak openly about their inner lives, their sources of support in navigating uncertainty and complexity, and their practices for healing.
- Build more explicit competencies in clarifying and refining values, purpose, and motivations for public health leadership work. Adding attention to spirituality could be considered for incorporation into future CEPH public health accreditation related to leadership competencies (48).

Conclusion

Students should not be left on their own to develop leadership skills essential to address pandemics and other highly complex challenges. Our experiences offer a way forward for public health schools to support students in exploring spirituality themes of ultimate meaning, purpose, and connectedness to something greater than themselves. In our view, such training has great potential to strengthen a foundation that encourages students to take the leap of faith that public health leadership necessarily entails.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material. Further inquiries can be directed to the corresponding author.

Author contributions

HK led the coordination and writing of the piece and contributed subject matter expertise on all topics discussed in the paper and recommendations. CT, FP, and CD contributed extensively to the sections on spirituality and public health education, the curriculum at the Chan School and recommendations. EL and CH contributed to the sections about spirituality, leadership, and recommendations. They also led all fact-checking and references efforts. All authors contributed to the article and approved the submitted version.

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Conflict of interest

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Publisher's note

References

1. Ward JA, Stone EM, Mui P, Resnick B. Pandemic-related workplace violence and its impact on public health officials, March 2020–January 2021. *Am J Public Health 1971*. (2022) 112:736–46. doi: 10.2105/AJPH.2021.306649

2. Orr JM, Leider JP, Kuehnert P, Bekemeier B. ANALYSIS: COVID-19 revealed shortcomings of the US public health system and the need to strengthen funding and accountability. *Health Aff*. (2023) 42:374–82. doi: 10.1377/hlthaff.2022.01234

3. Leider JP, Castrucci BC, Robins M, Hare Bork R, Fraser MR, Savoia E, et al. The exodus of state and local public health employees: separations started before and continued throughout COVID-19: study examines state and local public health agency employees intent to leave or retire in 2017 with actual separations through 2021. *Health Aff*. (2023) 42:338–48. doi: 10.1377/hlthaff.2022.01251

4. Baker M, Ivory D. *Why public health faces a crisis across the U.S. New York Times (online)*. (2021).

5. Koh HK. Educating future public health leaders. *AJPH*. 105:2385. doi: 10.2105/AJPH.2014.302385

6. Puchalski CM, Blatt B, Kogan M, Butler A. Spirituality and health: the development of a field. *Acad Med*. (2014) 89:10–6. doi: 10.1097/ACM.0000000000000083

7. Wigglesworth Cindy. Integral theory (also called AQAL theory) and its relationship to spiritual intelligence and the SQi assessment. Available at: https://deepchange.com/IntegralSpiritualIntelligence2011.pdf.

8. Frenk J, Chen LC, Chandran L, Groff EOH, King R, Meleis A, et al. Challenges and opportunities for educating health professionals after the COVID-19 pandemic. *Lancet*. (2022) 400:1539–56. doi: 10.1016/S0140-6736(22)02092-X

9. Koh HK, Jacobson M. Fostering public health leadership. *J Public Health*. (2009) 31:199–201. doi: 10.1093/pubmed/fdp032

10. Koh HK. Navigating government service as a physician. *Health Educ Behav*. (2016) 43:7–10. doi: 10.1177/1090198115614318

11. Koh HK. The public health journey: the meaning and the moment. *Health Educ Behav*. (2013) 40:635–9. doi: 10.1177/1090198113501514

12. Hertelendy AJ, Chekijian S, McNulty E, Mitchell CL, Grimes JO, Durneva P, et al. Crisis leadership: a case for inclusion in accredited master of public health program curricula. *Public Health*. (2022) 209:14–8. doi: 10.1016/j.puhe.2022.05.012

13. Ganz M. *Why David sometimes wins: leadership, organization, and strategy in the California farm worker movement*. Oxford; New York: Oxford University Press; (2009). xvii–344.

14. Sinek S. *Start with why: how great leaders inspire everyone to take action*. East Rutherford: Penguin Publishing Group (2009).

15. Koh H. Leadership in public health. *J Cancer Educ*. (2009) 24:11–8. doi: 10.1080/08858190903400385

16. Balboni TA, VanderWeele TJ, Doan-Soares SD, Long KNG, Ferrell BR, Fitchett G, et al. Spirituality in serious illness and health. *J Am Med Assoc*. (2022) 328:184–97. doi: 10.1001/jama.2022.11086

17. VanderWeele TJ, Balboni TA, Koh HK. Health and spirituality. *J Am Med Assoc*. (2017) 318:519–20. doi: 10.1001/jama.2017.8136

18. Fry LW. Toward a theory of spiritual leadership. *Leadersh Q*. (2003) 14:693–727. doi: 10.1016/j.leaqua.2003.09.001

19. Fry LW, Latham JR, Clinebell SK, Krahnke K. Spiritual leadership as a model for performance excellence: a study of Baldrige award recipients. *J Manag Spiritual Relig*. (2017) 14:22–47. doi: 10.1080/14766086.2016.1202130

20. Dopelt K, Davidovitch N, Yahav Z, Urkin J, Bachner YG. Reducing health disparities: the social role of medical schools. *Med Teach*. (2014) 36:511–7. doi: 10.3109/0142159X.2014.891006

21. Koh HK, Nowinski JM. Health equity and public health leadership. *Am J Public Health*. (2010) 100:S9–S11. doi: 10.2105/AJPH.2010.191379

22. Lachance JA, Oxendine JS. Redefining leadership education in graduate public health programs: prioritization, focus, and guiding principles. *Am J Public Health*. (2015) 105:S60–4. doi: 10.2105/AJPH.2014.302463

23. Frankl VE. *Man's search for meaning. Rev. and updated* ed. New York: Washington Square Press/Pocket Books (1985). 221 p.

24. Gupta A. *Bridges across humanity*. Cambridge, MA: Rupa Publications (2023).

25. Miller L. *The awakened brain: the new science of spirituality and our quest for an inspired life. 1st* ed. New York: Random House (2021).

26. Thich Nhat Hanh. *The world we have: a Buddhist approach to peace and ecology*. Cambridge, MA: Parallax Press (2008).

27. King ML. Letter from a Birmingham jail. (1963). Available at: https://www.africa.upenn.edu/Articles_Gen/Letter_Birmingham.html (Accessed March 16, 2023).

28. Coffin WS Jr. *Letters to a young doubter. 1st* ed. Westminster: John Knox Press (2005).

29. Senge PM. *The fifth discipline: the art and practice of the learning organization*. New York: Doubleday/Currency (1990). 444 p.

30. Barry L. *Syllabus*. Montreal, Canada: Drawn & Quarterly (2019).

31. Brown AM. *Emergent strategy: shaping change, changing worlds*. Edinburgh, United Kingdom: AK Press (2017).

32. Freire P. *Pedagogy of the oppressed. 30th* ed. New York: Continuum (2000).

33. Hemphill P. *The wisdom of process*. In: T. Burke, B. Brown editors. *You are your best thing: vulnerability, shame resilience, and the black experience: an anthology*. 1st edn. New York: Random House (2021). p. 43–53.

34. Kabat-Zinn J. *Mindfulness for beginners: reclaiming the present moment--and your life*. Boulder, CO: Sounds True (2016).

35. Kegan R. *In over our heads: the mental demands of modern life*. Cambridge, MA: Harvard University Press (1994).

36. Kegan R. *An everyone culture: becoming a deliberately developmental organization. First eBook* ed. Boston, Massachusetts: Harvard Business Review Press (2016).

37. Kolb DA. *Experiential learning: experience as the source of learning and development*. Englewood Cliffs, NJ: Prentice-Hall (1984). xiii+256 p.

38. Palmer PJ. *A hidden wholeness: the journey toward an undivided life: welcoming the soul and weaving community in a wounded world (1st Edn.)*. San Francisco, CA: Jossey-Bass; (2004). xiii–208.

39. Scharmer O. *The essentials of theory U: core principles and applications*. Oakland: Berrett-Koehler Publishers (2018).

40. Goleman D. *Focus: the hidden driver of excellence. 1st* ed. New York, NY: Harper (2013).

41. George B. *Authentic leadership: rediscovering the secrets to creating lasting value (1st Edn.)*. San Francisco: Jossey-Bass; (2003). xix–217.

42. Heifetz RA, Linsky M, Grashow A. *The practice of adaptive leadership: tools and tactics for changing your organization and the world*. Boston, United States: Harvard Business Review Press (2009).

43. Edmondson A. Psychological safety and learning behavior in work teams. *Adm Sci Q*. (1999) 44:350–83. doi: 10.2307/2666999

44. Bennis WG. The seven ages of the leader. *IEEE Eng Manag Rev*. (2004) 32:45–5. doi: 10.1109/EMR.2004.25049

45. Nouwen HJM. Ministry by a lonely minister: the wounded healer. In: *The wounded healer*. 1st edn. New York: DoubleDay (1972). p. 79–96.

46. Sinek S. *The infinite game*. London, England: Portfolio Penguine (2020).

47. Tso C. *[Unpublished raw data from Public Health Leadership Lab Year-End Evaluation Survey]*. Harvard T.H. Chan School of Public Health. (2022).

48. Council on Education for Public Health (CEPH). *Accreditation criteria: schools of public health & public health programs*. Silver Spring, MD. (2021). p. 18. (Accessed September 29, 2023).

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The Learning Collaboratory: developing and evaluating public health students' skills while promoting community health

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Introduction: Complex and continuous developments in health and healthcare require innovative changes in programs that educate public health scientists and professionals. Public health change agents need critical competencies to confront today and tomorrow's leading problems including leadership, communication, interprofessional practice, and systems thinking.

The context: challenges in public health education: Public Health training programs teach competencies through their applied field experience and culminating project, typically late in the program, and often implemented in isolation from peers and faculty. Objectives and skills do not always align closely with community-based program needs. Students pursuing a degree in science in public health need to deeply comprehend multi-dimensional and interconnected systemic problems and communicate with diverse stakeholders across disciplines to produce relevant community-engaged research. The University of Miami Public Health Learning Collaboratory (LC) was established to transform the learning experience of public health master's students by providing opportunities to develop necessary core skills for effective public health practice early in their training, while applying these skills to address real-world public health needs in the community.

The Learning Collaboratory: structure, pedagogical approach and programmatic details: Spanning an average of 3 semesters, the LC promotes student involvement in collaborative and impactful capstone and thesis projects. Practice-based teaching and service learning are central approaches to teaching cross-cutting competencies of leadership, communication, problem solving, collaboration, and systems thinking in public health. Significant to the approach is the engagement of previous cohorts of senior students to teach back to junior students, further integrating concepts learned. Long term alumni feedback recognized strengths of the program, including its structure, teamwork & collaboration, critical thinking & problem solving, guidance, nurture & support, teaching back, and content & curriculum. Community partners agreed the LC prepared students to practice in the field of public health.

Discussion: The LC is a promising model for master's level public health education and community application, given the opportunities it provides to strengthen and integrate students' public health skills in a supportive environment, and enhance the transferability and sustainability of student and faculty's community public health work.

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experiential learning, community health, integrative learning experience, public health education, service learning

Introduction

Addressing continuous and complex challenges in public health and healthcare requires innovative approaches and well-prepared workers and scientists (1–6). To respond to challenges, such as rising health care costs and health disparities, public health education must provide a strong foundation in substantive and methodological areas, but also opportunities to strengthen cross-cutting professional competencies such as effective communication, community and cross-disciplinary collaboration, problem-solving, and leadership. Towards this end, over the years, several reports and guidance documents have been written about the significance and urgency of building professional competencies among public health students to prepare the change agents needed to confront the public health problems of today and the future (1, 2, 4, 7). In addition, the importance of interprofessional education and collaborative practice has been heightened by major organizations as instrumental to bringing about improvement in health for persons and communities. In 2021, the Council on Education in Public Health revised accreditation criteria for public health programs that have redefined the foundational knowledge and competencies for Master of Public Health (MPH) degrees. These criteria group foundational competencies across professional development domains, including leadership, communication, inter-professional practice and systems thinking (8). The culminating experience, defined under the new criteria as "applied practice experience" and "integrative learning experience," continues to be seen as a program's central educational component intended to strengthen the student's area of concentration and provide opportunities to learn and apply analytic, synthesis and evaluation skills (6, 9).

These cross-cutting professional skills are equally important for public health scientists, including Master of Science (MS) in public health students. For scientific findings to be influential in ultimately solving complex public health problems, students must be able to deeply comprehend multi-dimensional and interconnected systemic problems, communicate with diverse stakeholders and scientists across disciplines, and participate in "team science," that is "…research conducted by more than one individual in an interdependent fashion…" (5). This kind of research can generate more innovative, robust and influential science, but it is challenging to accomplish. It requires well-honed professional skills such as effective communication, community and cross-disciplinary collaboration, problem-solving, and leadership are fundamental.

Context: The challenge in public health education

Public health master training programs have been challenged to innovate their educational approaches to help students gain foundational competencies in public health and prepare students for the workforce. While traditional classroom courses play an important role in teaching public health concepts and may offer the chance to apply this knowledge, they might not routinely provide opportunities to practice these cross-cutting skills in real-life settings. Many training programs tackle the culminating experience (i.e., capstone, thesis) as the vehicle by which students obtain these competencies and offer these integrative learning opportunities. However, under this approach, students might begin their culminating experience late in the program, might implement it in isolation from peers and faculty, and partners in the community might be challenged with students arriving one at a time, with skills that might not align closely with community-based program needs. These limitations in approach were recognized by master's program advisors at the Department of Public Health Sciences, University of Miami. First, students began their culminating experiences late in the program, reducing opportunities for learning and ensuring these were impactful. Second, while students become immersed in community work during their capstones or considered the long-term impact of their thesis, they were frequently isolated from the master's program and fellow students, reducing valuable opportunities to integrate academic and practical work and to collaborate with peers and faculty. Finally, the public health work they conducted was often time-limited and discontinuous, given that the work often ended before goals were achieved. For example, a student might conduct an insightful needs assessment that identified high rates of substance abuse in a neighborhood and recommend strategies to address this, but the student did not have time to implement these strategies by the completion of their culminating experience. This discontinuity limited the utility of student's work and the service provided to surrounding communities, many of which have significant health needs. To address these shortcomings, the University of Miami Public Health Learning Collaboratory (LC) was established in 2014 as an educational initiative to transform the learning experience of master's students in public health by providing opportunities to develop core skills necessary for effective public health science and practice, and simultaneously apply these skills to address real-world public health needs. The objective of this –case study is to describe the structure and organization of the LC, its pedagogical framework, and to present an evaluation of the long-term results.

The Learning Collaboratory: Structure, pedagogical approach and programmatic details

The LC's teaching strategies are aligned with adult learning theories and models, emphasizing real application of concepts as well as experiential, practice based and service learning (10–12). Spanning an average of 3 semesters, the LC promotes student involvement in collaborative and impactful capstone and thesis projects. Students begin the LC during their first semester in the public health program

by enrolling in a 3-credit course (Fall), alongside other new students. This initial course is comprised of small groups of students and community partners around common thematic areas of interest, such as Access to Health Care, Health in Latin America, Prevention with Children and Families, and HIV and Substance Use. Students are selected to join the course based on 1) demonstrating a professional interest in the group topics, 2) their understanding of the substantive area and LC goals, and 3) committing to participate for three semesters. Both in-class sessions and field visits blend conceptual and applied learning in the community.

In-class sessions include seminars, workshops, and group discussions. With the full class and within their small groups, students learn and practice concepts fundamental for public health science and change, including evidence based public health, community engagement, needs assessment, logic models and models of change, program planning and evaluation, communication, and ethics, among others. Through discussions, interactive exercises and home-learning, students enhance their understanding of substantive areas (e.g., epidemiology of diseases, determinants of health). As students learn class concepts, each thematic group meets with pre-selected community agencies to apply what they have learned and to more deeply understand the complexity of existing public health problems from diverse professionals working to address these problems. The students' applied work aims to understand the community and agency's needs, with field visits involving community meetings with partners, stakeholders, and instructors. Community representatives become active partners in the LC, with the projects and theses emphasizing community-based participatory research methods that engage key community stakeholders throughout the life of the project (13).

Modeling is a central part in the learning process. Instructors lead initial community sessions to demonstrate characteristics of effective engagement, such as active listening, effective communication, promoting participation and engagement of partners, identifying evidence-based programs that can help communities frame their approach to addressing public health problems. Students initially observe and subsequently become active participants in these community sessions. During community visits, students engage with agencies, residents, and other professionals around public health needs, as well as practice the key professional competencies introduced in class, such as communication, problem-solving, and building inter-disciplinary and community collaborations. Targeted assignments evaluate students' knowledge and skills, such as illustrating a project's logic model or writing a needs assessment. Students finish their first semester having a proposed concentration, a deep understanding of the public health problem, including a robust review of the literature and evidence base. Students also finish this initial semester with a strong relationship with the community agency, as well as other professionals and stakeholders in their area of public health interest. MPH students finish with an established field site placement for their capstone.

During the second semester (Spring), MPH students begin their 150-h capstone field experience (i.e., applied practice experience). They draft learning objectives and activities for the field experience, individualized to meet the student, agency, and community's needs. For example, to address low rates of community HPV vaccination, a student interested in prevention of sexually transmitted infections worked with a mobile pediatric clinic to analyze existing data on acceptability and completion of HPV vaccine among adolescent patients. While embedded in the community, students apply and reflect upon what they have learned in class. MS students, on the other hand, work on their master's thesis proposal, which is also informed by their connections with community stakeholders and other professionals. During this second semester, students meet five times with the instructors of the LC, with the goal of reflecting on the field experience and thesis proposal as these unfold, trouble shooting and receiving guidance as they work on these products.

The focus on practice-based teaching and service learning are central approaches to teaching these cross-cutting skills in public health (14–16). These approaches provide a pragmatic and progressive learning experience while meeting societal needs (17). The problem-based learning approach further allows the specific public health problems and challenges experienced in community to provide the groundwork for developing students' needed to competently solve public health problems. Notably, these community-immersed, practice-based experiences place students in interprofessional settings, where critical competencies of interprofessional education are exercised. As students provide service to the community by supporting ongoing projects, they plan their capstone projects and theses, as informed by the community, to ensure projects are relevant and impactful. Projects and theses are executed in subsequent semesters, typically concluding in final semester.

The final semester (Fall) is when student integration of knowledge and skills is most prominent. These senior-level students work on their projects and present their insights to the incoming cohort of LC students. The senior-level students are invited to help teach the incoming cohort of students on topics they have learned and implemented, for example community stakeholder engagement or culturally-informed interventions. Similar to what Kolb (10) describes, students have concrete experiences in the field, which provide the foundation for reflective observation when they have the opportunity to consider what is working or failing. This reflection promotes thinking about ways to improve during the next attempt, a form of abstract conceptualization, and the "*teach back*" facilitates integration of concepts learned (18, 19). Overall, this three-semester sequence permits each student cohort to complete their capstones and help train and mentor students from the incoming cohort, fostering the development of new students into senior-level students better prepared to become public health scientists and practitioners. Figure 1 illustrates the model by steps and semesters.

Feasibility of the multi-semester educational initiative has been examined from the program's start. Preliminary results on feasibility, acceptability, and comparison of the LC MPH students with a cohort of students pursuing the traditional approach to the field experience and capstone project were presented at the American Public Health Association Conference, 2015 (20). LC students showed improved leadership, communication, and cultural competence skills as compared to control students. While these differences were not statistically significant, the LC students showed a significantly better sense of classroom community. Subsequent evaluations of the program revealed strong satisfaction and LC students repeatedly reported that the program had enhanced their knowledge, that they have enjoyed it, would recommend it to fellow students, had learned about teamwork and communication skills, and believed the LC had made them more competitive for the job market. While initial acceptability and early results were reassuring, evaluations were not

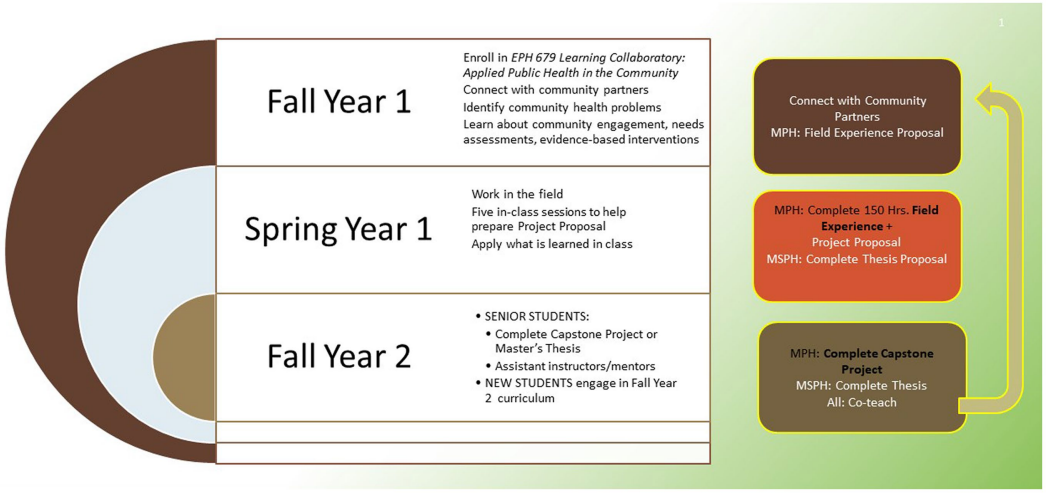

FIGURE 1
Timeline and structure of the Learning Collaboratory.

completed at program exit, not allowing for student reflections on their use of the skills on the job, and further limited by small number in the cohorts.

To assess longer term results of the LC, during the months of March and April 2023, a Qualtrics survey was conducted with alumni of the LC cohorts admitted from Fall 2014–2021 and with community partners of the LC. MPH students participated in all LC cohorts beginning in 2014, while Master of Science in Public Health (MSPH) students and MS in Prevention Science & Community Health students participated beginning in 2019. Each of 55 LC alumni with recorded contact information, as well as five longstanding community partners of the LC, received an email invitation to complete the online survey. Upon survey completion, participants were directed to a separate, unlinked Qualtrics survey to input their email to receive a $35 Amazon e-gift card as compensation for their time and feedback. As this study captured participant feedback regarding the program itself, it was determined by the University of Miami Institutional Review Board to not require IRB approval.

The alumni survey began with two descriptive questions, including degree pursued while in the program (MPH, MSPH, or MS in Prevention Science) and current employment type. Next, alumni were asked to rate, on a 5-point Likert scale from *Not at all helpful* to *Extremely helpful,* the extent which the LC was helpful to their development each of five public health critical skills: Critical Thinking, Communication, Problem Solving, Collaboration, and Leadership. Then, using the same Likert scale, alumni were asked to reflect on: 1) the extent to which applying skills learned in class to address real world public health problems with community partners helped them develop understanding and/or skills in community collaboration and community engagement, 2) the extent which the teach-back component helped them to integrate concepts, and 3) the extent which the teach-back component was helpful to their professional development. As in first studies on feasibility, acceptability, and comparison between LC students and students pursuing the traditional approach, survey items were developed by two authors (VEH and TP), focusing on the competencies developed by the LC but adapted to capture the long-term reflection on the experience. As part of the survey, alumni were also invited to respond to a series of three open-ended questions describing the strengths of the program, the weaknesses of the program, and any additional reflections they would like to share.

In their survey, community partners were asked to rate, on a 5-point Likert scale from *Strongly Disagree* to *Strongly Agree* (or Not Applicable), the extent to which LC students were adequately prepared for each of 25 core public health skills. These questions are the standard questions used in the University of Miami Department of Public Health Sciences to obtain feedback from organizations where students' intern. Some of the skills assessed included an evaluation on students' ability to use concepts of behavioral sciences to analyze and solve public health problems, interpret health information from local, and state level, determine program needs and rationale for operation, demonstrate professionalism, and skills and competencies needed to enter the public health profession. The survey similarly ended with three open-ended questions where participants were asked to describe the strengths of the program, the weaknesses of the program, and any additional reflections they would like to share.

Frequencies and percentages of responses were calculated for each Likert-scale item. For open-ended questions, three authors (VEH, RDS, STG), using a qualitative inductive approach, reviewed each of the responses to identify core themes emerging from the data and came to a consensus on the final themes and definitions before they coded each response as representative of a given theme or not. Frequencies and percentages of identified themes were then calculated. Cronbach's alpha coefficient was calculated to assess the internal consistency of the quantitative survey items.

Results

Alumni responses – quantitative

Thirty alumni responded to the survey (response rate 54.5% of all LC alumni). Among them, 66.7% were in the MPH program, 26.7% in the MSPH program, and 6.6% in the MS in Prevention

Science and Community Health program. When asked about their current employment type, almost half (46.7%) were working for an academic institution, 26.7% for a non-profit organization, 13.3% for government and for community organization, and 10% for private sector. There were also 10% of alumni enrolled in graduate studies and 6.6% who were pre- or post-doctoral scholars. One alumnus selected "other" and reported that they were working in the pharmaceutical industry (Note: respondents could choose more than one employment type).

When asked to rate the extent to which the LC helped their development public health competencies, over three-quarters of alumni responded *Very helpful* or *Extremely helpful* to each of the five competencies, including Critical Thinking (83.3%), Communication (80.0%), Problem Solving (76.6%), Collaboration (86.6%), and Leadership (83.3%). Similarly, 83.3% of alumni responded *Very helpful* or *Extremely helpful* to the extent to which they developed understanding and/or skills in community collaboration and community engagement and to the extent to which teach-back helped them to integrate concepts. 73.4% responded *Very helpful* or *Extremely helpful* to the extent which teach-back was helpful to their professional development. The internal consistency of survey items was acceptable with a Cronbach's α of 0.95 (Tables 1, 2).

Community partner responses – quantitative

Three community partners responded (response rate 60%). Partners *Agreed* that students of the LC demonstrated their preparation to practice in the field of public health (75%), produced products that were professional and appropriate (100%), and demonstrated the competencies required for their public health degrees (75%). They *Strongly Agreed* (75%) or *Agreed* (25%) that students accepted responsibility and fulfilled commitments to the agency, *Strongly Agreed* (75%) or *Agreed* (25%) that students were adaptable and worked well with agency staff and clients or citizens served by the agency, as well as *Agreed* or *Strongly Agreed* (75%) that students were able to assess results of their programs and make recommendations based on public health concepts. Community partners *Agreed* (100%) that students produced projects that were beneficial to the program or agency.

TABLE 1 Characteristics of alumni respondents.

		N	%
All		30	100
Program	MPH	20	66.70%
	MSPH	8	26.70%
	MS, Prevention Science	2	6.60%
Employment type*	Private sector	3	10%
	Government	4	13.30%
	Academic Institution	14	46.70%
	Community based organization	4	13.30%
	Non-profit	8	26.70%
	Pre- or Post-doctoral scholar	2	6.60%
	Enrolled in graduate studies	3	10%
	Not currently employed	0	0
	Other	1	3.33%

*Some participants had more than one employment type.

Alumni responses – qualitative

After initial review of the data, six themes emerged as strengths of the LC. *Structure* was an identified strength mentioned in 21 of 29 (72.4%) of responses provided. Structure was defined as overall organization duration over three semesters, set and established partners, sequence and nature of topics to prepare students for field experience and capstone. Highlights of comments regarding structure were: *"The hands-on mentorship and feedback throughout the community partnership component was invaluable. These relationships can be tricky to navigate, but the support and structure provided by the LC helped me thrive in making connections, understanding roles, delineating objectives, and pulling off my final project," "I appreciated getting off to an early start on Field Experience components as I was able to utilize so much more of my time enrolled in the MPH program towards building meaningful partnership and deliverables."* Other comments under this theme were: "*… it also kept me on track with really planning out my thesis and figuring out exactly what pieces were required along the way. I was not aware of how much time and trial and error even finding a feasible thesis project could take, and I'm glad I started making strides early with this class."*

Teamwork & Collaboration was defined as relationships with other students and with partners, something that was identified as a strength in 15 of the responses (51.7%). Some alumni comments highlighting this theme were: "*Helped me build connections with leaders in public health and explore* various *public health PH opportunities. This helped target my research questions and I was able to network with stakeholders. I also was able to envision a career in PH through the collaborative and connect with my peers and those in the cohort below me," "A small group that allowed us collaborate on our projects and interests,"* and that it *"created stronger bonds and friendships within the group."*

Critical Thinking & Problem Solving – defined as the ability to think critically and analyze problems, determine their potential causes and explore solutions – was found as a strength in 4 responses (15.8%), represented by comments such as: "The *strength of that class was the importance that gave to critical thinking and different methods of problems solving," … the class challenged us to think about the 'why' and try to understand things that are not at the surface level. As we challenge to think about the why, I felt we were empowered to reach out to the community and make an impactful change."*

Guidance, Nurture & Support – defined as mentorship and guidance by instructors, sustained support, and feedback – was identified as a strength in 10 (34.5%) of the responses. Participants stated "Both *Dr. H and Dr. P* [LC instructors] *are amazing in their own ways and together they made such a great team of mentors. It was so helpful to have the guided first experience into the research-community world," I believe I benefitted from the planning and guidance available to me so much earlier than my peers," "I felt so much more supported."*

Teaching Back – defined as senior students co-teaching concepts to incoming cohorts – was identified as a strength in 3 of the responses (10.3%). Some of the comments shared were: "*As a first year, hearing other students' experiences, lessons learned, and approaches helped me*

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TABLE 2 Frequencies and percentages of alumni ranking of extent to which LC helped them develop public health competencies.

		Not at all helpful	Not so helpful	Somewhat helpful	Very helpful	Extremely helpful
To what extent was the Learning Collaboratory helpful to your development each of the following competencies:	Critical thinking	0	1 (3.3%)	4 (13.3%)	12 (40%)	13 (43.3%)
	Communication	1 (3.3%)	0	5 (16.7%)	7 (23.3%)	17 (56.7%)
	Problem solving	1 (3.3%)	2 (6.6%)	4 (13.3%)	10 (33.3%)	13 (43.3%)
	Collaboration	0	2 (6.6%)	2 (6.6%)	10 (33.3%)	16 (53.3%)
	Leadership	1 (3.3%)	1 (3.3%)	3 (10%)	12 (40%)	13 (43.3%)
Through partnerships with public health practitioners, students address real-world public health needs in the community by applying essential skills they learn in class. To what extent do you think this component helped you develop understanding and/or skills in community collaboration and community engagement?		1 (3.3%)	2 (6.6%)	2 (6.6%)	10 (33.3%)	15 (50%)
To what extent do you think the teach-back component helped you to integrate concepts (e.g., reflect on topics and concepts you had learned, in a way that it helped expand your understanding)?		2 (6.6%)	1 (3.3%)	2 (6.6%)	9 (30%)	16 (53.3%)
To what extent do you think the teach-back component was helpful to your professional development (e.g., strengthened skills to succeed in the workplace and in your profession)?		1 (3.3%)	4 (13.3%)	3 (10%)	8 (26.7%)	14 (46.7%)

gain a broader understanding of competencies in various *scenarios. Then returning to share my experiences and "teach" around these competencies was the icing on the cake - it made me feel empowered and validated," "Having chances to present to the cohort and to the cohorts afterwards was great for practicing presenting parts of the thesis, and I found it very helpful to do things towards the project in a bite-sized amounts." Content & Curriculum* was identified as a distinct theme as well and identified as a strength in 9 (31%) of responses, highlighted by comments such as: "*Setting the foundation of core classes/ competencies for a future Public Health Professional. I feel it prepared me very well for the real world," "The professors ingrained in me the idea of writing a very good thesis proposal and they were correct in that it laid a wonderful foundation that carried me through the thesis writing process," "Learned leadership skills and improved my public speaking and communication with my mentors.*"

To the question about weaknesses, most of those responding indicated there were no weaknesses that they could think of. After a review of the data, six themes/categories emerged for weaknesses. Among those noting a weakness, the most common was *Need for more Flexibility* identified in 4 (13.8%) of responses. Comments in this theme included "*Sometimes the community partner was not a great match or fit, but that is not unlike real-life," "My only suggestion is to give us more time between deadlines." Premature Exposure of Concepts* – defined as students feeling inadequately prepared for course components – w as identified in 3 (10%) of the responses. Sample comments included: "*I remember being very overwhelmed with having to come up with a proposal my first semester in the program," "The exercise in writing the proposal for the thesis or capstone wasn't as helpful because it was too earlier for many of us to know what we would be doing." More Time Needed for Teaching* – defined as needing more time from instructors- was identified as a weakness in 3 (10%) of responses. Comments included statements such as: *"I would consider insufficient time of teaching for this magnific class as weakness," "I believe the Collaboratory is what the students make out of it…. Otherwise, the lectures are probably the next-weakest point of the program, but it's hard to compare a priori learning of generally useful concepts to practical, hands-on experience specific to my area of interest." Insufficient Skill Development* – defined as requiring more academic support within larger master's programs, having gained insufficient experience, or preparation for job placement – was identified by 5 responses (17%). Comments under this theme included: "*Not enough readily available academic support resources through the program. For instance, if I did not understand a certain topic or concept in one of my classes I felt like I did not have much to support to lean on for help," "No job placements or alumni presentations," "It's harder to get an in-depth understanding of the individual concepts, I felt like the semester went by so quickly that I did not get to master all of the concepts." Program might not be Best for MSPH Students* was identified as weakness theme and coded in 4 (13.8%) responses. Comments included: "*I think it could be valuable if there was a better way to integrate community engagement with the thesis project. At times it felt like community engagement projects in the Learning Collaboratory were directed toward the capstone," "Also, the program may not have been as well suited for some MSPH students," "I cannot think of many weaknesses of the program. I do however remember being initially confused on where it was possible or feasible to get a data set on a project.*" Finally, *Less than an Ideal Collaboration with Partner* emerged as a weakness theme and coded in 6 (21%) of the responses. Students identifying this indicated that: *"I heard from some during the program that they felt a lack of support or engagement from their community preceptor and/or mentor/ advisor, which led to delayed timelines and mediocre final projects," "Not all community partners are as responsive/able to assist students in completing projects or meeting requirements in a timely manner,*" and finally *"Accountability on the partner side*" was named as a weakness.

Community partner responses – qualitative

Identified strengths included faculty support, motivation and preparation: *"The support of faculty, some classes prepare them for the experience while there are opportunities for improvement," "For the most part, students are motivated and well-prepared. They are able to analyze needs and gaps from a systems level approach and public health perspective. They are an asset to [center's] interdisciplinary perspective."* While one partner identified no weaknesses, others identified certain weaknesses in students which included statistical skills: *"Some students lack skills necessary to carry out their projects-especially in the area of statistics, implementation and program evaluation concepts," "A potential solution is to have a better connection between the advisor and the community partner."* An additional comment was: *"working with the Collaboratory has been a worthwhile experience."*

Discussion

Alumni of the LC cohorts 2014–2021 found that the LC helped their development in public health competencies including Critical Thinking, Communication, Problem Solving, Collaboration and Leadership. Importantly, they felt that the LC helped them understand and value the concept of collaboration and they valued the "teach back" approach as one that expanded understanding and helped in professional development. Community Partners of the LC agreed that students produced projects that were valuable to their organizations. Qualitative analyzes revealed strengths and weaknesses. Structure, Teamwork & Collaboration, Critical Thinking & Problem Solving, Guidance, Nurture & Support, "Teaching Back," and Curriculum & Content were found to be strengths of the LC. While several alumni did not identify any weaknesses, some recommended more flexibility, and more time for teaching. Others recommended revisiting the inclusion of the MS programs in ways to more fully align it to their needs, addressing potentially premature exposure to certain concepts, and finding ways to address student-partner fit. Indeed, teaching team science skills and ensuring that MS students fully utilize and apply these relationships in their thesis projects may require additional time and effort, as has been clear in the science of team science literature (5). Partners found that the experience was overall valuable but additional areas of improvement could include stronger preparation on methodology, as well as check-ins with advisors. While the two LC instructors were advisors to most MPH and MS students, as the LC program grew, students were sometimes assigned outside advisors. This may have reduced the community agency's connection to the faculty, which can be important.

Practice-based teaching and problem-based learning have been recognized as a pedagogical approach that can ground professional public health skills education, as it provides applied educational opportunities for public health students (16). For instance, Greece, Wolff and McGrath (15) have described a conceptual model of practice-based education for MPH students, STEPS, which include securing partnerships, training and technology, engagement and implementation, presenting deliverables, and sizing up for results. The model ensures that students focus on learning through addressing existing problems and needs, as well as the design and the implementation of relevant deliverables in a public health agency. The capstone or culminating project resulting from the field experience is where the students produce a concrete deliverable for the community partner. Other models for teaching public health students in community work have embraced the pedagogy of collegiality. As described by Turalba and Malik (15), the essential features of this pedagogy incorporate experiential learning and critical thinking skills but inherent to its execution are principles of collaboration guided by principles of listening, relationship and community building, valuing diversity and collaboration, which are critical in team science and applied public health. Linnan et al. (14) highlight principles of Group Based Service Learning approaches, including cultivating authentic partnerships and planning projects with partners, giving students choices in selecting projects, providing a mentoring team, establishing intentional structures and processes to promote the partnership and encourage reflections, and a culminating event that celebrates the accomplishments. The LC includes several of these components, such as securing the partnership by offering students an array of pre-set partners, supporting the students in their exploration of the objectives and activities to be pursued in the field and helping assess together with the partner their relevance and feasibility for execution. It also supports technical training by exposing students to the content "tool kit" necessary for field work and providing ample feedback and mentorship along through structured time. Finally, the LC promotes reflection and supports teach back as means of integrating concepts learned, but most importantly to identify potential next steps for incoming cohorts of students in the field to support sustainability of the work of community partners.

Several lessons have been learned to date that could help future applications of the LC. Critical to success is the commitment of students to a three-semester trajectory. Additionally, students have to be ready to embrace community organizations' public health priorities with a selfless stance while committed to achieving the competencies necessary for their public health training program. This balance is possible if fueled by curiosity, adaptability, cultural humility, and determination to improving community health. Notably, commitment to hours outside the traditional classroom by students and instructors, is vital. These hours to coach and model students at community sites, and the flexible and adaptable stance of instructors to adjust to the realities of community partner organizations is necessary for attaining the goals of the LC.

The evaluation presented has several strengths. It provides an assessment of all LC cohorts over time, preliminary evidence of the value of the experience after graduation, as well as the perspective of community-based organizations involved in the LC. In addition, this longer-term evaluation with mixed methods supports the value of this pedagogical approach and expands with evidence beyond other models described. However, this evaluation has several limitations. First, it is limited by its sample size. More than 50% of LC alumni responded to the survey, representing just 30 students, though representing different cohorts of the LC since its inception. Also, only 3 community partners responded to the survey. Second, the quantitative alumni survey items were developed to assess the competencies that are supported by the LC by the authors, but these items are not part of a standardized assessment, limiting the validity of this assessment. Nonetheless, the contribution of the survey is provided by the comments that alumni provided, the qualitative component of this evaluation. Third, this examination relied on self-reported experiences. Further examinations could rely on more

objective assessment of the domains addressed by the LC, as well as controlled comparison to other student groups that do not receive the same learning experience. While these approaches could control for other confounders, they will not definitively control for bias resulting from non-randomized designs. Fourth, while responses are anonymous, these might be limited by social desirability and recall bias. Fifth, while some of the components of the LC are common to other practice-based approaches, generalizability is limited to other student populations or other teaching approaches.

Public health education is being challenged to innovate and develop students who will become change agents and who can combat the inequities in health being experienced across the globe today. The LC appears to be a promising model for applied and science-based public health education and community intervention. It provides students with opportunities to integrate, apply, and strengthen cross-cutting public health skills like community engagement, collaboration, and needs assessment, in a supportive environment, while enhancing the sustainability of student and faculty's community public health work.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

VEH: Conceptualization, Formal analysis, Methodology, Project administration, Supervision, Writing – original draft, Writing – review & editing. TP: Conceptualization, Project administration, Writing – original draft, Writing – review & editing. JK: Writing – review & editing, Conceptualization. RDS: Writing – review & editing, Formal analysis, Methodology, Writing – original draft. STG: Formal analysis, Writing – review & editing.

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Conflict of interest

The authors declare that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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References

1. Fried LP, Thibault GE. Reinventing public health education for the 21st century. *Am J Public Health*. (2015) 105:S4. doi: 10.2105/AJPH.2014.302544

2. Honoré PA. Aligning public health workforce competencies with population health improvement goals. *Am J Prev Med*. (2014) 47:S344–5. doi: 10.1016/j.amepre.2014.07.046

3. Petersen DJ, Weist EM. Framing the future by mastering the new public health. *J Public Health Manag Pract*. (2014) 20:371–4. doi: 10.1097/PHH.0000000000000106

4. Sepulveda MJ. Public health informatics and the public health workforce in an era of change. *Am J Prev Med*. (2014) 47:S386–7. doi: 10.1016/j.amepre.2014.07.014

5. Cooke NJ, Hilton ML. *Committee on the science of team science, board on behavioral, cognitive, and sensory sciences, division of behavioral and social sciences and education*. Ottawa: National Research Council (2015).

6. ASPPH (2014). Welcome to the new century of public health education: framing the future: Association of Schools and Programs of Public Health. Available at: http://www.aspph.org/educate/framing-the-future/

7. Hernandez LM, Rosenstock L, Gebbie K. *Who will keep the public healthy?: Educating public health professionals for the 21st century*. Washington, DC: National Academies Press (2003).

8. CEPH (2023). Council on education for public health: Criteria & Procedures. Available at: https://ceph.org/about/org-info/criteria-procedures-documents/criteria-procedures/

9. CEPH (2016). Accreditation criteria: council on education for public health. Available at: https://ceph.org/assets/2016

10. Kolb D. *Experimental learning: Experience as the source of learning and development*. Englewood Cliffs, NJ.: Prentice Hall (1984).

11. Wigington CJ, Sobelson RK, Duncan HL, Young AC. Service learning in public health: exploring the benefit to host agencies in CDC's public health associate program. *J Public Health Manag Pract*. (2017) 23:434–8. doi: 10.1097/PHH.0000000000000523

12. Higgs J, Gates A. Realising exemplary practice-based education. Realising exemplary practice-based education. *Brill*. (2013):275–97. doi: 10.1007/978-94-6209-188-7

13. Israel B, Eng E, Schulz A, Parker E. *Methods in community-based participatory research for health*. San Francisco, CA: Jossey-Bass (2005).

14. Linnan L, Landfried M, French E, Moracco B. Group-based service learning teaching approaches In: LM Sullivan and S Galea, editors. *Teaching public health*. Baltimore, MD: Johns Hopkins University Press (2019). 221–34.

15. Chávez V, Turalba R-AN, Malik S. Teaching public health through a pedagogy of collegiality. *Am J Public Health*. (2006) 96:1175–80. doi: 10.2105/AJPH.2005.062950

16. Greece JA, Wolff J, McGrath D. A framework for practice-based teaching in public health. *J Public Health Manag Pract*. (2019) 25:E30–8. doi: 10.1097/PHH.0000000000000863

17. Jacoby B. Service-learning in today's higher education In: B Jacoby, editor. *Service-learning in higher education: Concepts and practices*. San Francisco, CA: Jossey-Bass (1996). 3–25.

18. Godley S, Aumiller B, Horigian V, Khalil N, Kruger J, Pennel C, et al. Evidence-based educational practices for public health: how we teach matters. *Pedagogy Health Promot*. (2021) 7:89–94. doi: 10.1177/2373379920978421

19. Herodotou C, Sharples M, Gaved M, Kukulska-Hulme A, Rienties B, Scanlon E, et al. Innovative pedagogies of the future: an evidence-based selection. *Front Educ*. (2019) 113:4. doi: 10.3389/feduc.2019.00113

20. Horigian V, Perrino T, Kornfeld J. *A learning Collaboratory to develop student's core professional and practice skills: an innovative approach to improving community health*. Chicago, IL: American Public Health Association (2015).

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Responsibility of education in improving medical college students' ability to prevent and respond to public health emergencies in China – A systematic review

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Background: The outbreak of coronavirus disease 2019 (COVID-19) has highlighted the critical importance of sufficient preparedness for public health emergencies. This places higher requirements on the ability of medical staff to deal with such emergencies. Nonetheless, education courses on public health emergencies in China are usually aimed at public health students, and not at all medical college students. Importantly, these medical students will become medical workers who are generally the first-contact personnel and play an irreplaceable role in responding to most public health emergencies. Therefore, it is urgent to strengthen educational courses to enable these students to adequately prevent and respond to public health emergencies.

Objectives: The purpose of this systematic review was to reveal the current unsatisfactory status of Chinese medical college students' knowledge and skills in dealing with public health emergencies and their training needs.

Methods: We searched EMBASE, PubMed, Google Scholar, Web of Science, CNKI, Wan Fang, and VIP Information Network for all associated original studies written in English and Chinese from the inception of these databases until March 12, 2022.

Results: This systematic review screened out 15 eligible studies that met the inclusion criteria. These studies demonstrated that Chinese medical college students generally have a low ability to deal with public health emergencies. Most students believe it is essential to master coping with public health emergencies and desire to acquire this knowledge. But the participation rate is low, and only a few students actively seek relevant knowledge.

Conclusion: The findings of this review illustrate the importance of improving medical college students' education to prevent and deal with public health emergencies. It is necessary to improve medical college students' education in responding to public health emergencies.

Systematic Review Registration: PROSPERO, Identifier [CRD42023467374].

KEYWORDS

responsibility of education, medical education, medical college students, public health emergencies, prevention, response

Introduction

The COVID-19 pandemic has brought worldwide attention to preventing and responding to public health emergencies. Dealing with the pandemic has exposed the lack of competent medical talent to handle public health emergencies and revealed the drawbacks of the separation between clinical medicine and public health or preventive medicine in current medical education (1).

Public health emergencies refer to sudden outbreaks of major infectious diseases, mass illnesses of unknown origin, major food or occupational poisoning, and other events that seriously affect public health and cause or may cause severe damage to the health of the population (2). These events easily trigger public panic, anxiety, and other emotions, and their abruptness and collective nature have substantial negative impacts on the population, politics, economy, trade, and human health, among others (3, 4). Effective responses are crucial to minimizing the adverse impact of public health emergencies.

In recent years, the world has been facing an increasing number of public health emergencies. With the development of science and technology as well as societal progress, communication among different countries or regions is becoming more frequent and closer. Concurrently, the scale and complexity of public health emergencies are becoming more severe. Public health emergencies are not limited to a single country, but can spread rapidly to neighboring countries and even around the world in various ways. According to information released on the website of the National Health Commission of the People's Republic of China, among all kinds of public health emergencies, those involving infectious diseases are the most common and serious, followed by food poisoning, occupational poisoning, and environmentally related events (5). These events have challenged the capacity of many countries, especially developing countries, to prepare for and respond to public health emergencies.

Public health emergencies are difficult to predict and cannot always be avoided, as they can occur in different forms in the future. Therefore, optimizing prevention and control is of the utmost importance. Medical workers are the first contact personnel in most public health emergencies. They play crucial roles in responding to public health emergencies and are the main force in prevention and control (6).

In ongoing public health emergencies, however, the coping ability of medical workers is a concern and can reveal problems between clinical medicine and public health and preventive medicine in China as well as in other countries (6). For example, during the severe acute respiratory syndrome (SARS) epidemic in 2003 as well as the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) outbreak in 2019, medical workers were among the group of people experiencing the highest levels of stress and anxiety (7, 8). The infection rate of these medical staff was the highest among all groups, and the rate of infection was very high during the initial stages of these outbreaks (6, 7, 9, 10). In addition, severe nosocomial infections can occur in hospitals owing to nonstandard disinfection and isolation measures during a public health emergency (6, 7, 9). This situation can lead to environmental exposure of medical personnel. Many of the health professionals affected have insufficient ability to deal with a public health emergency, highlighting the importance of these medical personnel mastering the knowledge and skills to prevent and respond to public health emergencies (7).

Medical education is the cornerstone of the medical and health industry. To some extent, the problems exposed by public health emergencies expose the defects and deficiencies in medical education, which is focused on clinical medicine and neglects public health prevention (6, 11, 12). Because in China and some other countries, clinical medicine and public health/preventive medicine are taught separately. Medical students have a nearly exclusive focus on individual patients during their training. Therefore, students became proficient in the micro-dynamics of disease and its treatment, but risk losing their ability to see the patient's context and reasons behind their illness, such as unhealthy behaviors. Medical students rarely receive education on how public health might be relevant to their clinical careers (1). Many medical schools remain solely responsible for medical students' curricula and education and are mostly disconnected from the field of public health (13). Even most educational programs designed to prepare healthcare professionals are not organized to accommodate the rapid and often unpredictable changes in public health emergencies (13). In addition, medical colleges must equip their students with the skills to interact within multidisciplinary teams. However, to our knowledge, none of the existing curricula represent a systematic effort to prepare a large cadre of health professionals to respond to public health emergencies using a multidisciplinary, interdisciplinary, and collaborative approach (14). Finally, the number of instructors in public health education is insufficient, the educational structure is defective, and their teaching capacity is limited (15).

We sought to understand the knowledge and skill level of medical college students in dealing with public health emergencies and their training needs and to identify weak points in the relevant knowledge of these students in the previous education process in China. Our findings can help in achieving targeted and practical education for future medical college students in responding to public health emergencies and integrating clinical medicine and public health and preventive medicine education.

Medical graduates increasingly need public health skills to equip them to face the challenges of health care practice in the 21st century (16). Integrating clinical medicine with public health and preventive medicine in the course of medical education reform is particularly important for a timely and effective response to public health emergencies. However, to date, there has been no relevant literature analyzing the current situation and systematically discussing this issue. In this paper, we aim to fill this gap. We systematically analyzed medical students' cognitive status and training needs in responding to public health emergencies, identified existing problems and shortcomings, and then proposed possible solutions.

Methodology

Literature review

We performed this study in accordance with guidelines outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (PROSPERO ID: 467374) (17). We conducted a comprehensive search for relevant studies (written in English and Chinese) from major online databases, such as EMBASE, PubMed, Google Scholar, Web of Science, CNKI, Wan Fang, and VIP Information Network, from the construction of these databases to 12 March 2022. Two independent reviewers scanned the literature and included the eligible studies by common consensus after multiple rounds of screening.

Data sources and search methods

The search process included (i) reading the reference section of all relevant research carefully; and (ii) manually searching abstracts of key journals and papers published at major annual conferences. The search terms used were a mix of ("students" [Title] AND "public health emergency" [Title]) OR ("students" [Title] AND "public health emergencies" [Title]). We also checked the reference lists of the screened studies to identify other similar studies. The search strategy is shown in Figure 1. We included studies of medical college students' knowledge and training needs for responding to public health emergencies. The PICOS criteria are used to select the eligible studies. Studies were included if they satisfied the following inclusion criteria: (i) the study was limited to original empirical study and humans; (ii) the study was conducted in Mainland China; (iii) the study was peer-reviewed article with full-text available; (iv) all participants are medical college students and need to include clinical medicine majors; (v) the study was written in English or Chinese; (vi) the study quantitatively reported medical college students' knowledge or training needs for responding to public health emergencies. The exclusion criteria were as follows: (i) the studies focused on non-medical college students or clinical medicine students were not involved; (ii) the study conducted in other regions/countries rather than Mainland China; (iii) meeting abstracts, reports, editorials, or

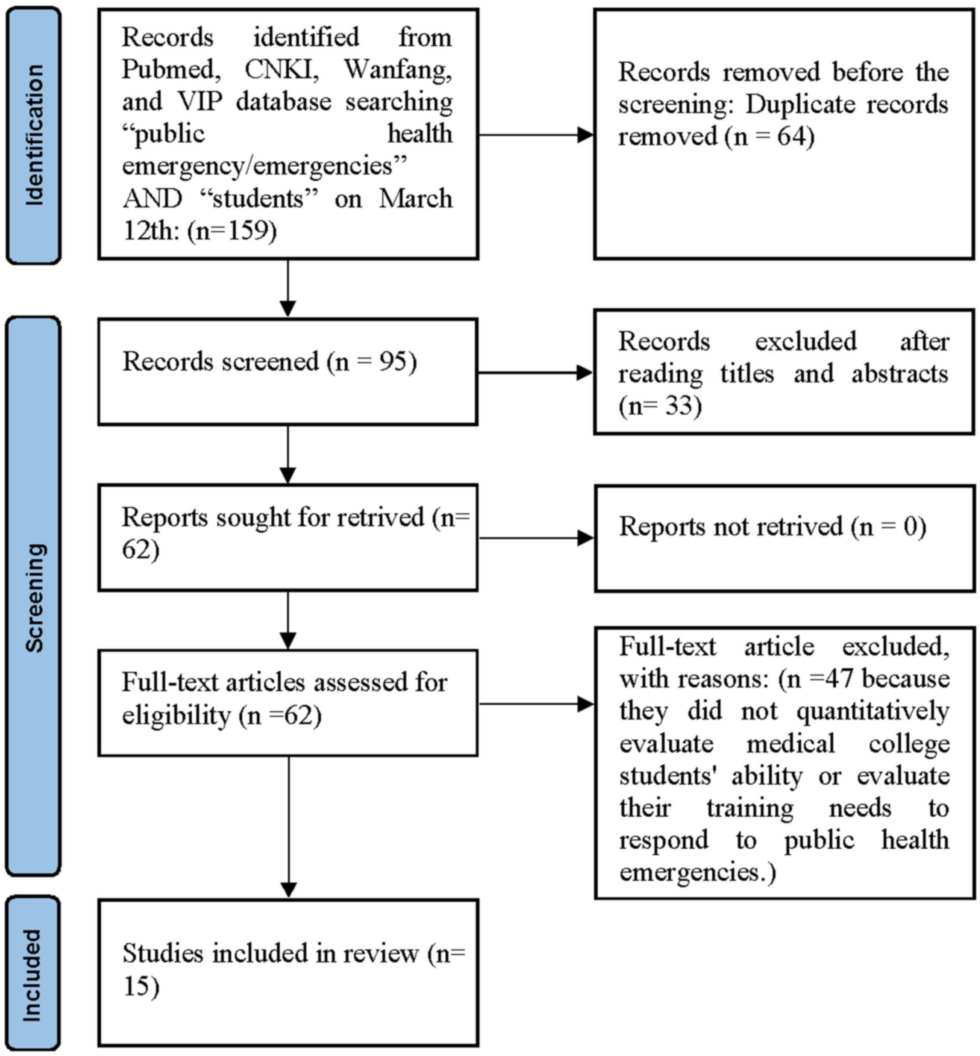

FIGURE 1
Articles assessment diagram.

reviews; (iv) unavailable fulltext articles; (v) the study did not quantitatively evaluate medical college students' ability or evaluate their training needs to respond to public health emergencies; (vi) duplicated reports.

Data extraction

For all articles included, we extracted the following information from the original articles using a standardized form, including the relevant data about bibliographic details: (first author, publication year), participant characteristics (sample size, University/college placement), and outcomes.

Quality assessment

As the reviewed articles differed in research design, a quality assessment tool developed by Rowe et al. that has been proven to be a useful tool for assessing qualitative, quantitative, and mixed methods was utilized (18, 19). The tool assesses five important methodological aspects of a study, namely the background or literature review, sample, study design or methodology, outcome measures, and conclusions (20). The total score ranges from 0 to 5, with the higher scores representing better methodological quality. Articles scoring 4 or 5 are considered to be high in quality, articles scoring 3 are considered to be of moderate quality, and studies scoring between 0 and 2 are considered to be low in quality. In this review, all included studies were independently evaluated by two reviewers (XF and PY). Divergences were resolved through discussion and consensus. Discrepancies between the two reviewers were resolved through discussion with a third author until consensus was finally reached. All 15 articles received a score between 4 and 5, indicating their high methodological quality.

Results

Study characteristics

The results of the systematic review are presented in Figure 1. We identified a total of 15 studies related to the cognitive status and training needs of medical college students in response to public health emergencies in China after a thorough review of all papers. The characteristics of the studies are listed in Table 1. Among the studies considered in this paper, all were conducted in China.

Quality assessment

Table 2 shows the results of a methodological quality assessment of all included studies. Due to the degree of heterogeneity observed in the study design, and outcome indices, meta-analysis was considered impractical. 15 studies mainly used a quantitative research design (6, 12, 21–33). All 15 articles received a score between 4 and 5, indicating their high methodological quality. All studies adopted a questionnaire survey as the significant approach to collect data. 3 studies provided unclear information of participants and participants in 2 studies were recruited through convenience sampling.

Cognitive status of medical college students in response to public health emergencies in China

As shown in Table 3, in the 15 studies, questionnaire surveys on medical college students' knowledge and training needs in responding to public health emergencies were conducted. The average score representing medical college students' knowledge of coping with public health emergencies only ranged from 52.13 ± 8.17 to 79.43 ± 10.40 (the total score was uniformly converted to 100 points). The percentage representing the passing rate of medical college students in the assessment of coping with public health emergencies, or the awareness/mastery/accuracy rate of knowledge related to public health emergencies, ranged from 32.55 to 72.38% (6, 12, 25, 33) (Table 3). These studies demonstrated that respondents generally have a low ability to deal with public health emergencies. Zhao further showed that these students self-evaluated their emergency response ability highly (data not shown) (26).

Training needs of medical college students in response to public health emergencies in China

The results of these studies showed that the majority of college students thought it was essential to master knowledge regarding public health emergencies (82.59%), hoped to acquire further related expertise (82.2–88.80%), and believed that it was necessary for colleges to carry out relevant emergency training and exercises in public health emergency response (75.14–96.6%) (6, 12, 24–26, 28–30, 33). However, not many college students would take the initiative to seek knowledge about public health emergencies (38.99%), participate in training related to coping with public health emergencies (52.73%), or actively seek information on public health emergencies (22%) (12, 29, 31). Zhao showed that many medical college students (46%) believed disasters were far removed from their daily life (26).

In Table 4, four of the 15 studies demonstrated that medical college students' expectations in public health emergencies were diverse in their choice of education methods (12, 21, 26, 29). The preferred training methods include watching media or video materials (1,232 students, 37.12%), using the Internet (1,164 students, 35.07%), and lectures (752 students, 22.66%).

From the above results, it can be seen that students in medical colleges have high self-evaluation of their ability to respond in a public health emergency. However, they do not have a comprehensive grasp of knowledge regarding coping skills, their cognitive level is not high, their practical knowledge is weak, and their crisis awareness needs further improvement. On the one hand, most students believe it is essential to master coping with public health emergencies and desire to acquire this knowledge. They believe that colleges must offer relevant courses and conduct public health emergency drills, indicating that these students wish to strengthen their knowledge and skills training. On the other hand, the participation rate is low, and

TABLE 1 Characteristics of included studies.

References	Year	Data collection location	Sampling method	Evaluation method	Participants	Sample size	Mean age	Gender (M/F)
Hu et al. (21)	2004	Health Science Centre of Lanzhou	Cluster sampling	Self-administered spot field questionnaire survey	Newly graduated medical students	463	NA	NA
Yu et al. (22)	2011	Zhengzhou University	Stratified cluster sampling	Self-administered spot field questionnaire survey	Medical college students in their first-fifth year	460	NA	NA
Zheng et al. (23)	2012	Putian University	Cluster sampling	Self-administered on-site anonymous questionnaire survey	Undergraduate medical students; junior medical college students	332	NA	NA
Wang et al. (24)	2012	Five medical colleges in Guizhou Province	Random sampling	Self-administered spot field questionnaire survey	Medical students of different majors and genders in grades 1 to 4	2,290	NA	925/1365
Liu et al. (25)	2013	Hainan Medical University	Multi-stage random sampling	Self-administered self-filling questionnaire survey	Undergraduate medical students; junior medical college students	1,276	NA	524/752
Zhao et al. (26)	2013	Lanzhou University and Gansu University of Chinese Medicine	Cluster random sampling	Self-administered on-site anonymous questionnaire survey	Undergraduate medical students	451	20 ± 0.61	285/166
Zheng et al. (27)	2015	Changsha Medical College	Cluster random sampling	Self-administered KAP questionnaire survey	First-third year medical college students	506	NA	NA
Mu et al. (28)	2015	Five colleges and universities in Jilin City	Stratified cluster sampling	Self-administered on-site anonymous self-filling questionnaire survey	First-fourth-year medical college students	71	NA	NA
Wu et al. (6)	2015	China Medical University	Cluster sampling	Self-administered on-site anonymous questionnaire survey	2009 medical students majoring in clinical and preventive medicine	176	22.25	102/136
Liu et al. (29)	2017	Five universities in Hainan Province	Multi-stage random sampling	Self-administered self-filling questionnaire survey	Undergraduate medical students; junior medical college students	1,100	NA	NA
Liu et al. (30)	2018	Three universities in Wuhu City, Anhui Province	Stratified random cluster sampling	Self-administered on-site KAP questionnaire survey	Medical college students in their first-third year	381	NA	NA
Hu et al. (31)	2020	Health Science Center of Shengzhen University	Cluster sampling	Questionnaire survey	2018 clinical medical students	58	NA	NA
Sun et al. (12)	2021	Binzhou Medical University	Convenience sampling	Network anonymous questionnaire survey	Medical college students in their first-fifth year	366	NA	141/225
Cao et al. (32)	2021	Six universities in Shandong Province	Stratified random sampling	Self-administered network anonymous questionnaire survey	Medical college students in their first-fifth year	2,153	NA	NA
Tang et al. (33)	2022	Southwest Medical University	Convenience sampling	Network questionnaire survey	Medical college students in their first-fifth year	5,465	NA	1676/3789

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TABLE 2 Methodological quality assessment of the included studies.

References	Year	Background/ Literature review	Sample	Study design or methodology	Outcome measures	Conclusions	Total score	Methodological quality
Hu et al. (21)	2004	1	0	1	1	1	4	High
Yu et al. (22)	2011	1	1	1	1	1	5	High
Zheng et al. (23)	2012	1	0	1	1	1	4	High
Wang et al. (24)	2012	1	1	1	1	1	5	High
Liu et al. (25)	2013	1	1	1	1	1	5	High
Zhao et al. (26)	2013	1	1	1	1	1	5	High
Zheng et al. (27)	2015	1	1	1	1	1	5	High
Mu et al. (28)	2015	1	1	1	1	1	5	High
Wu et al. (6)	2015	1	1	1	1	1	5	High
Liu et al. (29)	2017	1	1	1	1	1	5	High
Liu et al. (30)	2018	1	1	1	1	1	5	High
Hu et al. (31)	2020	1	0	1	1	1	4	High
Sun et al. (12)	2021	1	1	1	1	1	5	High
Cao et al. (32)	2021	1	1	1	1	1	5	High
Tang et al. (33)	2022	1	1	1	1	1	5	High

only a few students actively seek relevant knowledge (6, 12, 21–23, 25–33).

Discussion

A brief introduction to the model of public health education of clinical medicine in China

At present, the training mode of undergraduate education in the clinical medicine specialty in Chinese higher medical colleges adopts the former Soviet Union education mode, with clinical and public health education separated from each other (34). The emphasis on public health education is insufficient, and the education funds and teaching investment are relatively low (35). Although public health education runs through the whole process of clinical medical education, there is less cross-teaching between public health education and clinical medicine, and public health education is not closely related to clinical practice (36). The curriculum is basically "compulsory + elective," all of which are held by teachers from the College of Public Health (34). The public health teaching materials mainly focus on courses such as epidemiology, health statistics, labor hygiene, and environmental hygiene, and the content is disconnected from clinical knowledge, resulting in low enthusiasm, insufficient attention, and a sense of mission for students to learn public health (35).Due to the constraints of traditional teaching methods such as syllabus requirements, class hour limitations, and exam methods, most universities adopt a cramming teaching method where teachers give lectures and theoretical teaching is the main focus. Students have low levels of participation and low learning enthusiasm.

In class, more emphasis is placed on the teaching of subject knowledge and the training of basic skills. Social field practice and case teaching contents such as field epidemiological investigation, social health problem investigation, and handling of sudden public health incidents are insufficient, which leads to a lack of training of students' field investigation ability, comprehensive analysis ability, problem solving ability, and emergency response ability (35). In addition, the executive functions of teaching, research, and practice in China's public health system belong to the College of Public Health and the Center for Disease Prevention and Control, respectively, which leads to some separation and disconnection between the development of public health teaching and social practice. Undergraduate students majoring in clinical medicine have only arranged internships in various clinical specialties, with few opportunities to participate in public health practice. They lack knowledge and practical skills in public health and have a significant lack of theoretical knowledge and practical training in nosocomial infection, resulting in insufficient ability to deal with public health emergencies and solve practical problems (37). Most of the public health teachers graduated from medical colleges and universities, mostly from school to school, with little practical experience in public health work such as disease prevention and control, health supervision, etc. The lack of practical experience among teachers also restricts the knowledge structure and professional development of students to a certain extent. In addition, there is a lack of necessary practice bases. Moreover, the practice bases are mostly centers for disease prevention and control, health supervision centers, etc., without dedicated personnel responsible for teaching students. The theoretical knowledge of the teachers is insufficient, and they lack the ability to combine theory with practical work, making it difficult to ensure the quality of practice. Finally, the teaching evaluation system is not perfect, and the evaluation of public health education teachers focuses on the publication of scientific research projects and papers, neglecting their teaching ability and performance. The evaluation of students places more emphasis on their exam results, and the assessment of students' grades is still mainly based on traditional written exams. The evaluation of on-site practical abilities is ignored. There is a lack of

TABLE 3 Results of included studies.

Author and year	Number (percentage) of students	Number (percentage) of students	Average score (n = Medical college students)	Passing/Awareness/Mastery/ Accuracy rate (n = medical college students)
Hu et al. (21)	–	–	–	53.33% awareness rate, $n = 463$
Yu et al. (22)	1061 (88.80%) hoped to acquire relevant knowledge of public health emergencies further	–	78.56 ± 9.90, $n = 460$	–
Zheng et al. (23)	–	–	52.13 ± 8.17, $n = 332$	–
Wang et al. (24)	1884 (82.2%) willing to receive training in public health emergencies	–	–	–
Liu et al. (25)	80.0% of students willing to learn about public health emergencies and think it is necessary to set up relevant courses and conduct emergency drills.	–	65.86 ± 13.96, $n = 1276$	71.54% awareness rate, $n = 1276$
Zhao et al. (26)	388 (86%) think it is necessary to set up relevant elective courses in medical colleges	207 (46%) believe that disasters are far removed	–	–
Zheng et al. (27)	–	–	77.23 ± 13.11, $n = 506$	–
Mu et al. (28)	248 (85.50%) hope to acquire further knowledge related to public health emergencies and the coping methods	–	–	50% awareness rate, $n = 71$
Wu et al. (6)	169 (96.6%) felt it was necessary for medical students majoring in non–preventive medicine to master the relevant knowledge of public health emergencies	–	–	72.38% awareness rate, $n = 176$
Liu et al. (29)	1684 (82.59%) thought it was important to master the knowledge of public health emergencies; 1532 (75.14%) thought colleges needed to carry out relevant teaching activities	795 (38.99%) would take the initiative to seek knowledge about public health emergencies	69.18 ± 16.56, $n = 1100$	–
Liu et al. (30)	830 (77.7%) thought it was necessary to popularize the knowledge of public health emergencies and relevant emergency training	–	57.62 ± 9.30, $n = 381$	–
Hu et al. (31)		13 (22%) actively sought information about public health emergencies	–	67% awareness rate of public health emergencies; 45% mastery rate of knowledge on handling public health emergencies, $n = 58$
Sun et al. (12)	348 (95.00%) believed that it was necessary to conduct training and exercises related to public health emergency response	193 (52.73%) participated in training related to coping with public health emergencies	54.28 ± 15.40, $n = 366$	46.99% passing rate, $n = 366$
Cao et al. (32)				66.28% passing rate, $n = 2153$
Tang et al. (33)	5244 (96%) believed that medical college students needed to carry out training in knowledge and skills of emergency handling of public health emergencies			32.55% average accuracy rate of public health emergency knowledge, $n = 5465$

The above studies showing the number (ratio) of students who thought it was essential to master the knowledge of public health emergencies. They hoped to acquire the related expertise further and believed colleges should carry out relevant emergency training and public health emergency response exercises. Individual studies also show the number (rate) of students who would take the initiative to seek knowledge about public health emergencies and participate in the training related to coping with public health emergencies. One study showed that many students believed that disasters were far from themselves. In the above studies, some questionnaire surveys were conducted on their ability to respond to public health emergencies among college students in several universities. The average score represents medical college students' knowledge of coping with public health emergencies. The percentage represents the passing rate of medical college students dealing with public health emergencies or the awareness/mastery rate of expertise related to public health emergencies.

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TABLE 4 The following four studies show the preferred training methods of medical college students in knowledge or skills related to public health emergencies.

Author and year	University	Training methods	Number (Composition ratio) or frequency
Hu et al. (21)	Health Science Centre of Lanzhou University	1. Media (TV) 2. Radio 3. Special lectures on health education 4. Newspapers and books 5. Internet 6. Communication with insiders via telephone 7. Hotline	403 (87.04%) 361 (77.97%) 317 (68.47%) 314 (67.82%) 261 (56.37%) 122 (26.35%) 113 (24.41%)
Zhao et al. (26)	Lanzhou University and Gansu University of Chinese Medicine	1. Educational media 2. Visiting popular science education bases 3. Lectures 4. Contests with prizes	192 (42.57%) 164 (36.36%) 159 (35.25%) 141 (31.26%)
Liu et al. (29)	Five universities in Hainan Province	1. Network 2. Television 3. School teaching	768 (37.67%) 419 (20.55%) 376 (18.44%)
Sun et al. (12)	Binzhou Medical University	1. On-site demonstration 2. Attending lectures 3. Watching video materials 4. Learning relevant elective courses on campus 5. Using a first-aid knowledge exchange platform 6. Reading professional books 7. Reading brochures	304 (83.06%) 276 (75.41%) 218 (59.56%) 184 (50.27%) 135 (36.89%) 125 (34.15%) 103 (28.14%)

professional institutions and personnel for monitoring and evaluating the quality of public health education and teaching. Currently, administrative personnel are mainly engaged in this work, and their level of specialization in monitoring and evaluation is not high (35).

In recent years, some universities have promoted teaching reform and begun to adopt a student-centered approach, carrying out heuristic PBL interdisciplinary organizational teaching with organ systems as modules, expanding teaching venues, and strengthening students' public health education and community health practices towards the community. But generally speaking, there are still problems such as a single teaching mode, outdated teaching materials, disconnection between curriculum and actual work, insufficient attention from both teaching parties, insufficient faculty, and a single assessment method (34).

The experience and development of public health education in other countries and weaknesses in the medical education system of China

Public health education in different countries and regions is characteristic of the different cultural backgrounds and economic levels (34). These experiences are worth reviewing to enhance learning and as a reference. This is of great importance to the medical education system in China, which is facing a great challenge as it is reformed.

Public health education in the United States (US) has been established for more than 100 years. The US education system aims to improve the quality of its public health education, which influences countries worldwide. The US has implemented a competency-based educational model. The main component of medical education in the US is based on a competency-based core curriculum. These competencies are achieved through course-based learning objectives. Completion determines the level of graduates' abilities according to the expected learning objectives, primarily public health needs. The curriculum settings are adjusted as needed to cultivate students' required competencies and for final evaluations (38).

The core knowledge in public health education is disseminated to the public in the US. By integrating public health knowledge, concepts, and skills into other courses, the Association of American Schools and Programs of Public Health (ASPPH) has cooperated with the Association of American Colleges and Universities (AAC&U) to propose a core curriculum for non-public health students to promote public health education among all college students in the country (39). Having good public health knowledge has become common sense among "educated citizens" of the US (39). The US put forward practice-based public health education, scientific research, and service models. Public health education is based on public health practice, attaching importance to practical training and adapting to professional roles, which have substantially promoted the development of academic and public health practice (40–43).

The US established an accreditation system to ensure the quality of education. Accreditation is an integral part of the system for evaluating teaching quality in higher education. A core principle of professional education institutions is to connect their teaching activities with social purposes. In addition to schools of public health, other colleges and institutions in the US that carry out public health education are included in the accreditation system. Currently, most states in the US require medical practitioners to attend an accredited school of public health or train in an accredited training program (44).

Public financial investment in public health education is increasing in the US. Public finance is the primary sustainable funding source of public health education (38). In the history of public health education in the US, insufficient investment led to problems in health education. However, a depleted and overworked public health workforce has led to an enormous brain drain in public health over the past decade in the US (45).

The educational model of Canada is similar to that of the US, with the same curriculum content but more curriculum categories and class hours. The teaching content emphasizes the mutual penetration

and organic combination of basic theory and practice and adopts an equal and interactive teaching form. Students participate in various types of academic activities and prepare regular reports during their probation and internship (46).

Medical colleges in the United Kingdom (UK) integrate clinical work and prevention work, regarding disease prevention as parallel to medical treatment and rehabilitation, and physicians perform public health tasks. The teaching content highlights the cutting-edge nature of knowledge and is closely related to the current needs of public health and preventive medicine. Curriculum setting and teaching in the UK attach great importance to combining these with practical work, cultivating students' ability to solve practical problems and produce all kinds of talents with practical skills soon after graduation. The teaching methods are diverse, and the curriculum is flexible and not limited by textbooks. Teachers guide and assess students' learning, focusing on cultivating students' ability to acquire knowledge independently. The training objectives of students are clear and strict, and the government also strictly supervises the quality of education (34).

Australia adopts Harden's tricyclic instructional approach, which emphasizes training in attitude and behavior, operational and communication skills, public health safety, and understanding of the changing patterns of health care (34).

Europe and Australia focus more on cultivating "soft skills" in medical practice (34). The European School of Public Health has been affiliated with the medical profession since its inception, which limits its non-medical development in areas such as sociology and health policy (47).

Most institutions in Spain have established unique non-fixed courses in which students have maximum autonomy to participate in their curriculum design through self-directed learning. Schools also adopt the "outcome-based education" model, which determines the evaluation method based on the different abilities of students in their future work (34).

Medical colleges in Japan emphasize multiple forms of medical education and introduce problem-based, site-centered, and case-guided heuristic and discussion teaching methods to achieve the minimization of teaching activities, short-term curriculum arrangement, and diversification of teaching forms (34).

The Korean School of Public Health curriculum plan does not fully consider health care. The teaching process ignores the cultivation of practical skills, implementing teacher-centered didactic education, and the evaluation of students is still based on scores or examinations (34).

According to the experience of public health education in other countries, model of public health education of clinical medicine in China and the current low level of Chinese medical students' knowledge regarding public health emergencies, we can identify some weaknesses in the medical education system of China.

The traditional education model in China is that the curriculum determines the teaching objectives rather than the expected learning objectives. This means that the public's health needs cannot be effectively met.

In China, the core curriculum closely related to public health practice in public health education has not yet been established and popularized in medical colleges and universities, let alone among college students, which reflects the fact that these educational institutions do not pay sufficient attention to public health education.

For a long time, medical education in China has mainly adopted traditional theoretical courses to impart knowledge and experience. The teaching method is relatively simple, outdated, and unattractive to younger people. This old style of teaching cannot cultivate students' ability to analyze and solve practical problems (12, 28).

There is no public health education accreditation system in China for clinical medical students similar to those in other countries. Therefore, the quality of education cannot be guaranteed.

At present, China's investment in public health education is also far from adequate.

Recommendations for cultivating medical college students' ability to deal with public health emergencies in China

In this context, cultivating medical college students' ability to respond to public health emergencies has become an essential issue in medical education in China and globally. The following suggestions can be used as a reference in China and other countries.

In reviewing the experience of public health education in other countries and the weakness identified in the medical education system of China, we believe that, first, the traditional Chinese educational model must be transformed based on the goals of the curriculum in a competency-based education model. Competency-based (or outcomes-based) education requires the instructor to work backward, from the desired course learning outcomes to the method. Therefore, we need to first define the desired course learning outcomes according to public health needs, and then adjust the curriculum settings, create the content and learning objectives for the course that will yield those desired outcomes, and determine the assessment mechanisms that will supply data on whether those outcomes were met, to train students to achieve these goals. Competency-based approaches lead us more directly to ideas for assessment because the instructional content is explicitly tied to learning outcomes (48).

Second, we should build corresponding public health teaching platforms, such as core curriculum settings and teaching material planning according to the course learning outcomes, that is, health needs. In terms of teaching content, it is suggested that this mainly covers the background knowledge, basic concepts, and theories of public health emergencies, introduction to relevant laws and regulations, professional ethics education, the hierarchical management system, and specific cases of public health emergencies. In addition, students should be systematically and comprehensively introduced to the particular tasks and responsibilities of medical institutions and medical workers in treating public health emergencies (7, 11). We can refer to the core curriculum certified in the US since 2014, including (1) biostatistics; (2) epidemiology; (3) environmental health science; (4) health service management; and (5) social and behavioral sciences.

The importance of teaching methods can also not be ignored. Table 4 shows the preferred training methods of medical college students with knowledge or skills related to public health emergencies. This suggests that colleges and practice bases should diversify the educational forms using various channels and pay attention to the combination of theoretical knowledge and practice. Different methods can be adopted, such as educational media, visiting popular science education sites, networking, lectures, award-winning contests,

simulation exercises, case analysis, scenario demonstration, on-site observation, and on-site investigation (21, 24, 26, 28).

Third, public health education can be focused on ideologically, and the public health core curriculum in medical education can be promoted. China should incorporate the core concept of public health into the general education curriculum of medical colleges or universities as soon as possible such that every medical college student can master the basic knowledge, skills, and attitudes of public health. In particular, it is necessary to take adequate measures to organically combine the core public health curriculum with essential medicine and clinical medicine by reforming the curriculum of medical college students. The core curriculum should be taught and examined in compulsory courses. This will be of great help in improving the awareness of medical college students regarding knowledge related to public health emergencies (49).

Fourth, in public health education in China, practical courses should be strengthened to provide more practice opportunities for medical college students. In real-world examples and scenarios, students must be able to apply and practice techniques in each core discipline of public health. With public health practice as the link, we can ensure the quality of public health through teaching, research, and service. The emergency treatment of infectious diseases and public health emergencies is the most critical public health work undertaken by medical institutions. To perform these tasks well, medical institutions rely on timely reporting and handling by medical staff. Therefore, medical college students at the stage of clinical practice, under the instructor's guidance, can undertake some work such as writing medical records, reporting the epidemic situation of infectious diseases, and other public health monitoring tasks (7, 11). Teaching hospitals should educate students in clinical knowledge and skills and give these students the opportunity to master specific public health work undertaken by medical institutions and how to correctly complete such work as assigned by high-level health administrative departments (11). Students should be taught to consult the literature, capture the latest information in a timely manner, and write papers and reports.

Fifth, we need to implement a public health education certification system and include colleges or universities that carry out public health education-related projects in the accreditation system. The accreditation of public health education in the US has been implemented for nearly 80 years. The development of accreditation standards in public health promotes the development of public health competency in that country. In this regard, China is still in the exploratory stage and is facing the same challenge in terms of improving the quality of public health education.

Finally, public health education needs the guarantee and support of funds. Therefore, we should increase public financial investment in public health education and improve the efficiency of its use. Medical education donations and personal investments are also important sources of funds.

Looking back to the past, based on the present, the future is full of challenges and hope

Clinical medicine and public health medicine were integrated and inseparable in the past. However, the Rockefeller Foundation's decision to support the establishment of an independent school of public health in 1916 marked the institutionalization of the division between clinical and public health medicine. In the 1980s, China's higher education major catalog divided medicine into clinical medicine, basic medicine, and public health and preventive medicine. Since then, public health/preventive and clinical medicine have gradually become separated (11). This kind of medical education system involving the separation of clinical medicine from public health and preventive medicine has prematurely solidified the direction of development among medical college students, resulting in most focusing on individuals rather than groups and emphasizing treatment rather than public health and prevention (11).

In response to this problem, in 2006, the ASPPH and AAC&U reached a consensus that the core curriculum in public health (also known as 101 series courses) should be available in all undergraduate institutions and should fulfill the distribution requirements as part of general education (50, 51). Moreover, the training of students in public health and preventive medicine in the US is based on the exercise of clinical medicine; that is, public health and preventive medical students acquire a clinical medical degree before training in core knowledge and public health skills (52). Therefore, clinical medicine and public health and preventive medicine are well integrated in the US.

In China, however, this problem remains to be resolved. Most medical colleges and universities do not conduct theoretical or practical courses in preventing and responding to public health emergencies. Only a few colleges and universities offer such studies; however, due to the limited class hours, these courses are far from sufficient, and the content is relatively outdated and backward. The assessment of relevant knowledge is carried out in elective rotations for medical college students majoring in non-public health and preventive medicine, which also leads to students attaching little importance to these courses (6). All the above factors lead to an insufficient ability of medical college students to deal with public health emergencies. When the SARS epidemic broke out, medical staff and public health workers did not understand each other's working methods; these two groups could not communicate and collaborate in a timely manner, which result in heavy losses of health and life (11).

It is imperative to strengthen the reform of public health education for medical college students such that it becomes part of the essential contents of medical education (7, 53). We should help medical college graduates to appreciate the importance of acting effectively in public health emergencies as well as in people's everyday lives to ensure the health of the nation and countries worldwide. Medical college students should understand that in the future, they must take responsibility for medical responses and public health work in dealing with public health emergencies (11). Strengthening the cultivation of medical college students' knowledge and ability to prevent and respond to public health emergencies, enhancing their prevention/control awareness and coping ability, and highlighting the leading roles of medical college students in public health emergencies are necessary and vital measures to effectively prevent and control public health emergencies that may be faced in the future (6).

Most medical college students are highly interested in acquiring public health knowledge, especially those who enrolled after the COVID-19 outbreak in 2019, whose understanding and emphasis on public health knowledge have significantly improved. This has laid a good foundation for providing more in-depth education in public

health knowledge and responsibilities among medical college students and also reflects that the reform of responsible public health education for medical college students is urgent (11).

Through appropriate, reasonable, and targeted educational reform measures, it is believed that in the future, we can develop and maintain a clinical workforce with the skills and capacities to perform optimally in public health emergencies, to shoulder these vital tasks and minimize the harm caused by such emergencies (7). Achieving this goal can benefit all of society and warrants adequate support.

Strengths and limitations

For the first time, we systematically reviewed the cognitive status and training needs of medical college students in response to public health emergencies in China. However, several limitations need to be addressed. Firstly, due to the considerable heterogeneity of research design and outcome variables, it was impossible to perform an effective meta-analysis. Secondly, this review excluded studies that did not include clinical medical students, such as those examining the status of nursing students' ability to respond to public health emergencies. Finally, there may be interference from other related factors. Although the participants in some studies are similar in age, their sex ratios are quite different; moreover, most of the studies did not show this clearly. Nevertheless, this research should be adequate to reflect current situation of insufficient cognition and training needs of medical college students responding to public health emergencies in China.

Conclusion

This article illustrates the importance of improving medical college students' education to prevent and deal with public health emergencies. Through systematically reviewing the literature, we found some weaknesses in China's medical education system that result in the inability of current medical college students to deal with public health emergencies safely and effectively. By considering these weaknesses and summarizing the experience and development of successful public health education in the US and other countries, we put forward some recommendations to improve medical college students' education in responding to public health emergencies. It is necessary to establish a competency-based educational model, build a core curriculum related to public health, and promote this model in medical colleges and universities. This core curriculum should be based on practice and emphasize practical training. We need to improve the quality of education through a standardized accreditation system. Finally, we should increase public financial investment in public health education and improve the efficiency of its use.

Author contributions

PY conceptualized this study and made the tables for the manuscript. PY and LZ offered the main direction and significant guidance of this manuscript. XF performed the data analysis and drafted the manuscript with advice from PY. RP and HL revised the manuscript. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

References

1. Lu GY, Zhang YY, Li YP. A survey on the cognition of preventive medicine in clinical medical students. *Basic Med Educ*. (2021) 23:552–5. doi: 10.13754/j.issn2095-1450.2021.08.08

2. Li LM. *Epidemiology. 6th ed*. Beijing: People's Medical Publishing House, (2007): 284–299

3. Hao XN, Liu JC, Bo T, Wu J, Xu M, Zhang ZZ, et al. A cross-sectional study on the current situation of monitoring and early warning for public health emergencies in China. *Chinese J Health Policy*. (2013) 6:53–7. doi: 10.3969/j.issn.1674-2982.2013.12.009

4. Wang J, Yuan BB, Li ZM, Wang ZF. Evaluation of public health emergencies Management in China: a systematic review. *Int J Environ Res Public Health*. (2019) 16:3478. doi: 10.3390/ijerph16183478

5. National Health Commission of the People's Republic of China. Information on national public health emergencies from January to June 2012. (2012). Available at: http://www.nhc.gov.cn/jkj/s3578/201304/eb2e40346e164d35adb2362ae87e3e6f.shtml. (Accessed August 18, 2022).

6. Wu W, Yin ZH, Guan P, Li XL, Song WJ, Cai Y, et al. Investigation of the knowledge of medical college students in dealing with public health emergencies. *China Higher Med Educ*. (2015) 29:3–4. doi: 10.3969/j.issn.1002-1701.2015.11.002

7. Zhang XJ, Sun YH, Hao JH, Ye DQ. The teaching research on cultivating medical college students' ability to respond to public health emergencies. *Chinese J Disease Contr Prevent*. (2005) 9:266–8. doi: 10.3969/j.issn.1674-3679.2005.03.022

8. Huang JZ, Han MF, Luo TD, Ren AK, Zhou XP. Mental health survey of medical staff in a tertiary infectious disease hospital for COVID-19. *Chin J Industr Hygiene Occup Diseases*. (2020) 38:192–5. doi: 10.3760/cma.j.cn121094-20180914-00398

9. Zhang G. Reflection and countermeasures on management of nosocomial infection of medical staff under the COVID-19 epidemic. *Chin J Tuberculosis Respiratory Diseases*. (2021) 44:74–6. doi: 10.3760/cma.j.cn112147-20200722-00829

10. Pan A, Liu L, Wang CL, Guo H, Hao XJ, Wang Q, et al. Association of Public Health Interventions with the epidemiology of the COVID-19 outbreak in Wuhan, China. *JAMA*. (2020) 323:1915–23. doi: 10.1001/jama.2020.6130

11. Xu W, Shi N, Jin R, Zou CL, Feng L, Shi LY. Discussion on strengthening the responsibility education for emergency treatment of public health emergencies among clinical medical college students. *Med Soc*. (2009) 22:65–6. doi: 10.3870/YXYSH.2009.02.024

12. Sun YN, Zhang HR, Zhang L. A study on medical college students' cognitive status and training needs in public health emergencies. *Health Vocational Educ*. (2021) 39:71–3.

13. Leão T, Barros H. Merging academy and healthcare in the public health training of medical students. *Public Health Rev*. (2020) 41:28. doi: 10.1186/s40985-020-00146-1

14. Markenson D, DiMaggio C, Redlener I. Preparing health professions students for terrorism, disaster, and public health emergencies: core competencies. *Acad Med*. (2005) 80:517–26. doi: 10.1097/00001888-200506000-00002

15. Ren T, Lyu J, Yu CQ, Li L. Rethinking public health education and public health workforce development in China. *Chin J Prev Med*. (2020) 54:457–64. doi: 10.3760/cma.j.cn112150-20200330-00473

16. Shaw CV, D'Souza AJ, Cunningham R, Sarfati D. Revolutionized public health teaching to equip medical students for 21st century practice. *Am J Prev Med*. (2020) 59:296–304. doi: 10.1016/j.amepre.2020.02.019

17. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. (2021) 372:n71. doi: 10.1136/bmj.n71

18. Rowe M, Frantz J, Bozalek V. The role of blended learning in the clinical education of healthcare students: a systematic review. *Med Teach*. (2012) 34:e216–21. doi: 10.3109/0142159X.2012.642831

19. Ashraf MA, Mollah S, Perveen S, Shabnam N, Nahar L. Pedagogical applications, prospects, and challenges of blended learning in Chinese higher education: a systematic review. *Front Psychol*. (2022) 12:772322. doi: 10.3389/fpsyg.2021.772322

20. Wang C, Omar Dev RD, Soh KG, Mohd Nasirudddin NJ, Yuan Y, Ji X. Blended learning in physical education: a systematic review. *Front Public Health*. (2023) 11:1073423. doi: 10.3389/fpubh.2023.1073423

21. Hu XB, Bai YN, Qu Y, Zhao C, Pei HB. A cognitive intervention study on the 'regulations on preparedness for and response to emergent public health hazards' among graduating medical students. *Health Vocat Educ*. (2004) 22:115. doi: 10.3969/j.issn.1671-1246.2004.17.089

22. Yu EM, Wang CJ, Li WJ, Sun JF, Zhang WD, Zhang MX, et al. Knowledge, attitude, and behavior of public health emergencies among university students. *Chin J Public Health*. (2011) 27:920–2. doi: 10.11847/zgggws2011-27-07-47

23. Zheng JS, Yang LQ, Lin ZP. Comparison of the teaching effect of health education on the knowledge of public health emergencies among medical students. *J Hebei United Univ*. (2012) 14:100–1. doi: 10.3969/j.issn.1008-6633.2012.01.078

24. Wang Q, Du ZD, Lu C. Investigation and analysis of medical college students' cognition of public health emergencies. *J Zunyi Med Univ*. (2012) 35:532–5. doi: 10.3969/j.issn.1000-2715.2012.06.020

25. Liu YM, Wu L, Wang JH, Huang HR, Tian Y. Survey on KAP about public health emergency response in medical students. *Progr Mod Biomed*. (2013) 13:350–62.

26. Zhao J, Chang XY, Wu GX, Mao WJ, Tian JH. Analysis of policies and current situation of medical college students' ability deal with sudden public health incidents. *China J Emerg Resuscit Disaster Med*. (2013) 8:21–3. doi: 10.3969/j.issn.1673-6966.2013.01.006

27. Zheng JQ, Chen JY, Deng GJ, Tan X, Zeng WW, Yu JC, et al. KAP survey on public health emergencies among students of a medical college in Hunan Province. *Med Aesthet Cosmetol*. (2015) 2:644.

28. Mu YH, Jia CP, He RY, Fan L, Zhang YX. The analysis of the ability to cope with public health emergencies for different professional college students. *China Health Industr*. (2015) 24:116–8. doi: 10.16659/j.cnki.1672-5654.2015.24.116

29. Liu YM, Wu L, Wang JH, Huang HR, Tian Y. Investigation on the cognition and teaching needs of college students in public health emergencies. *China Health Industr*. (2017) 14:159–60. doi: 10.16659/j.cnki.1672-5654.2017.12.159

30. Liu WZ, Pang YM, Song L, Zhang HW, Lin JJ, Jia GL, et al. The investigation of knowledge, attitudes, and practice about dealing with emergency public health events among the college students in Wuhu and analysis of its influence. *J Qiqihar Med Univ*. (2018) 39:320–3. doi: 10.3969/ j. issn.1002-1256.2018.03.029

31. Hu Fl HDS, Zhang M. Investigation on the awareness level of clinical medical students on public health emergency. *Edu teach Forum*. (2020) 47:108–11.

32. Cao XH, Zhang W, Wang N, Du J, Zhao M, Lin JC. Factors associated with knowledge, attitude, and practice of college students in response to public health emergencies in Shandong province. *Chin Prevent Med*. (2021) 22:598–602. doi: 10.16506/j.1009-6639.2021.08.006

33. Tang Y, Xl Z, Tao ZY, Li DY, He T. Study on medical students' awareness of emergency knowledge and educational needs for public health emergencies. *J Med Theor Prac*. (2022) 35:345–6. doi: 10.19381/j.issn.1001-7585.2022.02.079

34. Wang LJ, Zhang SC, Liu H, Jin W, Chen ZX, Yu YX. Public health education mode of clinical medicine at home and abroad. *China Higher Med Educ*. (2014) 5:7–8. doi: 10.3969/j.issn.1002-1701.2014.05.004

35. Li CY, Wu NN, Liu PC, Jiang LW. Problems and countermeasures of public health education in China. *Med Soc*. (2016) 29:86–9. doi: 10.13723/j.yxysh.2016.04.027

36. Liu L. Analysis of the public health education of clinical medical students guided by post competency. *China Contin Med Educ*. (2023) 15:35–8. doi: 10.3969/j.issn.1674-9308.2023.02.008

37. Xiao W, Xing W, Liu ZG. Investigation on knowledge and awareness of nosocomial infection prevention and control in senior medical students. *Neural Regen Res*. (2019) 11:49–51.

38. Jin H, Shen XB. The new trends of higher public health education reform in the US. 2017 joint meeting of presidents/deans of the National School of public health, the 4th plenary meeting of the 4th public health education branch of the Chinese preventive medicine association, proceedings of the 8th plenary meeting of the 2nd preventive medicine education research Association of the Chinese society of higher education. (2017):71–81

39. Petersen DJ, Albertine S, Plepys CM, Calhoun JG. Developing an educated citizenry: the undergraduate public health learning outcomes project. *Public Health Rep*. (2013) 128:425–30. doi: 10.1177/003335491312800517

40. Association of Schools of Public Health. Demonstrating excellence in academic public health practice. *Public Health Rep*. (1999) 114:480–3. doi: 10.1093/phr/114.5.480

41. Atchison C, Boatright DT, Merrigan D, Quill BE, Whittaker C, Vickery AR, et al. Demonstrating excellence in practice-based teaching for public health. *J Public Health Manag Pract*. (2006) 12:15–21. doi: 10.1097/00124784-200601000-00004

42. Potter MA, Quill BE, Aglipay GS, Anderson E, Rowitz L, Smith LU, et al. Demonstrating excellence in practice-based research for public health. *Public Health Rep*. (2006) 121:100102. doi: 10.1177/003335490612100102

43. Potter MA, Burdine J, Goldman L, Olson D, Silver GB, Smith LU, et al. Demonstrating excellence in the scholarship of practice-based service for public health. *Public Health Rep*. (2009) 124:1–15. doi: 10.1177/003335490912400401

44. White F. The imperative of public health education: a global perspective. *Med Princ Pract*. (2013) 22:515–29. doi: 10.1159/000354198

45. Bauchner H, Sharfstein J. A bold response to the COVID-19 pandemic: medical students, National Service, and public health. *JAMA*. (2020) 323:1790–1. doi: 10.1001/jama.2020.6166

46. Cui H, Zhao CY. Comparison of medical education models between China and Canada. *J Clin Exp Med*. (2006) 5:2. doi: 10.3969/j.issn.1671-4695.2006.04.072

47. Jin H, Dong G, Zou L, Shen X, Li D. History and status quo of higher public health education in China. *Public Health Rev*. (2020) 41:12. doi: 10.1186/s40985-020-00120-x

48. Hooper L, Begg MD, Sullivan LM. Integrating competencies and learning outcomes in core courses for the MPH. *Public Health Rep*. (2014) 129:376–81. doi: 10.1177/003335491412900414

49. Yuan J, Jiang XY, Guo XH, Lan H, Liu C, Xiao SS. Thoughts on multi-dimensional cultivation of medical college students' ability to deal with public health emergencies. *Contemp Med*. (2021) 27:185–8. doi: 10.3969/j.issn.1009-4393.2021.08.078

50. Riegelman RK. Undergraduate public health education: past, present, and future. *Am J Prev Med*. (2008) 35:258–63. doi: 10.1016/j.amepre.2008.06.008

51. American College of Preventive Medicine. Preventive Medicine (EB/OL). (2016).

52. Zhang WW, Deng XD, Ye Y, Leng YB, Cheng DM, Zhu YF, et al. Enlightenment of the public health talent cultivation in the USA for public health and preventive medicine education in China. *Mod Prevent Med*. (2017) 44:1532–6.

53. Zhou ZH, Wang JJ, Lei YX, Bin XN. Practice and exploring on cultivating the medical college students' abilities in dealing with emergencies public health events. *Pract Prevent Med*. (2005) 12:1208–9. doi: 10.3969/j.issn.1006-3110.2005.05.112

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Education for public health 2030: transformation to meet health needs in a changing world

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Education for public health is at a critical inflection point, and either transforms for success or fails to remain relevant. In 2020, the Association for Schools and Programs of Public Health launched an initiative, Framing the Future 2030: Education for Public Health (FTF 2030) to develop a resilient educational system for public health that promotes scientific inquiry, connects research, education, and practice, eliminates inequities, incorporates anti-racism principles, creates and sustains diverse and inclusive teaching and learning communities, and optimizes systems and resources to prepare graduates who are clearly recognizable for their population health perspectives, knowledge, skills, attitudes, and practices. Three expert panels: (1) Inclusive excellence through an anti-racism lens; (2) Transformative approaches to teaching and learning; and (3) Expanding the reach, visibility, and impact of the field of academic public health are engaged in ongoing deliberations to generate recommendations to implement the necessary change. The article describes the panels' work completed thus far, a "Creating an Inclusive Workspace" guide, and work planned, including questions for self-evaluation, deliberation, and reflection toward actions that support academe in developing a resilient education system for public health, whether beginning or advancing through a process of change. The FTF 2030 steering committee asserts its strong commitment to structural and substantial change that strengthens academic public health as an essential component of a complex socio-political system. Lastly, all are called to join the effort as collaboration is essential to co-develop an educational system for public health that ensures health equity for all people, everywhere.

KEYWORDS

academic public health, inclusive excellence, curricular transformation, higher education, pedagogy, academic practice partnerships, graduates

Introduction

Education for public health is currently at a crucial crossroad, where its members must decide between adapting and thriving, or potentially failing to prepare learners to protect the health of the public. In response to this challenge, the Association of Schools, and Programs of Public Health (ASPPH) launched Framing the Future 2030: Education for Public Health (FTF 2030) in 2020 to advance "equitable, quality education in public health for achieving health equity and well-being for everyone, everywhere." Conceived prior to COVID-19 and the murder of George Floyd, FTF 2030 is powerfully informed by these events and other realities in seeking a proactive approach to positioning academic public health as a vital contributor in assuring health within a complex and ever-evolving world.

FTF 2030 builds on a prior ASPPH initiative, Framing the Future: The Second Hundred Years of Education for Public Health (2011–2015) (1). Planned in conjunction with the 100-year anniversary of academic public health in the United States, this first effort also sought to review the state of the educational system for public health to better prepare graduates for changes in the global marketplace. It included over 200 members from across the spectrum of public health players who recommended change in seven areas:

- The Master of Public Health Degree: Transitioning to a 21st Century Model.
- The Doctor of Public Health Degree: Preparing Transformative Leaders.
- Undergraduate Education in Public Health: A Dynamic Foundation.
- Incorporating Population Health into Other Professional Degree Programs.
- Community Colleges and Public Health: Providing Pathways to Public Health Education.
- Workforce Development: Bolstering the Governmental Public Health Workforce.
- Blue Ribbon Employers Advisory Board Report: Trends in Public Health Education.

Continually ensuring that education in public health supports the workforce in contributing to a healthier planet necessitates vigilance and constant realignment given changing social, political, technological, and other contexts. In the United States, late 19th and early 20th century pioneers for public health training advocated for hygiene instruction at multiple levels, including practical training in sanitation within medical schools that would confer a diploma of public health (2) and grounding public health in service to communities at four different levels of practice: teacher, research scholar, technical expert, or administrator (3). The subsequent Welch-Rose Report of 1915 defined an "institute of hygiene" that could produce a new cadre of public health professionals and soon after led to creation of the first formal academic institutions of public health in the United States (4).

Education in public health expanded throughout the 20th century while questions about its role, status as a profession, and the requisite content and methods for its teaching and learning resulted in incremental changes but lacked larger structural transformation (4–6). Calls for change in the 1980s and 1990s such as for more comprehensive Doctor of Public Health Training for creating public health leaders (7) and a stronger focus on service learning (8) were followed in the early 2000s by recommendations to ground public health in an ecological framework and new core competencies (9) including climate change (10). Additionally, calls for institutional and instructional reforms that could enable health professions education to better fit health system needs, integrating teaching and learning across disciplines, enhancing lifelong learning to enable acquisition of the enormous body of knowledge for successful practice (11–13), and the increasing interprofessional education (12, 14, 15) stimulated further change.

In the wake of COVID-19, important voices reflected on: education as a collective enterprise (16), the value of combining an eco-social framework with a life course perspective on population health (17), the imperative to combat health inequities (18, 19), and the role of undergraduate education in public health as filling a valuable contribution to the workforce (20). FTF 2030 is building on this rich historical legacy, synthesizing it with our panels' collective research, observations, and conversations with members and partners in three ASPPH FTF 2030 town halls and other venues to illuminate planning for educational transformation. Of particular note, FTF 2030 is paying special attention to health and social inequities exacerbated by COVID-19, our long overdue racial reckoning, increased gun violence, lack of access to quality healthcare, generational poverty, and catastrophic climate events as important and complex health-related components of our dynamic world and of central relevance to the work of public health professionals.

While interest in public health across the educational continuum increased during COVID-19 (21), so did distrust, even hostility, toward public health practitioners. Despite awe-inspiring scientific advances in fighting the COVID-19 virus, we witnessed a growing mistrust of science and public health practice and are concerned at the forecast that the US stands to lose almost half of its public health workforce by 2025 (22).

In exploring how academic public health is generating learning, readying learners to protect health, and communicating effectively to advance health, the FTF 2030 steering committee (SC) recognizes how public health was challenged in laying out policy choices in the COVID-19 pandemic against a backdrop of core values, priorities, and inevitable tradeoffs that shape decision-making in the face of scientific uncertainty. We saw how our graduates in the workforce were able to contribute and where they lacked the ability to protect the public's health. We saw how various system breakdowns—from supply chains, to communications, to equitable access to therapeutics, vaccines, and other health protections—harmed population health and raised questions about our professional credibility and cause.

The SC consulted many sources including the 2030 Sustainable Development Goals, which encourages higher education to exert a stronger social presence and engagement in society through purposeful partnerships (23). At a time when trust in higher education is also eroding and political polarization is on the rise, the SC supports universities in reclaiming their position in society as learning spaces for positive change, where critical issues are openly debated and discussed, toward solving complex problems in respectful collaboration with vested partners (24).

FTF 2030 vision and its expert panels

The SC began their work by formulating a vision, grounded in ASPPH's strategic plan to deliver equitable, quality education for public

health for achieving health equity and well-being for everyone, everywhere (25). ASPPH's values are explicit and comprised of: diversity, equity, inclusion, and social justice; collaboration; excellence; innovation; agility; and a commitment to public health (25). The SC articulated an aspirational, but achievable, goal: a resilient educational system for public health that promotes scientific inquiry, connects research, education, and practice, eliminates inequities, incorporates anti-racism, creates and sustains diverse and inclusive teaching and learning communities, and optimizes systems and resources to prepare graduates who are clearly recognizable for their population health perspectives, knowledge, skills, attitudes, and practices. The SC also outlined strategies and principles to realize the vision (see Supplementary Table 1).

The SC is engaging in critical examinations of the multiplicity of factors that transform education by centering on the roles of five key drivers—university systems and structures; faculty; staff; students; and partners—in improving structures and systems to better enable academic public health to serve health and wellness. Furthermore, FTF 2030 is drawing on recent work of fellow ASPPH task forces: the Scholarship of Teaching and Learning (26), Zero Tolerance of Harassment and Discrimination (27), Dismantling Racism and Structural Racism in Academic Public Health (28), Responding to the Climate Change Crisis (29), and Gun Violence Prevention (30) to iterate and synchronize their collective work.

To develop tactics, measures, and outcomes for each of the strategies and principles, the SC identified three cross-cutting areas to focus efforts:

1 Inclusive excellence through an anti-racism lens;
2 Transformative educational models and pedagogy; and
3 Expanding the reach, visibility, and impact of the field of academic public health.

In 2021, the SC populated and charged three cross-cutting expert panels to address each focus area. Each panel is charged with assessing the current state of the environment of education for public health, envisioning future developments encompassing inherent uncertainty and the complexity of systems and structures, and developing promising practices and exemplars addressing these strategies along with principles for schools and programs to model or adapt, as appropriate. The three expert panels are communicating broadly as part of a cohesive approach including annual town halls, sessions with partners, and a recent Teaching Public Health Conversation (31).

The panels view inclusive excellence through an anti-racism lens as foundational and essential to the success of this effort. Without inclusive representation, perspectives, and experiences from all people, we cannot envision transformative educational models and pedagogy that are necessary to meet the needs of the field now and into the future. Likewise, without inclusive representation and engagement in more effective educational models and pedagogy, we cannot possibly expand the reach, visibility, and impact of academic public health (see Figure 1).

FTF 2030: Inclusive excellence through an anti-racism lens

The Inclusive Excellence through an Anti-racism Lens panel includes 14 representatives from academe and practice, who in their formation process developed a "Creating an Inclusive Workspace" guide their work (32). This document articulates the panel's values, norms, and principles to direct their efforts, and includes their commitment to a participatory decision-making process. With the understanding that the process would adjust as the group matured, the panel offers their process as an example for potential adaptation or adoption by groups advancing similar efforts.

The panel worked together to define key terms including developing a collective understanding of what is meant by inclusive excellence through an anti-racism lens in higher education. The definitions have been expanded and attached to examples in a comprehensive glossary that builds on other work and will soon be shared.

After completing these foundational steps, the panel undertook an environmental scan of promising practices, underway or planned, to promote inclusive excellence across each of the five drivers. The purpose is to identify what success looks like in a sample of ASPPH-member institutions for surfacing working models and lessons learned. Concrete, living examples, along with the institutions where they were implemented, will be posted for others to review, adopt or adapt, and connect on mutual efforts. The intent is to build a resource for the community, and to invite others to contribute their own models or adaptations to add to a dynamic repository for the benefit of all.

FTF 2030: Transformative approaches to teaching and learning

The Transformative Approaches to Teaching and Learning expert panel includes 17 representatives from academe and practice who began their work by identifying four workstreams: Foundational skills and values needed by public health professionals to succeed in the current socio-political context; Teaching (pedagogy) and learning; Interacting with those outside of academic public health; and Content delivery and pathways. The workstreams' discussions paved the way for a forthcoming framing document with transformative approaches to teaching and learning in public health, the associated assessment of learning outcomes, and recommendations to deliver on the change.

The panel calls for a paradigm shift that requires more than teaching new knowledge and skills. It requires creating robust learning spaces with new ways of teaching, new opportunities tailored to learners across the life-course, and preparing graduates with not only science-based content but with a strong grounding in public health values and nuanced skills to engage in authentic deliberation and advocacy across sectors, professions, and communities for policies, programs, practices, and services that protect the people's health. As we in public health recognize the need for more upstream health interventions, the panel is addressing the need to prepare students to grapple with the root causes of health in complex systems to enable them to shape public policy conversations about population health. And just as the recommendations of the original Framing the Future initiative featured prominently in the Council on Education for Public Health criteria, the FTF 2030 leaders plan again to work collaboratively in advising on criteria changes to improve learner readiness to address public health challenges, with a renewed focus on values, ethics, and advocacy skills to contribute effectively to social justice and health equity.

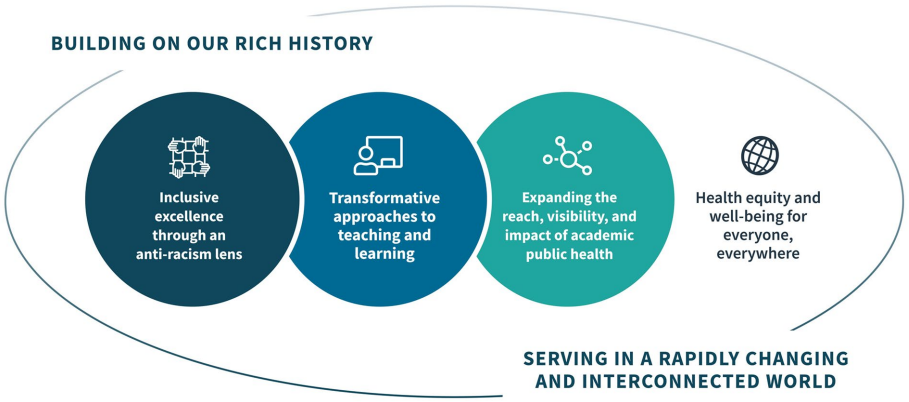

FIGURE 1
Framing the future 2030 cross-cutting expert panels,

FTF 2030: Expanding the reach, visibility, and impact of academic public health

The Expanding the Reach, Visibility, and Impact of Academic Public Health expert panel includes 13 representatives from academe, private industry, public health practice, and a philanthropic organization who began their work together by developing a series of guiding questions to shape recommendations for change. A core principle for recommending change is that academic public health should approach community engagement from a perspective of humility versus the "we are the experts" approach that has too often driven past efforts. The panel is stressing the urgency to rebuild trusting relationships with the community and to prepare for the next public health emergency as core goals for action. These aims point to the need for transformation in two areas: first, a deliberate focus on what communities and partners need from us in academic public health, and not the opposite, including, but not limited to, how we engage younger learners in public health and how to ensure public health is "at the table" in interprofessional educational for collaborative practice; and, second, education and training, curricular change, and competencies that better prepares graduates and that meets professionals where they are in terms of their continuing education needs while drawing from their expertise and assets in such training for protecting health. The panel's recommendations will be shared in a white paper for comment, as will examples of promising practices and recommendations for short- and long-term action.

Deliberative reflection

A critical issue, relevant to all three expert panels, is ensuring that FTF 2030 products are accessible and useful to all member schools and programs served by ASPPH. Understanding that members operate in unique contexts and with differing core missions, financial models, and other organizational factors, flexibility needs to be baked into recommendations. In addition to the work products outlined above, the SC is drafting questions for self-evaluation, deliberation, and reflection toward actions that support member schools and programs in approaching these issues and beginning or advancing through a process of change. The questions are aimed to support a participatory visioning and planning process whereby interested members could find answers for themselves that best fit their situations in responding to FTF 2030 recommendations.

The questions will "invite consideration for what it means to be responsive to what's happening in the world and how it makes its way into our classroom or our community learning spaces and, at a deeper level…how our choices influence effectiveness and sustainability (16)." It will include specific questions for the key drivers, honing in on the strategies and principles outlined in Supplementary Table 1. This approach is intended to support members and guide them in drawing upon their own lived experiences and data in planning for implementation and change. The questions are intended to generate creative and meaningful conversations and self-reflection, with the ultimate goal of identifying, very specifically, what success means and what it could look like in each specific culture and context. Similar to all other products of this effort, the draft questions will be shared for feedback and modification.

Discussion

The FTF 2030 effort is an opportunity to create a future educational system for public health that is inclusive, equitable, innovative, adaptive, and sustainable. The work required to do this cannot remain static nor can it occur in isolation. Academic public health will not deliver in protecting public health if constituents work within their schools and programs alone, in familiar, comfortable spaces. To transform education to meet health needs not only for today, but for tomorrow, schools and programs must work together

and strengthen existing outreach and create new partnerships if we are to be successful.

We are deep into a period of great disruption and have many options for transformation. During the COVID-19 pandemic, we had to change and adapt in ways and at a cadence that we never imagined possible. We learned much about what worked and what did not work to promote student learning, methods to use educational technology more effectively, and the importance of remaining true to our core values. We also observed greater injustices, widening gaps, in education and in most other sectors. While we acknowledge that this is a moment of profound social and political uncertainty and with existential challenges to core public health principles along with new barriers to making progress on health and social equity, we remain undaunted in our commitment to work for change. We are redirecting our energies toward structural and substantial change that strengthens academic public health as an essential component of a complex socio-political system that ensures health and well-being for everyone, everywhere.

Call to action

With support from ASPPH, the SC is committed to amplifying existing, positive efforts by the ASPPH-member schools and programs and improving this work across sectors, professions, and politics. Products of the FTF 2030 initiative are disseminating in real-time and all partners are not only welcomed but needed to join this effort by contributing feedback at academics@aspph.org to improve our work and to make it more useful for all. A key question we continue to ask ourselves and post to readers is: Are we bold enough?

We invite all interested in advancing promising strategies and initiatives for creating a more just and healthier world to collaborate in sharing lessons learned and developing metrics to monitor shared progress. Everyone is necessary and essential for building a common evidence-base to inform future decision-making.

As our core principles of diversity, inclusivity, equity, innovation, resilience, and social justice continue to be challenged, we must respond to the scrutiny through organized, collaborative efforts. We need more open conversations to surface all perspectives, and to ensure that strategies to advance the health of all are based on science and evidence and that we co-communicate our messages effectively and respectfully. We need to strengthen education for public health, collaborating with all players for enabling health decisions to draw from relevant and timely data so individuals and communities can respond effectively. This is how we could contribute to a culture of trust and improved health and wellness. And, at this important socio-political inflection point, those of us who can do more, must do more to create a more just and healthier world.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

LS: Conceptualization, Methodology, Writing – original draft, Writing – review & editing. EW: Conceptualization, Methodology, Project administration, Writing – original draft, Writing – review & editing. WB: Conceptualization, Methodology, Writing – review & editing. AF: Conceptualization, Methodology, Writing – review & editing. WH: Conceptualization, Methodology, Writing – review & editing. MK: Conceptualization, Methodology, Writing – review & editing. SM: Conceptualization, Methodology, Writing – review & editing. VW: Conceptualization, Methodology, Project administration, Writing – review & editing. LA: Conceptualization, Methodology, Writing – review & editing. LM: Conceptualization, Methodology, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2023.1269272/full#supplementary-material

References

1. Petersen DJ, Weist EM. Framing the future by mastering the new public health. *J Public Health Manag Pract*. (2014) 20:371–4. doi: 10.1097/PHH.0000000000000106

2. Sedgwick WT. Report of committee on the teaching of hygiene and granting a diploma of doctor of public health. *Public Health Pap Rep*. (1902) 28:170.

3. Rosenau MJ. Courses and degrees in public health work. *J Am Med Assoc*. (1915) LXIV:794–6. doi: 10.1001/jama.1915.02570360010003

4. Welch W. *The welch-rose report: a public health classic, a publication by the delta omega alpha chapter to mark the 75th anniversary of the founding of the Johns Hopkins University School of hygiene and public health, 1916–1992*. Washington: Delta Omega Honorary Public Health Society (1992).

5. Evashwick CJ, Begun JW, Finnegan JR. Public health as a distinct profession. *J Public Health Manag Pract*. (2013) 19:412–9. doi: 10.1097/PHH.0b013e31828002d2

6. Fee E, Acheson RM. *A history of education in public health: health that mocks the doctors' rules. A history of education in public health: Health that mocks the doctors' rules*. Oxford: Oxford University Press (1991).

7. Roemer MI. Preparing public health leaders for the 1990s. *Public Health Rep*. (1988) 103:443.

8. O'Neil EH. *Health professions education for the future: Schools in service to the nation*. San Francisco: Pew Health Professions Commission (1993) 2.

9. Hernandez LM, Rosenstock L, Gebbie K. *Who will keep the public healthy?: educating public health professionals for the 21st century*. (2003).

10. Evans D. The role of schools of public health: learning from history, looking to the future. *J Public Health*. (2009) 31:446–50. doi: 10.1093/pubmed/fdp065

11. Frenk J, Chen L, Bhutta ZA, Cohen J, Crisp N, Evans T, et al. Health professionals for a new century: transforming education to strengthen health systems in an interdependent world. *Lancet*. (2010) 376:1923–58. doi: 10.1016/S0140-6736(10)61854-5

12. Rosenstock L, Helsing K, Rimer BK. Public health education in the United States: then and now. *Public Health Rev*. (2011) 33:39–65. doi: 10.1007/BF03391620

13. Sullivan L, Galea S. A vision for graduate public health education. *J Public Health Manag Pract*. (2017) 23:553–5. doi: 10.1097/PHH.0000000000000664

14. Goldman L, Editor responding to the climate change and health crisis: a framework for academic public health. APHA 2022 annual meeting and expo, Boston. (2022).

15. Thibault GE. The future of health professions education: emerging trends in the United States. *FASEB Bio Adv*. (2020) 2:685–94. doi: 10.1096/fba.2020-00061

16. Sullivan LM, Velez AA, Galea S. Graduate public health education in the post-COVID-19 era. *Lancet Public Health*. (2020) 5:e473. doi: 10.1016/S2468-2667(20)30181-X

17. Shultz JM, Sullivan LM, Galea S. *Public health: an introduction to the science and practice of population health*. New York, NY: Springer Publishing Company (2021).

18. Frenk J, Chen LC, Chandran L, Groff EO, King R, Meleis A, et al. Challenges and opportunities for educating health professionals after the COVID-19 pandemic. *Lancet*. (2022) 400:1539–56. doi: 10.1016/S0140-6736(22)02092-X

19. Magaña L, Biberman D. *Training the next generation of public health professionals*. American Journal of Public Health: American Public Health Association (2022). 579–581.

20. Riegelman RK. *Two decades of progress in undergraduate public health: where do we go from here?* American Journal of Public Health: American Public Health Association (2023). 9–11.

21. Warnick A. Interest in public health degrees jumps in wake of pandemic: applications rise. *Nation's Health*. (2021) 51:1–12.

22. Leider JP, Castrucci BC, Robins M, Hare Bork R, Fraser MR, Savoia E, et al. The exodus of state and local public health employees: separations started before and continued throughout COVID-19: study examines state and local public health agency employees intent to leave or retire in 2017 with actual separations through 2021. *Health Aff*. (2023) 42:338–48. doi: 10.1377/hlthaff.2022.01251

23. Parr A. *Knowledge-driven actions: transforming higher education for global sustainability*. Paris, France: UNESCO223 (2022).

24. Spector P, Shreve G, Daniels RJ. *What universities owe democracy*. (2021).

25. Association of Schools and Programs of Public Health. Strategic plan 2030. (2022). Available at: https://aspph-prod-web-assets.s3.amazonaws.com/StrategicFramework2030.pdf.

26. Association of Schools and Programs of Public Health. Education – scholarship of teaching and learning (SoTL) task force. (2020–2022). Available at: https://aspph.org/education-practice-research/education/.

27. Halkitis PN, Alexander L, Cipriani K, Finnegan J Jr, Giles W, Lassiter T, et al. A statement of commitment to zero tolerance of harassment and discrimination in schools and programs of public health. *Public Health Rep*. (2020) 135:534–8. doi: 10.1177/0033354920921816

28. Association of Schools and Programs of Public Health. *Dismantling racism and structural racism in academic public health: a framework*. Washington, D.C: Association of Schools and Programs of Public Health (2022).

29. Association of Schools and Programs of Public Health. *Responding to the climate change and health crisis: a framework for academic public health Association of Schools and Programs of Public Health 2022 October 2*.(2022).

30. Association of Schools and Programs of Public Health. *Gun violence prevention: an academic public health framework*. Washington, D.C: Association of Schools and Programs of Public Health (2023).

31. Boston University. Teaching public health equity for all. (2023). Available at: https://www.bu.edu/sph/conversations/education/teaching-public-health-3/#phc-section-videos

32. Association of Schools and Programs of Public Health. *Creating an inclusive workspace thorugh an anti-racism lens, an example of consensus process in academic public health* (2022).

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Community Health Scholars: a summer program developing a public health workforce pipeline for diverse high school students

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In response to the growing interest in public health and needs to both increase and diversify the public health workforce, opportunities to engage students early in their educational journey are essential. The University of Hawai'i at Mānoa launched the Community Health Scholars Program to provide activities for high school students to learn about and build enthusiasm for the field of public health. During the 6-week, in-person summer program, students underrepresented in higher education and who are from historically underrepresented communities completed a college course and participated in activities to enhance their successful entry into a higher education institution. The Community Health Scholars completed an introduction to public health course and gained an array of public health skills through different hands-on activities. The students gained self-confidence and expanded their social capital by attending workshops led by campus faculty, staff, and community partners. A final project highlighting what students learned about themselves and their community was part of a final program showcase. Here we share information about the process of developing the program, the components of the program curriculum, and feedback from both students of the initial cohort and program faculty, where overall satisfaction with the program was reported.

KEYWORDS

public health education, undergraduate public health, workforce, curriculum, outreach, recruitment, diversity

1 Introduction

Diversifying the public health workforce is essential in addressing the health issues facing our communities (1, 2). With increasingly diverse populations facing complex health issues, a public health workforce that not only represents diverse populations is urgently needed. While some countries face workforce challenges associated with migration and "brain-drain" (3, 4), in the United States, additional need exists to actively work toward addressing systemic issues to achieve health equity. One strategy to diversify the workforce is to diversify the educational pipeline to and through higher education (3, 4).

Diversifying the educational pipeline requires addressing the educational barriers that impact underrepresented and marginalized populations in higher education (5–8). Integrative approaches include providing affordable college credits,

and college preparation activities to high school students which help to demystify the college-going experience for underrepresented and marginalized students (5, 9).

Recruitment into public health professions additionally face discipline-specific challenges. Barriers are in place that limit student interest in science, technology, engineering, and mathematics (STEM) education, in primary and secondary educational levels in the United States (10), in addition to barriers related to determinants of health that limit the ability of public health programming to accessing diverse communities (11). Even among high school STEM students, there is limited interest in life and social science, suggesting a need to diversify awareness and conversations of STEM pathways (10, 11).

The Association of Schools and Programs of Public Health (ASPPH) Framing the Future of Public Health Education reports the importance of expanding public health education and engagement in primary and secondary school settings (12). When colleges and universities provide high school students with the opportunity to explore public health careers and gain fundamental public health knowledge and skills, students can widen their perspectives of health (4). Engaging students early can also challenge them to think about the role they can play in making an impact in their communities from a public health perspective.

Facilitating meaningful relationships among a cohort of high school students and recent high school graduates creates space for shared learning and peer support during times of exploration and transition. Underrepresented and marginalized populations in higher education include ethnically diverse (e.g., Black and Indigenous People of Color), low-income, and first-generation college students who may feel uneasy about their college prospects. Summer learning can help students gain confidence and feel more prepared to face the next steps of their educational journey.

2 Pedagogical framework

High school students start to think about careers during their sophomore and junior years (13). Introducing this age demographic of students to public health provides an opportunity to expand their understanding of health professions beyond careers that are more familiar to them. Alongside career exploration is also the preparation needed to support students' readiness for higher education (13). By targeting rising high school seniors, students are developmentally primed to gain the confidence and skills to make it through what can be a stressful time in their lives (14). Partnerships with high school and college counselors, health pathway, and career and technical education teachers are essential to recruit students in this age group (15, 16) and demographic (17).

Summer learning programs provide students with an opportunity to explore, gain new skills, and develop more self-awareness. Summer programs with similar goals in recruitment and retention of students in higher education, such as GEAR UP (Gaining Early Awareness and Readiness for Undergraduate Programs), have reported strong outcomes in meeting these objectives as well as evidence supporting the need for additional support in the transition from high school to higher education (13, 14, 18). The availability and flexibility of summer opportunities also give students a chance to feel out what being a college student is like in a supportive environment. College faculty and staff are also generally more available during the summer months. Connecting students to campus resources during this time can help to build a sense of community and belonging for them even before they start college (13, 14).

Including *'ohana* (family) promotes a shared partnership for the student's success. Navigating college can be difficult for students and family members, especially for first-generation college-going students. *'Ohana* activities are not limited to immediate family members, but rather, are open to any participants a student identifies as a support person (e.g., neighbors, extended family members, or other supportive adults). These activities also give families and other members of students' social support system a chance to be part of the college-going experience, which helps students feel supported as well (19, 20).

In order to successfully engage with young learners, the curriculum was designed to be interactive and problem-based to promote authentic learning (21, 22). Activities that students complete involve connecting what they learned to their lived experiences, the campus community, and the communities they are from. Applying knowledge gained in public health to their personal lives allows students to think about ways they can improve their own health, their families' health, and more broadly, the health of their communities (21).

This is especially important for students from underrepresented and marginalized communities where there is an increasing need to train a diverse population of public health populations to reflect the communities they are from and identify with (3, 23, 24). Place-based learning strategies are essential for our students, especially in Hawai'i where local culture and indigenous roots place high significance on engagement with *'aina* (land) (25, 26). The linkages to local communities help students understand the need to learn about and address health disparities impacting the people of Hawai'i (19, 20). In applying place-based learning through engaging directly with *'aina* (land) students also gain outdoor exposure, which is associated with improved mental health, particularly stress management, among youth and adolescent populations (27, 28).

A culminating project where students share with their community what the needs, strengths, and opportunities are in their community builds confidence in communicating public health data, and ways to promote health. *Hō'ike*, an end-of-program showcase translated from Hawaiian as an "exhibition, demonstration of knowledge" (29), celebrates students' work during the program and is a chance to share their summer learning experiences with their families and communities through a public event held on-campus. In addition to family members and other student-invited support people, faculty, staff, and University administrators are invited as well as local community partners (e.g., local policymakers, representatives from the Hawai'i Department of Health, high school teachers/administrators, and local non-governmental organizations), allowing for further opportunities for students to connect with community and professional partners.

3 Learning environment, learning objectives, and learning format

3.1 Learning environment

Summer program activities were conducted through the Office of Public Health Studies (OPHS) at the University of Hawai'i at Mānoa. Within the Thompson School of Social Work and Public Health, OPHS is a CEPH-accredited program of public health offering a bachelor of arts degree in public health, a minor in public health, as well as a Masters of Public Health (MPH) degree in four specializations, a Master of Science (MS) degree in epidemiology, and PhD degrees in both epidemiology and public health, focused on community-based participatory research.

The University of Hawai'i at Mānoa is a public, research-intensive university and the flagship campus for the University of Hawai'i system. Campus enrollment is 19,074 students, including 74.4% undergraduates (30). The University of Hawai'i system has self-identified as an indigenous-serving institution and a Hawaiian place of learning. This identity reflects the prioritization of indigenous populations and services within the administration and across multiple campuses.

Information about the program was disseminated among the OPHS faculty and staff to share with their respective contacts. Targeted recruitment activities included presentations to high school health courses and participation at college and career fairs held at various high schools. Broader range outreach was done via high school college counselors, health pathway, and career and technical education teachers. Local non-profit agencies (Hawai'i Public Health Association, Hawai'i Public Health Institute, and Hawai'i Youth Services Network) were asked to also share this opportunity with their respective email lists.

3.2 Learning objectives

Inspired by past and existing programs including Area Health Education Centers (AHEC) (31, 32), Health Careers Opportunity Programs (33), and a local post-baccalaureate program, 'Imi Ho'ola (34, 35), the Community Health Scholars Program was developed to meet six objectives.

- LEARN: Scholars complete PH 201—Introduction to Public Health alongside current college students.
- ENGAGE: Scholars engage in interactive public health activities to supplement knowledge gained in the PH 201 course.
- GROW: Scholars engage in personal and professional development.
- PREPARE: Scholars assess, then build, college readiness skills.
- 'OHANA (Family): Participants have the opportunity to bring their family members to engage with events and workshops at specified intervals throughout the program to build familial support for college attendance and public health career pathways.
- COMMUNITY: Participants build connections with peers, near-peer college students, public health professionals, and members of the community.

3.3 Learning format

The 6-week Community Health Scholars Program was launched in the summer of 2022. It was in-session, in-person from mid-June through the near-end of July to accommodate the summer availability of high school students. The program was held daily on Mondays through Fridays from 9 am to 2:30 pm. The program was anchored by a morning college course attended by both scholar participants as well as college students looking to enroll in summer coursework. The course was offered from 9 am to 10:15 am, with two additional scholar program-specific sessions held for 90 min each from 10:30 am to 2:30 pm, inclusive of an hour-long lunch break. In general, Monday and Friday's sessions focused on student development, including college readiness and activities promoting self-reflection or social-emotional learning. Tuesday and Thursday sessions focused on public health content engagement activities, and Wednesday sessions focused on components of a scaffolded summer program community capstone project. An overview schedule is provided in Table 1.

3.3.1 Foundational coursework

Throughout the program, a 3-credit introductory public health overview course was used as both the academic foundation for the program and as an important touchpoint for scaffolding public health content. The course itself includes such course objectives as identifying and discussing a range of real-world public health problems, identifying gaps in knowledge related to a public health problem, discussing ethical concerns and promoting ethical decision-making behaviors, engaging in self-directed inquiry and intellectual curiosity, and fostering cultural awareness and social justice. Class sessions include lectures, large and small group discussions, and in-class activities. Student scholars participating in the program enrolled in a course session offered simultaneously with current college students, resulting in both formal and informal opportunities for students to engage in a course alongside near-peers with similar interests, especially during small group discussions and in-class activities. Over 6 weeks, content themes discussed during class were applied during program-specific public health engagement activities. These activities served to reinforce academic content introduced during the course, as well as to engage students more actively in public health practice. Students earned three college credits (regularly priced at 1,500 USD), and a grade after completion of the course.

3.3.2 Content engagement activities

Sample engagement activities include a mask assessment lab linked in epidemiology and public health biology, a state-level budget balancing scenario linked to health policy, the development of a video-based public service announcement to promote COVID-19 protection measures linked to behavioral

TABLE 1 General overview schedule of summer scholars program.

	Monday	Tuesday	Wednesday	Thursday	Friday
9:00–10:15 am	PH 201: Introduction to Public Health Class				
10:15–10:30 am	Break				
10:30 am—12:00 pm	Student Development Activity	Public Health Engagement Activity	Summer Program Community Activity	Public Health Engagement Activity	Student Development Activity
12:00–1:00 pm	Lunch (Provided) + Occasional Community Visitors				
1:00 pm—2:30 pm	Student Development Activity	Public Health Engagement Activity/Movie	Summer Program Community Activity	Public Health Engagement Activity/Movie	Student Development Activity

health and communication, and a public health heroes activity linked to public health history.

The mask assessment was based on existing activities (36, 37) adapted to this program. Students worked in pairs and rotated through four different lab stations. Stations included a light test station, where students visually assess mask thickness using a flashlight, a respiration test station, where students attempt to blow out a candle from a standard distance while wearing each mask, a "sneeze" test station, where students use a spray bottle to assess the penetration of sprayed water, and finally, the physical layers test station, where students cut each mask to identify the number of physical layers. At each station, the student pairs conducted the associated lab test and rated the quality of each mask on a 5-point scale (one being the lowest quality and five being the highest). Three different masks were assessed—a cloth mask, a surgical mask, and a KN-95 mask. Findings were reported back to the larger group for broader discussion related to respiratory disease transmission and linkages to epidemiology.

The budget-balancing activity engaged students in communication and advocacy as small groups (3–4 per group) of students reviewed a mock state budget of roughly 50 line items accompanied by past funding requested. Students were then provided with mock state revenue projections and, assuming they were representing their home communities, asked to debate which line items to fund and at what level, based on past and requested funding information, in order to achieve a balanced budget. In a subsequent round of discussion, the small groups of students were asked to review their budget line items as a full class and debate the development of a final consensus budget. This activity allowed students to better understand health policy, gain a perspective of the policy-making process, and promote both communication and collaboration skills.

When discussing behavior change and health communication skills, students engaged in the development and production of a brief video-based public service announcement to promote COVID-19 protection measures among a peer group. Following lectures and discussions regarding behavior change theories and health communication, students worked in small groups to complete a worksheet to apply social marketing strategies. The worksheet was developed and modified by a faculty colleague at OPHS based on student need for a step-wise approach to brainstorming a theory-based behavioral intervention. Applying the worksheet, students were guided in developing a health message, then a messaging strategy, to promote COVID-19 protection measures among a peer group using a TikTok video format. Students recorded the videos and shared the final products, along with the associated worksheets.

Documentaries or public health-related fictional films and debriefing, instructor-led discussions were also incorporated into content-related programming. Using these films allowed students to see complex public health issues in action and on the ground, frequently as told from personal accounts centered on lived experiences, and forge connections between public health action and both the individuals and communities involved. Films shared included "I am Greta" (38), a documentary focused on the climate-change-related activism of Greta Thunberg, "Aftershock" (39), which discussed maternal mortality among black women in the U.S., and "*Ola*: Health is Everything" (40), a documentary highlighting social factors impacting health among populations in Hawai'i and showcasing promising practices to address these.

3.3.3 Student development activities

Throughout the program, students were also involved in activities to prepare them for transitions to college, and in activities intended to promote social-emotional development. College readiness activities included guided activities and discussions where students identified their motivations in seeking a college education, discussed the college application process with an invited guest speaker from the University of Hawai'i at Mānoa Admissions Office, then developed college application materials.

Students also engaged directly with topics of particular relevance to underrepresented and first-generation college students. Program faculty were intentional in the inclusion of both discussions and activities centered on topics of financial literacy, budgeting, applying for scholarships, student success strategies (e.g., time management and note-taking strategies), and recognition of privilege. Academic partners and community experts were invited to share and discuss many of these topics with students. For example, a speaker from a local bank was invited to discuss financial literacy, and student support colleagues across campus were asked to share more about student success strategies.

Personal development activities included personal skill assessments such as the True Colors personality test (41, 42). Students also engaged in self-discovery activities intended to facilitate student identification of their motivations to pursue higher education based on the work of Sinek (43), and an activity

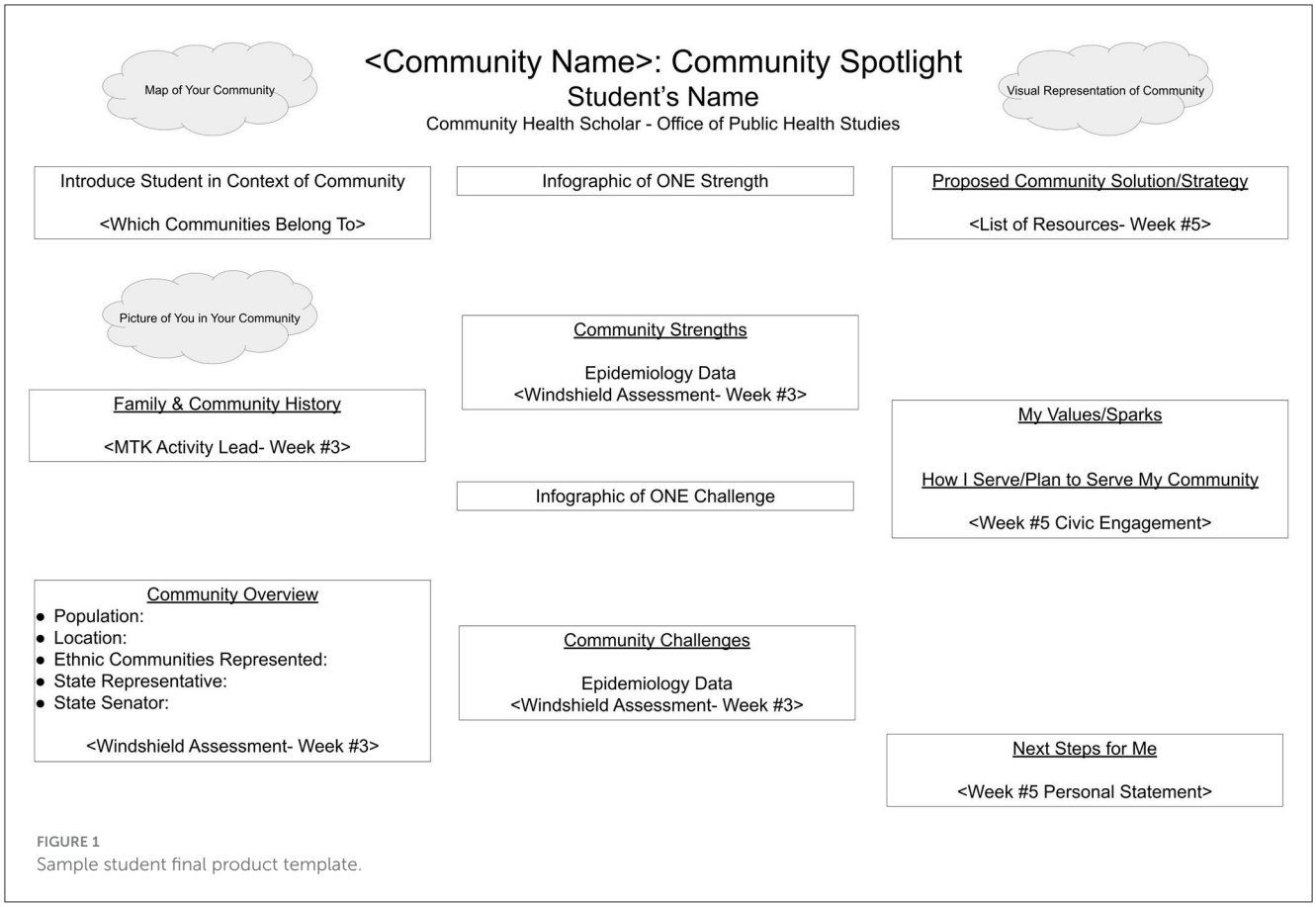

FIGURE 1
Sample student final product template.

of naming, describing, and then grouping emotions based on a resource by Brown (44).

3.3.4 *'Ohana* (family) engagement activities

Engagement of family members was an integral component of the Community Health Scholars Program. Students were encouraged to invite family members to events and/or activities held every 2 weeks throughout the 6-week program. Both students and family members were invited to a brief virtual orientation held a week prior to the beginning of the program, so everyone would learn about what to expect and how to prepare for program participation, as well as have the opportunity to ask questions. During the program, *'ohana* activities were held for roughly 90 min on alternating Saturday mornings. These activities integrated with public health content and concepts students were engaged in within the program. Activities were also intended to promote community engagement and connection. A second *'ohana* activity intended to promote environmental community connections. A third activity focused on community advocacy and health communication strategies associated with advocacy and was supported by a faculty colleague with expertise in this area. The program celebration held the Saturday after the program's final day was the fourth, and last, *'ohana* event, highlighting the students, their work products of the semester, and sharing a journey of their program experiences.

3.3.5 Final project and *Hō'ike* (showcase)

Throughout the summer, students engaged weekly in activities integrating both their growing public health skills and knowledge with applications to better understand, and engage with, their local home communities. These scaffolded activities were conducted weekly (each Wednesday), and were shared as a culminating community highlight presented in a format similar to that of an academic poster (Figure 1). Students also engaged in personal development scaffolded throughout the summer program. Components of this developmental process included the following: (1) recognizing self in community, (2) conducting a community overview (windshield assessment and accessing existing data), (3) identifying community strengths and challenges, and finally (4) identifying community resources and opportunities for community engagement.

At the beginning of the program, students worked to identify the multiple diverse communities they were engaged with. Subsequent activities focused on their self-identified, geographic home community. Students applied recently acquired biostatistics and epidemiology knowledge and skills to seek out high-quality data describing the demographics of their community and interpret data and statistics to describe both strengths and challenges within their communities. Centered on discussions about environmental health, the built environment, and determinants of health, students developed, pilot tested, then applied a windshield assessment (45) in their home communities to collect qualitative data to complement publicly available community statistics.

TABLE 2 Summer scholars learning objectives linked to program activities.

Learning objectives	Program activities
LEARN: Scholars complete PH 201—Introduction to Public Health alongside current college students	Foundational Coursework
ENGAGE: Scholars engage in interactive public health activities to supplement knowledge gained in the PH 201 course	Content Engagement Activities
GROW: Scholars engage in personal and professional development	Student Development Activities
PREPARE: Scholars assess, then build, college readiness skills	Student Development Activities
'OHANA (Family): Participants have the opportunity to bring their family members to engage with events and workshops at specified intervals throughout the program to build familial support for college attendance and public health career pathways	*'Ohana* (Family) Engagement Activities
COMMUNITY: Participants build connections with peers, near-peer college students, public health professionals, and members of the community	Foundational Coursework Student Development Activities Final Project and *Hō'ike* (Showcase)

Complimented by discussions of health policy, students identified local state and county-level political representatives, and linked to subsequent discussions of behavioral change, identified local community organizations serving as community resources.

Final, student-developed community profile posters were shared at a public showcase and celebration following the conclusion of the program. In addition to student posters, a gallery walk display was also developed by students, with mentored support, to highlight activity work products, methods, and photos of activities students participated in throughout the program. Posters were given to students to take following the presentation; however, the gallery walk display was maintained for viewing by OPHS faculty, staff, and students for several months following program completion.

A summary of activities linked to identified Community Health Scholars learning objectives is provided in Table 2.

4 Results and assessment

4.1 Cohort overview

A total of eight students participated in our program in the summer of 2022. Three identified as male and five identified as female. Six were high school students at the time including, two juniors and four seniors. Two students were incoming 1st-year college freshmen. All students were from a local, public high school and seven of the eight students met the criteria of being from an ethnic background that is underrepresented in higher education at the University of Hawai'i at Mānoa.

4.2 Student scholar feedback

Throughout the summer program, students were provided with optional, weekly check-in surveys by email, to allow for opportunities for general feedback on the program as it progressed. Feedback was generally favorable, with opportunities identified for minor adjustments including the need to provide greater clarity in instructions and additional support in elements of the final project.

On the final day of the program, verbal feedback was collected from students in a loose focus group format facilitated by a public health faculty not previously affiliated with the program or known to the students. Students identified free college course credit as a primary motivation for participation. They were critical of the final project, expressing both technical challenges as well as low motivation, and suggested a more direct-to-community media engagement deliverable as an alternative. For example, a photovoice project or social media campaign about "What is Public Health," to promote public awareness of the field of public health and its role in community health. Documentaries and public health films received mixed reviews, with some student appreciation but others who felt they were disengaging. Participation of guest speakers, both as lunch-time speakers and content presenters throughout the program, was not spoken of favorably. Students expressed wide variability, with many guest speakers focused on a lecture-based approach with minimal, if any, direct student engagement.

Interactive, public health-related engagement activities interwoven throughout the summer received positive feedback from students, however, students expressed interest in additional activities related to social-emotional learning, as well as a desire for more workshops related to the development of college success skills. Overall, students expressed feeling cared about throughout the summer program and particularly appreciated encouragement by program faculty to continue engagement.

4.3 Program faculty debrief findings

Feedback was also collected from debrief meetings of the two program faculty- the program coordinator, and the course instructor, both of whom were involved in the full program schedule. Data were compiled and summarized by program faculty from notes taken during debrief discussions on the final day of the program, 2 weeks following program completion, and roughly 6 months later. The length of the program day, 9 am—2:30 pm, was identified as too long. Students rarely needed more than 15–20 min as a lunch break and reported getting bored and tired during the long lunch hour. Program faculty, too, felt several activities may be condensed in time frame, and lack of student enthusiasm with both guest speaker engagements and documentary viewing-discussion sessions, may yield opportunities to achieve similar program outcomes in a shorter time frame. Pandemic-associated grant funding of student lunches also created concerns regarding the sustainability of providing a meal.

Throughout the program, college success skill activities were conducted primarily by guest speakers from campus and community partner organizations, rather than program faculty. While the intent was to showcase a diversity of resource contacts,

a greater focus on a consistent pedagogical approach seemed to be more valuable and effective. Critical feedback from students regarding guest speakers overall may be associated with the increased demand for college success skill activities, especially if shared by program faculty or partners with a similar active learning approach. Another area for further development included the need to promote communication skills among student scholars. Often students found themselves challenged with articulating their thoughts and understanding to share with peers, and to a greater extent, with program faculty and community professionals. Greater scaffolded support and training should be devoted to this skill area in the future.

5 Discussion and lessons learned

Plans are currently in place to offer the Community Health Scholars Program in the summer of 2023. Moving forward, program faculty have made adjustments to strategies to recruit prospective students, including more targeted outreach to local high school counselors and specifically to teachers at high schools that offer students either a health academy program or public health-related coursework. We hope these adjustments to recruitment will help to expand interest and increase the number of applicants, and subsequent participants. Thus, far, 12 students have applied for summer 2023, 11 have met program inclusion criteria, and have been invited to participate. Seven students have committed to program participation. A modified schedule will include repeating the introduction to public health course from 9 am to 10:15 am but will include two subsequent 50-min program sessions, allowing for program dismissal at 12:30 pm, rather than 2:30 pm. Shortening the program time can also provide students the opportunity to have a summer job, participate in other summer activities, or fulfill family obligations.

Based on findings and feedback, revisions to future program implementation will include similar course-based and content-engagement activities. However, student development activities will be expanded to include scaffolded support and training in verbal communication and other forms of expression, including encouragement of active, respectful engagement with both peers and professionals. Integration of guest speakers will be more judicious, with active encouragement and support by program faculty to incorporate active learning strategies during student engagement.

Constructive feedback from both students and faculty regarding the final project suggested a reimagining of the scaffolded, community-specific program activities and culminating product. Current plans center around community-specific program activities to be modified and shared as a visual portfolio collection of work products to be displayed during the program's *Hōʻike* event. To address interest in a media-forward product, the cohort of students will be given the opportunity to decide how they together would like to showcase their summer experiences for their families and community guests. Suggestions from program faculty include the development of a brief summary video or slideshow.

Looking to the future, there are concerns regarding the sustainability of funding to support both student tuition costs and personnel expenses, as well as financially supporting student transportation costs to access the University of Hawai'i at Mānoa campus. While one of the biggest motivators to participate in the program was free college credit, we recognize that students from underrepresented and marginalized populations in higher education may need additional financial support (e.g., a stipend or available time for employment), while participating in summer learning experiences. This project was initiated as part of a temporary extramural funding opportunity. The summer time commitment is also substantial for faculty, especially those who also engage heavily in student support and instruction during the academic year. There are additional concerns regarding the return, in terms of student applicants, on faculty engagement in outreach and recruitment efforts to local high schools and college counselors, especially as student participation continues to be lower than anticipated. However, in examining early long-term outcomes from scholars a year following the initial 2022 cohort, all five eligible participants are pursuing higher education, and of them, two scholars are either enrolled or enrolling in bachelor's level public health degree programs. The remaining three scholars are current high school students. While financial and time costs are meaningful, the benefits and return on investment in terms of increased student enrollment and diversity are also substantial, with long-term, compounding impacts and implications in increased access to higher education and subsequently to the public health workforce. This program is also easily scalable to accommodate larger enrollment in the range of 50–75 students per cohort, with additional, incremental costs almost entirely focused on per-student enrollment fees (roughly 260 USD).

It is our hope that through initiatives such as the Community Health Scholars Program, the academic pipeline, and subsequent public health workforce will increase in diversity to be increasingly reflective and representative of the communities they serve.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The requirement of ethical approval was waived by University of Hawai'i Institutional Review Board, Human Studies Program, University of Hawai'i for the studies involving humans because identified as not human subjects research. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin.

Author contributions

DN-H: Formal analysis, Funding acquisition, Methodology, Project administration, Resources, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. MT-K: Conceptualization, Formal analysis, Funding acquisition, Methodology, Project administration, Resources, Supervision,

Validation, Visualization, Writing – original draft, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

References

1. Annang L, Richter DL, Fletcher FE, Weis MA, Fernandes PR, Clary LA. Diversifying the academic public health workforce: strategies to extend the discourse about limited racial and ethnic diversity in the public health academy. *ABNF J.* (2010) 21:39–43.

2. Zou Y. Improving healthcare workforce diversity. *Front Health Serv.* (2023) 3:1082261. doi: 10.3389/frhs.2023.1082261

3. Coronado F, Beck AJ, Shah G, Young JL, Sellers K, Leider JP. Understanding the dynamics of diversity in the public health workforce. *J Public Health Manag Pract.* (2020) 26:389–92. doi: 10.1097/PHH.0000000000001075

4. Duffus WA, Trawick C, Moonesinghe R, Tola J, Truman BI, Dean HD. Training racial and ethnic minority students for careers in public health sciences. *Am J Prev Med.* (2014) 47:S368–75. doi: 10.1016/j.amepre.2014.07.028

5. Bragg DD, KimE, RubinMB. *Academic Pathways to College: Policies and Practices of the Fifty States to Reach Underserved Students*. Association for the Study of Higher Education (2005).

6. Kelly P, Lugo ST. The imperative of closing racial and ethnic gaps in college attainment. *Change Mag High Learn.* (2017) 49:46–9. doi: 10.1080/00091383.2017.1366811

7. Phinney JS, Haas K. The process of coping among ethnic minority first-generation college freshmen: a narrative approach. *J Soc Psychol.* (2003) 143:707–26. doi: 10.1080/00224540309600426

8. Tran JH, Wong M, Wright EK, Fa'avae J, Cheri A, Wat E, et al. Understanding a pacific islander young adult perspective on access to higher education. *Calif J Health Promot.* (2010) 8:23–38. doi: 10.32398/cjhp.v8iSI.2040

9. Gigliotti J. Rice University: innovation to increase student college readiness. *Contin High Educ Rev.* (2012) 76:166–74.

10. National Science Board (NSB), National Science Foundation. *Science and Technology: Public Perceptions, Awareness, and Information Sources*. Alexandria, VA: National Science Board, National Science Foundation (2022). Available online at: https://ncses.nsf.gov/pubs/nsb20227/public-perceptions-of-science-and-technology#stem-education (accessed October 18, 2023).

11. Nasruddin SZ, Johnson T, Presley M, Wade B, Whalen Q, Gordineer E, et al. Overcoming barriers to training the next generation of public health professionals. *Am J Public Health.* (2023) 2023:e1–5. doi: 10.2105/AJPH.2023.307412

12. Association of Schools and Programs of Public Health. *Framing the Future*. (2022). Available online at: https://aspph.org/our-work/initiatives/framing-the-future/ (accessed March 17, 2023).

13. Schneider B, Broda M, Judy J, Burkander K. Pathways to college and STEM careers: enhancing the high school experience. *New Dir Youth Dev.* (2013) 2013:9–29. doi: 10.1002/yd.20076

14. Ferguson KS. *Dual Enrollment and Its Impact on the College Access and Persistence of Students of Color*. (Ph.D.), Notre Dame of Maryland University, Maryland, United States (2023). p. 144. Available online at: https://www.proquest.com/docview/2818550631/abstract/41B55FA8E39C4B7EPQ/1 (accessed November 1, 2023).

15. St. Cyr A, Barclay SR, Couture VG, Bruick T. Increasing college knowledge: the role of school counselors. *J Educ Learn.* (2023) 12:17–25. doi: 10.5539/jel.v12n3p17

16. Ray MS. *The College-Choice Process for High School Students: An Evaluation of High School Counselor Interventions and Strategies*. (1992). Available online at: https://eric.ed.gov/?id=ED350541 (accessed November 7, 2023).

17. Campbell-Heider N, Sackett K, Whistler MP. Connecting with guidance counselors to enhance recruitment into nursing of minority teens. *J Prof Nurs.* (2008) 24:378–84. doi: 10.1016/j.profnurs.2008.10.009

18. Eather N, Mavilidi MF, Sharp H, Parkes R. Programmes targeting student retention/success and satisfaction/experience in higher education: a systematic review. *J High Educ Policy Manag.* (2022) 44:223–39. doi: 10.1080/1360080X.2021.2021600

19. Hamilton L, Roksa J, Nielsen K. Providing a "Leg Up": parental involvement and opportunity hoarding in college. *Sociol Educ.* (2018) 91:111–31. doi: 10.1177/0038040718759557

20. Roksa J, Kinsley P. The role of family support in facilitating academic success of low-income students. *Res High Educ.* (2019) 60:415–36. doi: 10.1007/s11162-018-9517-z

21. D'Agostino EM. High school epidemiology: helping students practice science through guided inquiry and authentic learning strategies. *Pedagogy Health Promot.* (2019) 5:293–8. doi: 10.1177/2373379918811822

22. Stein SJ, Isaacs G, Andrews T. Incorporating authentic learning experiences within a university course. *Stud High Educ.* (2004) 29:239–58. doi: 10.1080/0307507042000190813

23. Custodio R. Insights in public health: the University of Hawai'i West O'ahu undergraduate health science program: training the workforce of the future. *Hawai'i J Med Public Health.* (2019) 78:175.

24. Leider JP, Yeager VA, Kirkland C, Krasna H, Hare Bork R, Resnick B. The state of the US Public Health Workforce: ongoing challenges and future directions. *Annu Rev Public Health.* (2023) 44. doi: 10.1146/annurev-publhealth-071421-032830

25. Antonio M, Keaulana S, Keli'iholokai L, Felipe K, Vegas J, Hui W, et al. A report on the Ke Ola O Ka 'Āina: 'Āina connectedness scale. *Int J Environ Res Public Health.* (2023) 20:3302. doi: 10.3390/ijerph20043302

26. Keaulana S, Kahili-Heede M, Riley L, Park MLN, Makua KL, Vegas JK, et al. Scoping review of nature, land, and environmental connectedness and relatedness. *Int J Environ Res Public Health.* (2021) 18:5897. doi: 10.3390/ijerph18115897

27. Piccininni C, Michaelson V, Janssen I, Pickett W. Outdoor play and nature connectedness as potential correlates of internalized mental health symptoms among Canadian adolescents. *Prev Med.* (2018) 112:168–75. doi: 10.1016/j.ypmed.2018.04.020

28. Wells NM, Evans GW. Nearby nature: a buffer of life stress among rural children. *Environ Behav.* (2003) 35:311–30. doi: 10.1177/0013916503035003001

29. Papa Wehewehe 'Olelo. *Hō'ike. Wehewehe Wikiwiki.* Available online at: https://hilo.hawaii.edu/wehe/?q=h%C5%8D%CA%BBike&l (accessed July 10, 2023).

30. University of Hawai'i at Mānoa. *About UH Mānoa*. (2023). Available online at: https://manoa.hawaii.edu/about/ (accessed July 10, 2023).

31. Vyas KJ. Review of the area health education center scholars didactic curricula: a federal program for students interested in rural health. *J Med Educ Curric Dev.* (2023) 10:23821205231175030. doi: 10.1177/23821205231175030

32. Fowkes V, Blossom HJ, Mitchell B, Herrera-Mata L. Forging successful academic–community partnerships with community health centers: the California Statewide Area Health Education Center (AHEC) experience. *Acad Med.* (2014) 89:33. doi: 10.1097/ACM.0000000000000069

33. Testoff A, Aronoff R. The Health Careers Opportunity Program: one influence on increasing the number of minority students in schools of health professions. *Public Health Rep.* (1983) 98:284–91.

34. Tsuhako S, Bell C. Imi Ho'ola post-baccalaureate program: one solution to the crisis of inadequate representation of minorities in medicine. *Hawai'i Med J.* (2002) 61:75–6.

35. Purdy CM. *Evaluation of a Post-Baccalaureate Medical Education Program for Disadvantaged Students to Diversify the Healthcare Workforce in Hawai'i (1996–2016)*. Manoa, HI: University of Hawai'i at Manoa (2019). p. 112. Available online at: https://www.proquest.com/docview/2315539549/abstract/B0200965A2840B1PQ/1 (accessed November 7, 2023).

36. David J. Sencer CDC Museum. *Masks Against COVID-19-Student Instructions.* Atlanta, GA: Centers for Disease Control and Prevention (US). Available online at: https://www.cdc.gov/museum/pdf/cdcm-pha-stem-lesson-masks-against-covid-19-instructions.pdf (accessed June 20, 2023).

37. Eichler SE, Hopperton AP, Alava JJ, Pereira A, Ahmed R, Kozlakidis Z, et al. A citizen science facemask experiment and educational modules to improve coronavirus safety in communities and schools. *Front Med.* (2020) 7:486. doi: 10.3389/fmed.2020.00486

38. I Am Greta. *Documentary, Biography. B-Reel Films, Hulu, Westdeutscher Rundfunk (WDR)* (2020).

39. Aftershock. *Documentary. Impact Partners, Madstone Company, Malka Films* (2022).

40. Ola. *Documentary, News*. Hawai'i Primary Care Association (2013).

41. Hunter KM, Westwick J. "I see your True Colors": mitigating grouphate by exploring personality differences. *Commun Teach.* (2020) 34:19–23. doi: 10.1080/17404622.2019.1593476

42. Weber MR. An exploratory study into student leadership and True Colors personality with learning and training. *J Hosp Tour Manag.* (2019) 40:125–33. doi: 10.1016/j.jhtm.2019.08.001

43. Sinek S. *Start with Why: How Great Leaders Inspire Everyone to Take Action. Reprint Edition*. Portfolio (2011). p. 256.

44. Brown B. *Atlas of the Heart: Mapping Meaningful Connection and the Language of Human Experience a book by Brené Brown*. Random House (2021). p. 301. Available online at: https://bookshop.org/p/books/atlas-of-the-heart-mapping-meaningful-connection-and-the-language-of-human-experience-brene-brown/17210802 (accessed June 30, 2023).

45. Sharpe PA, Greaney ML, Lee PR, Royce SW. Assets-oriented community assessment. *Public Health Rep.* (2000) 115:205–11. doi: 10.1093/phr/115.2.205

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Latent profile and network analysis of risk perception among a sample of Chinese university students during the COVID-19 pandemic: a cross-sectional and longitudinal study

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Background: The risk perception of contracting COVID-19 is an important topic for assessing and predicting COVID-19 infection and health education during the pandemic. However, studies that use latent profiles and network analysis together to measure the risk perception of COVID-19 are rare. Therefore, this study combined latent profile analysis and network analysis to measure risk perception toward COVID-19 among Chinese university students through a cross-sectional and longitudinal study.

Methods: A sample of 1,837 Chinese university students (735 males, 40%) completed the cross-sectional study with an eight-item risk perception questionnaire in January 2020, while 334 Chinese university students (111 males, 33.2%) completed the longitudinal study at three time points.

Results: A two-class model including a low risk perception class (n = 1,005, 54.7%) and a high risk perception class (n = 832, 45.3%) was selected for the cross-sectional study. Nodes rp6 (*"Average people have chances of contracting COVID-19"*) and rp7 (*"Average people worry about catching COVID-19"*) had the strongest edge intensity (r = 0.491), while node rp5 (*"The COVID-19 outbreak affects the whole country"*) had the highest strength centrality in the cross-sectional study. The risk perception of contracting COVID-19 decreased continuously at the three time points. Moreover, the network structures and global strengths had no significant differences in the longitudinal study.

Conclusions: The risk perception of contracting COVID-19 decreased continually during the COVID-19 pandemic, which indicated the importance of cultural influence and effective government management in China. In addition, university students displayed strong trust and confidence in the government's ability to fight COVID-19. The results indicate that the government should take strong measures to prevent and intervene in various risks and reinforce the public's trust through positive media communications.

KEYWORDS

risk perception, latent profile analysis, network analysis, cross-sectional study, longitudinal study, Chinese university students

1 Introduction

Risk perception is regarded as a subjective and intuitive judgement that people make, such as the risk of contracting an illness, being injured or dying (1). Risk perception also refers to "an individual's perceived susceptibility to a threat" and has three components: deliberative, affective, and experience (2). In addition, risk perception may be classified into two dimensions: cognition and emotion from a psychological perspective or individual and public from a demographic perspective (1, 3). High perceived probability and strong feelings of anxiety or nervousness may jointly correspond to high risk perception (4). Moreover, behavior motivation theory and risk reappraisal theory propose a reciprocal relationship between risk perception and protective behaviors (5). Risk analysts have indicated that there is a significant gender difference in risk perception in different situations (6), which may originate from gender structure, especially gendered ideology and gendered practice. For example, women generally worry about health and safety issues, which causes them to perceive high environmental risk (7).

Coronavirus disease 2019 (COVID-19), described as a contagious disease by the World Health Organization (8), spread quickly from January 2020 and still influences public health worldwide. Some scholars reported that perceived COVID-19 infection risk significantly increased from March 10 to March 31, 2020 (9). Dryhurst et al. also assessed the public's risk perception of COVID-19 worldwide between March and April 2020 and reported factors influencing risk perception toward COVID-19, such as prosocial values, individual knowledge and protective health behaviors (10). Individuals' awareness of COVID-19 risk may influence preventative health behaviors and increase or reduce the negative outcome of COVID-19. Risk perception of COVID-19 as a social phenomenon may contribute to managing public health risks. A longitudinal study from March 2020 to January 2021 investigated the stability of the psychological factors (e.g., prosociality, trust, and efficacy) of risk perception toward COVID-19 and found that psychological factors may predict better risk perception of COVID-19 (11).

When COVID-19 broke out in 2019, the disease was an unfamiliar risk that filled people with dread. As time went on, the risk perception of COVID-19 may have changed for different groups in different countries. A two-wave longitudinal study reported that COVID-19 risk perception declined in an analysis from March 2020 to July 2020 among an Italian population (12). Another study reported that few relationships between risk perception of COVID-19 and protective behaviors were found in a sample of the Chinese population due to conforming behaviors, while risk perception of COVID-19 and protective behaviors influenced each other in the later stage of COVID-19 in the United States (13). Health behavior theory cannot be used to explain this difference, which may be associated with culture, policy, and the stage of the COVID-19 evolution. Moreover, high risk perception of COVID-19 predicted worse psychological problems, such as depression and anxiety (14, 15). Individuals often believe that they have a lower risk of infectious diseases than others, which is regarded as optimism bias of risk perception (16). In society, social media, culture and policy may influence the public's risk perception of COVID-19.

Latent profile analysis (LPA) refers to a statistical method that focuses on identifying subpopulations or latent profiles, which requires continuous measured variables (17). LPA may offer many advantages over traditional multiple regression and cluster analysis, such as describing multiple profiles and analyzing the relationships of risk perception and other variables in the present study. Network analysis is a powerful tool to identify patterns and trends in the relationships between multiple variables to better understand the structure and function of complex systems. Network analysis is also a relatively new and promising approach for modeling interactions between many variables and is represented by a visual graph.

Although risk perception during the COVID-19 pandemic has been studied from multiple perspectives using different methods, latent profile analysis and network analysis have rarely been used together in cross-sectional and longitudinal studies. A large sample is needed for latent profile analysis. In addition, the supporting evidence for the internal structure of risk perception of contracting COVID-19 needs to be examined through a longitudinal study. Therefore, the aims of the present study were to (i) explore latent classes of risk perception toward COVID-19 among a sample of Chinese university students during the COVID-19 breakout (T1); (ii) examine gender differences in risk perception toward COVID-19 during the COVID-19 breakout (T1); and (iii) utilize a network comparison test to examine the change in risk perception toward COVID-19 in a longitudinal study (T1, T2, and T3).

2 Methods

2.1 Participants

A convenience sample of university students from four provinces of China was collected, and the self-report survey was completed through the online Wenjuanxing Platform. The cross-sectional study included 1,837 students (735 males, 40% and 1,102 females, 60%) at T1. Of the participants, 863 (47%) students lived in urban areas, and 974 (53%) lived in rural areas. In the T2 study, the 1,166 students included 431 males (38.6%) and 685 females (61.4%), 531 (47.6%) lived in urban areas, and 585 (52.4%) lived in rural areas. In the T3 study, 334 students (111 males, 33.2% and 223 females, 66.8%) completed the survey. There were 160 (47.9%) and 174 (52.1%) participants in urban and rural areas, respectively. With the time change, some students had graduated, and some refused to attend or did not complete the late surveys (T2 and T3).

The participants ranged in age from 18 to 25 years (mean = 19.0 years; SD = 1.8 years).

2.2 Procedures

The study was conducted from January 2020 to September 2021 at three time points (T1: January 2020, T2: January 2021, T3: September 2021). In January 2020, the first survey was conducted in five universities in four provinces of China (i.e., Jiangxi, Heilongjiang, Shannxi and Liaoning). University teachers invited students to take the online survey voluntarily. To facilitate the longitudinal study, all participants were asked to report their exclusive identity numbers. Among them, 835

participants submitted the second survey in January 2021. Next, 529 participants submitted the third survey in July 2021. Some respondents returned the third survey with incomplete or questionable answers (i.e., the respondents answered the same options) and were excluded from further participation, leaving 334 participants for the longitudinal study.

2.3 Ethics

Ethical approval was obtained from the research team's university, and oral informed consent was received from participants who were advised about the aim of the study and their ability to withdraw at any time.

2.4 Measures

The risk perception questionnaire originated from a study by Yan and Wen (3) and has four dimensions: individual risk perception, public risk perception, individuals' behaviors and interpersonal communication. In the present study, eight items were selected, including two dimensions: individual risk perception and public risk perception. The dimension of individuals' risk perception included four items: "*The COVID-19 outbreak is closely related to me*," "*I have chances of contracting COVID-19*," "*I worry about catching COVID-19*," and "*I think the COVID-19 outbreak is serious*," while the public's risk perception included another four items: "*The COVID-19 outbreak affects the whole country*," "*Average people have chances of contracting COVID-19*," "*Average people worry about catching COVID-19*," and "*Everyone thinks that the COVID-19 outbreak is serious*" (Appendix 1). Participants answered using a 5-point Likert scale ranging from 1 ("totally disagree") to 5 ("totally agree"). Higher total scores represent higher levels of risk perception. The Cronbach's alpha and McDonald's ω of the risk perception questionnaire were 0.807 and 0.805, 0.66 and 0.69 for individual risk perception, and 0.79 and 0.81 for public risk perception, respectively.

2.5 Statistical analysis

Likert scales are primarily used in many social science fields because they capture the level of agreement or respondents' feelings about a specific topic. Although the variables of interest derived from Likert scales are measured on ordinal scales, when the sample size is large enough, researchers typically apply parametric tests for statistical hypothesis testing due to the underlying asymptotic results emphasizing the normal distribution.

Descriptive statistics, the reliability of the risk perception questionnaire, and network analysis were conducted using Jeffrey's Amazing Statistics Program (JASP) version 0.16.1.0 (18). Latent profile analysis was performed using Mplus version 9. In addition, the network comparison test (NCT) was conducted utilizing R version 4.2.2 (19).

Normal data distribution was described through skewness, kurtosis (20, 21), and quantile-quantile plot (QQ-plot). JASP reduced the kurtosis formula by 3 to compare the resulting parameter with the value zero. The gender difference in risk perception toward COVID-19 was assessed using two-sided independent *t*-tests.

Latent profile analysis (LPA) was performed to identify and describe the optimal number of profiles for risk perception toward COVID-19 among a sample of Chinese university students. Two to five profiles were conducted for all participants. The optimal number of profiles was based on the concept of risk perception toward COVID-19, smallest estimated class proportions (should be more than 5% of the total sample), and statistical model fit indices including the Akaike information criteria (AIC), Bayesian information criterion (BIC), sample size-adjusted BIC (A-BIC), Lo-Mendell-Rubin-adjusted likelihood ratio test (LMRA-LRT), and bootstrap likelihood ratio test (BLRT) (22–25). The model fit indices, including decreased AIC, BIC, A-BIC and the LMRA-LRT and BLRT with a significant *p*-value (<0.01), may indicate a better model fit (26). Replication analysis was conducted for cross-validation through two split samples at random ($n1 = 892$, $n2 = 945$). Moreover, multinomial logistic regression was conducted with gender and residential status as covariates and risk perception classes as the outcome variable (i.e., high risk perception class as the reference class), and *t*-tests were performed to examine the difference between classes.

Network analysis is an effective and visual method of studying the interaction between multiple variables or the structure of some variables through nodes (i.e., variables) and edges (i.e., the connection of variables). The network model was assessed through the graphic least absolute shrinkage and selection operator (LASSO) method, which originated from the Extended Bayesian Information Criterion (i.e., EBICglasso) (27, 28). The indices, which included betweenness, closeness, strength and expected influence, represented the centrality of nodes (29, 30). In addition, the network accuracy was examined through edge-weight accuracy, centrality stability and testing for significant differences in nodes and edges (28). Non-parametric bootstrapping (i.e., 1,000 samples) was utilized to calculate edge-weight accuracy and test for significant differences in nodes and edges, while case-dropping subset bootstrapping (95% confidence intervals) was utilized to assess the stability of centrality indices (28). The correlation stability coefficient (*CS*-coefficient, at least ≥ 0.25) indicated node centrality stability (28). The strong and weak connections of nodes were indicated by thick edges and thin edges, respectively. The blue edge and orange edge represent positive and negative correlations between variables, respectively. The network comparison test (NCT) was conducted across time (T1, T2, and T3).

Latent profile analysis (LPA) was used to identify latent subpopulations with perceived risk of contracting COVID-19 based on a sample of Chinese university students, while network analysis examined the interaction of dimensions of risk perception.

3 Results

3.1 Descriptive statistics of risk perception in the cross-sectional study (T1)

For skewness (<2) and kurtosis (<7), based on previous studies (20, 21), most items were considered normally distributed, except item 5 (skewness $= -2.218$, kurtosis $= 7.973$). The QQ plot also

showed that the data were approximately normal (Appendix 2). The corrected item-total correlation of eight items ranged from 0.43 to 0.66. Alpha if item deleted (eight items: 0.77–0.80) and factor loading (eight items: 0.39–0.68) indicated that the risk perception questionnaire had fitted psychometric characteristics (Appendices 1, 2). In addition, there was no significant gender difference in risk perception among the 1,837 participants (all Cohen's $d < 0.2$, Appendix 3).

3.2 Latent profile analysis of risk perception toward COVID-19 in the cross-sectional study (T1)

The fit indices and class membership size of LPA are shown in Table 1. The two-class model including the low risk perception of the COVID-19 class (n = 1,005, 54.7%) and the high risk perception of the COVID-19 class (n = 832, 45.3%) was selected as the optimal model based on the fit indices and interpretability of the model (Figure 1). The three-class, four-class and five-class models had decreasing values of AIC, BIC, A-BIC, and good entropy; however, only the two-class model had a significant value of LMR-LTR (<0.001). In addition, the results of the replication analysis also indicated that the two-class model had a more suitable class membership size than the three-class model (<5% of the total sample). The high posterior probabilities of memberships of the two latent classes were 0.929 and 0.944, respectively. Multinomial logistic regression was performed with gender and residential status as covariates. There were no class differences between males and females ($\chi^2 = 0.26$, $p = 0.61$, Phi = −0.012) or between those living in urban and rural areas ($\chi^2 = 0.351$, $p = 0.553$, Phi = −0.014; Appendices 4, 5). The t-tests of two factors, eight items and total score of risk perception between the two classes were examined, and significant differences were found between the two classes (all $p <$ 0.001 and Cohen's $d > 0.8$; Appendix 6).

3.3 Network analysis of risk perception toward COVID-19 in the cross-sectional study (T1)

The EBICglasso networks of eight-item risk perception toward COVID-19, including all participants (n = 1,837), males (n = 735), and females (n = 1,102), are shown in Figures 2A–C. For the network of all participants, rp6 ("*Average people have chances of contracting COVID-19*") and rp7 ("*Average people worry about catching COVID-19*") had the strongest edge intensity ($r = 0.491$; Appendix 7). Node rp5 ("*The COVID-19 outbreak affects the whole country*") had the highest strength centrality (0.999, Appendix 8). The edge-weight accuracy and centrality stability are shown in Appendix 9. The narrow gray area indicates that the bootstrapped CIs may be appropriate to interpret the edge-weight accuracy. The stability of node strength (CS > 0.5) represented better centrality stability. The tests for significant differences indicated that the edges rp6 ("*Average people have chances of contracting COVID-19*")—rp7 ("*Average people worry about catching COVID-19*") and rp2 ("*I have chances of contracting COVID-19*")—rp3 ("*I worry about catching COVID-19*") were significantly different from each other. All node strengths were also significantly different from each other. In the different gender networks, rp4 ("*I think the COVID-19 outbreak is serious*") and rp5 ("*The COVID-19 outbreak affects the whole country*") ($r = 0.436$), and rp6–rp7 ($r = 0.516$) were the strongest edges among males and females, respectively. The node rp5 was the strongest node for males (strength = 1.338) and females (strength = 0.895; Appendices 10–12).

3.4 Risk perception of COVID-19 in the longitudinal study (T1–T3)

The risk perception of COVID-19 significantly differed among the three time points ($\eta^2 > 0.01$; Appendix 13). The risk perception of COVID-19 decreased continuously at the three time points for all participants (Figure 3). In addition, the items rp1 ("*The COVID-19 outbreak is closely related to me*") and rp2 ("*I have chances of contracting COVID-19*") had gender differences at the three time points (all $p < 0.05$ and Cohen's $d > 0.2$; Appendix 14). However, a significant correlation was not found between the total score of risk perception at the three time points (T1, T2, and T3) and gender [$\log(BF_{10}) < 3$; Appendix 15].

3.5 Network comparison of risk perception of COVID-19 in the longitudinal study (T1–T3)

The EBICglasso networks of risk perception at the three time points are shown in Figure 4 (T1, T2, and T3). Nodes rp6 ("*Average people have chances of contracting COVID-19*") and rp7 ("*Average people worry about catching COVID-19*") had the strongest edge intensity at TI ($r = 0.464$) and T3 ($r = 0.471$), while nodes rp2 ("*I have chances of contracting COVID-19*") and rp3 ("*I worry about catching COVID-19*") had the strongest edge intensity at TI ($r = 0.423$; Appendices 16–18). Node rp7 had the highest strength centrality at TI (1.266) and T2 (1.648), while node rp2 (1.432) had the highest strength centrality at T3 (Appendix 19).

The network structures had no significant differences between T1 and T2 (M = 0.175, $p = 0.252$), between T1 and T3 (M = 0.213, $p = 0.064$), or between T2 and T3 (M = 0.159, $p = 0.397$). In addition, the global strengths also had no significant differences between T1 and T2 (3.27 vs. 3.06, $p = 0.261$), between T1 and T3 (3.27 vs. 2.74, $p = 0.075$), or between T2 and T3 (3.06 vs. 2.74, $p = 0.402$).

4 Discussion

The questionnaire about risk perception toward COVID-19 had good psychometric characteristics, which was similar to the results of Yan and Wen (3). Although some scholars have reported that gender influenced risk perception toward COVID-19 among the Pakistani population, gender differences were only shown in the "trust government" dimension, not in other dimensions (i.e., fear, attitude, awareness, all $p > 0.05$) (31). Another study indicated that females had higher risk perception toward COVID-19 than

TABLE 1 Fit indices for LPA of eight items on risk perception toward COVID-19 among 1,837 participants.

	Model	*k*	AIC	BIC	A-BIC	Entropy	LMR-LTR (*p*)	BLRT (*p*)	Class membership size
Total sample	Class 2	25	37,070.02	37,207.92	37,128.49	0.78	**<0.001**	<0.001	1,005 (54.7%)/832(45.3%)
	Class 3	34	35,787.53	35,975.07	35,867.05	0.88	0.26	<0.001	120 (6.5%)/1,043 (56.8%)/674 (36.7)
	Class 4	43	32,011.16	32,248.34	32,111.73	1.00	0.14	<0.001	**50** (2.7%)/799 (43.5%)/272 (14.8%)/716 (39%)
	Class 5	52	31,724.12	32,010.94	31,845.74	0.98	0.10	<0.001	**50** (2.7%)/106 (5.8%)/799 (43.5%)/166 (9%)/716 (39%)
Sample 1	Class 2	25	17,609.86	17,729.70	17,650.30	0.80	**<0.001**	<0.001	487 (54.6%)/405 (45.4%)
Sample 2	Class 2	25	19,455.84	19,577.12	19,497.72	0.76	**<0.01**	<0.001	536 (56.7%)/409 (43.3%)
Sample 1	Class 3	34	16,969.30	17,132.28	17,024.30	0.90	0.02	<0.001	63 (7.1%)/335 (37.5%)/494 (55.4%)
Sample 2	Class 3	34	18,786.07	18,951.01	18,843.03	0.88	0.34	<0.001	**14** (1.5%)/558 (59%)/373 (39.5%)

AIC, Akaike Information Criterion; BIC, Bayesian Information Criterion; A-BIC, Sample Size-Adjusted BIC; LMR-LRT, LoMendell Rubin Likelihood Ratio Test; BLRT, Bootstrap Likelihood Ratio Test. The LMR-LTR with a significant value (<0.01) and smallest estimated class proportions should be more than 5% of the total sample.

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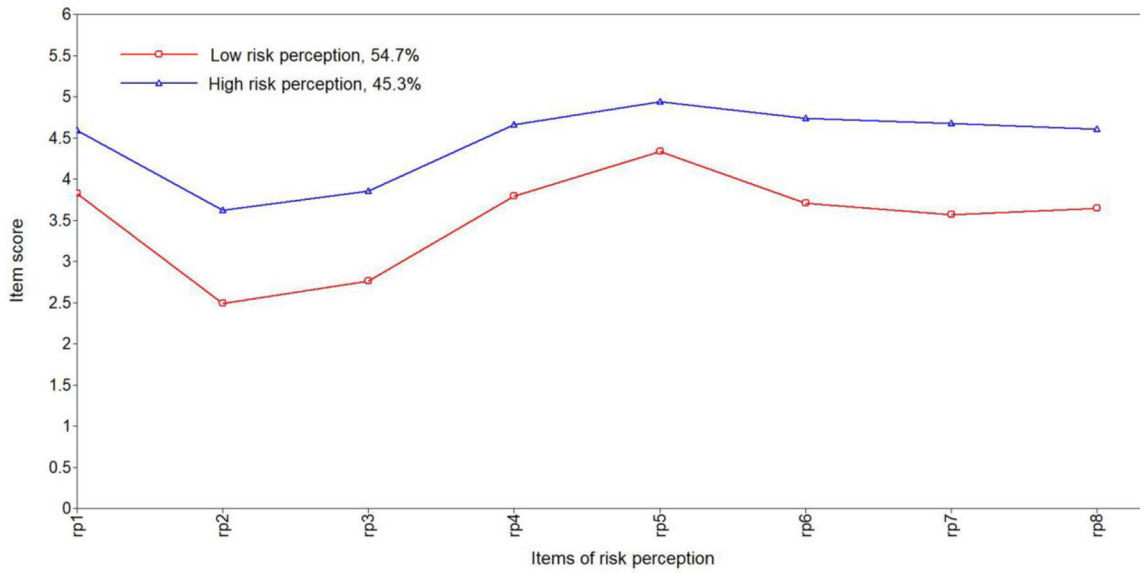

FIGURE 1
Latent class profile of risk perception toward COVID-19.

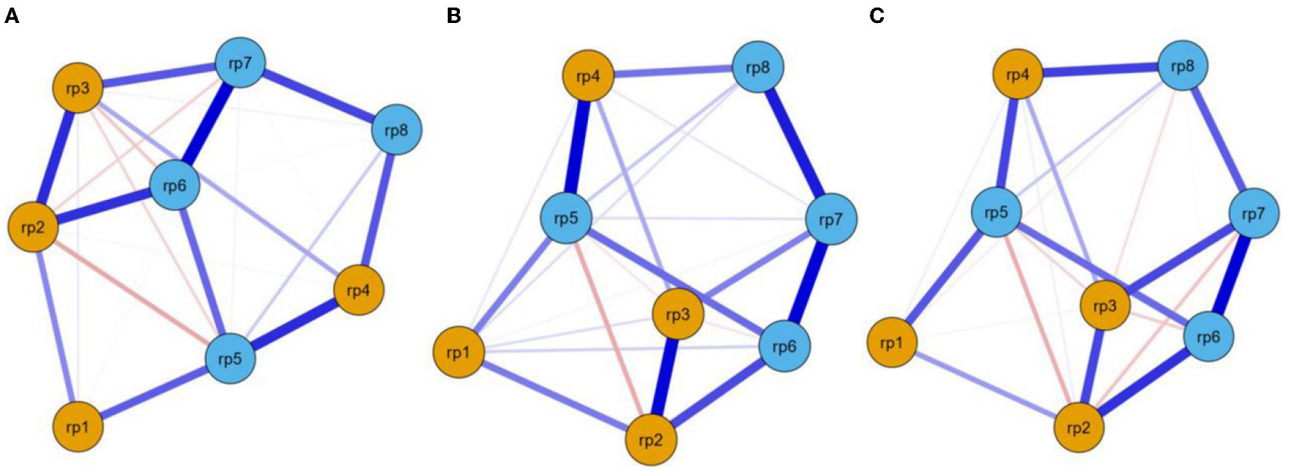

FIGURE 2
EBICglasso model based on network analysis according to risk perception among all participants **(A)**, males **(B)**, and females **(C)**. rp–rp4 = individual's risk perception, rp5–rp8 = the public's risk perception.

males, but the effect of COVID-19 was the same in different individuals' lives (32). In addition, a survey from the United States also reported that females had higher danger perception and fear of COVID-19 (33). In the present study, a gender difference in risk perception toward COVID-19 was not found, which was consistent with Li et al.'s study (13). The possible reason is that the Chinese government took many strong measures to increase the public's trust and confidence through media broadcasts about health education and interventions, travel restrictions and social distancing at the beginning of the COVID-19 pandemic and effectively provided COVID-19 vaccinations. Moreover, China is a typical collectivist country in which the public commonly trusts, supports and advocates for the government. Therefore, cultural differences, strong policies, and the positive effects of social media may influence the risk perception of COVID-19 among the Chinese population, including university students.

A survey reported four classes, including low-, mild-, moderate-, and high-risk perceptions of COVID-19, among Chinese nurse clinicians (34). Another study identified three classes, risk neutral, risk deniers, and risk exaggerators, among the Chinese population during the COVID-19 pandemic (35). Replication analysis as a method of verifying LPA was not conducted in these studies. In addition, Kleitman et al. (36) classified two groups, including the compliant group and non-compliant group, for protective behaviors during the COVID-19 outbreak. In the compliant group, people perceived a high risk of

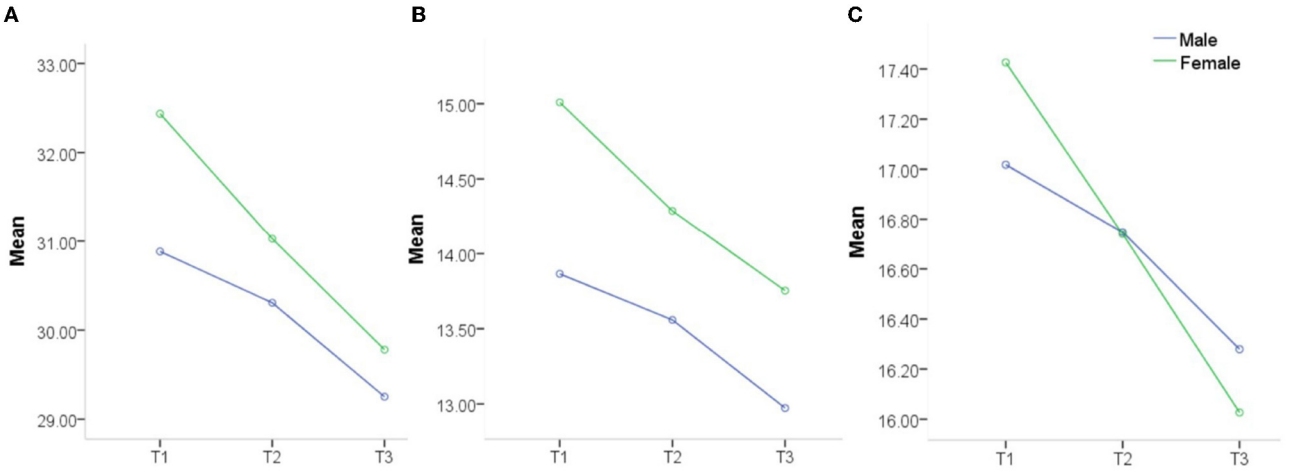

FIGURE 3
Risk perception of COVID-19 between genders at three time points (T1, T2, and T3). **(A)** Total risk perception score, **(B)** Individual risk perception score, and **(C)** Public risk perception score.

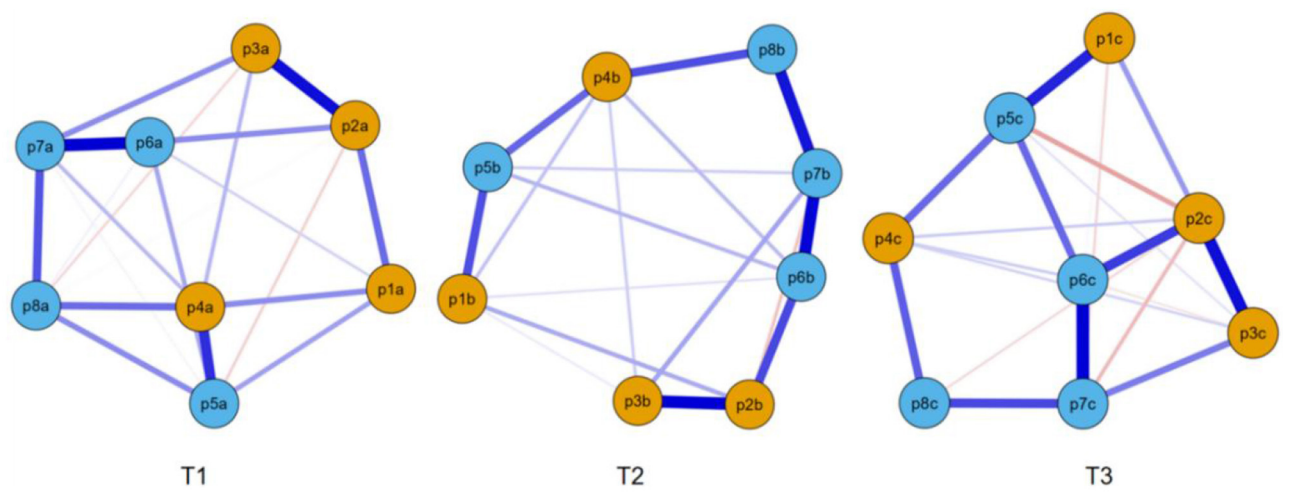

FIGURE 4
EBICglasso model based on network analysis according to risk perception at three different times. rp1–rp4 = individual risk perception, rp5–rp8 = public risk perception.

contracting COVID-19, and in the non-compliant group, members perceived a low risk. In the present study, the low entropy value of the two-class model may be related to the large sample size, which was not considered the important fit index of LPA due to the poor statistical capacity (37). In addition, the two-class (i.e., high and low) model of risk perception toward COVID-19 may be explained and distinguished more easily by average people, which is also suitable for individuals of different genders and living statuses. Due to the lack of a validity assessment tool, the receiver operating characteristic curve (ROC) and the threshold value were not available in the present study.

The cross-sectional results of network analysis indicated that the items rp6 ("*Average people have chances of contracting COVID-19*") and rp7 ("*Average people worry about catching COVID-19*") were the very important components of risk perception of COVID-19, which represented the public's perception of COVID-19 risk in the questionnaire and indicated the importance of public interest in collectivistic countries. As the pillar of society and national development, Chinese university students thought "*the COVID-19 outbreak affects the whole country*" during the COVID-19 pandemic and believed that only interdependent communities and stable countries could fight the disease. Therefore, all types of rules (e.g., washing hands, wearing masks in public places, and home quarantine) were strictly observed by most people, including university students in China. Some studies also found that collectivistic regions were more likely to wear masks as cultures and countries required (38). In addition, high coping efficacy is more easily stimulated due to sufficient health information and psychological support through the collectivism system in China (39).

In the present study, the risk perception of COVID-19 significantly decreased at the three time points. The most likely reason is that the infection and mortality of COVID-19 declined rapidly from February 14, 2020 (5,090 local confirmed cases and 121 deaths), to October 31, 2021 (33 cases imported from abroad, 59 local confirmed cases, and no deaths), based on statistical data from the China National Health Commission (40, 41). By October 31, 2021, 2,274,072 doses of the COVID-19 vaccine had been given in mainland China (42), which may have decreased the risk perception of COVID-19 and increased health awareness and confidence. In mainland China, almost all university students except individuals with physical reasons received the COVID-19 vaccine based on the requirements of universities and the government.

A survey in the United States reported that COVID-19 infection and mortality may have increased the willingness to wear a mask among youth, while different political ideologies, regardless of similar risk perceptions toward COVID-19, may have influenced protective behaviors (e.g., social distancing and wearing masks) (43). In addition, the items rp1 ("*The COVID-19 outbreak is closely related to me*") and rp2 ("*I have chances of contracting COVID-19*") had gender differences at the three time points, but no significant correlation was found between risk perceptions and gender. A survey reported that females were more likely to take precautionary measures and reduce COVID-19 risk perception during the COVID-19 pandemic (31). However, many factors, including the role of social media, perceived understanding, coping strategies, social communication needs in real life, and trust attitudes toward the country and government, may have interacted and influenced the risk perception of COVID-19, which may explain the gender difference in risk perception (44–46).

The network structures and global strengths had no significant differences among the three time points through pairwise comparison, which may explain the stability of the risk perception structure. High risk perception of COVID-19 is more likely to trigger negative emotions (e.g., worry, anxiety, fear, and even depression) and lead to a higher level of vaccination intention for preventing and fighting against COVID-19 (47). In China, with widespread mass vaccination, declining infection and mortality, and positive precautionary measures, the risk perception of COVID-19 has continually decreased, especially for females.

From a psychological perspective, the declining risk perception of COVID-19 may be explained by psychological immunization theory, that is, repeated exposure is able to reinforce resistance to stressful events (48). Individuals at risk may more easily change their cognition and attitudes toward COVID-19 and not change their location based on cognitive dissonance theory (39, 49). In addition, protection motivation theory stresses the importance of coping efficacy, that is, beliefs and behaviors about effective responses to avoid the COVID-19 threat (39, 50). Based on media system dependency theory (51), an individual's attitudes and behaviors may be changed or reinforced through the media's information dissemination. Moreover, risk perception is socially constructed based on cultural cognition theory (52). People living in collectivistic societies are more likely to perceive COVID-19 risk and adhere to social standards than people living in individualistic cultures (12). In the present study, gender theory cannot be used to explain the risk perception of COVID-19, which indicated that cultural and policy factors may significantly influence risk perception among individuals more than gender.

Some limitations should be considered when viewing these results. First, this convenience sampling of university students may not represent all Chinese university students. Second, a single risk perception questionnaire was conducted, which led to the receiver operating characteristic curve (ROC) and the threshold value of the risk perception questionnaire being unavailable due to a lack of validity assessment tools. Third, individuals self-reported their risk perception toward COVID-19, which may be inadequate and lack objectivity. Moreover, the effect factors of risk perception toward COVID-19 and prediction of health protective behaviors may be examined together through the network analysis method.

5 Conclusion

Risk perception of COVID-19 declined continually during the COVID-19 pandemic in China, which indicated the importance of cultural influence and effective government management. In addition, university students displayed strong trust and confidence in the government's ability to fight COVID-19. The results may provide a reference for coping with other great risks in the future; that is, the government should take strong measures to prevent and intervene in various risks and reinforce the public's trust and confidence through positive media broadcasts.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving humans were approved by Gannan Medical University Ethics Committee. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

ZN and LLiu conceived and designed the experiments and wrote the first draft of the paper. ZN, LLi, and SM performed the experiments. ZN and LLi analyzed and interpreted the data. SM contributed reagents, materials, and analysis tools. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2023.1171870/full#supplementary-material

References

1. Paek HJ, Hove T. Risk perceptions and risk characteristics. *Oxf Res Encycl Commun.* (2017) 13:283. doi: 10.1093/acrefore/9780190228613.013.283

2. Ferrer RA, Klein WMP. Risk perceptions and health behavior. *Curr Opin Psychol.* (2015) 5:85–9. doi: 10.1016/j.copsyc.2015.03.012

3. Yan Y, Wen J. Media use, risk perception and individual behaviors at the early stages of the COVID-19 pandemic. *J Mass Commun.* (2020) 6:50–61. doi: 10.15897/j.cnki.cn51-1046/g2.2020.06.002

4. Wolff K, Larsen S, Øgaard T. How to define and measure risk perceptions. *Ann Tour Res.* (2019) 79:102759. doi: 10.1016/j.annals.2019.102759

5. Brewer NT, Weinstein ND, Cuite CL. Risk perceptions and their relation to risk behavior. *Ann Behav Med.* (2004) 27:125–30. doi: 10.1207/s15324796abm2702_7

6. Flynn J, Slovic P, Mertz CK. Gender, race, and perception of environmental health risks. *Risk Anal.* (1994) 14:1101–8.

7. Gustafsod PE. Gender differences in risk perception: theoretical and methodological respectives. *Risk Anal.* (1998) 18:805–11.

8. WHO. *Coronavirus Disease (COVID-19).* (2022). Available online at: https://www.who.int/health-topics/coronavirus#tab=tab_1 (accessed December 31, 2022).

9. de Bruin WB, Bennett D. Relationships between initial COVID-19 risk perceptions and protective health behaviors: a national survey. *Am J Prev Med.* (2020) 59:157–67. doi: 10.1016/j.amepre.2020.05.001

10. Dryhurst S, Schneider CR, Kerr J, Freeman A L, Recchia G, Bles AM, et al. Risk perceptions of COVID-19 around the world. *J Risk Res.* (2020) 23:994–1006. doi: 10.1080/13669877.2020.1758193

11. Schneider CR, Dryhurst S, Kerr J, Freeman A L, Recchia G, Spiegelhalter D, et al. COVID-19 risk perception: a longitudinal analysis of its predictors and associations with health protective behaviours in the United Kingdom. *J Risk Res.* (2021) 24:294–313. doi: 10.1080/13669877.2021.1890637

12. Savadori L, Lauriola M. Risk perceptions and COVID-19 protective behaviors: a two-wave longitudinal study of epidemic and post-epidemic periods. *Soc Sci Med.* (2022) 301:114949. doi: 10.1016/j.socscimed.2022.114949

13. Li Y, Luan S, Li Y, Wu J, Li W, Hertwig R. Does risk perception motivate preventive behavior during a pandemic? A longitudinal study in the United States and China. *Am Psychologist.* (2022) 77:111. doi: 10.1037/amp0000885

14. Oyenubi A, Kim AW, Kollamparambil U. COVID-19 risk perceptions and depressive symptoms in South Africa: causal evidence in a longitudinal and nationally representative sample. *J Affect Disord.* (2022) 308:616–22. doi: 10.1016/j.jad.2022.04.072

15. Dratva J, Zysset A, Schlatter N, von Wyl A, Huber M, Volken T. Swiss university students' risk perception and general anxiety during the COVID-19 pandemic. *Int J Environ Res Public Health.* (2020) 17:7433. doi: 10.3390/ijerph17207433

16. Weinstein ND. Unrealistic optimism about future events. *J Pers Soc Psychol.* (1980) 39:806–20.

17. Harring JR, Hodis F A. Mixture modeling: applications in educational psychology. *Educ Psychol.* (2016) 51:354–67. doi: 10.1080/00461520.2016.1207176

18. JASP Team. *JASP (Version 0.14. 1) [Computer Software].* (2021).

19. van Borkulo CD. *Network Comparison Test: Statistical Comparison of Two Networks Based on Three Invariance Measures.* (2016). Available online at: https://cran.r-project.org/web/packages/NetworkComparisonTest/index.html (accessed January 5, 2023).

20. West SG, Finch JF, Curran PJ. Structural equation models with non-normal variables: problems and remedies. In: RH Hoyle, editor, *Structural Equation Modeling: Concepts, Issues, and Applications.* Thousand Oaks, CA: Sage (1995). p. 56–75.

21. Finney SJ, DiStefano C. Non-normal and categorical data in structural equation modeling. In: Hancock GR, Mueller RO, editors. *Structural Equation Modeling: A Second Course.* Greenwich, CT: Information Age (2006).

22. Carragher N, Adamson G, Bunting B, McCann S. Subtypes of depression in a nationally representative sample. *J Affect Disord.* (2009) 113:88–99. doi: 10.1016/j.jad.2008.05.015

23. Bauer DJ, Curran PJ. Distributional assumptions of growth mixture models: implications for over extraction of latent trajectory classes. *Psychol Methods.* (2003) 8:338–63. doi: 10.1037/1082-989X.8.3.338

24. Grimm K. Multilevel modeling using Mplus. *Multidiscipl J.* (2017) 24:960–2. doi: 10.1080/10705511.2017.1347045

25. McCutcheon AL. *Latent Class Analysis.* Thousand Oaks, CA: Sage Publications (2002).

26. Muthén LK, Muthén BO. *Mplus User's Guide.* 7th ed. Los Angeles, CA: Muthén & Muthén. (2012).

27. Chen J, Chen Z. Extended Bayesian information criteria for model selection with large model spaces. *Biometrika.* (2008) 95:759–71. doi: 10.1093/biomet/asn034

28. Epskamp S, Borsboom D, Fried EI. Estimating psychological networks and their accuracy: a tutorial paper. *Behav Res Methods.* (2018) 50:195–212. doi: 10.3758/s13428-017-0862-1

29. Epskamp S, Cramer AO, Waldorp LJ, Schmittmann VD, Borsboom D. qgraph: network visualizations of relationships in psychometric data. *J Stat Softw.* (2012) 48:1–18. doi: 10.18637/jss.v048.i04

30. Robinaugh DJ, Millner AJ, McNally RJ. Identifying highly influential nodes in the complicated grief network. *J Abnormal Psychol.* (2016) 125:747–57. doi: 10.1037/abn0000181

31. Rana IA, Bhatti SS, Aslam AB., Jamshed A, Ahmad J, Shah AA. COVID-19 risk perception and coping mechanisms: Does gender make a difference? *Int J Disast Risk Reduct.* (2021) 55:102096. doi: 10.1016/j.ijdrr.2021.102096

32. Rodriguez-Besteiro S, Tornero-Aguilera JF, Fernández-Lucas J, Clemente-Suárez VJ. Gender differences in the COVID-19 pandemic risk perception, psychology, and behaviors of Spanish university students. *Int J Environ Res Public Health.* (2021) 18:3908. doi: 10.3390/ijerph18083908

33. Niño M, Harris C, Drawve G, Fitzpatrick KM. Race and ethnicity, gender, and age on perceived threats and fear of COVID-19: evidence from two national data sources. *SSM-Popul Health.* (2021) 13:100717. doi: 10.1016/j.ssmph.2020.100717

34. Qianlan Y, Tianya H, Wei L, Jia G, Chunyan N, Wei Z, et al. The psychological outcomes of COVID-19 affected the pandemic-after risk perceptions of nurse clinicians: a latent profile analysis. *Glob Mental Health.* (2022) 13:1–10. doi: 10.1017/gmh.2022.13

35. Yang Z, Xin Z. Heterogeneous risk perception amid the outbreak of COVID-19 in China: implications for economic confidence. *Appl Psychol.* (2020) 12:1000–18. doi: 10.1111/aphw.12222

36. Kleitman S, Fullerton DJ, Zhang LM, Blanchard MD, Lee J, Stankov L, et al. To comply or not comply? A latent profile analysis of behaviours and attitudes during the COVID-19 pandemic. *PLoS ONE.* (2021) 16:e0255268. doi: 10.1371/journal.pone.0255268

37. Tein JY, Coxe S, Cham H. Statistical power to detect the correct number of classes in latent profile analysis. *Struct Eq Model.* (2013) 20:640–57. doi: 10.1080/10705511.2013.824781

38. Lu JG, Jin P, English AS. Collectivism predicts mask use during COVID-19. *Proc Nat Acad Sci USA*. (2021) 118:e2021793118. doi: 10.1073/pnas.2021793118

39. Zhang L, Ma M, Li D, Xin Z. The psychological typhoon eye effect during the COVID-19 outbreak in China: the role of coping efficacy and perceived threat. *Glob Health*. (2020) 16:1–10. doi: 10.1186/s12992-020-00626-8

40. National Health Commission of the People's Republic of China. *The Latest COVID-19 Situation as of 24 PM on February 13*. (2020). Available online at: http://www.nhc.gov.cn/xcs/yqtb/202111/322b05206c644e658990d821e504a4f3.shtml (accessed February 2, 2023).

41. National Health Commission of the People's Republic of China. *The Latest COVID-19 Situation as of 24 PM on October 31*. (2021). Available online at: http://www.nhc.gov.cn/xcs/yqtb/202111/322b05206c644e658990d821e504a4f3.shtml (accessed February 2, 2023).

42. National Health Commission of the People's Republic of China. *COVID-19 Vaccination Status as of 24 PM on October 31*. (2021). Available online at: http://www.nhc.gov.cn/jkj/s7915/202111/a533ee03be4648a5858554ab04591ef6.shtml (accessed February 2, 2023).

43. Joslyn S, Savelli S, Duarte HA, Burgeno J, Qin C, Han JH, et al. COVID-19: risk perception, risk communication, and behavioral intentions. *J Exp Psychol*. (2021) 27:599. doi: 10.1037/xap0000398

44. Tsoy D, Tirasawasdichai T, Kurpayanidi KI. Role of social media in shaping public risk perception during COVID-19 pandemic: a theoretical review. *Int J Manag Sci Bus Admin*. (2021) 7:35–41. doi: 10.18775/ijmsba.1849-5664-5419.2014.72.1005

45. Xie K, Liang B, Dulebenets MA, Mei Y. The impact of risk perception on social distancing during the COVID-19 pandemic in China. *Int J Environ Res Public Health*. (2020) 17:6256. doi: 10.3390/ijerph17176256

46. Huynh TL. The COVID-19 risk perception: a survey on socioeconomics and media attention. *Econ Bullet*. (2020) 40:758–64. Available online at: http://www.accessecon.com/Pubs/EB/2020/Volume40/EB-20-V40-I1-P64.pdf

47. Hilverda F, Vollmann M. The role of risk perception in students' COVID-19 vaccine uptake: a longitudinal study. *Vaccines*. (2021) 10:22. doi: 10.3390/vaccines10010022

48. Lewitus GM, Schwartz M. Behavioral immunization: immunity to self-antigens contributes to psychological stress resilience. *Mol Psychiatry*. (2009) 14:532–6. doi: 10.1038/mp.2008.103

49. Festinger L. *A Theory of Cognitive Dissonance*. Stanford, CA: Stanford University Press (1957).

50. Maddux JE, Rogers RW. Protection motivation and self-efficacy: a revised theory of fear appeals and attitude change. *J Exp Soc Psychol*. (1983) 19:469–79.

51. Merskin D. Media dependency theory: origins and directions. In: D Demers, K Viswanath, editors, *Mass Media, Social Control and Social Change: A Macrosocial Perspective*. Ames, IA: Iowa State University Press (1999). p. 77–98.

52. Kahan DM. Cultural cognition as a conception of the cultural theory of risk. In: S Roeser, editor, *Handbook of Risk Theory, Forthcoming, Harvard Law School Program on Risk Regulation Research Paper*. (2008). p. 8-20.

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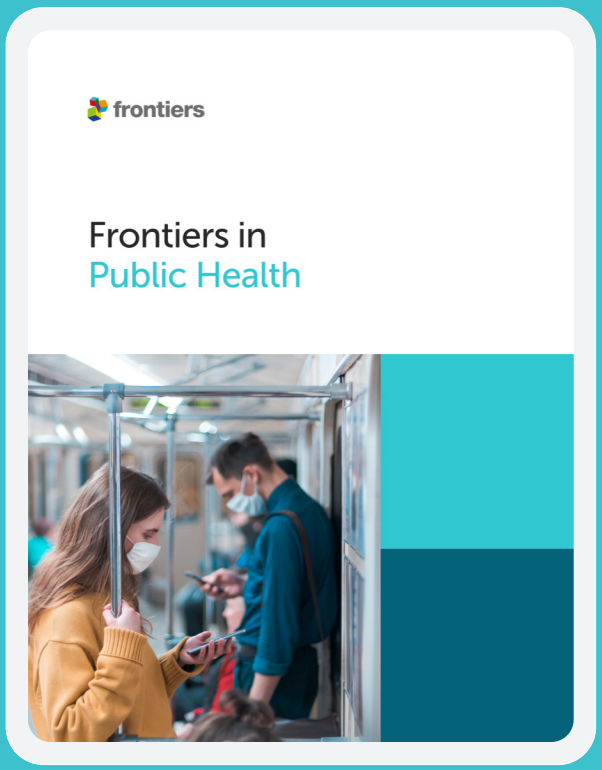

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