INSIGHTS IN HEALTHCARE PROFESSIONS EDUCATION: 2021

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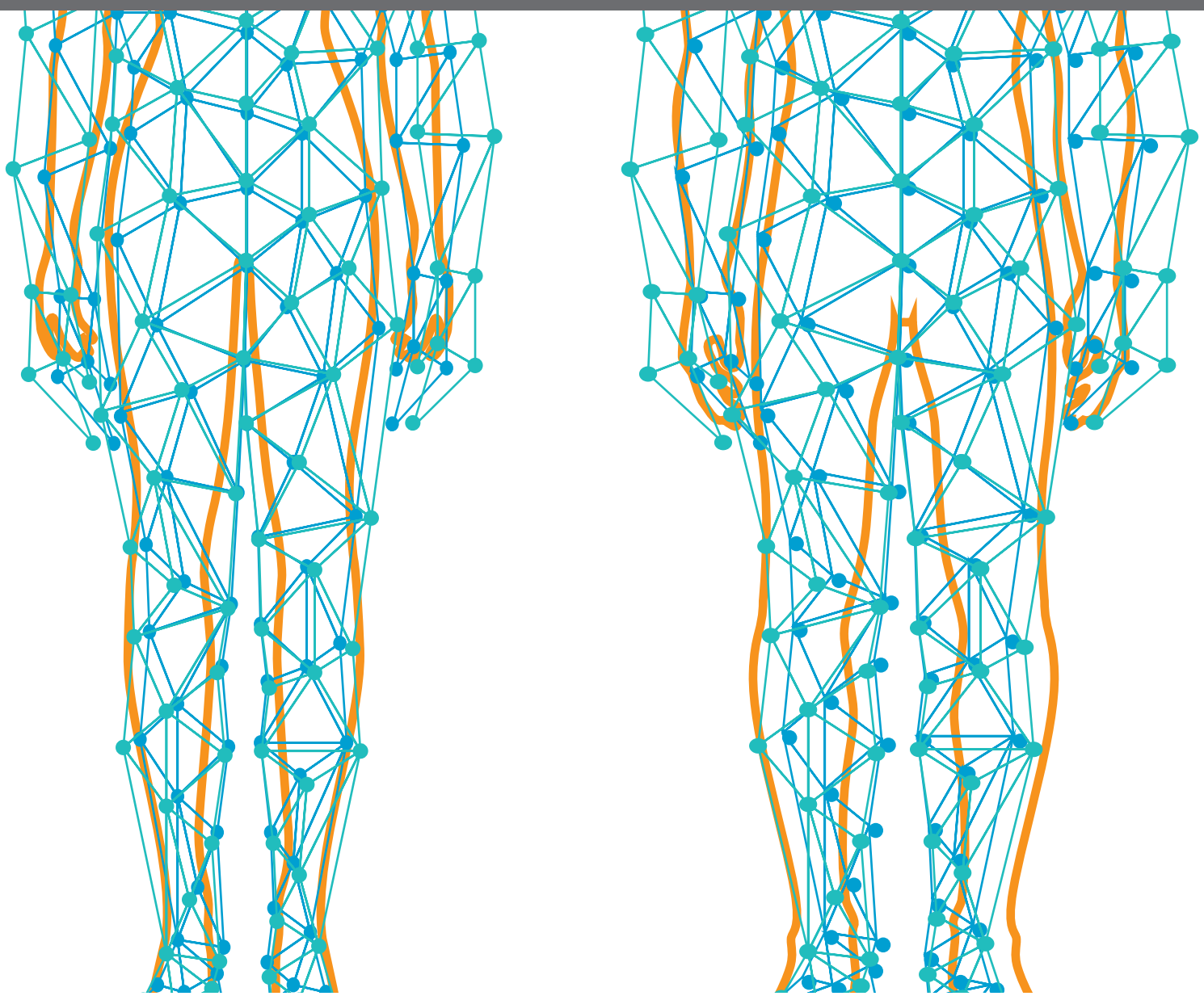

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INSIGHTS IN HEALTHCARE PROFESSIONS EDUCATION: 2021

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Editorial: Insights in healthcare professions education: 2021

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Editorial on the Research Topic
Insights in healthcare professions education: 2021

The Healthcare Professions Education specialty section of Frontiers in Medicine opened for submissions in May 2021, with this interesting collection of articles being the first to be developed. As we discussed in our previous editorial, healthcare professions education is a widely diverse field covering multiple topics (Monrouxe and Bloomfield). This research collection is no exception. Thus, we cover a range of considerations within the field of healthcare professions education broadly grouped into the themes of interprofessionalism, social media use, knowledge synthesis, assessment and theory-driven research. Furthermore, our publications span a range of different contributions including opinion articles, original research and reviews.

Interprofessionalism

Interprofessionalism remains a hot topic in healthcare professions education, being of central importance to successful teamworking and collaboration across a diverse range of healthcare settings. Furthermore, we see diversity in terms of the articles we have grouped into this theme as a few cross-cut our other themes (with some reporting incidental findings around interprofessionalism). This attests to the complexity and interdisciplinarity of healthcare education.

Samuriwo comments on how the success of interprofessional collaboration in healthcare practice is to some extent dependent upon interprofessional education during the undergraduate years. He points out that these interprofessional concepts can be thought of as "*muddy zones of practice*" (1): complex and uncertain areas that, for successful outcomes, requires us to think through different lenses (e.g., beliefs, sociocultural influences) due to the diversity inherent across different professional groups' practices (Monrouxe and Bloomfield). Indeed, interprofessional learning appears to be one of the numerous success factors of the undergraduate nursing interactive curriculum, as reported by Fooladi et al. thinking through different lenses and addressing students' stereotypes, developing their communication skills. We also see interdisciplinary collaboration being fostered through theory-driven

approaches in Mukhalalati et al.'s review of theory-use in healthcare professionals' programme development. Thus, simulation exercises using the constructs of self-efficacy is found to enhance problem-solving, communication skills and clinical competency (2). Additionally, educators drew on Communities of Practice theory to create interprofessional teamworking during clinical placements (3). Umar et al.'s review of healthcare students' pandemic-related volunteering also reveals that a key benefit from undertaking these activities includes interprofessional collaboration. Furthermore, in their review of virtual simulation learning over a 2-year period (2020–2021), Wu et al. report two studies of interprofessional training across a range of healthcare students (medicine, nursing, pharmacy, occupational therapy, physiotherapy, medical social work). Together, these two studies suggest that immersive technologies are useful for delivering high-quality interprofessional training. Perhaps, therefore, the use of virtual reality avatars, giving healthcare students a chance to inhabit the body of others, is one way of clarifying this *muddy zone* of interprofessional practice highlighted by Samuriwo.

Social media use

The use of social media by healthcare students is the focus of two of our articles. Bansal highlights that, for the past 10 years, the exponential growth in Open Access online educational materials for preclinical and clinical medical students has resulted in over 90% of students using these resources regularly (10). Furthermore, this global shift in approaches to learning draws on a diverse range of resources including social media platforms (e.g., podcasts, Twitter, YouTube) bringing with it some challenges alongside the obvious benefits associated with flexible learning. Challenges around the educational quality of the resources include developers' skills, understanding of instructional design and sustainability. Future submissions focusing on research addressing such challenges are welcome, alongside other commentaries on the inclusion of high-quality Open Access online educational materials for healthcare professional students.

While Bansal focuses on the educational benefits and challenges of social media platforms, Guraya et al. consider the issue of students' e-professionalism lapses which: "merely addresses professionalism in the online world" ((4), p. 170). The issue of e-professionalism lapses by healthcare students is of international concern with students openly violating professional standards involving a diverse range of stakeholders including breaches of patient confidentiality, being derogatory about patients, seniors and peers, and even "partying and drinking alcohol in inappropriate attires" (Guraya et al., p. 2). Utilizing the Theory of Planned Behavior as an underlying construct (5), Guraya et al.'s mixed-methods evaluation of an intervention designed to increase awareness and behaviors shows promising results with participants' displaying (among other things) strong *intentions* to be digitally professional (e.g., raising concerns, taking responsibility seriously and being digitally reflective). The issue of e-professionalism is of great importance in healthcare professional education, and there is real gap in our understanding of the deeper underlying issues around students' online lapses. We encourage researchers to address this gap in future submissions to our section.

Knowledge synthesis

Partly as a response to the call for evidence based education, knowledge synthesis approaches across healthcare professions research have increased 10 times more than other research approaches over the past 20 years or so (6). Echoing this trend, we have four articles in our collection, two scoping and two systematic reviews, each providing us with an overview of the state of research on specific educational interventions: virtual simulation (Wu et al.), the medical humanities (Hoang et al.), the application of learning theory in healthcare professions education (Mukhalalati et al.), and students' extra-curricular responses to the pandemic (Umar et al.).

Thus, Wu et al. reveal that, in a brief 2-year period, 92 articles focusing on virtual simulation in medical education settings have been published from 25 countries: although predominately Europe (45%) and North America (33%). The largest category of work reports on undergraduate students' surgical training (38%) covering areas such as endoscopic, orthopedics/bone and neurosurgery/neuroanatomy. Other areas serviced by virtual simulation interventions include emergency and pediatric emergency medicine training, basic medical sciences, medical radiation/imaging, puncture/catheterization and (as highlighted earlier) interprofessional healthcare. Across these diverse virtual simulation use cases, over half use virtual reality deploying headsets or goggles and/or hand controllers, and with the vast majority demonstrating evidence of an increase in learners' knowledge or skills (Wu et al.). Where evidence is lacking is in the wider "so what" for change in practice and patient benefit.

The medical humanities comprise a diversity of humanity-based interventions aimed at counterbalancing the relatively "sterile" and clinical focus of healthcare training (an intrinsic rationale), developing communication and empathy skills (an instrumental rationale), bringing an analytical/questioning perspective health practices (a critical rationale), and/or making the relevance of the humanities disciplines and enquiry obvious to healthcare professions education and practice (an epistemological rationale) (7). Hoang et al. reviewed the state of research around the medical humanities across a 20-year period in one Asian country, Taiwan, identifying 17 articles. The majority of articles from their review drew on the instrumental and intrinsic rationales, reporting on the efficacy of a range of

interventions including visual arts, narrative, reflective practice and fieldwork. However, evidence for efficacy appears to be mixed. Eight studies reported positive increases for attitudes around treating patients with greater humanity or being more creative and critical in their studies, or increases in knowledge and skills in critical thinking, reflective writing and empathy. Despite this, three studies failed to deliver the expected outcomes of greater empathy or ethical decision-making. As with Wu et al. there is a lack of research examining the higher levels of behavioral change and impact on patient benefit. We encourage researchers to consider these higher levels of impact when designing future studies and welcome submissions reporting on the degree to which interventions reach these outcomes.

As Lewin's Maxim states, in the case of applied research, "*there is nothing as practical as a good theory*" ((8), p. 118). Mukhalalati et al. sought to identify how social learning theories are utilized in healthcare professions education programmes (2011–2020). They found only nine studies reporting this use, drawing on Bandura's Social Learning Theory and Lave and Wenger's Communities of Practice. Studies are predominately in nursing programmes but also medicine, pharmacy and multi-disciplinary contexts, focusing on teaching and learning, assessment and curriculum design. This review highlights the relative absence of explicit work around theory-use in programme development. Indeed, the authors comment on how many articles were excluded through failing to explain *how* theory were used, or because they theories were used as exploratory lenses, looking *onto* research data (rather than using theory to *develop* interventions). Future research using theory to drive curricula development is encouraged and we welcome manuscripts with this in mind.

Umar et al. found 41 studies in a 22 month period, identifying the motivations, benefits, activities and barriers around health professional students' pandemic-related volunteering. Over 75% of these studies focused on medical students. Diverse activities include working in hospitals (e.g., emergency departments and admissions), call centers, contact tracing/testing and online consultations. Key considerations around students' engagement in these activities comprise a range of internal (self) and external (societal/healthcare system) rationales including their sense of moral responsibility, possibilities for learning, adequate PPE provision, appropriate knowledge/skills and financial remuneration: many of which were also cited as benefits arising from participating. Participating in these activities also facilitate psychological wellbeing. Although it is likely, as we move forward into a post-pandemic area, that such volunteering will change, we wonder what the longer-term educational impact of such volunteering is. For example, at an individual level, do students feel better prepared for practice? At an institutional level, will undergraduate healthcare programmes encourage (or develop) post-pandemic activities in this likeness? Or will these practices merely fade away? We are interested in hearing more about the outcomes and evolution of these practices over time.

Assessment

Assessment in healthcare education is complex and diverse, as evident by the different purposes of assessment, the various ways in which assessment can be conducted, and the different tools that can be used to facilitate assessment (e.g., checklists, marking guides, proformas). Further to this diversity is the variation in assessors' backgrounds and roles. Some are totally university-based, while others share their time between university and clinically-based roles. It is because of this diversity that educators continue to grapple with issues of variability in clinical assessment and subjectivity among assessors. This raises concerns about cognitive bias, as well as having assessment methods that are fit for purpose. These issues have informed both studies in our collection grouped together under the Assessment theme.

Recently, the notion of the *prototype intern* has emerged. Grounded in the heuristic mental construct of assessors' professional and clinical expectations of an *ideal new graduate* working within their team, the concept of a prototype intern influenced Malau-Aduli et al. to conduct an interesting study, emphasizing the diverse complexity of an OSCE assessment. Informed by an interpretivist paradigm, 20 assessors from ten medical schools across Australia and New Zealand engaged in focus group discussions exploring how the concept of the prototype intern influenced their judgements during senior medical students' exit-level OSCEs. Findings suggest a complex but interrelated influence of academic and workplace constructs on assessors' judgements. Thus, individual assessors balanced the task-orientated expectations of the academic system (i.e., outcomes of knowledge, skills and behaviors), with professional expectations of the clinical workplace (e.g., respect, reliability, teamwork and trustworthiness). Malau-Aduli et al. also identified variation among individual assessors. Those who are more clinically experienced relied on their mental construct of the prototype intern than those who are less experienced. In concluding, the researchers suggest the need for explicit assessor training aimed at reducing unconscious bias and identify the need for further research in this area. We look forward to future submissions that address this gap.

We also see the diversity of assessment methods in health profession education in the longitudinal study reported by Liu et al. Again, focusing on medical education, these researchers analyzed retrospective educational data collected over a four-year period from multiformat in-training examinations (ITE) of emergency medicine residents at a large teaching hospital in Taiwan. With the goal of determining the validity, reliability, cost and learner satisfaction of the multiformat ITE, Liu et al. found that that the incorporation of different assessment formats

in the ITE [written tests, oral examinations and high-fidelity simulations (HFS)] demonstrated good reliability. They also found that the inclusion of HFS as part of the ITE expanded the domains that could be tested, in that they added a clinically authentic assessment. The researchers' identified, however, the high potentially inhibitive costs associated with HFS and the need for educators to understand the strengths and weaknesses of each type of assessment, and the context in which they are to be used. This is an issue that all healthcare educators involved in the development of assessment strategies should consider.

Theory-driven

The final three articles in our first collection align well with the diverse nature of research in the field of health professional education in that they address a broad and fascinating array of topics that include: imposter syndrome and its relationship to self-esteem in medical students (Naser et al.); the impact of gendered transitions on female surgeons (Offiah et al.); and factors influencing the tolerance by medical students of uncertainty (Stephens et al.). Not only are these topics varied, although, commonly linked in that each is clearly underpinned by a specific theory, drawing on participants' personal experiences, but all have been conducted using distinctively different study designs: a cross-sectional questionnaire (Naser et al.); narrative inquiry (Offiah et al.); and a qualitative longitudinal design that involved analysis of reflective diaries and semi-structured interviews (Stephens et al.).

In a study of 290 medical students from 28 different nationalities studying at an Irish medical college situated in Bahrain, Naser et al. sought to assess the prevalence of imposter syndrome and its relationship to self-esteem. Findings indicated that imposter syndrome was higher among students with low self-esteem and that students from Gulf corporation countries (Bahrain, Kuwait, Oman, Saudi Arabia and the United Arab Emirates) had the highest levels of self- esteem. Interestingly, the researchers found no differences between gender. This finding is dissimilar to other studies which have shown an association between imposter phenomenon and female medical students (9, 10).

Gender was also the focus of a fascinating study that explored transition across surgical training as experienced by female surgeons within Scotland and Ireland (Offiah et al.). Drawing on Multiple and Multidimensional Transitions theory (MMT), Offiah et al. using qualitative methods, found that female surgeons experienced four intersecting transitions within their surgical training trajectory, with gender having a considerable impact. These included maternity leave transitions, part-time training/working transitions, leadership transitions and transitions out of surgery. Each bringing with it a multitude of challenges. In discussing these findings, the researchers highlight the need for greater awareness around these factors and for educators, leaders and policy-makers to develop interventions and services to aimed at addressing the needs of female surgeons as they progress through their careers.

In the third of these articles, the construct of uncertainty tolerance was the focus of an Australian qualitative, longitudinal study of medical students (Stephens et al.). According to Hillen et al. (11), after perceiving uncertainty, a person will appraise and respond to it across cognitive, emotional and behavioral domains with different moderators influencing either their perception of the uncertainty or their response to it. Uncertainty tolerance is now considered an essential trait for medical graduates, with research demonstrating a link between lower uncertainty tolerance in physicians and medical students and negative outcomes such as paternalistic attitudes toward patients, increased use of healthcare resources and a higher risk of burnout. Stephens et al. used semi-structured individual and group interviews and analyses of diary entries to explore the factors perceived by medical students as moderating their perceptions and responses to uncertainty in the clinical context. A broad and diverse range of moderators, which were categorized as individual factors, sociocultural factors and academic factors were identified as having either a positive or negative impact on the medical students' perceptions of uncertainty. A fourth moderator, reflective learning, was reported to be a positive influence. In discussing the implications of these findings for educators, the researchers emphasize the need to incorporate opportunities for reflection within teaching and learning as well as the importance of educators helping students' navigation of uncertainty. Further research is now needed, and we welcome future papers that address this key topic of uncertainty tolerance.

Conclusion

In our roles as Chief Specialty Editors for the Healthcare Professions Education section of Frontiers in Medicine we have been delighted at the diversity of high-quality submissions that have been received over our first year. We take this opportunity to sincerely thank the reviewers and handling editors for their work, without which would make the success of the section impossible. We look forward to a diversity of future publications that continue to challenge, to educate and to advance knowledge in this important field.

Author contributions

LM lead the writing of the manuscript, theming the articles in the section, structuring the paper, and finalized the

manuscript to completion. LM and JB summarized the articles. Both authors approved the final manuscript for submission.

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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OPINION
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Expanding Free Open-Access Medical Education

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Keywords: medical education, e-learning (web based learning/distance learning), faculty development, continuing medical education (CME), virtual learning and education environment (VLE)

During my medical school cardiology placement, I remember our clinical tutor printing out the cardiovascular examination checklist from *Geeky Medics*© as our learning tool for the term. When I would study later for my pre-clinical exams, *Amboss*© and *UpToDate*© were the first and most useful resources that I looked at, rather than my course lectures. When I would study for finals, the advice from seniors was to get through the core lectures from our university quickly, and then to move onto online question banks. My experience was not unique; I would rather confidently say it characterized the learning and revision approach of most of my peers.

These examples are not to point out the failings of my medical school; it taught and prepared me exceptionally well, and I received a very high quality of medical education and support. Rather, it reflects a broader shift within medical education. Ebbing are the days of learning from the 1-h, in-person, didactic teaching style that is the cornerstone of medical education. Flowing are the days of open-access, online learning resources.

Over the last decade, there has been considerable growth in free open-access medical education (FOAM), which refers to openly accessible and predominantly online materials used to supplement and enhance traditional educational methods. FOAM includes teaching resources such as blogs, podcasts, tweets, online question banks, YouTube videos, and other social media platforms that are easily and freely available.

Over 90% of both pre-clinical (1) and clinical (2) medical students use online FOAM resources on a weekly basis, and it is a core source of core learning and revision material for students. This information crosses institutional and geographical borders, and allows for the global, continuous, and instantaneous spread of clinical knowledge. In doing so, FOAM has the unique ability to promote the equity (3) and quality of medical education, and more broadly promote global health equity. Especially considering the COVID-19 pandemic, the need for clinical knowledge to be easily and quickly disseminated has been highlighted.

As such a predominant and important teaching pedagogy, its current landscape and areas for development need to be considered. This article will first discuss what FOAM exists, justify the importance of faculty development in FOAM and offer a set of recommendations for what faculty development in FOAM should exist.

THE CURRENT LANDSCAPE OF FREE, OPEN ACCESS MEDICAL EDUCATION

FOAM resources are concentrated in their geographical origin and content domain; most resources are created in a small number of high-income countries: Australia, UK, and USA (4). This is despite the fact the users of FOAM resources are from a diverse range of high-, middle- and low-income countries around the world (4), and that most doctors work in middle- and low-income countries. Further, although expanding, there are certainly clinical domains that are over and under-represented. Emergency and critical care medicine (5) and pediatric medicine have both

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TABLE 1 | The challenges in the implementation of free, open access medical resources, and the role of faculty development programs in addressing them.

Challenge	Role of faculty development programs
Lack of motivation, skills, and experience	Faculty development programs would offer clinical educators background on the importance of FOAM and the tools and confidence to create resources
Best practice for instructional design	Formal training in creating FOAM resources would offer a pedagogical framework to inform the design of appropriate and useful FOAM resources
Evaluation of FOAM resources	Resources made by medical faculties would go through their institutional checks and verifications
Sustainability	Faculty development programs would train a cohort of clinical educators who can drive the creation of FOAM resources

been pioneers in the FOAM medicine, whereas a number of other clinical specialities have a death of resources. Both these factors may potentially result in poor alignment of FOAM resources to the educational needs of students around the world.

In addition, most resources are developed by dedicated individual clinicians independent of an academic institution. A notable excision to this is massive open online courses (MOOCS), which are generally developed by universities and available through several platforms (such as *Coursera*© and *edX*©), However, MOOCS for medical students are scarce, and they are overall not as comprehensive or widely used as other FOAM tools.

POTENTIAL CONCERNS WITH FOAM

As a new learning pedagogy, there are potential barriers and challenges regarding the development, design, and evaluation of FOAM resources. The four main challenges are:

1. A lack of motivation, skills, and experience- The most significant barrier is the perceived difficulty and challenges in making FOAM resources, with clinical educators describing a lack of technical expertise, time, resources and motivation (6).

2. Best practice for instructional design- There is concern regarding best practice for the instructional design and pedagogical frameworks for FOAM resources. For example, although podcasts are frequently used by doctors to review new literature and learn core material, most did not perform active learning whilst listening to the podcast, limiting their retention of information (7). Since the pedagogical design can affect the effectiveness of FOAM (8), this must be carefully considered to ensure they are beneficial.

3. Evaluation of FOAM resources- It may be difficult to verify the legitimacy and accuracy of information of resources produced online (9). Further, there is limited literature on how to discern high quality FOAM material. Although there are some metrics and tools that have been established to score FOAM resources (10), these have not been validated and widely adopted at this time.

4. Sustainability- There are concerns regarding the sustainability of FOAM materials. Their creation is currently being driven by individual clinicians and is hence contingent on their altruism and availability. As a result of this, it is feared that FOAM resources may not be a sustainable and comprehensive teaching pedagogy long-term.

FACULTY DEVELOPMENT IN ONLINE LEARNING RESOURCES

The growing use of FOAM resources and some of the potential concerns regarding their use justifies the need for academic institutes to invest and take an active role in developing and evaluating them. Faculties should consider developing FOAM resources to empower their faculty in adopting a new era and dominant pedagogy in medical education. This will not only benefit their own students, who are increasingly turning to such resources for their education, but also help these faculties become more active members in the global community of medical educators.

Faculty development programs in developing FOAM resources are likely to play an instrumental role in overcoming the challenges mentioned above and ensuring the creation of more high-quality resources, as summarized in **Table 1**.

Several medical faculties have developed faculty programs in developing e-learning resources and FOAM education more broadly. However, of the few programs that do currently exist, they tend to be institution-specific, paid, and in-person, counter-intuitive to the principle of open-access.

In light of this, this article makes the following suggestions:

1. Free, open access medical education (FOAM) is increasingly becoming an important teaching pedagogy, and medical faculties should therefore consider creating FOAM resources.
2. To achieve this, implementing faculty development programs in developing FOAM resources are necessary.
3. Faculty development programs should themselves be free, open access, and available online.

AUTHOR CONTRIBUTIONS

The author confirms being the sole contributor of this work and has approved it for publication.

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Factors Associated With Undergraduate Nursing Students' Academic and Clinical Performance: A Mixed-Methods Study

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Background: There is conflicting and limited information regarding factors that influence undergraduate nursing students' academic and clinical performance prior to entry to practice.

Objective: To identify factors influencing the academic and clinical performance of undergraduate nursing students throughout the course.

Design: Mixed methods study utilizing a retrospective cohort and a qualitative study.

Setting: Monash University, Melbourne, Australia.

Participants: Longitudinal existing data of nursing undergraduate students who commenced in 2017 (n = 176) and 2018 (n = 76), and two focus groups with final year nursing students were analyzed.

Methods: Retrospective students' records were used to determine the students' academic and clinical performance using the weighted average mark (WAM) of the theoretical and clinical components of the curriculum, separately. The WAM considered the year level of each unit and was scored out of 100. Multivariate linear regression was used to determine predictor factors of academic and clinical performance. Variables include entry cohort (with no previous nursing qualification vs. diploma of nursing), admission category (domestic vs. international), campus (metropolitan vs. outer metropolitan), and secondary school (year 12) results. Two focus group discussions were conducted and thematically analyzed.

Results: More than two-thirds of the students were aged 18–20 years and mainly female. Almost 20% of the participants were international students. Students with higher secondary school (year 12) results and studying at the outer metropolitan campus achieved a higher academic performance while international students had significantly lower academic performance compared to domestic students. Students with a previous diploma of enrolled nursing and international students had lower clinical performance. Students identified that a comprehensive orientation, interactive curriculum, formal and

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informal support structure, and educator qualities influenced their academic and/or clinical performance.

Conclusions: A supportive educational environment with an interactive curriculum may enhance students' academic and clinical performance and readiness for practice. Furthermore, targeted interventions for international students, those with lower secondary school (year 12) results, and those with a former diploma of nursing may be required to increase academic and clinical performance.

Keywords: nursing education, clinical performance, academic performance, bachelor of nursing students, support structures, educator qualities, interactive curriculum

INTRODUCTION

With the recently celebrated International Year of the Nurse, it is timely to consider the education of tomorrow's nursing workforce in increasingly difficult and complex environments. To promote excellence in nursing, Darbyshire et al. [(1), p. 2] suggest that faculties need to "develop and sustain a culture in which excellence in scholarship can flourish and deliver responsive, challenging educational programs." The question of whether universities are providing education programs that prepare students with sufficient levels of academic and clinical capability is of vital importance to the future of the nursing profession. One strategy to address this issue is to identify factors that facilitate nursing students' academic and clinical performance success.

An increasing number of students enrolling in Bachelor of Nursing (BN) courses are older than 21 years of age (2) and come from diverse academic, ethnic, and cultural backgrounds (3). Pitt et al. (4) examined the predictive nature of demographic, academic, and personality/behavioral factors in determining the academic success of nursing students, concluding that information on key factors impacting clinical performance is scarce. While academic outcomes for different entry pathways into a BN program have been studied, other influences, such as student background, have not been explored (5). To date, only one Australian study has examined factors such as grade point average (GPA) (the number signifying the median value of the accrued final course grades) and domestic or international status (6). Findings from that study concluded that international students, and those with a lower GPA, were more likely to demonstrate lower clinical performance (6). Understanding why this occurs is problematic as no qualitative studies have been done to date that explores students' perspectives on the diverse factors that affect academic and clinical performance, including support mechanisms and structures.

The School of Nursing and Midwifery of this higher education institute in Australia offers a 3-year accredited undergraduate nursing course to prepare graduates to be eligible to apply for entry into the nursing profession (7). The BN course employs an integrated active learning curriculum involving scaffolded content over 3 years (8). Assessment in the curriculum was based on best practice assessment development (8). Consistent with the active learning model, assessment activities in the curriculum are learner-centered and designed to reflect a pedagogical approach. Formative and summative assessments are used to encourage learners to act as learning resources for one another reflecting a commitment to collaborative and cooperative learning, reciprocal teaching, and peer assessment. The summative assessment takes an integrated approach that represents a holistic approach to learning. The assessments include quizzes, concept or mind maps, objective structured clinical evaluation (OSCE) skill assessments in a simulation environment, oral presentations, reflective activities, and class participation. Peer-to-peer assessment, abstracts and posters, written assignments, and exams are also included.

The objectives of this study were 1) to examine the impact of demographic characteristics and admission criteria on undergraduate nursing students' academic and clinical performance; 2) to explore final year nursing students' perceptions of factors influencing their academic and clinical performance throughout the course.

METHODS

This mixed methods study utilized quantitative data (nursing student records) to explain the impact of demographic characteristics and admission criteria, and qualitative data (focus group discussions) to explore final year students' perceptions of academic and clinical performance to produce detailed insights (9). Student cohorts were from two Monash Nursing and Midwifery campuses (metropolitan vs. outer metropolitan), in Victoria, Australia who entered *via* two pathways. The first cohort transitioned from secondary school education to commence a 3-year BN in 2017 ($n = 176$). The second cohort, who commenced their 2-year BN in 2018 ($n = 76$), held a diploma of nursing (Enrolled Nurse, EN) and were exempted from the first year. Both groups graduated in December 2019. Of note, all students with a previously enrolled nursing degree were domestic. Students who discontinued other tertiary courses prior to joining the BN course were excluded from the study ($n = 18$) as they might have different knowledge and experiences that might impact their academic and clinical performance.

Demographic and admission information, including admission category (domestic/international), campus location (metropolitan vs. outer metropolitan), age, gender, having a diploma of nursing (yes/no), and secondary school final year 12 (Australian Tertiary Academic Ranking, ATAR) score were

retrieved from the Monash Nursing and Midwifery enrolment records. The ATAR score for mature entry students was calculated the same as the other group and was retrieved from administrative students' records.

The weighted average mark (WAM) was used to measure the students' academic, clinical and overall performances (10). The WAM is calculated based on students' actual marks and the year level of each unit and scored out of 100 (10). The WAM is the average mark students achieve across all completed units in a course, including any failed and repeated units. The total WAM, clinical and academic WAM for each year level, and for the whole course, was calculated for each student. The total WAM as a proxy to overall performance was calculated from the total marks obtained in each unit (10). The WAM for clinical performance was calculated using clinical scores (out of 100) obtained in six units with clinical components (10). For example, if a unit has a 20% clinical component, and the student received 18, the clinical mark would be 90% [(18*100)/20]. To calculate WAM for academic performance, only marks obtained in theoretical units were used (10). For units with clinical components attached to them, the clinical score was deducted from the total marks. For example, if a students' total mark in the same unit was 75, and their score for the clinical component was 18, the academic mark for this unit would be 75–18 = 57. This 57 score is converted to a percentage using this formula: [(57*100)/80] which gives a value of 71.

A clinical portfolio records clinical skills and placement reports. The weighted clinical assessment report utilizes a Bondy scale (11) to allow varying levels of capability to be awarded. The six clinical units have different component percentages attached to placement assessment, including one unit in the first year (20%), three units in the second year (30, 15, and 15%), and three units in the third year (30% each).

A purposeful sample was utilized to recruit participants for our focus group discussion (FGD) by asking BN student representatives at both campuses to advertise the study to year three nursing students *via* the year three-unit Moodle sites (Learning Management System). To recruit participants for our FGD, the study flier was posted on year three-unit Moodle sites (Learning Management System). The students' representatives at both campuses were approached to encourage them to advertise the study to the other year three nursing students they knew. Qualitative data were captured during two, 1-h FGD sessions at metropolitan ($n = 4$) and outer metropolitan ($n = 9$) campuses. All FGDs were conducted by female interviewers, SV and EF, at the metropolitan campus, and by GB and EF at the outer metropolitan campus. None of the interviewers taught into the BN program for these cohorts of students. Students knew that the interviewers are academic members of the Monash Nursing and Midwifery and the Student Academic Support Unit in the Faculty of Medicine, Nursing and Health Sciences. At the start of each focus group, students completed a questionnaire about demographic characteristics and whether they utilized university and/or faculty support services (e.g., Peer Assisted Study Sessions, PASS; Student Academic Support Unit, SASU) (**Supplementary Material**). The FGD was guided by open, semi-structured questions (**Supplementary Material**) to explore final year students' perceptions of factors that influenced academic and clinical performance in both positive and negative ways.

Ethics

The study was approved by the Monash University Human Research Ethics Committee (19337). De-identified data from students' admission and progress records were extracted. The student privacy collection statement allows for the use of the information for research purposes. In addition, we posted a note on one of the Moodle sites of year three nursing students asking them to inform us if they would let us use their demographic, and admission data (e.g., admission qualifications, ATAR score), and all unit scores collected by the University. They were informed that there would be no implications in their personal or academic life for disallowing the use of their data. Informed written consent was obtained for FGD participation which was audio-recorded, and pseudonyms were used for participants.

Data Analysis

All categorical and continuous variables are described using frequencies (percentages) and means (SDs), respectively. The distribution of the WAM and GPA were assessed, with the assumption of linear regression (12), through generating histogram with normal distribution curve. Correlations between Academic performance and clinical performance WAM across year levels were assessed employing person correlation (13). Pearson correlation coefficient and *p*-values are presented as a correlation matrix. We have generated a histogram for all quantitative variables and a normal distribution curve for checking the skewness. Normality was assessed using Kolmogorov-Smirnov test. All the WAM data were found to be normally distributed. Hence, we used parametric tests. We have adopted a complete case analysis protocol and students with missing data were excluded from the analysis.

The univariate association of gender (male vs. female), student cohort (2017 entry vs. 2018 entry), campus (metropolitan vs. outer metropolitan), and admission category (domestic vs. international) with each of the academic, clinical, and overall performance (WAM) scores was assessed through fitting simple linear regression.

Multivariate linear regression modeling was fitted with each of the academic, clinical, and overall performance (WAM) scores with plausible predictors adjusting for all variables (gender, student cohort, campus, admission category, and year 12 results) simultaneously entered in the model. Analyses were performed using IBM SPSS version 26 (IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp). All statistical tests were two-sided and the statistical significance was set at the level of 5%.

The FGD data were transcribed verbatim and independently analyzed by three co-authors focusing on ideas and key concepts that stood out from the FGD data. Manual color coding was used to code each FGD to search for meanings and identify thematic threads and patterns (Braun and Clark, 2006). This initial coding and review were then discussed and validated with the remaining authors and distilled into three main themes presented below with student participants' supportive quotations from the FGD transcripts. The trustworthiness of the data was maintained by

two authors attending each FGD and debriefing directly after to ensure the accuracy of interpretations of what the participants were saying during the FGD.

RESULTS

Quantitative Results

Data from 252 nursing students were used, with 69.8% commencing the course in 2017 and 30.2% in 2018. The mean (SD) age of the students was 21.7 ± 5.4. Student demographics are presented in **Table 1**.

The academic and clinical WAMs of year 2 and 3 students were positively correlated with the total academic WAM and overall WAM. No statistically significant correlation was identified between year 1 academic WAMs with yearly WAMs and overall scores. No correlation was observed between year 1 clinical WAMs and overall scores, however, a statistically significant negative correlation was observed between year 1 clinical WAMs with yearly WAMs (**Table 2**).

Academic ($p = 0.646$), clinical ($p = 0.879$), and overall ($p = 0.610$) WAM were similar between male and female students. Clinical WAM was found to be significantly higher in the 2017 entry in comparison to the 2018 entry ($p < 0.001$). Academic WAM ($p = 0.028$), clinical WAM ($p = 0.02$), and overall WAM ($p = 0.001$) were significantly higher in domestic students in comparison to the international students (**Table 3**).

TABLE 1 | Participant's characteristics.

Characteristics	
Age, years, median (range)	19.5 (18–56)
Age, years, *n* (%)	
18–20	165 (65.7)
21–25	48 (19.1)
26–30	20 (8.0)
>30	18 (7.2)
Gender, *n* (%)	
Female	221 (87.7)
Male	31 (12.3)
Year 12 results, median (range)	73.8 (20.9–98.2)
Student cohort, *n* (%)	
2017 entry*	176 (69.8)
2018 entry	76 (30.2)
Admission category, n (%)	
Domestic	206 (81.7)
International	46 (18.3)
Campus, *n* (%)	
Metropolitan	136 (54.0)
Outer metropolitan	116 (46.0)
Academic total WAM, mean (SD)	73.0 ± 5.0
Clinical total WAM, mean (SD)	88.2 ± 5.1
Overall WAM, mean (SD)	74.8 ± 4.7

BN, Bachelor of Nursing; SD, Standard Deviation; WAM, Weighted Average Mark.
**2017 entry had no previous nursing qualification.*

No significant difference in academic ($p = 0.157$) and overall ($p = 0.128$) WAM was identified between the students of 2017 and 2018 entries. However, clinical WAM was significantly higher in 2017 entry students ($p < 0.001$). The academic ($p = 0.028$), clinical ($p = 0.020$), and overall ($p = 0.001$) WAM appeared significantly higher in domestic students when compared to international students. Between the two campuses,

TABLE 2 | Correlation matrix for yearly and overall WAM of academic and clinical performance.

	Academic year 2	Academic year 3	Academic total	Overall WAM
Academic year 1	0.082	0.140*	0.079	0.024
Academic year 2		0.736***	0.867***	0.886***
Academic year 3			0.833***	0.834***
Academic total				0.991***
	Clinical year 2	**Clinical year 3**	**Clinical total**	**Overall WAM**
Clinical year 1	−0.359***	−0.201**	0.344***	−0.017
Clinical year 2		0.334***	0.705***	0.328***
Clinical year 3			0.473***	0.219**
Clinical total				0.337***

WAM, Weighted Average Mark.
**p < 0.05.*
***p < 0.01.*
****p < 0.001.*

TABLE 3 | Univariate association of academic, clinical and overall performances WAM score using simple linear regression.

		Academic WAM		Clinical WAM		Overall WAM	
	n	**Mean (SD)**	***P*-value**	**Mean (SD)**	***P*-value**	**Mean (SD)**	***P*-value**
Gender							
Male	30	74.4 (5.2)	0.646	88.1 (5.2)	0.879	74.4 (5.1)	0.610
Female	207	74.9 (4.9)		88.2 (5.1)		74.9 (4.6)	
Student cohort							
2017 entry$^{\pi}$	161	74.5 (4.9)	0.157	89.1 (5.1)	<0.001***	74.5 (4.5)	0.128
2018 entry	76	75.5 (5.0)		86.2 (4.6)		75.5 (5.0)	
Campus							
Metropolitan	126	74.4 (4.6)	0.210	87.8 (5.3)	0.198	74.1 (4.8)	0.008**
Outer metropolitan	111	75.3 (5.4)		88.6 (4.9)		75.6 (4.4)	
Admission category							
Domestic	195	75.2 (5.1)	0.028*	88.6 (5.1)	0.020*	75.3 (4.6)	0.001**
International	42	73.3 (4.0)		86.6 (5.1)		72.8 (4.5)	

BN, Bachelor of Nursing; SD, Standard Deviation; WAM, Weighted Average Mark.
** p < 0.05.*
*** p < 0.01.*
****p < 0.001.*
$^{\pi}$ 2017 entry had no previous nursing qualification.

students at the outer metropolitan campus ($p = 0.001$) scored a slightly higher WAM than those at the metropolitan campus.

Three multivariate linear regression models assessed the predictors of students' performance (**Table 4**). Adjusting for all other factors entered in the model, higher year 12 results (β = 0.2, 95% CI.1 to.2); $p < 0.01$) and outer Metropolitan campus (β = 2.0, 95% CI.5 to 3.4; $p = 0.007$) predicted higher academic performance. Conversely, international student status predicted lower academic performance compared to domestic students (β = −2.5, 95% CI −4.8 to −0.2; $p = 0.034$).

For clinical performance, the entry in 2018 (β = −2.7, 95% CI −5.0 to −0.4; $p = 0.024$) and international student status (β = −3.6, 95% CI −5.9 to −1.3; $p = 0.003$) predicted lower clinical performance.

TABLE 4 | Predictors of academic, clinical and overall performances assessed using multivariable linear regression models.

Variables	*n*	β	95% CI	*p*-value
ACADEMIC PERFORMANCE (ACADEMIC WAM AS AN OUTCOME)				
Student cohort				
2017 entry*	161	Reference	-	
2018 entry	76	1.8	−0.4 to 3.9	0.103
Campus				
Metropolitan	126	Reference	-	
Outer metropolitan	111	2.0	0.5 to 3.4	0.007
Admission category				
Domestic	195	Reference	-	
International	42	−2.5	−4.8 to −0.2	0.034
Year 12 results	202	0.2	0.1 to 0.2	<0.001
CLINICAL PERFORMANCE (CLINICAL WAM AS AN OUTCOME)				
Student cohort				
2017 entry	168	Reference	-	
2018 entry	76	−2.7	−5.0 to −0.4	0.024
Campus				
Metropolitan	132	Reference	-	
Outer metropolitan	112	1.0	−0.5 to 2.5	0.203
Admission category				
Domestic	198	Reference	-	
International	46	−3.6	−5.9 to −1.3	0.003
Year 12 results	202	0.1	−0.0 to 0.1	0.160
Total PERFORMANCE (OVERALL WAM AS AN OUTCOME)				
Student cohort				
2017 entry	175	Reference	-	
2018 entry	76	2.4	0.5 to 4.3	0.014
Campus				
Metropolitan	136	Reference	-	
Outer metropolitan	115	2.1	0.8 to 3.4	0.002
Admission category				
Domestic	175	Reference	-	
International	76	−3.2	−5.2 to −1.2	0.002
Year 12 results	202	0.1	0.1 to 0.2	<0.001

**2017 entry had no previous nursing qualification.*

For overall performance, higher year 12 grades (β = 0.1, 95% CI.1 to.2; $p < 0.001$), entry in 2018 (β = −2.4, 95% CI.5 to 4.3; $p = 0.014$), and studying at the outer metropolitan campus (β = 2.1, 95% CI 0.8 to 3.4; $p = 0.002$) predicted higher overall performance. International students demonstrated lowered overall performance compared to domestic students (β = −3.2, 95% CI −5.2 to −1.2; $p = 0.002$).

Characteristics of the FGDs Participants

The majority of FGD participants were aged between 20and 25 years; 10 of the 13 students were female, and three were international students. Nine students completed the 3-year BN and four the 2-year EN entry-level pathway.

Qualitative Themes

The three major themes that influenced the nursing students' academic and clinical performance were comprehensive orientation, formal and informal support structures, and educator qualities.

Comprehensive Orientation

A comprehensive orientation to the university and clinical life was identified as a positive influence on subsequent performance, especially for international students and enrolled nurses. Students highlighted aspects of academic orientation such as navigating the learning management systems (LMS), library tours, referencing handbook, and peer-assisted study sessions (PASS):

> *"It's just the big step up to university ….it's like just to get your bearings and then to practice academic writing and then the Moodle* [LMS] *session and all that sort of stuff just to get your head into it."* (outer Metropolitan FGD (P-FGD).

This introduction to university life fostered students' connections with their peer group and academic staff. This was particularly important for international students acclimatizing to the Australian culture:

> *"Back in the first year I've been to SASU [the Faculty's Student Academic Support Unit] as well. So, it really helped me doing assignment, explain the assignment instructions… So that's really helpful And then I work with English Connect [the University's general English language support service]. So, it pretty much helped me to adapt to Australia, and as well as gain confidence in speaking English Teaching like how to engage with domestic students as well. So that really helped me to make more local friends."* (Metropolitan FGD (C-FGD).

In the clinical environment, overwhelmingly, the most positive influences were feeling welcomed on clinical placement and having clearly stated guidelines about their scope of practice:

> *"… the educator discusses about our scope of practice in the very first day at the orientation, which really benefits. Then we don't have to being a bit scared when I want to take bloods, then I have to page the educator, to double check whether I'm able to doing that or not…"* (C-FGD).

In addition to a comprehensive orientation, insight into clinical performance was enhanced when the university or the health service prioritized formal or informal debriefs following clinical placement too:

> *"Designate a time when you finish your practice, come back to have a debrief. So, you hear that everyone else is going through the same thing."* (P-FGD).

The Interactive Curriculum

The interactive curriculum included simulated clinical learning environment (CLE), workshops; peer-assisted, case-based, and small group learning; mentoring and networking, which fostered students' academic performance. Students enjoyed interprofessional education with other health professionals as a mechanism to address any stereotypes and misconceptions, and build communication skills and professional relationships that prompted self-reflection as future professionals:

> *"… were quite insightful in terms of providing an idea of what the different roles of health professionals have within the health care system itself. And that also got me to think of how I would be approaching different occupations… how I will be talking in approaching different professionals while studying or working."* (C-FGD).

Students found the course materials logically organized, with systems-based foundational topics in the first year, and cumulative knowledge and skills refinement in subsequent years increasing in complexity:

> *"You will still be applying the theory that you learned in first year, you might be in second year learning a bit more complex nursing care and diseases and conditions."* (C-FGD).

Students valued a practice-based approach to learning in the context of "real world" scenarios (e.g., case studies), and the opportunity for interaction with others, such as group work.

Formal and Informal Support Structures

The course integrates various informal and formal support structures, including PASS mentoring:

> "*The content was quite overwhelming for people. They* [PASS tutors] *just really broke it down. You know, just simplified everything for us"* (P-FGD).

The formal peer learning program with final year students supports first-year students in their practical lab sessions:

> *"I was asking the questions with them.… So, it would give me like an insight of what I expected going into the placement, and …my nursing journey will be going on."* (C-FGD).

The clinical support offered to international students by SASU, including simulated role-play, was important in preparing them for clinical placements:

> *"So that really helps me to build up the foundation and build the basis of how placement will work and how* [on] *placement I should communicate."* (C-FGD)

Despite the formal supports, the EN cohort felt that the informal collegial (peer) supports were the most significant factor affecting their academic and clinical performance:

> *"Every single person in this room I've contacted at one point or another. Yeah, I wouldn't have finished this course without a good group of friends.*" (P-FGD).

Educator Qualities

Students reported that supportive nurse educators helped them learn and *get the best marks* (P-FGD) across both the academic and clinical settings. Educator qualities included being approachable, knowledgeable, fun, setting high academic expectations, providing clinically relevant examples, and being available.

> *"We can organize a meet up with one of the educators to actually discuss about that assignment. And that helps to further improve the next assignment that we're going to do. Students would ask questions frequently and would be met with quite quick replies from tutors and lecturers"* (C-FGD).

One student highlighted the impact of having positive role models:

> *"a particular lecturer who was just phenomenal … the way that she taught was just so clear and concise … she really pushed me to want to learn."* (P-FGD).

In contrast, students recounted how unclear assessment tasks, feedback time, and/or inconsistent marking deflated their confidence.

> "*I feel like assignment feedback can tend to be quite vague and general, so maybe something like a comment of 'you were too brief here', but they're not really telling you where"* (C-FGD).

Enhanced clinical performance and learning were dependent on the clinical educators as one student identified that support varied considerably between clinical placement sites:

> *"The support of the educators and the senior nurses on the ward greatly impacted how I did on all my placements. There were some placements where I felt less supported … and then I'd go to another placement where full support was given to students, regular check-ups and positive educator attitude toward students… And I think that one was the placement that I got the best out of all …."* (C-FGD).

For some students their clinical placement resulted in negative learning experiences due to unsupportive behaviors:

> *"But there are …nurses who are in there to get their pay and get out. Yeah, so nasty sometimes…I was the only student who*

didn't end up in the toilets in tears because they've been ridiculed or bullied." (P-FGD).

DISCUSSION

Findings from our mixed methods study highlighted that nursing students with higher secondary school results, a prior EN diploma, or students based on the outer Metropolitan campus achieved a higher total academic performance. Nursing students with a prior EN qualification, or enrolled as international students, had lower academic performances. Our findings support recent studies that have concluded that no single criterion is predictive of academic success in undergraduate nursing programs (14, 15).

Universities traditionally select students based on their year 12 secondary school performance. Our findings support those from studies in Pakistan (16), New Zealand (17), and the USA (18) of a positive predictive validity of secondary school performance with students' academic performance. Conversely, an Australian study (19) found no correlation between secondary school scores and first-year results, although that particular study did not focus on the final course results.

International students in our study scored lower in academic performance when compared to domestic students. While acknowledging the multifaceted nature of academic outcomes, possible explanations for this discrepancy include a lack of familiarity with the Australian education system, English language acculturation (20–22), alongside non-academic, personal, and other contextual factors (23–25).

Similarly, a variety of factors may impact international student performance in the clinical context including knowledge of the Australian health care system, role confusion, and mismatch of expectations between students and clinical staff (25, 26). Cultural issues may also influence performance including differences in cultural values, misunderstanding between students and educators (27–29), and level of assertiveness (30, 31). The use of idiom and slang, the rapid speech and accent of Australian speakers (27, 29, 32), and familiarity with medical terminology, jargon, and language use within specific contexts, such as during a nursing handover (21, 33–35), have also been found to negatively impact on international students' clinical performance.

Clinical supervisors who educate students during clinical placement simultaneously have to provide patient care and constructive learning opportunities which can be impacted by a limited provision of time, reluctance to assign particular tasks, and/or the use of inexperienced preceptors (25). The cultural differences and language backgrounds of the clinical educators or nursing students can also add to this cognitive load, influencing perceptions of challenge and time constraints (27) and may explain why international students scored lower in clinical performance indicators. According to (36), the preceptor (educator) role in the clinical setting also does not consider socio-cultural practice and social learning perspectives, therefore educators' lack of cultural awareness may result in negative assessments of international student behaviors (30, 31). In addition, a term is known as the "halo effect" may lead examiners to focus on first impressions due to differences in accent or minor surface errors in expression, with unsubstantiated extrapolation to a lack of English language proficiency or a lack of knowledge or skills (29).

International students in FGD identified that clear guidelines, expectations, and engagement with accessible, responsive, and empathic educators are central to their academic and clinical performance. Scaffolding and capacity-building aspects of the curriculum, including formal language and targeted academic skills, support, and peer mentoring, were key factors to both their academic and clinical performance success.

Interestingly, this study also found that while ENs performed well academically, they performed less well on clinical placement. This is consistent with recent research that suggests ENs are stressed because they have previous healthcare experience "but then lost this status when becoming a student, resulting in a loss of self-esteem" (37); p. 399 and/or a lack of development of critical thinking, essential for tertiary-level study (37). The ENs transitioning to BN study may also "grapple with their dual identity, have difficulty reconciling their academic and clinical competence, and struggle to assimilate to the academic learning environment" (38); p. 1919. Further research is needed, especially relating to clinical supervisors' perceptions and expectations of ENs compared to BN students whilst on clinical placement. Exploring ENs' transition into BN courses and how it impacts their clinical placement performance also warrants further exploration.

Limitations and Recommendations for Further Research

The participant selection for the two FGD was voluntary; therefore, a limitation of this study is selection bias (39) as the student participants may have had pre-existing positive or negative perceptions of factors that influenced their academic and clinical performance throughout the course. Moreover, quantitative data from one institute was used which might limit the generalizability of the findings. In addition, the sample size could have been larger; however, we have checked assumptions for correlation and regression prior to the analysis, hence the impact of low sample size is less likely. There are also multiple factors not examined in this study that may affect clinical performance (24, 40), including the students' learning preferences (41), personal qualities, age, and outside employment (4). In addition, the students' personal characteristics (e.g., gender, ethnicity) and qualities of academic and clinical examiners themselves (experience in assessing, site effects) can have an impact on clinical and academic performance (6, 42). Clinical performance measured by grades cannot be always translated to clinical competency. Hence, future longitudinal research is needed to assess the relationship between clinical grades and clinical competency.

The quantitative component of this study is based on demographic data, including the enrolment status category (international or domestic), which has inherent limitations (e.g., some students enrolled as domestic students were born overseas).

The international/domestic dichotomy could lead to assumptions about cohort performance that may not be supported. There may also be differences in academic outcomes with international students less likely to withdraw and have a higher GPA than domestic students (43).

Despite the limitations, this study provides valuable insight into the educational needs of our diverse nursing student cohorts. Both international students and ENs are assets to help fill the future nursing workforce shortfall, especially in providing quality patient care outcomes and potentially reducing health discrepancies (28, 40) in the Australian population. Future research should include participants' cultural background, years of study in English, length of residence in Australia, and prior work experience in nursing overseas. Future research could also investigate the educators' experience in assessing students' academic and clinical performance and site-specific factors to ascertain why students in the same course at different campuses scored differently. It would also be interesting to see if other health professions courses have found similar factors influencing students' academic and clinical performance.

CONCLUSION

With the national shortage of nurses imminent, higher education institutions need to create targeted education to support diverse undergraduate nursing cohorts. This is particularly important to ensure enrolled nurses' clinical performance success and international nursing students' academic and clinical performance success. Enhancing nursing courses through a comprehensive orientation, embedding formal and informal support structures, and providing quality academic and clinical educators will ensure all BN students can progressively develop the knowledge, skills, and clinical practice required to sustain the Australian nursing workforce.

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 Monash University Human Research Ethics Committee (19337). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

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

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fmed.2022.793591/full#supplementary-material

Data Sheet 1 | Focus group discussion questionnaire.

Data Sheet 2 | Interview guide.

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Multimodal In-training Examination in an Emergency Medicine Residency Training Program: A Longitudinal Observational Study

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Background: In-training examination (ITE) has been widely adopted as an assessment tool to measure residents' competency. We incorporated different formats of assessments into the emergency medicine (EM) residency training program to form a multimodal, multistation ITE. This study was conducted to examine the cost and effectiveness of its different testing formats.

Methods: We conducted a longitudinal study in a tertiary teaching hospital in Taiwan. Nine EM residents were enrolled and followed for 4 years, and the biannual ITE scores were recorded and analyzed. Each ITE consisted of 8–10 stations and was categorized into four formats: multiple-choice question (MCQ), question and answer (QA), oral examination (OE), and high-fidelity simulation (HFS) formats. The learner satisfaction, validity, reliability, and costs were analyzed.

Results: 486 station scores were recorded during the 4 years. The numbers of MCQ, OE, QA, and HFS stations were 45 (9.26%), 90 (18.5%), 198 (40.7%), and 135 (27.8%), respectively. The overall Cronbach's alpha reached 0.968, indicating good overall internal consistency. The correlation with EM board examination was highest for HFS ($\rho = 0.657$). The average costs of an MCQ station, an OE station, and an HFS station were ∼3, 14, and 21 times that of a QA station.

Conclusions: Multi-dimensional assessment contributes to good reliability. HFS correlates best with the final training exam score but is also the most expensive format among ITEs. Increased testing domains with various formats improve ITE's overall reliability. Program directors must understand each test format's strengths and limitations to bring forth the best combination of exams under the local context.

Keywords: multimodal examination, high-fidelity simulation, in-training examination, emergency medicine, residency training

BACKGROUND

During residency, periodic performance assessments, which facilitate the identification of strengths and weaknesses and help ensure program quality, are essential (1, 2). Various medical specialties have adopted In-training examinations (ITEs) as a powerful and multifunctional assessment tool to measure residents' competency (3–5). Written and oral examinations are the most common test formats adopted in ITEs. They have usually been applied to assess the degree of medical knowledge and clinical skills of the learners. However, oral and written test performance may not directly reflect residents' clinical experience and multitasking abilities, especially relevant for clinical competency in a busy and rushed clinical environment, such as the emergency department (E.D.) (6–8).

Simulations have been used in medical education since the 1960s (9). They have been integrated as a component of curricula emphasizing core competency and communication skills for emergency medicine (EM) residents (10, 11). The use of simulations in assessments has been extensively studied in anesthesiology (12, 13). Simulations can be used to evaluate residents' competency in differential diagnosis, resuscitation, and anesthesiology procedures (14, 15). Simulation-based assessment is also applied to EM residents, evaluating their milestones such as critical care and procedural skills (16). Simulation-based assessments can be formative or summative, and some studies have even supported the use of simulation-based assessments in board certification examinations (17, 18). High-fidelity simulation (HFS), which uses computer-controlled manikins, has been demonstrated to be realistic and effective in medical education (19, 20). The use of HFS in medical education has been reported to be associated with positive learning outcomes, both at the undergraduate and postgraduate levels (21–23). However, the high cost of HFS is a major obstacle to its implementation (24, 25).

There is a lack of literature to compare the different modes of assessments used in the ITEs. Understanding the nature of various assessment methods helps program directors gain a more holistic view of trainers' abilities. This longitudinal study examined the cost and effectiveness of the different testing formats within this multiformat biannual ITE.

METHODS

Study Setting

This study was a retrospective analysis of educational data regularly collected between September 2015 and July 2019. The study site was the E.D. of a tertiary medical center in northern Taiwan with a 3,600-bed capacity and an annual E.D. census of 180,000 patient visits. The study site is one of the largest EM residency programs in Taiwan and accepts 7 to 10 new residents each year. This study was approved by a local institutional review board (I.R.B. No. 202000099B0) and was eligible for a waiver of informed consent.

EM residency training in Taiwan is a 3.5-year program. The program is designed and monitored by the Taiwan Society of Emergency Medicine (TSEM). The training sites are accredited annually by the TSEM according to the Residency Review Committee of the Taiwan Ministry of Health and Welfare guidelines. A complete description of the full residency training program is provided in **Supplementary Table 1**.

Participants and Data Collection

The study enrolled a total of nine residents who were admitted to the EM residency program in 2015. Data from our biannual ITE and final EM board examination results were collected. The Taiwan EM board examination consists of single best answer MCQ test and oral examination stations. Each ITE round contained 8 to 10 stations concerning different topics and skill domains. Each station had one of four formats:

Multiple-choice question (MCQ) written tests: Each MCQ test contained 50 four-item, single-best-answer questions. The time limit was 50 min. The questions were all new, written for each examination by 5 to 10 EM faculty members.

Timed stations with questions and answers (QA): Each ITE had two to three QA stations. No examiners were required at the QA stations. The students rotated through the stations every 10 min. The questions were presented on a computer screen or paper. The topics suitable for this station format were electrocardiogram reading, image reading (radiograph, computed tomography, ultrasound), emergency dermatology, emergency ophthalmology, and emergency obstetrics/gynecology.

Oral examination (OE) stations: Each ITE had two to three OE stations. Within each OE station, one board-certified senior EM faculty member served as the examiner. The examiner examined the learner using prespecified test material and checklists. The OEs may contain several probing questions and were especially suitable for observing the clinical reasoning of residents.

Ultrasound or HFS: Each ITE included one ultrasound simulation and two HFS scenarios. The ultrasound simulation stations contained one rater, one standardized patient, and one teaching ultrasound machine equipped with phased array, curvilinear, and linear transducers. The test usually began with a scenario, and the examiner rated the residents using predefined point-of-care ultrasound checklists. Each HFS contained one rater, two standardized nurses, and one technical assistant. We used either a high-fidelity manikin or standardized patients with make-up. The topics were usually major EM topics such as pediatric emergency, emergency toxicology, medical emergency, and major trauma. The checklists included various competency domains such as communication skills, teamwork, leadership, and system-based practice routines.

Table 1 summarizes the number of stations per ITE, venue and faculty requirements, and topics and competencies tested by each format. Except for the MCQ stations, all stations were video-recorded for retrospective review or analysis. The costs of each format, including the expenses of the drafters of the test, the

Abbreviations: ED, emergency department; EM, emergency medicine; ITE, in-training examination; HFS, high-fidelity simulation; MCQ, multiple-choice question; OE, oral examination; QA, question and answer; TSEM, Taiwan Society of Emergency Medicine.

TABLE 1 | Characteristics of ITE formats.

	Stations per ITE	Venue	Additional faculty or staff per station	Topics included	Clinical competencies
Multiple choice question	1	Ordinary meeting room	1 administrative assistant	All contents related with Emergency Medicine	MK
Oral examinations	2–3	OSCE rooms	1 faculty as the rater	Pediatric emergency Emergency toxicology Medical emergency Disaster medicine Critical care medicine	PC / MK / ICS / SBP
Timed Q&A stations	2–3	OSCE rooms	None	ECG reading Image reading Dermatology (photos) Emergency ophthalmology Emergency OB-GYN	PC / MK
High fidelity simulations	3	Simulation center	1 faculty as the rater 2 standardized nurses 1 technical assistant	Pediatric emergency Emergency toxicology Medical emergency Major traumas	PC / MK / ICS / P / SBP

Core competencies: PC, patient care; MK, medical knowledge; ICS, interpersonal and communication skills; P, professionalism; PBLI, practice-based learning and improvement; SBP, systems-based practice.

raters, the equipment, and the standardized patients or nurses, were also collected and analyzed.

Statistical Analysis

Continuous variables are presented as mean (S.D.) and categorical variables as count and percentage. The reliability of the overall ITE and that of each format were calculated using Cronbach's alpha. The association between a resident's average ITE score and board examination results was evaluated using Pearson's correlation coefficient. Percentile scores of residents in this cohort vs. all residents in the program were evaluated to assess the validity of the training program using the ITE. All statistical analyses were performed using Microsoft Excel 2016 and SAS 9.4 (S.A.S. Institute Inc., Cary, NC).

RESULTS

A total of 486 station scores were recorded during the study period. The numbers of MCQ, OE, QA, and HFS stations were 45 (9.26%), 90 (18.5%), 198 (40.7%), and 135 (27.8%), respectively. The reliability of each format, measured using Cronbach's alpha, was lowest for MCQ (0.444) and highest for QA (0.935). The overall Cronbach's alpha reached 0.968, indicating good overall internal consistency (**Table 2**). The criterion validity, measured as the correlation with EM board examination results, was highest for HFS ($\rho = 0.657$), followed by MCQ ($\rho = 0.634$), QA ($\rho = 0.571$), and OE ($\rho = 0.555$) (**Table 2**).

The progressions of resident ITE percentile scores are illustrated in **Figure 1**. Individual progressions are presented as colored lines, and the average percentile scores of this cohort compared with all the residents in the program are presented as green bars. As displayed in the figure, the average percentile score improved from 18.2% in the first year to 69.5% in the final year, indicating the effectiveness of the training program.

TABLE 2 | Quantitative ITE data: ITE scores, reliability of the format, resident satisfaction with the format, and correlation of scores with board examination results.

	Number of station marks	Cronbach's alpha	Average satisfaction	Correlation with board
Overall	486 (100%)	0.968	4.34 ± 0.78	0.620
Multiple choice question	45 (9.26%)	0.444	4.13 ± 0.77	0.634
Oral examinations	90 (18.5%)	0.846	4.42 ± 0.74	0.555
Timed Q&A stations	198 (40.7%)	0.935	4.30 ± 0.79	0.571
High fidelity simulations	135 (27.8%)	0.899	4.50 ± 0.76	0.657

The average cost of the ITE stratified by format is displayed in **Figure 2**. Setting up QA stations for 1 day costs US$35, on average. The average costs of an MCQ station, an OE station, and an HFS station were ∼3, 14, and 21 times that of a QA station. High learner satisfaction rates were reported from the OE and HFS stations, which both contained interactions with real people.

DISCUSSION

Our study examined the implementation of a multiformat ITE in an EM residency training program and demonstrated its validity and reliability. The average and individual ITE scores improved gradually with seniority. The ITE was also determined to exhibit good overall reliability, with HFS demonstrating the highest reliability. HFS was previously reported to have a reliability of 0.80 to 0.95, which is comparable to our study (26). In our

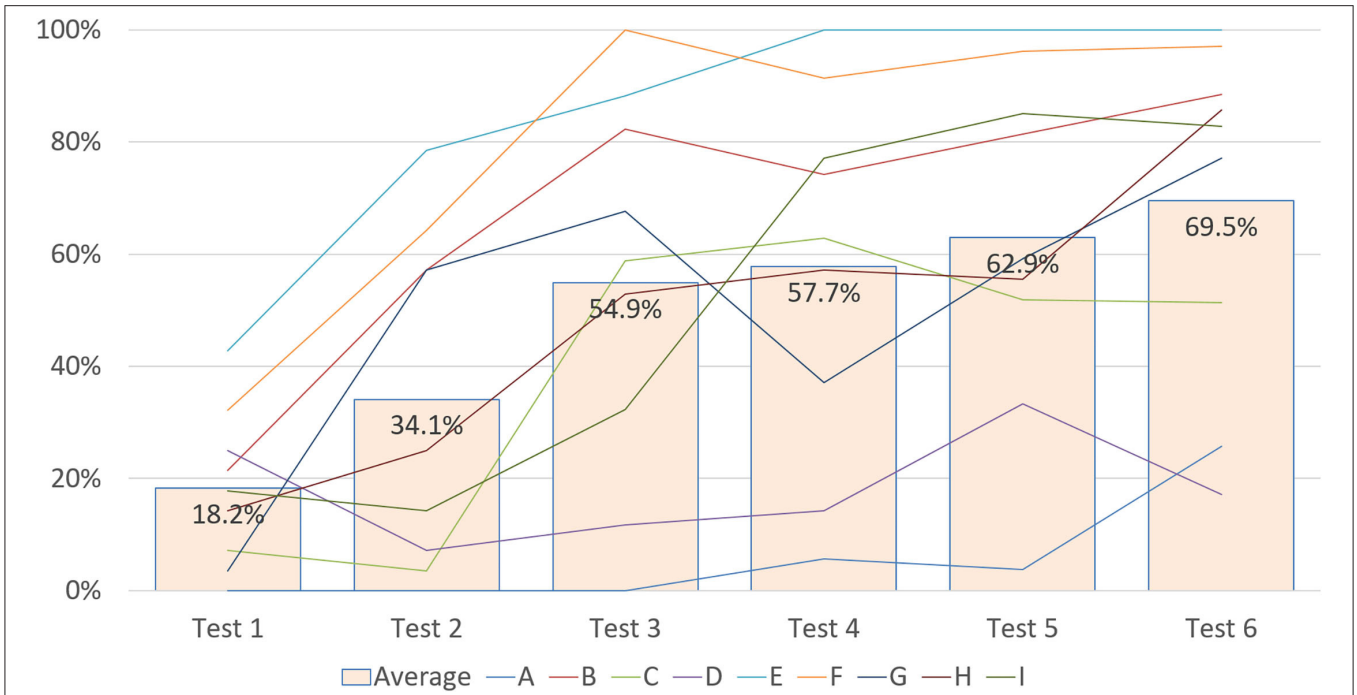

FIGURE 1 | Progressions of individual and aggregate ITE percentile scores. Individual percentile scores are listed from lines A to I; the green bar represents the average percentile score of this cohort compared with all the residents in the program.

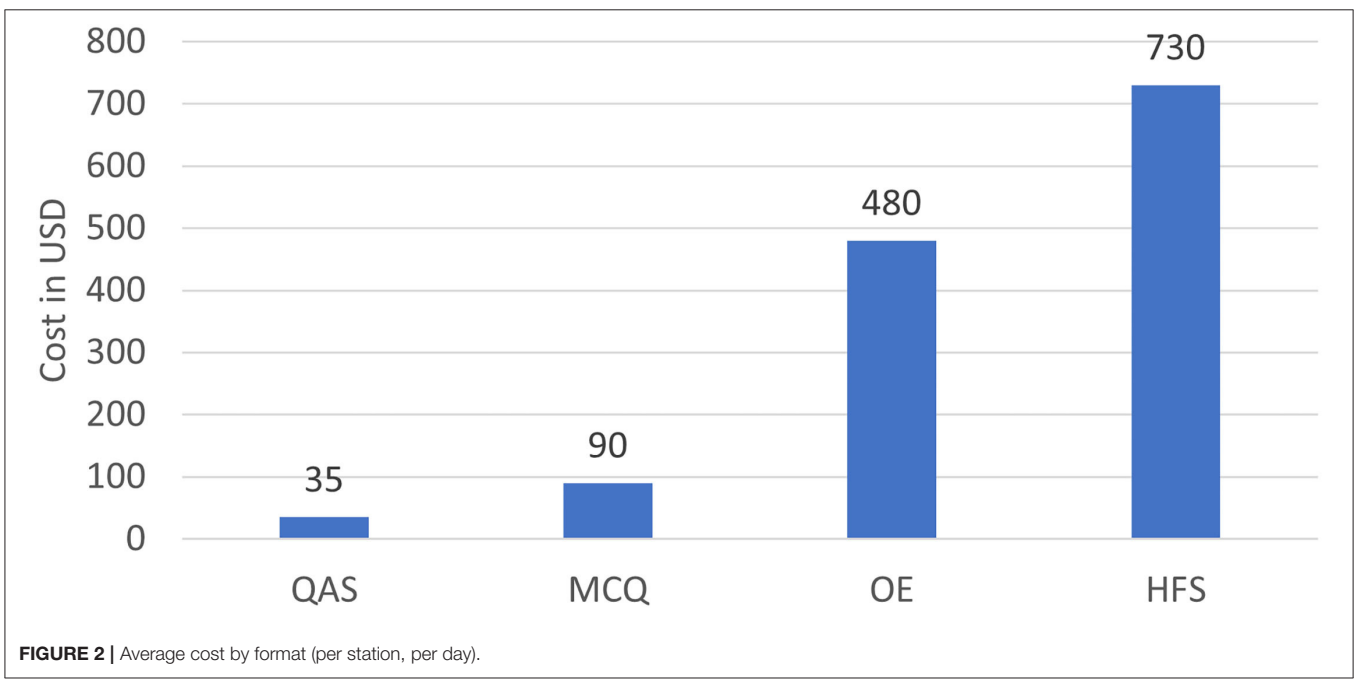

FIGURE 2 | Average cost by format (per station, per day).

ITE, the same rater was deployed to each HFS station. The rater used a structured checklist, thereby improving the objectivity of the scoring process and likely improving the consistency and reliability of the implemented HFS. Furthermore, HFS mimics clinical scenarios; the test content is close to clinical work and assesses residents' comprehensive competencies rather than rote medical knowledge. HFS tests different domains than MCQ, QA, and OE; hence, adding HFS to an ITE can increase the number of domains tested and improve the overall reliability of the ITE.

Medical education is currently oriented toward competency-based training. Training programs are challenged by the need

to introduce appropriate and feasible assessment methods to evaluate the competency of residents. ITEs constitute a common tool used in residency training programs of multiple specialties. However, previous research has reported a poor correlation between ITEs and quantitative markers of clinical ability, such as patients per hour in EM or complication rates in anesthesiology (6, 27). Another study reported that clinical experience before an ITE was not correlated with examination scores (7). Traditional written and oral examinations used in ITEs may not accurately assess resident competency on their own. Simulation-based examinations and HFS have been demonstrated to accurately assess resident competencies across multiple domains (8, 28, 29). Integrating HFS into ITEs can improve the accuracy and efficiency of competency assessments and make them more comprehensive.

ITEs are used as summative assessments and as formative assessments for clinical teachers to know residents' deficiencies (30, 31). For specialty training, passing a board examination is the final outcome of the training program. The correlation between ITEs and board examinations has been studied in previous research, but the results were inconsistent (6, 32–34). Withiam-Leitch and Olawaiye reported that ITEs were weak assessment tools for predicting the probability of residents failing board examinations in obstetrics and gynecology in 2008 (32). Other studies have yielded different results and concluded that ITEs were suitable predictors of board examination scores in several specialties; improvement of ITE scores was also associated with an improvement in the pass rate (6, 33, 34). These diverse results may be attributed to the evolution of the ITE format. ITEs have become more similar to real board examinations, including written and oral examinations. HFS has long been added to the ITEs of our EM residency training program to establish a comprehensive and multifaceted assessment. HFS performance was found to have a higher correlation with board examination scores than performance on other test formats. Several studies have demonstrated that incorporating simulations into ITEs could improve the function of ITEs as a formative assessment and improve resident preparation for board examinations (35, 36). Furthermore, residents reported the highest satisfaction with HFS, and clinical teachers could evaluate learner competencies. Remedial teaching can be used for residents with lower ITE scores to improve their performance (37, 38).

Although HFS can increase the reliability and accuracy of ITEs, the cost of HFS is much higher than that of other test formats (25). Many educators have attempted to develop a low-cost HFS model or balance teaching efficacy and cost (39–41). However, HFS can compensate for the insufficiencies of other test formats; the benefit to learning outcomes is significant. The high cost of HFS engenders budgetary restrictions on how much it can be used in an ITE. Our study demonstrated that the use of HFS for 20 to 25% of an EM ITE can increase the reliability of the assessment and the ability of ITEs to predict board examination results without considerable extra cost. Determining the appropriate percentage of HFS use in ITEs of other specialties may warrant further research.

Limitations

This study involved a single-center design; the results reflect the local situation. The generalizability of the results awaits confirmation from further studies. The detailed items of cost may also differ from country to country and from institution to institution. Furthermore, the study may have had selection bias and inadequate statistical power because of the small sample size. Our study also focused on the EM specialty and EM residents; further research is required to apply the results to other specialties.

CONCLUSIONS

Multi-dimensional assessment contributes to good reliability. High-Fidelity simulation correlates best with final training exam score but is also the most expensive format among ITEs. Increased testing domains with various format improves ITE's overall reliability. Program directors must understand each test format's strengths and limitations to bring forth the best combination of exams under the local context.

AUTHOR'S NOTE

The authors of this article are board-certified EM physicians at Chang Gung Memorial Hospital in Taiwan. Our hospital is the largest EM resident training institution in Taiwan, and the authors are all members of the EM education committee.

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 human participants were reviewed and approved by Chang Gung Medical Foundation Institutional Review Board. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

C-HC conceived, designed the study, performed data acquisition, conducted data analysis, and interpretation. Y-CC provided statistical expertise. S-YC wrote the manuscript draft. PL and C-JN made major revisions to the manuscript. All authors read and approved the final version of the manuscript.

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SUPPLEMENTARY MATERIAL

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OPINION
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Interprofessional Collaboration—Time for a New Theory of Action?

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Keywords: interprofessional collaboration, systems thinking, muddy zone of practice, theory of action, healthcare professions education

INTRODUCTION

Interprofessional collaboration (IPC) is integral to the quality, equity, justice, and safety of healthcare (1–3). Having a diverse group of healthcare professionals engaged in IPC with different backgrounds, insights and perspectives increases the chances of generating unique and innovative solutions to challenges that often arise with regards to care quality in clinical practice. However, there is a long history of shortcomings in IPC that have a deleterious impact on patient safety arising from conflict relating to professional boundaries, license, jurisdiction, and mandate between different healthcare professionals, such as doctors and nurses (4–14). These recurring narratives about the relationships between doctors and nurses, who are in two of the oldest healthcare professions, highlight the challenges that exist in facilitating IPC which achieves the lofty aim of consistently delivering safe, high-quality care to all in a just and equitable manner. Efforts to improve IPC have mainly relied on interprofessional education, learning, or leadership interventions to foster a collegiate and integrated approach to the healthcare in which the contribution of people from different disciplines is valued (15–18). The success of IPC improvement efforts based on interprofessional education, learning, and leadership has been mixed (18–23). The reported variation in the efficacy of different interprofessional education and learning efforts in bringing about IPC may be due to the focus on teaching and upskilling individuals, groups, or teams from different professions with the objective of making them more collaborative. It is worth considering the nature of context in which IPC takes place and some of the factors that are at play which may account of the mixed results of improvement efforts.

HEALTHCARE SYSTEMS, AND IPC

Healthcare is delivered in a pressurized context with a complex adaptive ecology by systems which are inherently fractal and self-similar (24–27). There are also a wide range of psychological, social and individual "human factors" that are at play within complex healthcare systems that influence healthcare professionals' clinical practice and determine the quality of patient care (28–30). Healthcare systems are the product of socio-cultural beliefs, norms, and value ecologies that interact in complex ways, but are manifested explicitly, or tacitly in the behavior of individual actors. Consequently, there are many factors that affect healthcare professionals IPC in clinical practice, which means that IPC improvement efforts need to be cognizant of individual, social and cultural factors that arise due the course of care delivery in different contexts. There are benefits in using a systems-thinking approach to consider why they continue to be many reported challenges relating to IPC and care quality in clinical practice. Systems-thinking or the capacity to analyze systems in their totality is of cardinal importance in healthcare, which is delivered in systems which are complex and concatenated (31–33). Over the last decade, there has been a move

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toward integrating systems-thinking into different facets of healthcare professional education with varying levels of success (31–33). Some of the more recent efforts to integrate systems thinking into medical education have extended to interprofessional education and IPC (34, 35). Efforts to extend systems thinking into healthcare professional education and IPC have at times received a lukewarm reception because of uncertainty about its application, and a mistaken view that it is peripheral to clinical practice (34, 35). Even though there appear to be challenges with regards to the adoption of systems-thinking, it is worth considering how it can inform new ways of thinking about IPC and how it can be addressed.

IPC AS A MUDDY ZONE OF PRACTICE

There are many as aspects of healthcare professional education that are laden with complexity, contingencies, uncertainties, and unintended consequences that are often referred to as "*muddy zones of practice*" (36). Interprofessional collaboration is in many respects a muddy zone of practice in healthcare professional education, which is often cited as a causative or contributory factor to adverse patient safety events and near misses (1–3). The recurring narrative relating to interprofessional collaboration manifests a key characteristic of muddy zones of practice, which often appear to be intractable or resistant to improvement initiatives (36). Veen and Canciolo (36) contend that addressing the complex problems that constitute muddy zones of practice in healthcare professional education require a slow, deliberate, and considered approach which reconsiders prevailing practice in an effort to get a better perspective of the situation in which things are seen more clearly, and can be done in better or more appropriate ways. This exhortation suggests that there is value in a systems-thinking approach which conceptualizes IPC as a muddy zone of practice and considering what can be done to address its concomitant challenges with regards to healthcare professional education and patient care in clinical practice.

TOWARD A NEW THEORY OF ACTION

Given the complex adaptive ecology of healthcare systems, and the plethora of human factors that arise in clinical practice, understanding IPC as a muddy zone of practice points to improvement efforts with a different theory of action. Healthcare is delivered in systems that are incessantly evolving to populations with values, norms and expectations that are constantly shifting. The organization and delivery of healthcare is reliant on healthcare professionals with their own values, beliefs and attitudes which are moderated and influenced by a variety of different socio-cultural factors. In addition, healthcare professionals often belong to a discipline specific community of practice with its own distinct professional identity, license, jurisdiction, and mandate that may be contested by others and give rise to conflict that undermines IPC. Catastrophic failures in healthcare often arise in organizations and systems where there is a dominant culture or mind-set which overlooks alternatives that are inconsistent with the dominant group narrative (37, 38). Considering the environment in which these failures arise, IPC needs to function and be effective in systems where healthcare professionals' practice which is subject to and influenced by the prevailing culture. The culture in any facet of healthcare invariably has people that are consigned or ascribed to in groups, out groups or a subculture (39). Continuing with a systems-thinking mindset and understanding IPC as a muddy zone of practice, a different view of healthcare professionals with the same nature, beliefs, and socio-cultural influences as any other human being points toward a more nuanced theoretically informed approach.

Meaningful change arises when things are understood as they are experienced, and people have a theory of action that reflects their reality and praxis (40). There may be scope then, to develop IPC improvement interventions that better reflect the complex and evolving nature of healthcare. Modern healthcare is not just about treating a condition or managing an illness, but it is about providing people with the treatment that they need and providing them with the knowledge and support that they need to live healthy and fulfilling lives. Given the rapid changes that can arise in societal norms, culture, and the health of populations as evinced by the COVID-19 pandemic; there are many challenges that lie ahead to facilitate IPC that enhances the quality of care. The COVID-19 pandemic has also surfaced the impact that faith and belief have on how people act and behave in relation to healthcare. In Theaetetus, Plato defined knowledge as the intersection of truth and belief where knowledge cannot be claimed if something is true but not believed, or believed but not true (41–43). This assertion gives added credence to the notion that efforts to understand and improve IPC must reflect the reality of patient care as experienced by healthcare professionals so that they not only see and understand its relevance but believe that they have a key role to play in it as part of their responsibility to improve patient care.

In sum, it may be prudent to focus on ensuring that the theory of action that underpins efforts to embed and improve IPC in clinical reflects the vicissitudes of patient care is credible and is believed by the healthcare professionals whose practice it seeks to change. Efforts to improve and embed IPC that enhances patient safety, requires healthcare professionals with an appropriate mindset, skills, attitude, as well as insight or belief to interpret and utilize the evidence at hand appropriately to improve the health and wellbeing of those in their ward with due consideration of their values or preferences.

CONCLUSION

Improving IPC and the quality of healthcare has long been the focus of considerable improvement efforts with varying levels of success. In more recent times, there has been a better understanding of the complexity of healthcare systems and their impact on the behavior and actions of healthcare professionals. Systems-thinking is a useful way of understanding the nature of healthcare systems and designing improvement interventions that reflect the complex ecology of organizational and human factors in clinical practice. While efforts to improve IPC using

approaches informed by systems-thinking have limited success thus far, there is still merit and scope in pursuing this line of endeavor. Reconceptualizing IPC as a muddy zone of practice that requires improvement is consistent with a systems-thinking approach, but points toward a more nuanced theory of action to underpin improvement efforts. Such as theory of action needs to reflect the reality of healthcare professionals from different backgrounds if the objective of improving the quality of patient care is to be achieved. Education fulfills its true emancipatory apogee, or pinnacle, when students and educators collectively develop a dialogical theory of praxis as a community (44). If the quality, safety, justice, and equity of healthcare is to be improved through IPC, then it would be apt for healthcare professions educators to focus on creating IPC landscapes of practice with communities of healthcare professionals, educators, students from different disciplines engaged in an ongoing dialogue and working partnership in which everyone is heard, seen, and valued for their contribution to healthcare. Perhaps then, a shared dialogical theory of meaning and action aligned to a culture of effective IPC can be fostered and flourish within the complex milieu of health care systems. Thus, IPC may one day cease to be a muddy zone of practice in healthcare professionals' education.

AUTHOR CONTRIBUTIONS

The author confirms being the sole contributor of this work and has approved it for publication.

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Changing Professional Behaviors in the Digital World Using the Medical Education e-Professionalism (MEeP) Framework—A Mixed Methods Multicentre Study

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Background: There is increasing evidence on the exponential use of technology-based social media in medical field that has led to a proliferation of unprofessional behaviors in digital realm. Educating, training, and changing the behaviors of healthcare professionals are essential elements to restrain the rising unprofessional incidents. Therefore, this research was designed to determine the impact of an interventional workshop on the medical and dental students in improving their professional behaviors in the digital world using the newly developed medical Education e-Professionalism (MEeP) framework.

Methods: We adopted the Theory of Planned Behavior (TPB) as a benchmark reference which explores constructs intertwined with the mission-based MEeP framework; values (whistleblowing-raising concerns), behaviors (being responsible in the digital world) and identity (reflective practice in the digital world). A multicentre 3-phased mixed-method study was conducted using a pre-workshop survey, an online interventional workshop, and a post-workshop survey. SPSS and NVivo were the tools used for the data analysis.

Results: A total of 130 students registered for workshop out of which 120 completed the pre-workshop survey, 62 joined the workshop and 59 completed the workshop and post-workshop survey. From the *whistleblowing – raising concern* perspective, we found that attitudes and perceived behavioral control had a significant relationship. While for *responsible in digital world* category, attitude and perceived behavioral control had a significant bearing on the intentions. Third, for *reflective practice*, attitude and subjective norms significantly enhanced the intention of participants. A multi layered thematic analysis yielded four overarching themes of attitudes, subjective norms, perceived behavioral control and intentions. Most students showed positive *attitudes* of being

reflective, self-directed, and humane. Students realized the *subjective norms* had made them *conscientious, self-aware and conformative*. While *perceived behavioural control* manifested as identity and *Intentions* were heavily reliant on *self-actualization*.

Conclusion: Our mixed method study found that the interventional workshop using MEeP framework significantly improved attitudes, subjective norms, perceived behavioral control, and intentions. This study provides valuable evidence of MEeP framework evaluation using the theoretical underpinning of TPB by reporting positive changes in professional values, behaviors, and identities of undergraduate medical and dental students.

Keywords: professional values, professional behaviors, professional identity, e-professionalism, digital world, Theory of Planned Behavior

BACKGROUND

Medical professionalism is a multi-faceted construct which tends to foster professional values, behaviors and attitudes among medical students and healthcare professionals (HCPs) (1). The prime goal of medical professionalism remains a high-quality patientcare (2). Despite its sensitive nature and fundamental role in the medical sphere, we have witnessed lapses in medical professionalism which can potentially threaten patients' confidentiality, privacy, autonomy, and other core principles of medical ethics (3, 4). The most commonly reported domains of the lapses in professional behaviors have been rightly grouped into four Is; lapses in involvement, integrity, interaction, and introspection (5). These lapses can be partly attributed to the absence of a standard curriculum of medical professionalism worldwide (6).

Reciprocally, in concordance with the rapidly evolving technology based social networking sites, there is a growing interest in medical e-professionalism, "the behaviors and attitudes reflecting typical professionalism's examples that are manifested through social media" (7). Medical educators and policy makers look at e-professionalism as a crossroad between medical professionalism and social networking (8). Regrettably, there is a plethora of reports about the decay and gross violation of professional behaviors of medical students and physicians in the digital world (9, 10). These include, but are not limited to, unauthorized postings of patients' pictures, physician-patient communication podcasts, vlogs with obvious patient identification, HCPs' partying and drinking alcohol in inappropriate attires, and imparting inaccurate medical information mostly driven by commercial agenda of pharmaceutical companies (11).

Despite an abundance of lapses in e-professionalism in the medical field, little is known about the remedial efforts to rescue the prescribed codes of conduct in the digital world (3). Guraya et al., have recently developed a medical education e-professionalism (MEeP) framework; a mission-based social contract which furnishes essential competencies of e-professionalism for HCPs (12). The core tenet of MEeP framework provides a structured road map for a clear recognition of professional and personal digital space for HCPs in social media while preserving confidentiality, privacy, conscientiousness, accountability. The MEeP framework contains three major constructs of professional values (conformity, benevolence, universalism, and integrity), professional behaviors (communication, tolerance, and power) and professional identity formation (reflective, conscientious, self-directed, and self-actualization).

There is a little evidence about the use of a structured framework for an evaluation of the changes in professional behaviors and attitudes in the medical field. We employed the Theory of Planned Behavior (TPB) which examines a change in intentions by looking into attitudes, subjective norms, and perceived behavioral controls (13). TPB is a social psychological theory which has been widely used to predict human intentions which are precursor of behaviors. As described in TPB, attitudes refer to HCPs overall evaluation of behavior, subjective norms the degree of pressure felt from various organizations and people to act in a certain way, perceived behavioral control the confidence and beliefs of HCPs in their ability to carry out the behavior, while intentions are the extent to which HCPs intend to perform future professional behaviors. Keeping the enormous reach of digital world in mind where a single message/post/tweet can influence the life of millions. Competencies in the professional values construct of MEeP framework can be envisaged as an ability to "raise concerns" in case of any violation or breach of conduct (14). Continuous monitoring of users posts in terms of its nature, form and intent, social networking sites are generating digital algorithms (15). Such hidden manipulations have urged the need to depict responsible digital behaviors. So in the professional behavior construct "being responsible in digital world" was probed. The combination of digital power and manipulation has rendered the "self/identity" vulnerable. To mitigate the risks of this dynamic, intrusive, and manipulative world a reflective practice ensues a buffering effect (16). Therefore, there is a need to measure the intention for being reflective in digital world. In order to evaluate the MEeP framework, in this mixed-method study, we ascertained the changes in professional values, behaviors, and identities of the undergraduate medical and dental students during an interventional workshop.

MATERIALS AND METHODS

In this mixed-method funded research project, we evaluated the MEeP framework in determining the change in professional values (whistleblowing-raising concerns), behaviors (being responsible in digital world) and identity (being reflective in digital world) of the undergraduate medical students of Royal College of Surgeons Ireland (RCSI), Bahrain, Medical University of Bahrain (RCSI-MUB) Bahrain, University Sains Islamic Malaysia (USIM) Malaysia and undergraduate medical and dental students from University of Sharjah (UoS), United Arab Emirates (UAE). This study used an interventional workshop for determining the changes in professional values, behaviors, and identities of the undergraduate medical and dental students of three medical institutions. To achieve this objective, we evaluated these constructs using the concepts of whistleblowing-raising concerns (professional values), being responsible in the digital world (professional behavior) and being reflective in the digital world (professional identity), respectively.

The following research questions were used in our research.

1) Does the MEeP framework improve the understanding of the expected competencies in the digital world?
2) Will the MEeP framework interventional workshop improve the professional attitudes and behaviors of the participants about whistleblowing, reflective practice and being responsible in the digital world using TPB?

Research Design

During August 2021, we conducted our mixed-method study, a pre-workshop survey, an interventional workshop and a post-workshop survey. We replicated a pragmatic study strategy used by Guraya et al. (12) keeping axiology, epistemology and ontological perspectives in mind (17). An email invitation was sent to all undergraduate medical and dental students of RCSI-MUB), USIM, and UoS). The invitation included details of the research study, a participant information leaflet, and a consent form. A unique participant ID was sent only to students who expressed an interest to participate in the research. A week before the workshop, a link was then sent to all registered participants via SurveyMonkey which contained TPB questionnaire (**Appendix I**). The participants who completed the pre-workshop survey received another link containing three pre-recorded lectures about an introduction to e-professionalism, details of the MEeP framework, and information about case scenario learning. Additionally, an invite to participate in the interventional workshop was also included. A 2-h online structured workshop was conducted with the help of trained facilitators. A dedicated facilitators guide and toolkit was prepared along with numerous meetings to standardize the facilitation process A comprehensive plan of the interventional workshop is enclosed in **Appendix II**. Finally, a post-workshop survey was administered using the same TPB questionnaire immediately after the participants had completed the workshop.

Ethical Approval

Approval for the study was obtained from 3 different universities in three different countries.

Royal College of Surgeons Ireland – Bahrain REC **139/25-Mar-2021**

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University Sains Malaysia Research Ethics Committee **(JEPeM) USM/JEPeM/19050291**.

Quantitative Methods

Using a convenient sampling design, we sent an online invitation was sent to all the registered undergraduate medical students across all years in the participating institutions. There are varied recommendation depending upon the research context, we did not stipulate a minimum sample size requirement (18). The quantitative data from pre-and post- workshop surveys was collected and analyzed using the Statistical Package for Social Sciences (SPSS) 24.0 software. We adopted a TPB questionnaire from the study by Medisauskaite et al. (19) (**Appendix I**). The TPB questionnaire collected demographic information of age, gender, ethnicity, place and year of study, and students' previous exposure to professionalism teaching. Attitudes, subjective norms, perceived behavioral control, and intentions were measured on a 7-point Likert scale that ranged from 1 to 7. Higher scores indicated more positive attitudes, norms, perceived controls, and intentions. We measured the internal consistency of the scales of changing professional behaviors in digital world. An internal consistency of the instrument was measured by calculating Cronbach's alpha (cut-off *0.70*) (20)**.**

In the univariate analysis, we used paired sample *t*-test for a comparison of responses to statements in the questionnaires that were administered before and after the workshop. In the descriptive statistics, we reported the mean, standard deviation, minimum and maximum values of scales. In the multivariate analysis, intentions were considered as dependent while attitudes, subjective norms and perceived behavioral control as independent variables. We employed a path analysis based on regression analysis of scales of changing professional behaviors. However, before the path analysis was carried out, we conducted a correlation analysis to ensure a linear relationship between variables to determine the possible chances of multicollinearity. A *p*-value of 0.05 or less was considered as significant. A structural equation modeling (SEM) was performed to assess the interrelations between observable variables in the retrieved data using the Analysis of Moment Structure (AMOS) software to determine the achievement of the minimal requirement of goodness of fit indices: where the acceptable values were considered as comparative fit index (CFI) more than 0.90 (21), goodness of fit index (GFI) more than 0.90 (22), Tucker–Lewis index (TLI) more than 0.90 (23), root mean square of error approximation (RMSEA) <0.80 (24)and Chi-square/degree of freedom (χ^2/df) <3 (25–27).

Intervention

The online interventional workshop consisted of a 2-h structured program using Zoom Video Communications, Inc. The data was collected from small groups (10–12 participants) using structured case-based discussions facilitated by a member of the research team. There were 15 facilitators, who were trained

using the Zoom application, and training included outlining the facilitators' roles in breakout rooms, facilitating a mock session in a breakout room, practicing the functionality of a digital interactive whiteboard: Jamboard-Google and rehearsing how to supervise small group interactive sessions using technology. A comprehensive facilitator's guide was produced and distributed to all facilitators before the start of the training session (**Appendix III**). A trained IT support person was recruited to monitor and to provide technical support during all phases of our research.

During the workshop, in the main meeting room, the principal investigator introduced facilitators to all participants, and briefly described the objectives and perceived outcomes of the workshop. Participants were requested to abide by data privacy regulations and their institutional code of professional conduct. Afterwards, all participants were distributed to breakout rooms where, in the presence of trained facilitators, three to five hypothetical case scenarios were discussed. A total of eight hypothetical cases about the lapses of professional behaviors in the digital world were used to generate discussions and to attain plausible solutions using the MEeP framework as a reference. These cases were developed by all researchers using the three Ps model of Biggs; presage, process, and product (28). The final list of cases was approved after several rounds of reviews and discussions. We took inspiration from GMC and AAMC guidelines while constructing the cases (29–31). **Table 1** illustrates the mapping of competencies and constructs of MEeP framework with the relevant core concepts of the selected eight cases in our study. During the breakout discussions by various groups, the key messages from each case were identified and documented on the Jamboard, a digital interactive whiteboard developed by Google. Later, all breakout room teams reconvened back to the main meeting room and a pre-nominated spokesperson from each team presented the group's key findings. Finally, moderators wrapped up the session and a post-workshop survey link was sent to all participants.

TABLE 1 | Mapping of competencies and constructs of the MEeP framework with eight case scenarios selected the framework evaluation.

No.	Case title	MEeP Framework competencies and constructs
1.	Free speech vs. professionalism	Benevolence (Values)
		Power (Behavior)
		Self-direction (Identity)
2.	The never forgiving digital world!	Communication (Behavior)
		Self-actualization (Identity)
		Reflective (Identity)
3.	A medical student on vacation	Benevolence (Values)
		Integrity (Values)
		Reflective (Identity)
4.	This platform is strictly professional!	Conscientious (Identity)
		Communication (Behavior)
		Self-direction (Identity)
5.	Is anything ever private?	Power (Behavior)
		Self-direction (Identity)
		Self-actualization (Identity)
6.	WhatsApp is a closed space!	Conscientious (Identity)
		Integrity (Values)
		Conformity (Values)
7.	Mr. Google's wise opinion	Benevolence (Values)
		Conscientious (Identity)
		Integrity (Values)
8.	Social media saved my son!	Conscientious (Identity)
		Power (Behavior)
		Universalism (Values)
		Integrity (Values)

Qualitative Methods

Participants were informed in detail of workshop proceedings in the Participant information leaflet. They provided consent to all the audio recordings and anonymous Jamboard contributions analysis. All audio recordings of the workshop were verbatim transcribed by one researcher using Trint software, while the Jamboard data was exported on word document. We followed the thematic analysis approach by Braun and Clarke (32), which contains a six-phase process to capture unique findings from the transcripts. However, the analytical process characteristics of each phase was not confined to that phase rather kept on moving back and forth to ensure a continued and prolonged engagement with the data. The analysis of case discussions focused on identifying TPB and MEeP constructs. In this study, we performed three layers of analysis. First, as a benchmark, we followed a deductive analytical approach for the TPB constructs; second, a deductive approach to analyse the MEeP framework findings; an inductive approach to ascertain unique findings that were not already detected by the deductive approach. All these phases were augmented by revisiting the literature to help inform analysis. Using multiple iterations, sensitized by the TPB constructs and MEeP framework attributes, a thematic analysis framework was developed. The emergent themes generated by merging codes helped us in the identification of patterns. Converging and diverging patterns were identified between two researchers using mind and concept maps. Two researchers SSG and MOH developed and coded scheme by independently analyzing one of the Jamboards and an audio transcript of the breakout rooms. Once the initial framework was agreed upon, the rest of coding was done using the thematic framework with NVivo 12 - QSR international software.

Ensuring Research Rigor

In our research the credibility of information was maintained by combining quantitative and qualitative data (33). Thick descriptors were provided in the detailed methodology section as appendices (questionnaire, workshop structure and facilitator's guide). Despite data collection and analysis are presented in two different sections, we found a significant overlap of concept evolution. TPB and MEeP framework constructs guided the questionnaire selection and case construction. Numerous meetings to discuss the intervention structure, content and flow along with facilitators training sessions added rigor to the

research process. While analyzing data, a constant comparative process was established to avoid over or underrepresentation of the findings ensuring research rigor. A deductive and inductive lens and constant revisiting of data generated some interesting findings in the intentions theme. To triangulate and ratify our results we were mindful of any counter or aberrant evidence indicating the researcher's reflexivity. The originality of raw data was preserved by saving the original Jam boards contents NVivo 12-QSR international software as transcribed files.

RESULTS

Quantitative

An online invitation was sent to all the registered undergraduate medical students across all years in the participating institutions. A total of 130 students registered for the workshop, out of which 120 completed the pre-workshop survey, 62 joined the workshop and 59 completed the workshop and post-workshop survey. The demographic characteristics of 59 participants are shown in **Table 2**. All results reported below are extracted from 59 respondents who completed all phases of the interventional workshop and surveys.

To assess the attrition bias, responses from students who completed questionnaires at pre-post workshop were compared to those who only completed questionnaire in pre-workshop. We did not find significant differences among the responses about demographic variables such as age, gender, college, year of study, and professional behavioral changes. **Table 3** shows the reliability of scales of changing professionalism behaviors variables in our study in post-workshop survey. We found that the Cronbach's alpha (α) values of all scales were greater than the cut-off point 0.70, which indicated the reliability of scales. The results of the univariate analysis of the study using paired sample *t*-test are shown in **Table 4**.

TABLE 2 | Demographic characteristics of our study participants ($n = 59$).

Demographics	No. (%) of participants
Gender	
Male	19 (32)
Female	40 (68)
Level of Study	
Pre-clinical	29 (49)
Clinical	30 (51)
Exposure to professionalism teaching	
Yes	38 (64)
No	21 (36)

TABLE 3 | Questionnaire reliability measure analysis in post-work-shop survey ($n = 59$).

Measures	Scale	Cronbach alpha	No of items
Whistleblowing—Raising concern	Attitudes	0.766	6
	Subjective norms	0.92	11
	Perceived behavioral control	0.739	2
	Intentions	0.803	3
Responsible in the digital world	Attitudes	0.828	8
	Subjective norms	0.959	12
	Perceived behavioral control	0.737	4
	Intentions	0.854	3
Reflective practice	Attitudes	0.873	8
	Subjective norms	0.875	12
	Perceived behavioral control	n/a[a]	1
	Intentions	0.761	3

Cronbach's alpha 0.7–0.79 acceptable, 0.8–0.89 good, 0.9 or higher excellent.
[a]*Cronbach's alpha cannot be calculated for 1-item measures.*

TABLE 4 | A univariate analysis of MEeP domain scores following an online social media professionalism intervention ($n = 59$).

Measures	Scale	Average		Diff	St_Err	t_value	*p*_value
		Post	Pre				
Whistleblowing—Raising concern	Attitudes	5.654	5.095	0.559	0.123	4.550	0.000*
	Subjective norms	4.030	3.978	0.052	0.185	0.300	0.780
	Perceived behavioral control	5.664	5.043	0.621	0.171	3.650	0.001*
	Intentions	4.632	4.285	0.347	0.104	3.336	0.003*
Responsible in digital world	Attitudes	6.244	6.138	0.106	0.103	1.050	0.309
	Subjective norms	4.965	4.205	0.759	0.171	4.439	0.000*
	Perceived behavioral control	5.938	5.230	0.708	0.158	4.481	0.000*
	Intentions	6.551	6.449	0.103	0.101	1.050	0.263
Being reflective in digital world	Attitudes	6.392	5.934	0.458	0.097	4.750	0.000*
	Subjective norms	4.615	3.783	0.832	0.187	4.450	0.000*
	Perceived behavioral control	5.397	5.914	−0.517	0.162	3.191	0.009*
	Intentions	4.620	4.782	−0.161	0.102	1.600	0.118

**p-value < 0.001*
*Variables were scored from 1 to 7 where 7 scored the highest except the statements which were reversely interpreted as shown in **Appendix 1**.*

In the *whistleblowing – raising concerns* perspective, we found that attitude, perceived behavioral control and intention of participants significantly improved in the post-workshop phase. For *responsible in digital world* category, we found that only two scales of subjective norms and perceived behavioral control significantly improved during the post-workshop stage. However, we did not find any difference in *attitude and intentions* of participants. Finally, for *reflective practice*, attitude, subjective norms, and perceived behavioral control of participants improved substantially by the workshop. However, intentions and reflections of students' behaviors remained unchanged during the pre-post workshop. In conclusion, we observed a significant improvement in the students' professional behaviors in the post-workshop analysis as reflected by a higher mean of all scales in the post-workshop survey. Therefore, we further focused on the data of the post-workshop analysis.

Table 5 lays down the results of the correlation analysis of the post-workshop data to examine the possible chances of multicollinearity in our study. We observed that a highest correlation between two independent variables did not exceed the cut-off point 0.70 with no chance of multicollinearity in this data. In **Table 5**, from the *whistleblowing – raising concern* perspective, the participants' attitudes had a positive and significant relationship with intentions ($r = 0.537$, $p < 0.01$). This indicates that a higher value of attitude leads to a greater intention, which ultimately enhances the professional behavior of participants. Likewise, we found that perceived behavioral control had a positive and significant relationship with intentions ($r = 0.361$, $p < 0.01$); a higher value of perceived behavioral control enhances intentions. For *responsible in digital world* category, similar results were reported,; attitudes ($r = 0.605$, $p < 0.01$) and perceived behavioral control ($r = 0.484$, $p < 0.01$) had a positive associations with intentions. In the *reflective practice* category, we found that attitudes ($r = 0.521$, $p < 0.01$) and subjective norms ($r = 0.355$, $p < 0.01$) significantly enhanced the intentions of participants.

Figure 1 shows the path analysis of professional behavioral scales for *whistleblowing – raising* concern. The regression coefficient analysis revealed significant paths between intentions and perceived behavioral control ($\beta = 0.561$, $p < 0.001$) and intentions and attitudes ($\beta = 0.501$, $p < 0.001$). This shows that an increase in the value of attitudes leads to greater intentions which ultimately strengthen professional behavior. We also found significant regression coefficients paths between attitudes and perceived behavioral control ($\beta = 0.561$, $p < 0.001$). However, the path analysis didn't show a significant relationship between subjective norms and intentions, and perceived behavioral control and intentions. **Figure 2** shows similar findings for *being responsible in the digital world*. The regression coefficients showed significant paths between attitudes and intentions ($\beta = 0.493$, $p < 0.001$), and attitudes and perceived behavioral control ($\beta = 0.570$, $p < 0.001$). Finally, **Figure 3** *being reflective in the digital world* reported similar results as regression coefficients carried significant paths between attitudes and intentions ($\beta = 0.612$, $p < 0.001$), and attitudes and perceived behavioral control ($\beta = 0.451$, $p < 0.001$). **Table 6** endorses the goodness of the fit of our study model

TABLE 5 | A correlation analysis of MEeP domain scores following an online social media professionalism intervention ($n = 59$).

Measures	Scale	1	2	3	4	5	6	7	8	9	10	11	12
Whistleblowing—raising concern	1. Attitudes	1											
	2. Subjective norms	−0.133	1										
	3. Perceived behavioral control	0.561**	−0.082	1									
	4. Intentions	0.537**	0.031	0.361**	1								
Being responsible in digital world	5. Attitudes	0.661**	0.032	0.391**	0.389**	1							
	6. Subjective norms	−0.003	0.551**	0.144	0.099	0.239	1						
	7. Perceived behavioral control	0.586**	0.026	0.487**	0.442**	0.587**	0.092	1					
	8. Intentions	0.545**	−0.112	0.534**	0.227	0.605**	0.124	0.484**	1				
Being reflective in digital world	9. Attitudes	0.689**	−0.01	0.405**	0.328*	0.578**	0.18	0.557**	0.639**	1			
	10. Subjective norms	0.068	0.578**	0.139	0.168	0.182	0.490**	0.149	0.097	0.142	1		
	11. Perceived behavioral control	0.269*	−0.122	0.385**	0.026	0.404**	−0.122	0.339**	0.415**	0.415**	−0.168	1	
	12. Intentions	0.516**	0.176	0.120	0.639**	0.513**	0.261*	0.481**	0.152	0.521**	0.355**	−0.078	1

*The correlation coefficient (r) values **$p < 0.01$; *$p < 0.05$, respectively.*

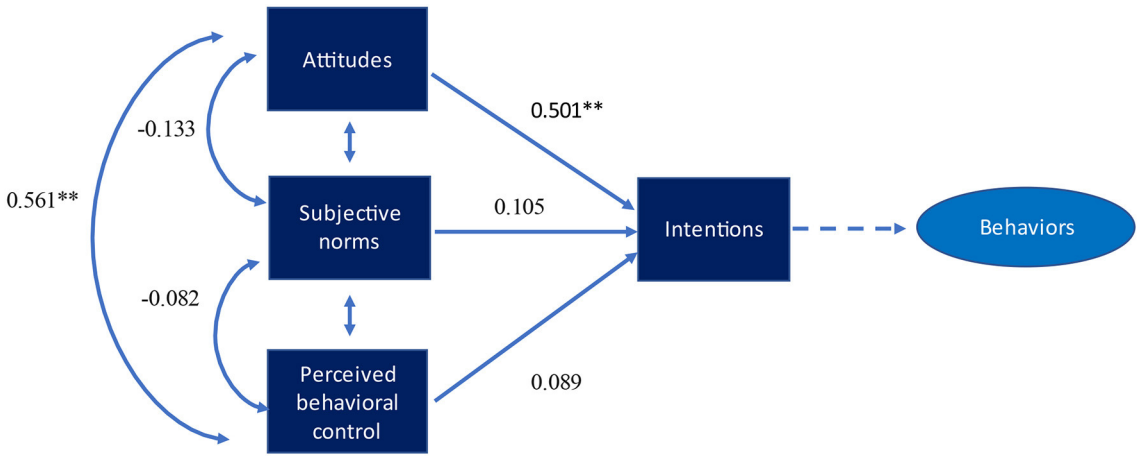

FIGURE 1 | Path model with standardized regression coefficients for whistleblowing—raising concerns in digital world. *$p < 0.05$; **$p < 0.01$.

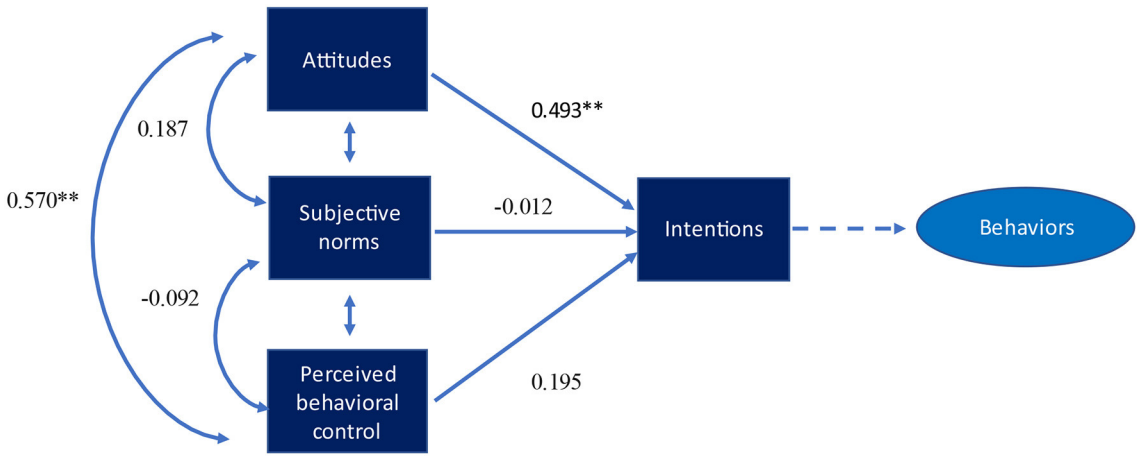

FIGURE 2 | Path model with standardized regression coefficients for being responsible in digital world. *$p < 0.05$; **$p < 0.01$.

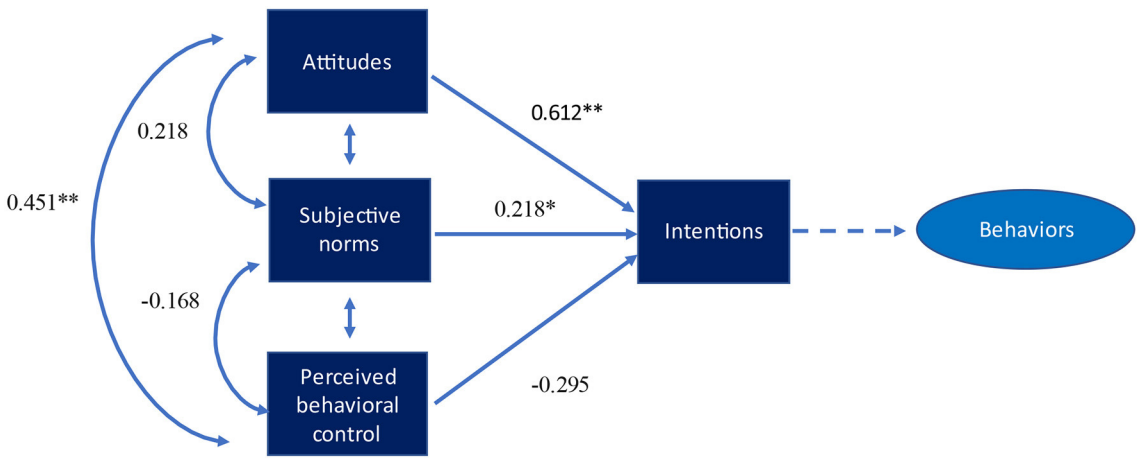

FIGURE 3 | Path model with standardized regression coefficients for being reflective in digital world. *$p < 0.05$; **$p < 0.01$.

TABLE 6 | The goodness of fit indices used to signify model fitness (n=59).

Fit indices	Rule of thumb	Raising concerns	Responsible in digital world	Reflective in digital world
RMSEA	≤0.08	0.06	0.05	0.05
GFI	>0.90	0.92	0.91	0.94
CFI	>0.90	0.97	0.94	0.93
TLI	>0.90	0.93	0.92	0.96
χ^2/df	<3	2.317	2.290	2.471

χ2/df, Chi-square/degree of freedom; RMSEA, root mean square of error approximation; GFI, goodness of fit index; CFI, comparative fit index; NFI, normed fit index; TLI, Tucker–Lewis index.

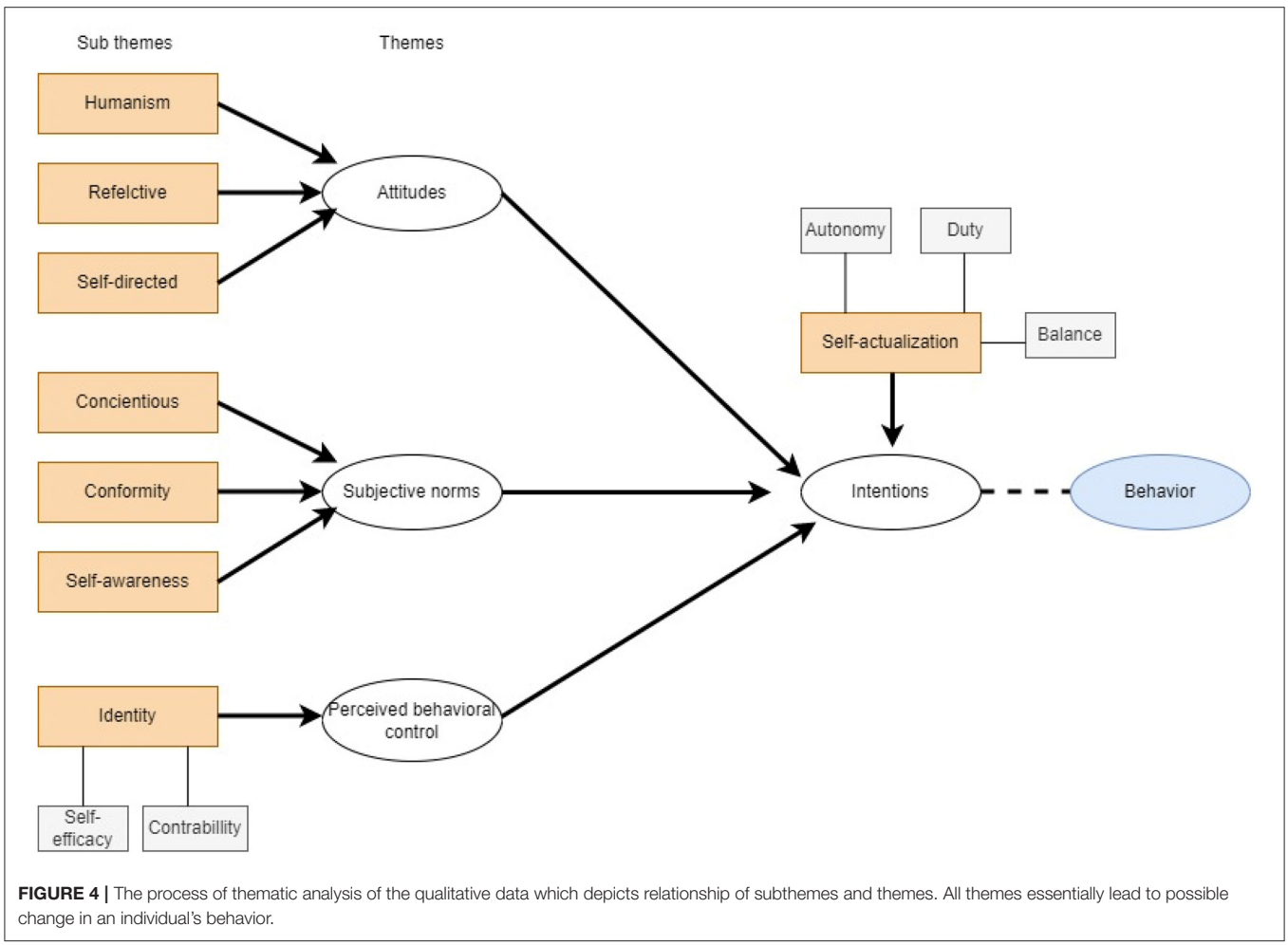

FIGURE 4 | The process of thematic analysis of the qualitative data which depicts relationship of subthemes and themes. All themes essentially lead to possible change in an individual's behavior.

as they exceeded the defined cut point values and validated the findings of our study. We evaluated the path model using several criteria with comparative fit index (CFI) values >0.90 and root mean square error of approximation (RMSEA) values of 0.80 or lower indicating a good fit of the model to the data (34).

Qualitative

According to our suggested propositions of TPB and MEeP framework, our thematic analysis yielded four overarching theme their subthemes. The process of thematic analysis of the qualitative data which depicts relationship of subthemes and themes is shown in **Figure 4**. This intertwining of theoretical and professional frameworks generated a broad canvas of findings as detailed below. The below mentioned part of the manuscript provides a detail of themes along with the most relevant excerpts and their interpretations.

Theme I—Attitudes

Attitude constitutes a crucial determinant to affect behavioral intentions in TPB. If an individual likes a specific behavior, then the intention to conduct such behavior will be high.

We found three subthemes: reflective, self-directed and humanism and most participants showed positive and favorable attitudes toward e-professionalism. The most common subtheme that emerged was being reflective. When asked about the freedom of speech, the participants showed a reflective attitude.

-*"If exercising your free speech could go against this code of conduct given by the institution/hospital you should reflect and re-consider your purposes/goals and behave in an ethical manner"-(Preclinical /RCSI)*

-*"Use your freedom of speech wisely and stay mindful of what you say as something which may seem respectful to you could hurt someone"- (Clinical /RCSI)*

Participants also showed a good understanding of the implications of befriending a patient on social media and how online communication was different from face-to face.

-*"Don't add your patients on social media. You're providing care, you're not there to be their friend. Forming one connection with a patient might open opportunities for more connections"-(Clinical/RCSI)*

-*"The idea of understanding between the poster and reader might be different. It will be the same but have a certain difference that we need to acknowledge such as nonverbal and the other person limitation in bringing the discussion"-(Clinical/USIM)*

Participants also highlighted the importance of keeping a check on their social media posts and online activities. The digital world being devoid of any need for a referee, made the idea of agency and constant self-checking essential determinants in this situation.

-*"You also need self-reflection, because although the physician may have posted something in the past, they still need to reflect back and like we all as physicians should reflect back on what we what we have been doing in the past, because it may reflect the image in the present"-(Clinical/UoS)*

The concept of agency was prominent in the participants' attitudes as they had a clear understanding of the status that healthcare professionals enjoy in society.

-*"Respect the opportunity, privilege and power given to medical students/professional"-(Preclinical/RCSI)*

-*"Physicians have a greater responsibility to get social media skills right and therefore, medical students should begin practicing proper conduct and take it with seriousness"-(Preclinical/USIM)*

A humanistic attitude was identified where participants emphasized the importance of factual accuracy of information posted online. Exponential increase of knowledge has placed another obligation on the users to maintain the information ecosystem for the betterment of society. This humanistic aspect of medicine with such a positive attitude in the digital world was evident among our participants.

-*"Use the social media to contribute the community in the way we spreading the awareness must be universalism so everyone has the right to get treatment and services from the provided doctor"-(Clinical/USIM)*

-*"Reflect and think about the patients' wellbeing and the necessity of sharing the information before doing so"-(Preclinical/RCSI)*

Theme II—Subjective Norms

Subjective norm explains an individual's understanding that most people who are important to him consider that he should or should not perform a behavior. Three subthemes were identified: *conscientiousness, self-awareness and conformity* which explain how these qualities shape the influence of subjective norms. Conscientiousness and self-awareness were dominant traits which described students' perceptions of the people who were essential to them. Once participants understood the overarching concept of mission, they realized that keeping a clean digital track record was as important as knowledge about social media account settings. This reflected their sense of belongings to the profession.

-*"Instead of just fixing your privacy settings, consider removing posts which may be conflicting to avoid future disputes and keep your reputation clean"- (Clinical/RCSI)*

-*"Depending on the patient and their values, different things can be a trigger. We should be considerate to the country we live in and the culture there"-(Clinical/UoS)*

-*"Medical students are held up to a high standard and their behaviours on social media directly reflects on the type of students the medical school grows"-(Clinical/USIM)*

When students grasped the understanding of their mission to be digitally aware, it was evident that they felt the pressure to behave, depict and represent a certain sector of society. It was natural for the individuals to modify their understandings and their online conduct if it was contrary to the group they belonged to. We noticed that when students were given the option to choose a personal vs. professional identity in the digital world, subjective norms played an important role in the real depiction of their identity and a confirmative approach.

-*"We carry the institution image - Healthcare professionals should be mindful that they are ambassadors of their institution. Their behaviour reflects not only on themselves but their place of employment"-(Clinical/UoS)*

-*"We represent a trustful group of society whom we feel safe with. So our picture should be appropriate"-(Clinical/UoS)*

Theme III—Perceived Behavior Controls

Perceived behavioral control is considered to determine behavioral intentions of individuals. Only one subtheme was identified under this main theme. We looked at the data from a self-efficacious and perceived controllability aspect. These two aspects made up the subtheme, identity. We identified the self-efficacy feature of identity as perceived behavioral control which was influenced by recognition of attitude and a control emanating from internal concerns. Such salient internal concerns to one's self concept shape self-identity. Participants showed a clear understanding of communication in the digital world. This self-efficacy was enhanced when clear institutional guidelines and policies were made available to the participants.

-*"Communication becomes risky when it's online because there's a possibility of that information becoming public"-(Preclinical/RCSI)*

-*"Rules need to be set and explained clearly to medical professionals in order to have the freedom and save themselves from serious consequences"-(Clinical/RCSI)*

We sensed that an understanding of true meaning of their identity was an effective driver in the digital world which allowed them to adjust their internal locus of control. Digital world being public, powerful, and permanent exerted that power by which self-regulation shaped the participant's identity. But an inability to maintain that control was also attributed to a peculiar nature of online world.

-*"Yes, however it is increasingly hard since the digital footprint you leave behind can never be erased and it is easier not posting than having to deal with things you post in the future. It's possible if you really limit posting on social media, thereby decreasing your digital footprint"-(Preclinical/RCSI)*

-*"We are much more careful about what we say in real life but when its online, which is impulsive, easy going and nontolerant, we tend to forget that we are breaching others privacy"-(Clinical/RCSI)*

-*"Often people have more confidence over social media because they are hiding behind a screen, so they may be more outspoken on social media"-(Preclinical/USIM)*

An interesting aspect emerged where participants agreed that digital world has led to a context collapse and a clear distinction of personal and professional self was difficult to obtain. This strengthened their self-efficacy to manage their online identities in a conformative manner.

-*"It is close to impossible to separate your personal and professional life online and so due to this, i think it is best to be aware of what you post and think about how that may affect your professional life while still maintaining a private life, yes this is limiting and it is not sustainable, but with today's digital world, there is very little you can hide from the public"-(Preclinical/RCSI)*

Our participants recognized the concept of volitional control, controllability of their image and self-identity. This aspect showed their motivation and their power to control self-image (personal vs. professional). It was also evident that the understanding of mission and a sense of belonging to a particular sector allowed to think them beyond this personal vs. professional self and empowered the participants to shift locus of control in the right direction.

-*"Remember you are a healthcare professional and remember your boundaries"-(Clinical/RCSI)*

Although, external control was rightly understood but still some participants argued that high expectations placed on them as healthcare professionals by the society was not always right.

-*"Judgements are often made about health professionals competence based on their profile, which is not always correct but understandable"-(Clinical/USIM)*

-*"We represent a trustful group of society whom people feel safe with. So our picture should be appropriate"-(Clinical/UoS)*

These findings highlight a general sense of motivation which could be considered as an antecedent of intention. However, there were some remarks which gave insights into the frustration of participants due to societal expectations and how society judge them, indicating an obvious gap between perceived behavioral control and intentions. This brought a tension in the seamless integration of the digitally natives subjects between the online and physical realms. This strengthens the assumption that several behaviors were not completely under one's volitional control. This was more prevalent in preclinical students who struggled to identify a clear line between professional and personal territories.

-*"I don't get the point, just coz we are medical students why should we have a professional looking social media account, isn't fun not allowed? "But this also brings conformity into question. A lot of people will post of social media to fit in with others and be part of a society (e.g., flex culture)."-(Preclinical/RCSI)*

-*"The problem is related to the expectations that the society had set to doctors. We all had lives before becoming doctors, its insane to judge someone for something social media post as such, it just seems really odd to base her judgement on a picture of him rather than his actual practice"-(Preclinical/UoS)*

-*"It's unfair to assume that doctors make no mistakes whatsoever. We are all humans but on the other hand some doctors also have a god complex"-(Preclinical/USIM)*

Theme IV—Intentions

Intention discerns the extent to which a individual intends to carry out the behavior in future. Self-actualization was the main subtheme under intentions. Self-actualization is the ultimate need and one of the motivating elements in the realization of one's own maximum potential. A unique finding from the inductive analysis yielded the process of achieving one's own full potential through balance, duty, integrity, autonomy, and respect of one's desires and wishes, the core tenets of medical profession that help to fulfil the professional responsibilities.

-*"Keep a balance. Stay alert and be focused. Stay true to yourself and your values and be mindful of what your words can do to others be beyond the muddle you can create a public page to share, and you can have a personal page for your leisure time without the public pressure."-(Clinical/UoS)*

-*"We have to self-direct ourselves and think about the cause and effect of my action"-(Clinical/USIM)*

-*"Reflection, accountability and duty should be taken into professional connection in the digital world"-(Clinical/USIM)*

We also noticed how the participants understanding of the "self" evolved and brought forward the concept of singularity of the "digital self" when the mission was understood.

-*"The sooner we realize our mission, our status, the faster we can differentiate what we need to do and avoid in this digital world"-(Clinical/UoS)*

TPB Factors and MEeP Constructs—Data Triangulation

Combining the results from quantitative (survey) with qualitative (Jamboard contributions and breakout rooms recordings) we identified some congruence as well as some significant dissimilarities. Participants who attended the workshop showed a significant improvement in attitudes and subjective norms leading to increased chances of intentions to be digitally professional in the values, behaviors and identity constructs depicted by the path analysis. However, perceived behavioral control did not show a significant positive relationship with the intention. Same pattern crystallized in qualitative findings where perceived behavioral control emerged as identity (self-efficacy and perceived controllability) lacked a control emanating as internal concerns. These concerns were raised due to lack

of concrete guidelines and the distinct nature of digital world. Participants asked for ever dynamic social media specific institutional guidelines. While manipulative, intrusive, and uninhibited nature of digital world makes it difficult to regulate internal locus of control. However, some excerpts spoke loudly than rest about the clear understanding of mission. This aspect also strengthens the Cruess (35) take on professional identity formation. Peripheral participation in community of practices will not strengthen the perceived behavioral control as the subjective norms are not truly understood by the individuals which was a striking dissimilarity in quant-qual results. Intentions will improve only once the self-actualization sets in. For this to ensue, core attributes of MEep framework (integrity, benevolence, tolerance and self-directions) are required. This post-positivist approach strengthened our analyses by mapping the relation from different points of reference.

DISCUSSION

Our mixed method study has evaluated the MEeP framework with its mission-based constructs of professional values, behaviors and identities using the theoretical underpinning of TPB as a benchmark. The interventional workshop using MEeP framework improved attitudes, subjective norms, perceived behavioral control, and intentions. The quantitative data highlighted the participants' intentions to be digitally professional with an improvement in attitude in terms of value (whistleblowing-raising concerns), behavior (being responsible in digital world) and identity (being reflective in digital world) constructs. A significant relationship was found between attitudes and subjective norms, and perceived behavioral control, but a gap was evident when perceived behavioral control and subjective norms couldn't alter their intentions to be digitally professional. This finding was also reflected in the qualitative data where participants showed a positive attitude by showing reflective, self-directed, and humane attributes. Conscientiousness, self-awareness and conformative aptitudes were shaped by subjective norms, while identity formation, controllability and self-efficacy values fell short of achieving self-actualization.

The forthcoming section of the discussion elaborates the key findings of our research with reference to four elements of TPB.

Attitudes

Evidence-based research has eluded that individuals show positive attitudes toward certain behaviors when they strongly perceive a positive outcome by adopting that behavior (36). Likewise, our study has reported a positive impact of attitudes on behavioral intentions to use the social media related services. We have also noticed that the participants believed in reflection as the first step toward the professional identity formation. Reflection is considered as the process of analytical thinking by individuals which may be potentially relatable to their professional practice (37). In our study, we found reflective, self-direction and humanism as three major concepts under professional attitudes. *Reflective* approach is a powerful human characteristic which enriches individuals in appraising and reflecting on their own experiences (38). William Branch has rightly argued that longitudinal educational pedagogies of critical reflection tend to enhance humanistic values with substantial transformative impact on learners (39). Owing to the fluid nature of professional values, behaviors and identities in the digital realm, a robust reflective practice would help steer the HCPs and medical students to develop their own appetite toward e-professionalism. This is a positive finding from our research which articulates well with the basic principles of professional conduct in the digital climate (40).

Self-direction, another fundamental pillar of autonomy, relies on self-regulation (41). Self-direction is closely related to self-actualization, defined by Maslow as "using one's capabilities in the most creative and effective way" (41). Interestingly, the digital world has no reference, and this pitfall intensifies the need of an agency for professional diligence (42, 43). Our interventional workshop underpinned the significance of giving priority to the participants' ability to act as agency. Such empowerment brought context-based results which are extrapolated toward self-efficacy and self-actualization. Our participants preferred self-regulation and self-actualization to empower their beliefs and potentials for managing challenges and obstacles in achieving their targets.

Recently, we have witnessed an exponential growth of the digital contents of biomedical knowledge. HCPs, physicians and medical students have now a generic trend to update, and not to recall, biomedical knowledge from an ubiquitous and digitalized health care repositories (44). Unfortunately, the Internet and especially social media contain a mix of concrete evidence based scientific knowledge as well as unverifiable information. This creates an uncertainty about the accuracy of digital contents which leads to misleading information with its potential adverse consequences (45). As evident in our research, most participants preferred *humanism*, another constituent of attitudes, which may allow them to analyse Internet-based biomedical information using a personalized humanistic perspective. Therefore, a humanistic factor, along with a technology-based approach is essential in accessing accurate biomedical information (46).

Subjective Norms

Subjective norms, "the degree of pressure felt from various aspects to act in a desired manner," can be conveniently divided into two categories: subjective injunctive norm (individual's perceptions) and subjective descriptive norm (behaviors elicited in a social environment) (47). According to Ajzen, in TPB, subjective norms play a pivotal role in altering human behaviors and attitudes (48). In addition, subjective norms can be determined by normative beliefs and by the motivation to accept certain beliefs. Therefore, subjective norms can be related to social identity (49). Our study illustrated a strongly positive correlation between subjective norms and intentions, but only for participants who were willing to develop strong professional relations with peers.

Our research has also demonstrated that subjective norms are substantially associated with the referents' behavioral intentions toward being digitally expert. Such referents include friends, families, and peers. Generally, individuals are keen to get acquaintance with their referents (50). However, in

our study, the participants were unwilling to own a problem due to the perceived associated adverse consequences of increased workload and due to the uncertainty about the existing regulations about the usage of social media. This finding underpins the need for an emphasis on organizational as well as subjective norms in making the individuals aware of personal and professional ownership of roles and responsibilities. Under subjective norms, we found three subthemes of *conscientiousness*, *self-awareness*, and *conformity*. *Conscientiousness* and *self-awareness* encompass personality traits that reflect students' perceptions of the people whom they consider to perform a behavior (51). In our study, the participants considered conscientiousness and self-awareness as sources of inspiration and commitment in decision-making, judgements, and interpersonal engagements.

Conformity pertains to a specific internalized and personalized impression which may include a glimpse of ethical, professional or collegial (52). In an interesting study by Beran et al., the authors have demonstrated that the learners, while performing knee arthrocentesis, would insert a needle into an wrong anatomical location if they had strong reasons to believe that their peers had also inserted a needle into the same site (52). Such phenomenon of conformity reflects the influence of peers and referents on one's performance, behavior, and conduct. Our study has also depicted the impact of conformity as most participants did not want to stand out of the peer group due to either being more compliant to the group or due to the lack of confidence in asserting their opinions during group discussions.

Perceived Behavioral Control

Perceived behavioral controls are the individuals' ability belief to carry out a behavior (53). Under perceived behavioral controls, our study identified *self-efficacy* (pertaining to the ease or difficulty of carrying out a behavior) and *perceived controllability* (the degree to which behavioral conduct depends upon the person performing that behavior). Both subthemes heavily rely on an easy access to the resources essential to perform certain behaviors (54). Self-efficacy and perceived controllability by the participants in our study led them to endorse a crucial role of HCPs and medical students in defining their own digital space in social media. This reflects an appraisal of their self-confidence and the ease of control over their behaviors. Such phenomenon resonates well with the finding that digitally native users of the Internet and social media are self-efficacious and possess a better control over their drive to use technology-based tools in the medical field (55). However, most participants agreed that regulatory guidance on raising a concern would have given them a contextualized support in the digital environment and will increase their self-efficacy.

Intentions

Under intentions, we identified *self-actualization* subtheme which sheds light on subjective experience with a discourse to find out one's own potential (56). Self-actualization contains one's emotions, empathy, interpersonal relations, and the ability to express one's influences and cognitive knowledge (57). From the context of HCPs in the digital realm, medical educators aim at the psychological, professional, and technical profiling of self-actualized medical personnel (58). In our study, we noticed that the participants recognized that self-understanding of their objective sense of digital reality, accepting their own experiences, autonomy and mission had a significant impact on the case scenario analysis.

Study Limitations

Our mixed method study had a small sample size. However, from the viewpoint of a focused and precise aim of the study, a specific sample worked well on the application of an established TPB. Also, data triangulation across methods required matching participants across qaun-qaul designs hence our study ended up in a smaller sample size (59). This brought integrated and intense discussions among the participants and facilitators. Another weakness of our study was the representation the workshop facilitators from a diverse range of clinical and basic sciences in the medical and dental disciplines. While this can be viewed as a strength, a homogenized group of facilitators would have given a more contextualized data. Nevertheless, the reported data meticulously fulfills our research requirements, and this has enabled us to address all research questions. Lastly, an absence of the participants' previous knowledge of e-professionalism was evident. We circumvented this shortcoming by providing pre-recorded lecture on a digital platform, a comprehensive participant information toolkit, and a facilitator guide. This managed to harmonize the knowledge and approach of all stakeholders toward e-professionalism before and during the workshop.

CONCLUSION

This mixed method study has diligently evaluated the MEeP framework using the elements of TPB as a benchmark. The study identified significant improvement in attitudes, subjective norms, perceived behavioral control, and intentions in the pre-post analysis. There was significantly positive relationship between attitudes and subjective norms, attitudes and perceived behavioral control. In contrast, perceived behavioral control and subjective norms failed to change the participants' intentions to be digitally professional. Mostly, there was a positive attitude toward reflection, self-direction, and humane attributes. Though the values of conscientiousness, self-awareness and being conformative were enhanced by subjective norms, the identity formation, controllability, and self-efficacy values could not achieve self-actualization. Our study endorses a successful application of the mission based MEeP framework in enhancing the professional values, behaviors, and identities of undergraduate medical and dentals students.

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 RCSI-MUB REC 139 / 25-Mar-2021 University of Sharjah REC-21-06-03-01 University Sains Malaysia Research Ethics Committee (JEPeM) USM/JEPeM/19050291. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

SSG conceived and drafted the idea, prepared the proposal, developed the content, prepared the relevant appendices, conducted the facilitators training session,and applied for ethical approvals. SSG, FR-D, MY, and SYG contributed substantially to the development of workshop plan. SSG and MH analysed the data and prepared the results. Final draft was prepared by SSG while SYG and FR-D proofread and improved the intellectual content. FR-D, SYG, SF, DH, and MY reviewed the first and final draft. All members underwent multiple and iterative training sessions to unify the workshop process and agreed to take responsibility for the final draft submission. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fmed.2022.846971/full#supplementary-material

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REVIEW
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Virtual Simulation in Undergraduate Medical Education: A Scoping Review of Recent Practice

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Virtual simulation (VS) as an emerging interactive pedagogical strategy has been paid more and more attentions in the undergraduate medical education. Because of the fast development of modern computer simulation technologies, more and more advanced and emerging VS-based instructional practices are constantly increasing to promote medical education in diverse forms. In order to describe an overview of the current trends in VS-based medical teaching and learning, this scoping review presented a worldwide analysis of 92 recently published articles of VS in the undergraduate medical teaching and learning. The results indicated that 98% of included articles were from Europe, North America, and Asia, suggesting a possible inequity in digital medical education. Half (52%) studies reported the immersive virtual reality (VR) application. Evidence for educational effectiveness of VS in medical students' knowledge or skills was sufficient as per Kirkpatrick's model of outcome evaluation. Recently, VS has been widely integrated in surgical procedural training, emergency and pediatric emergency medicine training, teaching of basic medical sciences, medical radiation and imaging, puncture or catheterization training, interprofessional medical education, and other case-based learning experiences. Some challenges, such as accessibility of VS instructional resources, lack of infrastructure, "decoupling" users from reality, as well as how to increase students' motivation and engagement, should be addressed.

Keywords: virtual simulation, virtual reality, undergraduate medical education, simulation-based learning, computer simulation

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INTRODUCTION

As a positive, safe, and valid reality-based educational approach complementing the traditional teaching methods, simulation is increasingly used in the healthcare areas. Especially in the field of undergraduate education as the cornerstone and starting point of training medical professionals, an extensive body of published studies (1–5) have demonstrated that, when the learners act as they would respond under an environment that they believe to be real, simulation-based learning (SBL) experiences are helpful in integrating theoretical knowledge with practice, and gaining skills necessary for independent practice. As defined as "*a dynamic process involving the creation of a hypothetical opportunity that incorporates an authentic representation of reality, facilitates active student engagement, and integrates the complexities of practical and theoretical learning with opportunity for repetition, feedback, evaluation, and reflection*" (6), simulation used

in undergraduate medical education often utilizes goal-based role-plays in the replicated clinical problematic scenarios or case settings in an interactive manner (1–5). Compared with real clinical learning experiences, SBL may be more efficient because the learners intentionally practice skills and higher order thinking. The use of SBL can expose medical students in ethically safe environments without risk of jeopardizing real patients/animals, let them feel safe to make mistakes, and can enhance their confidence while also developing professional knowledge, critical thinking skills, comprehensive decision-making skills, clinical judgment, better clinical preparation, as well as self-efficacy, satisfaction and emotions. Moreover, SBL as a form of education offers repeated practice opportunities especially for less common conditions, and reduces the time consuming to reach professional and clinical competence (1–5). Some previous systematic reviews (4, 7, 8) have shown that medical SBL is effective for the acquisition of clinical skills and contributes to better care of patients. SBL in clinical training such as the use of high-fidelity mannequins, partial task simulators, animal materials or standardized patients, etc. prepares future physicians with communication skills, physical diagnosis, medical interviewing, basic clinical procedures and basic surgical skills in safe and repeated manners, as well as without legal and ethical limits. In pre-clinical undergraduate medical education, the use of SBL serves to reinforce biomedical concepts and other professional knowledge *via* immediate feedback, and introduces low-risk clinical experiential learning amidst a shortage of qualified clinical preceptorships (1). Especially in a resource limited setting, SBL acts as a cost-effective, easily accessible, safe, feasible and promising educational tool that provides more opportunities for medical students to interact with "patients"/"animals" and engage in team work (3, 5). However, multiple factors including the shortages of funding and simulator technologies, the low supply of simulators, the lack of full-time trained staff, the poor motivation and experience limitations of instructors, the time intensive characteristic, etc. have been considered to have negative effects on effective implementation of current simulation-based undergraduate medical education (2, 9, 10).

Driven by the advanced innovations of modern computer and Internet technologies as well as the recent evolution of the medical profession and its teaching dynamics, SBL has conspicuously shifted to virtual platforms, on which simulation-based e-learning is accessible *via* a Web browser, and an upgraded SBL strategy named as virtual simulation (VS) has been produced (11, 12). VS is defined as "*a screen-based simulation where the graphics, sound, and navigation emphasize the three-dimensional (3D) nature of the environment*" (13). The boundaries between the term VS and other technologies such as virtual reality (VR), augmented reality (AR), and virtual standardized patient (VSP), etc. are difficult to define and these terms have been interchangeably used in academic research (13).

During the world wars, VS was initially used in the military area as an aviation training strategy based on a flight simulator. Subsequently, this innovative teaching and learning technological strategy was gainfully applied to more and more technical and workplace training interventions in equipment design, firefighting, law enforcement, lathe operation, vehicle prototyping, crane driving, automotive spray painting, hazard detection, and forestry equipment operation, etc. (9, 12). Sufficient practical learning opportunities are critical for the training of future physicians. However, it is paradoxical that the clinical instructional resources and opportunities for practice are often limited within a university setting due to a large number of undergraduate medical students and finite resources. The positive outcomes of VS in occupational practical training led to its use in undergraduate medical education. Through the re-creation of realistic clinical situations depicted on a computer screen, VS applied in medical teaching based on virtual patients/animals and AR simulations can create an immersive, interactive and risk-free environment for learning practical activities and procedures, thus provide the learners with multiple training possibilities for clinical practices (9, 13). So far, a global interest in VS-based medical teaching programs has been stimulated, and the use of VR, artificial intelligence, machine learning technologies and computer-based serious games is increasingly incorporated into undergraduate medical education practice.

However, because of the fast development of modern computer simulation technologies, more and more advanced and emerging VS teaching instruments, ideas, solutions and practical programs are installed to promote medical education in diverse forms. In order to describe an overview of the current trends in VS-based medical teaching and learning, we here review reports on the practice of using VS tools in medical education at the undergraduate level as documented in recently published literature.

METHODS

In this study, we performed a bibliographic search on the electronic database MEDLINE *via* PubMed using key words "*virtual simulation (VS)* OR *e-simulation* OR *computer simulation* OR *virtual reality (VR)* AND *medical education* OR *medical students*". Only peer-reviewed articles written in English involving undergraduate medical students and fully published online in recent 2 years (between January 2020 and December 2021) were included. The reviews, technical reports or study protocols without the practical outcomes were excluded. Full-texts of articles were obtained, screened, and underwent quality appraisal independently by two researchers then a consensus reached for included papers. Narrative data were extracted from each included article and downloaded into Excel using the categories listed in **Supplementary Tables 1, 2**. Data were thematically analyzed. Based the fact that the included studies are pitching at varied levels of outcome measurement, in order to evaluate the outcomes of VS practices, the Kirkpatrick evaluation model (14) was adopted in the present review to aid to segregate, analyze and present the findings of the included articles. Two independent researchers reviewed and grouped data within four levels of the Kirkpatrick model, which are as follow (14): Assessment of learners' views/satisfaction (Level 1); Change in learners' views or attitudes (Level 2a); Change in learners' knowledge or skills (Level 2b); Change in

learners' behavior/practice (Level 3); Change in organizational practice (Level 4a); Change in benefit to patients/health outcome (Level 4b).

RESULTS

We identified a total of 92 articles reporting the application practice of VS in the undergraduate medical teaching and learning published since 2020 through our search strategy. In **Supplementary Tables 1, 2**, we summarized the study characteristics and main findings of these previous studies in detail. By and large, the annual numbers of related articles published during 2020 and 2021 were evenly split.

Distribution of Included Studies

From the 92 published studies, VS was reported to be applied in the educational practice involving undergraduate medical students across 25 countries including the United States [26 studies (15–40)], the United Kingdom [9 studies (41–49)], Germany [7 studies (50–56)], China [6 studies (10, 57–61)], Denmark [6 studies (62–67)], France [4 studies (68–71)], Japan [4 studies (72–75)], Sweden [3 studies (76–78)], Canada [3 studies (79–81)], Netherlands [3 studies (82–84)], Spain [3 studies (85–87)], Australia [2 studies (88, 89)], Singapore [2 studies (90, 91)], Korea [2 studies (92, 93)], Finland [1 study (94)], Italy [1 study (95)], Ireland [1 study (96)], Colombia [1 study (97)], Pakistan [1 study (98)], Thailand [1 study (99)], Iran [1 study (100)], Poland [1 study (101)], Mexico [1 study (102)], Norway [1 study (103)], Saudi Arabia [1 study (104)], and Switzerland [1 study (105)]. The distribution of included studies among different continents was shown in **Figure 1**. Results showed that nearly half of studies (45%) were from Europe; one third (33%) from North America; 20% from Asia, while none was from Africa.

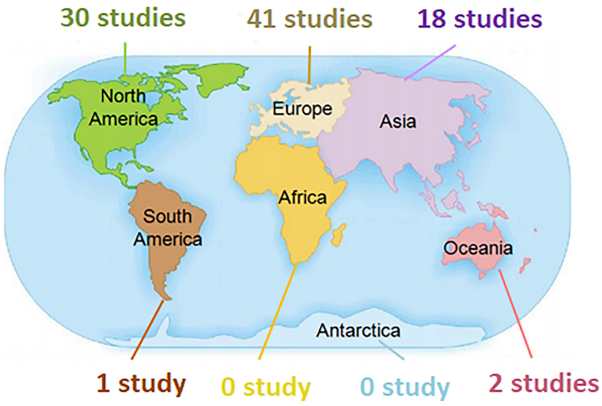

FIGURE 1 | Graph showing the distribution of included studies reporting the use of VS in undergraduate medical education among different continents.

Virtual Simulation Tools Used in Undergraduate Medical Education

Despite the diversification of virtual simulators/platforms/systems used in undergraduate medical education, we found that 48 (52%) studies (18, 22, 23, 27–31, 33–35, 37–39, 42, 44–48, 50, 52, 54, 57–67, 71, 72, 75, 78, 81–84, 93, 96, 99, 101, 103, 105) reported the immersive VR application, which is characterized by the use of VR equipment consisting of head-mounted displays (headsets or goggles) and/or hand controllers. This finding suggested that VR might be a typical and popular representative of modern VS technology used in medical education. Moreover, only one third of (31) articles (15, 16, 22, 26, 31–33, 38, 47, 48, 52, 53, 56, 58, 60–62, 64, 65, 67, 71, 73, 75, 76, 78–80, 95, 96, 101, 105) included in this review were based on the commercially available or free VS softwares/platforms, the rest used the self-developed ones.

Kirkpatrick's Four-Level Evaluation of Included Studies

All the included studies involved the outcome evaluation that can be mapped to Kirkpatrick's four-level model. Using the Kirkpatrick's evaluation model to structure the analysis of evidence from these studies, a lens was afforded for integrating the findings to identify that a vast majority of included studies (67 studies; 73%) evaluated at Level 2b of the Kirkpatrick's model, included the changes in learners' knowledge or skills. In addition, 23 studies included the Kirkpatrick Level 1 evaluation of learner satisfaction, and two studies reported the changes in learners' views or attitudes (Level 2a). No study met the Level 3 (practice change) and Level 4 (health outcome) of Kirkpatrick's model.

These findings suggested that evidence for educational effectiveness of VS in medical students' knowledge or skills was sufficient. There was no study particularly presenting the students' performance change in clinical practice or the possible benefit to patient/health outcome. More pedagogical research might be merited to inform effective evaluation of the effect of VS used in undergraduate medical education on learners' behavior/practice as well as its clinical effectiveness.

Virtual Simulation-Based Learning Contexts and Practical Aspects

In spite of the varied study purposes of included articles, these previous attempts at least open up possibility and suggest potential for VS application in undergraduate medical education. Based on the studies included for review, we summarized that, in the recent 2 years, VS has been integrated in the following learning contexts and practical aspects of undergraduate medical education (**Figure 2**).

Simulation for Surgical Procedural Training

Of the included 92 papers, 38% (35 paper) reported the integration of VS in surgical training for medical undergraduates, among which 12 studies focused on the instructional application of virtual endoscopic [including laparoscopic (31, 36, 37, 56, 73, 76, 78, 98), arthroscopic (26, 47, 48), and otoscopic (53)] simulators; 7 studies were for learning procedures or concepts of orthopedic and bone surgery (32, 33, 35, 45, 57, 66, 70); 5 studies were based on VS system or platform as a primary mode of teaching neurosurgical procedures, neuroanatomy and

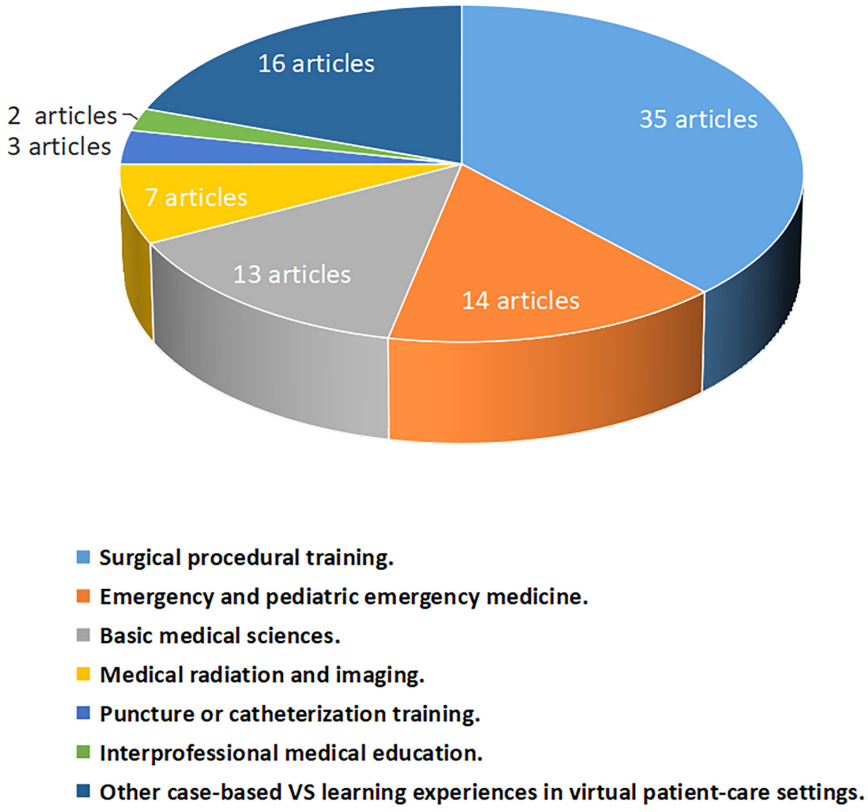

FIGURE 2 | Graph showing the distribution of 92 articles included in this review among learning contexts and practical aspects of undergraduate medical education.

pathologies (22, 28, 71, 80, 81); 4 papers (38, 61, 75, 84) reported the exposure of medical undergraduates as novice surgeons to the robotic surgery simulators; 2 studies conducted by the same team (64, 65) explored the VR simulation-based training in Cochlear Implant surgery; the other 2 were for learning basic motor skills in liver surgery (50, 52); 1 in minimally invasive surgery (97), and 1 in vitreoretinal surgery (67). In addition, Fukuta et al. (46) generated a virtual operating theater orientation to improve knowledge and confidence of medical undergraduates. Except five validation studies of virtual simulators (26, 47, 53, 65, 81) in which the undergraduates acted as the novice group for comparison with the skilled group, the findings of all the other included studies positively supported the usability and its feasibility of integrating VS in surgical training.

As one of crucial links in medical education, competence-based training of surgical skills is important from the undergraduate phase. Sufficient and high-quality training, deliberate practice, as well as mastery of surgical techniques and instruments are imperative for future surgeons. However, the high risks of injury, the slow learning curves, as well as the limited opportunities to practice, etc. are challenging the modern surgical training. Compared with the traditional master-apprentice surgical education, VS-integrated surgical training can provide desirable alternative allowing an active, independent, repeated and safe learning for students to become familiar with procedures, instruments, and equipment before performing surgeries on patients. In particular, VS-based learning has been found to be conducive to the development of complex psychomotor skills, such as hand-eye coordination that endoscopic and robotic surgery sets particular demands on (64, 65, 97). A recently published article conducted by Petersen et al. (67) found no positive skill transfer from basic skills pre-training in a VR vitreoretinal simulator to the procedure-specific modules, suggesting that, compared than spending valuable training time on basic skills VS pre-training, proceeding directly to VS-based training of procedures was more meaningful for learners.

Simulation for Emergency and Pediatric Emergency Medicine Training

The second focus of VS-integrated learning contexts in undergraduate medical education was emergency and pediatric emergency medicine training, with 14 articles (10, 16–18, 29, 30, 34, 39, 51, 55, 68, 79, 93, 101) published recently. Among them, eight studies (10, 16–18, 30, 34, 39, 68) used VS-based teaching in pediatric emergencies. The VS simulators used in these studies were mainly based on virtual patient cases, and simulated the clinical critical events.

Emergencies especially pediatric and neonatal emergencies are relatively rare, but potentially catastrophic. However, the life-saving emergency management skills are difficult to master, and accordingly used uncommonly enough to make skill

acquisition a challenge (18). In order to provide a safe environment for unlimited exposure to rare clinical events and training in high-risk procedures, SBL has long been considered as a cornerstone of emergency medicine training (16).Unfortunately, as a frequent approach to traditional SBL, standardized patients for emergencies especially for pediatric emergencies are not on option. Many available mannequin-type patient simulators cannot fully display the realistic conditions for training and assessment of competency, as well as critical physical examination findings, such as work of breathing and mental status, in clinical emergency events (30). The above studies showed the integration of VS in emergency medicine training provided promising zero-risk training for undergraduates. In particular, seven studies (18, 29, 30, 34, 39, 93, 101) used the VR simulation systems consisting of VR headsets or goggles to realistically and immersively replicate clinical settings and findings, allowing students to deliberately practice and receive vivid feedback on their assessment.

Integration of Virtual Simulation in Teaching of Basic Medical Sciences

As the foundation of medical practice, basic or pre-clinical sciences are considered as the "*core component*" for clinical education. The active and efficient learning experiences in pre-clinical years for in-depth mastery of the basic medical knowledge shape up clinically competent and scientifically grounded physicians (106). Modern pre-clinical curricula lay emphasis on practical-oriented, laboratory-based hands-on training. However, most basic medical curricula are highly information-intensive. Especially facing the reduction of contact hours and limited resources, the use of VS in teaching of basic medical sciences has been paid more and more attentions (106).

We found that, since 2020, there were 13 articles reporting the application of VS for teaching basic medical sciences, including anatomy (23, 42, 44, 49, 59, 60, 69, 72, 82, 104), physiology (92, 94) and pharmacology (19). Obviously, VS-enhanced anatomy training is a focused program as a powerful supplement in conventional anatomy teaching settings. Traditional methods for understanding anatomy include lectures, textbooks, cadaveric dissection, the viewing of prosections, illustrations, photographs, physical models, etc. (42). However, the teaching efficiency may be lacking because of traditional 2D images, as well as limited and expensive cadaver or mannequin resources. As the revolution of anatomy education through digital media, VS has been demonstrated to provide vivid and dynamic imagery that the students can interact with an active learning experience without having to study in an anatomy laboratory (23, 42, 44, 49, 59, 60, 69, 72, 82, 104). Especially for some topics that are challenging to teach because of complex 3D nature, VS-integrated teaching facilitated the 3D spatial perception of anatomy, and helped the students learn more efficiently. Among the included 10 articles reporting VS application in anatomy education, 6 (42, 49, 59, 60, 72, 104) used virtual simulators to help students see the details of muscle and bones; 1 (44) for neuro-anatomy; 1 (23) for cerebrovascular anatomy; and 1 (69) for prostate. The other study conducted by Bogomolova et al. (82) developed a virtual 3D assessment scenario for undergraduate anatomical education. Similarly, the other reports about teaching practices on the use of VS in the pre-clinical phase were in the fields of neurophysiology (94), cardiac physiology (92) and psychopharmacology (19), respectively.

Virtual Simulation-Integrated Learning in Medical Radiation and Imaging

Medical radiation and imaging data such as CT, MRI, and ultrasound are indispensable for the clinical diagnosis. Undergraduate medical education is responsible for pedagogical preparation of medical radiation practitioners. However, being limited by radiation safety reasons, the exposure of medical undergraduates to clinical imaging teaching materials is generally insufficient (88, 96). With the technological development of digital radiographic reconstruction with geometric as well as density characteristic accuracy (107), more and more VS computer software programs have been designed and used in undergraduate medical education, allowing students gain more hands-on experience and develop their clinical skills without worrying about exposing to any unnecessary radiation. In the recent 2 years, we found five studies (20, 85, 86, 88, 96) used VS serious games or systems simulating a radiologist's practice in the real world among medical undergraduates for radiology learning. The results collectively showed that, for medical undergraduates, the integration of VS as a valuable learning resource had the potential to improve preparation for the clinical environment and increase student confidence (20, 85, 86, 88, 96).

The other two studies (58, 62) demonstrated the effectiveness of VR learning integrated in ultrasonography training for improving students' ultrasound skills, and students reported they wanted more VS learning. As the VR educational tool is not as space demanding or as expensive as ultrasound simulators, it could be appealing for medical schools with limited resources for basic ultrasound training (62).

Simulation for Puncture or Catheterization Training

Mastering the skill and procedures of puncture or catheterization is essential across many medical specialties. However, as an invasive operation that may cause patients discomfort and have the risk of complications, puncture or catheterization has been considered as a challenge for medical training (63, 99). In the recent 2 years, three published articles reported the application of VR in VS training among medical undergraduates for lumbar puncture (25), ultrasound-guided peripheral venous catheter placement (63), and endotracheal intubation (99), respectively. The results collectively suggested that, as a teaching method well-received by students, VS training can engage learners, develop their practical competencies and proficiency in performing procedures under safe and controlled environments, facilitate spatial recognition and anatomic visualization, thus enhance medical education and skills training (25, 63, 99).

Offering Opportunity for Quality Interprofessional Medical Education Delivery

As a critical component of modern patient-centered healthcare practices, the interprofessional team–based model of care in

which multiple healthcare professionals including physicians, nurses and pharmacists, etc. work together has been associated with enhanced patient satisfaction and better quality in patient care (108, 109). It has been well-accepted that interprofessional team training should commence at the undergraduate level and continue into clinical practice (91). Simulation-based experiential learning methods represented by role-play have been widely used in undergraduate medical education, and proven to be effective for interprofessional team training (91, 108, 109). Nevertheless, traditional simulation-based interprofessional education in undergraduate stage is confronted with challenges, such as difficulties in getting together different professions of healthcare students as well as the lack of simulation facilities and interprofessional facilitators (90, 91). Importantly, based on its multi-user feature, VS offers an opportunity for healthcare undergraduates from different professions and different institutions to efficiently participate in interprofessional education. In 2020, Liaw et al. (91) reported an integration of computer-based VR into interprofessional team training curriculum among undergraduate medical and nursing students. No difference between virtual and live simulations was found in terms of students' attitudes toward teamwork and communication skill performances, suggesting the potential use of VR to substitute conventional simulation training in interprofessional education. Subsequently, under the background of COVID-19 pandemic, the same study team applied the Internet-based 3D virtual world mimicking the real hospital environment for VS-integrated interprofessional training, and geographically dispersed undergraduate students from six different healthcare professions (medicine, nursing, pharmacy, occupational therapy, physiotherapy, and medical social work) experienced this VS-based learning using their own avatar roles (90). Results also showed that this immersive and realistic VS tool offered opportunity for high-quality interprofessional medical education delivery.

Other Case-Based Virtual Simulation Learning Experiences in Virtual Patient-Care Settings

In addition to the above learning contexts and practical aspects, the remaining 18 articles (15, 21, 24, 27, 40, 41, 43, 54, 73, 77, 83, 87, 89, 95, 100, 102, 103, 105) reported the integration of VS into other case-based learning experiences in virtual patient-care settings. Despite the diversity of virtual patient systems and clinical scenarios, these studies generally showed that VS-integrated case-based learning as a feasible teaching approach (54) could result in students' learning gains, retention of information, and transfer of knowledge to clinical application (89, 95, 100, 102), help future physicians improve diagnostic accuracy thus enhance the clinical reasoning teaching (15, 27, 43), extend students' preparedness level for their future clinical experiences (40, 83), facilitate empathy (24), cultural competence (77) and comprehensive clinical skills such as communication-based skills (21), clinical decision-making skills (78) within undergraduate medical education, and improve students' confidence in managing clinical scenarios (41), thus was highly received by students (89, 95, 105).

Especially during the COVID-19 pandemic, this pedagogical modality avoided training interruption and was highly valued (41, 87, 95, 105). Due to risk of COVID-19 exposure and required social distancing, the students' clinical placements, face-to-face teaching and practical/lab sessions have all been limited even canceled in the pandemic situations, and a sudden and complete disruption in medical education has occurred (15, 16, 106, 110). The restrictions due to COVID-19 raise the need for innovative medical VS teaching methods, which provide educational contents in a learning environment where lecturers and students separated by space or time or both (41). However, the sudden outbreak of COVID-19 poses the difficulties in altering medical training modality during an extremely short period of time. In this situation, VS-based learning that has been widely adopted in medical schools is considered as a prompt turning point in medical education to overcome the educational gap due to COVID-19 (16, 17, 41, 79, 111). Through the application of VS, it is potential to digitally reconstruct the clinical environment, simulate the clinical learning and ensure the continuation of practical examinations, in spite of widely dispersed student or faculty placements (112). After outbreak of COVID-19, De Ponti et al. (95) conducted a questionnaire-based survey among 115 pre-graduated medical students, and showed that 97 students (84%) considered the future use of VS training useful in addition to the traditional apprenticeship at patient's bedside, suggesting medical students' appreciation for the application of VS in post-pandemic medical education. The integration of emergent technology represented by VS into medical curriculum has been considered as an indispensable component of the transformative change and post-COVID undergraduate medical education to keep the medical education on stream (106). Especially in the face of the current ongoing COVID-19 crisis, VS could act as a flexible teaching and learning modality in response to further pandemic waves.

In addition, the students' performance on learning tasks can be well-assessed using VSPs (21), or a computer-based case simulation objective structured clinical examination (OSCE) (87). However, a study (103) compared a fully immersive, interactive, multiplayer VR application in the group self-practice of systematic clinical observation using the airway, breathing, circulation, disability and exposure (ABCDE) approach to the physical equipment, and the results showed that group self-practice of the ABCDE approach in VR application was non-inferior to practice with physical equipment. Therefore, further practice and research on the integration of different virtual patient VS systems in case-based learning experiences under various clinical scenarios might be required to identify the role of VS in undergraduate medical education.

DISCUSSION

This study reviewed the recent practice of VS in the undergraduate medical teaching and learning reporting in 92 articles since 2020. Evidence for educational effectiveness of VS in medical students' knowledge or skills was sufficient

as per Kirkpatrick's model of outcome evaluation. We found that VS was applied in the educational practice involving undergraduate medical students across 25 countries. However, an overwhelming majority of (97%) involved studies were form Europe, North America, and Asia. This regional bias might be due to the uneven distribution of digital medical education resources across the world, which would influence the local medical students' access to education in underdeveloped areas. However, the highly shareable feature of digital resources has been considered to provide an opportunity to address the need for a fair learning system for medical students and promote equity in medical education globally (113, 114). Even in resource limited settings, the application of VS educational systems/platforms could help to promote medical learning by reducing instructor costs and laboratory materials. Along with the advancement and expansion of computer technology, VS has been believed as a less expensive and more accessible alternative for undergraduate medical education, allowing for its wide application in low-and-middle-income countries (85, 115). So far, increased availability and affordability of technology-based commercial platforms, such as Google, Apple, and Microsoft, allow any medical educational institution to share VS resources, or engage in research and development of VS projects to improve their efficiencies within curricula. For example, as an international virtual community with more than 1,500 million square meters allowing tens of thousands of users connected at the same time around the world, *Second Life*[1] created by Linden Laboratories in 2003 has become the most active virtual world in higher education. Currently, hundreds of universities around the world have used it to support teaching and learning activities. As an educational tool, *Second Life* has been dedicated to the training of medical undergraduate students in areas such as radiology (85, 116) and anatomy (86, 115, 117). Therefore, once being promoted to more medical schools around the world, VS learning produces based on platforms such as *Second Life* will help promote greater equity in global medical education. Similarly, the University of Southern California, United States, developed a freeware virtual patient community, the *University of Southern California Standard Patient Studio* platform, with funding from the Department of Defense. This platform allows for the creation of personalized VSP software for different teaching and learning purposes, and has been shared by other US medical schools (19). In addition, a company (Oxford Medical Simulation) is offering a VR medical education platform where undergraduate students can take medical histories, examine, diagnose and treat digitally simulated patients within a virtual clinical environment (118). Nowadays, *Human Patient Simulators and Virtual Reality Laparoscopic Trainers* have been well-developed by manufacturers and are available on the market (119, 120). Therefore, professional teaching materials that were previously limited to certain settings or world-renowned medical schools are now being released on VS-based platforms that can be employed by any user across institutions, areas and countries (121). In China, a profile file-sharing website named the *National Virtual Simulation Experiment Teaching Project Sharing Platform*[2] is readily available with minimal setup and free access, in which the abundant medical VS teaching resources contribute greatly to the nationwide equity in undergraduate medical education. To date (1 October 2021), the VS teaching resources in the areas of pre-clinical and clinical medicine have been visited near 350,000 times. If the language barrier can be overcome, these VS medical teaching materials may be shared by more medical schools around the world.

Lack of infrastructure such as computer hardware and network has been considered as one of major challenges to establishing VS-integrated curricula (90). It has been found that computer self-efficacy might affect the learners' willingness to adopt the VS as part of learning (90). For remote VS experiences, the Internet connection bandwidth could impact the learning experience, and contribute to the technical issues (90). Here, we found the immersive VR approach is the currently popular VS tool used in undergraduate medical education, the application of which was reported in half (52%) involved studies. However, the cost and the provision of satisfactory VR equipment such as head-mounted displays and hand controllers might limit final implementation of VR-integrated educational practice in low- and middle income countries. Some studies (75, 105) showed that, during the VR-simulation, "*visually-induced motion sickness*" shown as nausea, headache, blurred vision, and dizziness might cause a disturbing impact on some learners at the physical level. Moreover, because the headsets and other VR equipment are used communally among undergraduate medical students, it should be necessary to disinfect the VR simulation tools for public use between uses, especially during the COVID-19 pandemic (105). In addition, we found only one third of involved studies used the commercially available or free-accessible VS softwares/platforms for the undergraduate medical teaching and learning. Actually, designing and developing new VS instructional simulators or creating VS educational scenarios require significant inputs of time, funds and effort for educators. Currently, due to the excessive rapid change of VS technology, there are no standardized or well described VS design approaches (13). Continued back-and-forth collaboration among educators, clinicians and engineers in design and development teams is critical to advancing the establishment and implementation of VS-integrated undergraduate medical training (57). It had been estimated that at least 1 year need to be spent to achieve an acceptable VR simulator for medical undergraduates (57). These barriers might provide incentive for educators to centralize VS medical educational resources. However, only through increasing availability and awareness of developed VS instructional tools among larger audiences, individual costs can be shared and the above barriers will be minimized. If possible, freely sharing online VS educational resources may help equalize global medical education.

Recently, VS has been widely integrated in various learning contexts and practical aspects of undergraduate medical

[1]http://secondlife.com/

[2]http://www.ilab-x.com/ (in Chinese).

education, including surgical procedural training, emergency and pediatric emergency medicine training, teaching of basic medical sciences, medical radiation and imaging, puncture or catheterization training, interprofessional medical education, and other case-based learning experiences. Among them, the most focused field of study is the application of VS tools in training of surgical skills; however, more attempts are needed to apply VS in interprofessional medical education and training of puncture/catheter skills. Generally, VS has been well-accepted as a valuable pedagogical approach for undergraduate medical education. Through providing computer-generated immersive learning scenes being highly realistic, diversified, dynamic and customized, VS used in undergraduate medical education offers an opportunity for students to achieve first-person experiences in life-like and complex clinical scenarios that they may not normally be exposed to, or when it is hard to access patients, and makes learning effective and appealing to students. However, content provided on a screen using a digital device might "decouple" users from reality. Hands-on experience is essential for medical students to master clinical skills, for example, surgical techniques. Several previous studies (18, 122) have suggested that improved performance in the VS environment might not always transfer to the clinical setting. Therefore, VS is insufficient to replace hands-on experiential practice for medical students to master clinical skills, which might be another important challenge. The current VS simulators act as only part of the medical comprehensive training to supplement the hands-on experience but not the only training technique. In addition, an interesting study (86) explored the impact of compulsory participation on the VS learning experiences of medical undergraduates. The results showed that the learning performance and acceptance of VS technology were lower with a compulsory participation, and the opinion toward VS-based study was even worse if dropouts were not allowed. Therefore, learning in VS environments should be voluntary (86). And how to increase students' motivation and engagement is an important issue for medical educators to achieve the effective integration of VS into undergraduate education.

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QW and JW substantially contributed to the conception and the design of the work. All authors have contributed to the interpretation of the data and the drafting of the work, they revised several versions of it and have approved the submitted version.

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SUPPLEMENTARY MATERIAL

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Impostor Phenomenon and Its Relationship to Self-Esteem Among Students at an International Medical College in the Middle East: A Cross Sectional Study

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The atmosphere of constant scrutiny of academic ability that prevails in medical colleges may leave some students at risk of expressing feelings of intellectual fraudulence and phoniness. Impostor phenomenon (IP) traits have been associated with anxiety, depression, job dissatisfaction, and poor professional performance. Internationally trained junior doctors exhibit stronger IP feelings than colleagues trained within their own country of citizenship. These feelings may develop during student life. International universities are diverse and complex environments where students may be emersed in a cultural milieu alien to their societies of origin, leading to feelings of isolation. Individuals with IP traits often perceive themselves as the "only one" experiencing this phenomenon, resulting in further isolation and negative self-evaluation, especially among women and underrepresented minorities. IP has also been linked to low self-esteem among students. This study assessed the prevalence of IP and its relationship to self-esteem among students at a campus of a European medical college with a large international student body situated in the Middle East. The self-administered questionnaires: Clance's Impostor Phenomenon Scale (CIPS) and Rosenberg's Self-Esteem Scale (RSES) were completed by 290 medical students (58.3% females). Participants' median (range) age was 19 years (16–35). Students were of 28 different nationalities; the largest proportions were from Gulf Corporation Council (GCC) countries. The prevalence of low self-esteem was 18.6%, while 45.2% of the students demonstrated traits suggestive of IP. There was a strongly negative correlation between CIPS and RSES ($r = -0.71$). No significant gender differences were found in IP. Similarly, no differences in IP were found when comparing between age groups, previous experience in higher education or year of study. Multivariate analysis showed that students from GCC countries had higher levels of self-esteem relative to students from other regions. Low self-esteem was a strong predictor of IP. Country of origin may influence students' self-esteem studying in international university settings.

Keywords: imposter phenomenon, Clance's Imposter Phenomenon Scale, self-esteem, Rosenberg's Self-Esteem Scale, medical education

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INTRODUCTION

Students may perceive medical college as a place where skills, performance, and academic ability come under constant scrutiny. Competitive academic college environments position high-achieving students at risk of developing feelings of intellectual fraudulence and phoniness (1–3). The exhibition of these types of "impostor" characteristics has been associated with negative personality traits (4, 5), as well as anxiety and depression (6, 7). Impostor phenomenon (IP), as described by Clance & Imes in 1978, refers to the widely recognized fear of being exposed as a fraud (7), despite having validated self-achievement. Individuals with impostor feelings consider themselves as having deceived others into believing that they are more intelligent and more capable than they really are (8). They often attribute their accomplishments to luck, fate, personal charm, and attractiveness (9). In the workplace, IP has been associated with poor performance, job dissatisfaction, and burnout in several professions (10), including healthcare (6, 11).

Within student populations, self-esteem has been reported to be a principal precondition (12–14) and predictor of IP (15). Self-esteem being the evaluative dimension of self-knowledge, referring to how a person positively or negatively appraises themselves (16). Good mental health, competence, confidence and productivity all correlate positively with self-esteem (17, 18), whilst feelings of inferiority, sadness, depression, desperation and suicidal ideation are all associated with low self-esteem (19, 20). Individuals with high self-esteem demonstrate an acceptance of themselves as they are, regardless of their strengths and weaknesses. Therefore, they are less vulnerable to pressures to prove their worth (21). Neureiter and Traut-Mattausch investigated psychological barriers to a successful career-development process and suggested that imposter feelings are wrought by low self-esteem and both the fear of failure and the fear of success. The latter being more significant among a qualified workforce rather than among university students (12). This implies that low self-esteem may be predictive of IP at all stages of a skilled-worker's personal and professional development but it has a particular prominence at the undergraduate stage of education and training. Furthermore, a study of students categorized as impostors suffered more significant reductions in self-esteem than non-impostor students following subjective failure on a mid-term exam (15). In contrast, imposters did not differ from non-impostors after subjective success (15). These issues underline the importance of understanding the relationship between self-esteem and imposter feelings among all undergraduate students.

Academic achievement in medicine is attainable by individuals undeterred by IP (22, 23). However, it has been reported that 27.5% of healthcare students experienced IP (1), imposterism has been associated with burnout (8, 11, 24), and the feelings of self-doubt that accompany real and imagined underperformance (25). Insecurities about performance decrease with experience and career progression, but IP fosters feelings of incompetence at different stages across a doctor's career, including early stages of medical studies (24, 25). Admission to medical school is conditional upon students having high academic accomplishments, acting as concrete validation of aptitude. However, the nature and the sheer volume of the material comprising medical curricula may leave some students doubting their own academic abilities.

Experiences of racial discrimination have been associated with IP feelings by evoking a sense of "otherness" and thus reinforcing feelings of intellectual inferiority (5). Exposure to unfamiliar environments may exacerbate this sense of otherness, especially among women and underrepresented minorities (3, 7, 9, 11, 26, 27). The fear of being exposed as an "impostor" is a situational affective response, i.e., the presence or absence of IP is governed by the setting and the circumstance (28). A Canadian study found that foreign-trained residents were more susceptible to IP than graduates from medical colleges in Canada (11), implying that internationally trained doctors may have stronger feelings of IP than colleagues trained within their own country of citizenship. International medical colleges often have culturally diverse student populations. In these environments, individuals may find themselves emersed in a cultural milieu alien to their societies of origin (29), leading to further isolation and increased IP (3, 7, 9, 11, 26, 27).

There is disparity in the educational research literature regarding the strength of the relationship between IP and self-esteem measured in student populations (21, 30, 31). However, the various studies addressing this topic were not conducted among medical students, nor were they conducted in a university situated in the Middle East with a large Arab student body. To our knowledge, there are no published studies reporting upon IP and self-esteem among medical students in a predominantly Arabic speaking country.

We hypothesized that IP would be relatively high among medical students at a campus of an Irish medical college situated in the Middle East and that IP would be strongly predicted by low self-esteem. This study aimed at describing the prevalence of IP and low self-esteem within a medical college and quantifying the relationship between the two. Further, we assessed differences between subgroups of students regarding IP and self-esteem, focusing on gender, Arab/non-Arab, and domestic/international student status.

MATERIALS AND METHODS

Study Design

This cross-sectional descriptive study was conducted in the Bahrain campus of the Royal College of Surgeons in Ireland. Participants were recruited from students enrolled on the 5-year medical program which consists of an integrated curriculum. The first and second years of study predominately focus on pre-clinical themes and are delivered within the college campus setting. From the third year of study until the completion of the course, educational themes are predominately clinical and are taught mainly in the clinical setting. The study included students

Abbreviations: ANOVA, Analysis of variance; CIPS, Clance's Impostor Phenomenon Scale; GCC, Gulf Corporation Council countries; IP, Imposter phenomenon; MANOVA, Multivariate analysis of variance; RSES, Rosenberg's Self-Esteem Scale.

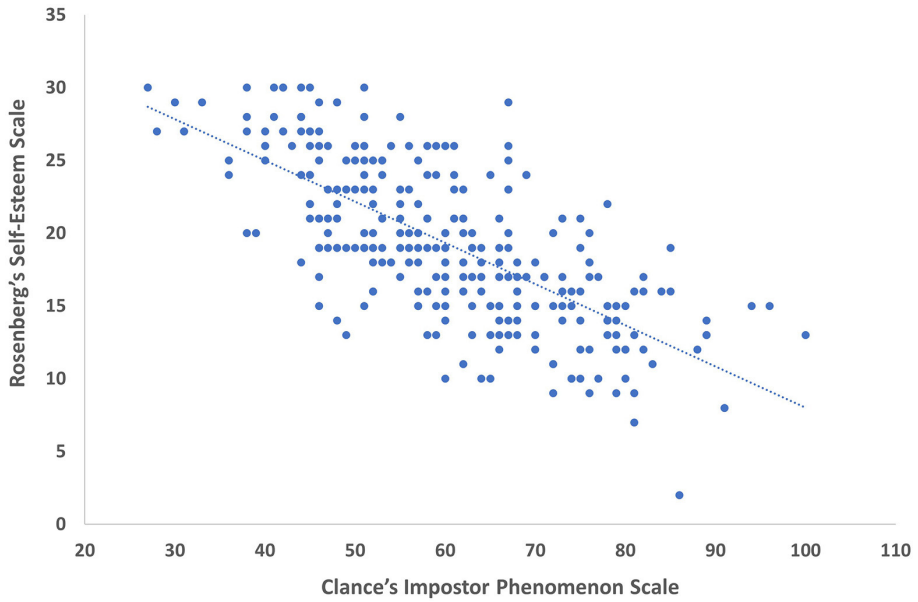

FIGURE 1 | Correlation between student scores for clance impostor phenomenon scale and Rosenberg Self-Esteem Scale.

from all 5-year groups. Recruitment took place before regularly timetabled teaching sessions in the school of medicine during the first semester of the academic year. Blank paper copies of the questionnaires were distributed to students at the beginning of their class and a verbal description of the research study was provided by one of the investigators. Students returned the completed questionnaire immediately after class.

Participants

There were 770 students enrolled in the medical degree program spanning across 5-year groups (first to fifth year of study). There were approximately 154 students in each year group. Convenience sampling was used to approach students attending teaching activities that took place on the college campus. Students attending clinical teaching sessions outside of the campus were not approached. A total of 360 students were approached and received copies of the questionnaires. These were distributed at the beginning of a teaching activity. Of these 360 questionnaires, 295 were returned for a total response rate of 82%. Five questionnaires were handed back with incomplete responses giving a final number of analyzed questionnaires of 290. The median (range) age of participants was 19 years (1, 16–34). There were 119 males (41.0%), and 169 females (58.3%) spread over the first to fifth year of study groups. Six (2.1%) of the participants were married and 34 (11.7%) had obtained a degree before joining the medical program (**Table 1**). Students were of 28 different nationalities. The largest proportion of students were citizens of Bahrain, these were considered "domestic" students and all others were considered "international" students. The nationalities of the international students were grouped into three broad categories: Gulf Corporation Council (GCC) nationalities (i.e., Bahrain, Kuwait, Oman, Saudi Arabia and the United Arab Emirates), North American (Canada and USA) and others (Australia, Bangladesh, Egypt, France, Ghana, Iceland, Ireland, India, Italy, Jordan, Libya, Morocco, Pakistan, Palestine, South Africa, Spain, Syria, Iraq, UK, and Yemen).

No incentive for participation was provided. Participation was voluntary and written informed consent was collected from all participants before enrolment onto the study. The study was approved by Research Ethics Committee of RCSI Bahrain (reference: approval letter dated, October 22, 2019).

Measures

Self-administered questionnaires of the Clance's Impostor Phenomenon Scale (CIPS) and Rosenberg Self-Esteem Scale (RSES) were used for this study. The two different tools were combined into one sheet and distributed together as a single questionnaire. The English version of both surveys was used.

Characteristics of the impostor phenomenon were assessed using CIPS (32). This survey consists of 20 items that each individual participant rates on a 5-point Likert scale (1; not at all true, 2; rarely true, 3; sometimes true, 4; often true, 5; very true). This results in a total score ranging from 20 to 100. The higher the score the more severe the manifestation of IP. A cut-off value of <63 was used to define an individual as an impostor (1, 3, 33). The CIPS has been reported to have a high internal reliability with Cronbach's α of 0.92 (33), and 0.96 (32). The current study gave a Cronbach's alpha coefficient of 0.87.

Self-esteem was assessed using RSES. This is a 10-item questionnaire, each having a 4- point Likert scale (0; strongly agree, 1; agree, 2; disagree, 3; strongly disagree). The total scoring ranges from 0 to 30 (34). The higher the score the more self-esteem the individual has. A cut-off value of <16 was used to define an individual as having low self-esteem. RSES has

TABLE 1 | Participant and year of study group demographics.

Year of study	Pre-Clinical		Clinical		
	First *N* (%)	Second *N* (%)	Third *N* (%)	Fourth *N* (%)	Fifth *N* (%)
Gender					
Male	27 (56.2)	19 (30.1)	18 (56.2)	35 (41.2)	20 (33.3)
Female	21 (43.8)	44 (69.8)	14 (43.8)	50 (58.8)	40 (66.6)
Not reported = 2					
Age					
<21 years old	43 (87.8)	46 (73.0)	18 (56.2)	31 (36.5)	7 (11.9)
>21 years old	6 (12.2)	17 (27.0)	14 (43.8)	54 (63.5)	52 (88.1)
Not reported = 2					
Marital status					
Unmarried	47 (100)	62 (100)	31 (96.9)	79 (96.3)	58 (96.7)
Married	0 (0)	0 (0)	1 (3.1)	3 (3.7)	2 (3.3)
Not reported = 7					
Previous education					
No degree	40 (85.1)	47 (74.6)	24 (8)	80 (97.6)	57 (95.0)
Degree	7 (14.9)	16 (25.4)	6 (2)	2 (2.4)	3 (5.0)
Not reported = 8					
Domestic or international					
Domestic	18 (36.7)	30 (48.4)	9 (28.1)	48 (57.1)	25 (41.7)
International	31 (63.3)	32 (51.6)	23 (71.9)	36 (42.9)	35 (58.3)
Not reported = 3					
Geographical region					
GCC	26 (53.1)	34 (54.8)	13 (40.6)	58 (69.0)	35 (58.3)
North America	6 (12.2)	12 (19.4)	10 (31.3)	7 (8.3)	9 (15.0)
Others	17 (34.7)	16 (25.8)	9 (28.1)	19 (22.6)	16 (26.7)
Not reported = 3					

reported Cronbach alpha coefficients ranging from 0.87 to 0.92 for American college students (34). The current study gave a Cronbach's alpha coefficient of 0.86.

Analysis

Returned completed questionnaires were coded with a specific sequential number. Data from each questionnaire returned was entered on to SPSS software package (IBM Corp. Released 2020. IBM SPSS Statistics for Windows, Version 27.0. Armonk, NY: IBM Corp). Descriptive statistics (mean, standard deviation, frequency, and percentage) were used to summarize data. Pearson Correlation was used to relate CIPS to RSES. Chi-squared test was used to risk of high CIPS as predicted by low RSES. Mean CIPS and mean RSES between variables were compared using *t*-test or ANOVA where appropriate. Median CIPS and RSES were compared for married and single groups using Mann-Whitney U test. Multivariate analysis (MANOVA) was used to predict demographic and personal variables affecting IP and self-esteem. The reliability of CIPS and RSES was assessed using Cronbach's alpha coefficient with a value of 0.70 or above considered as indicative of acceptable reliability. The statistical level of significance was set at $p \leq 0.05$.

RESULTS

There were 131 (45.2%) participants who were imposters (i.e., high CIPS) and 54 (18.6%) participants classified as having low self-esteem (i.e., low RSES). The comparison of CIPS with RSES revealed a Pearson Correlation $r = -0.71$, $p < 0.001$ (**Figure 1**). There was a significant difference in the average CIPS between groups of low self-esteem (mean = 73.7 ± 10.3) and normal self-esteem (mean =57.0 ± 12.2) students ($t_{(288)} = 9.3$, $p < 0.001$). The risk of being an imposter was strongly associated with having low self-esteem. The frequencies of participants with low self-esteem and impostors gave an Odds Ratio of 1.5 (1.3–1.7), $\chi^2_{(1,N=290)} = 51$, $p < 0.001$.

There were no significant differences in the average CIPS between demographic groups: males and females, <21 and >21 years of age, degree holders and non-degree holders, year of study groups, pre-clinical and clinical, domestic and international and geographical regions. Similarly, there were no significant differences in the average RSES between the listed demographic groups. These values are summarized in **Table 2**, **Table 3**. Also, there were no significant differences observed in the ratio of impostors between any of the demographic groups. There was a significant difference in the ratio of participants with low self-esteem between domestic students and foreign students, $\chi^2_{(1,N=287)} = 6.6$, $p < 0.01$. However, there were no other such differences observed in frequencies of individuals with low self-esteem for the other listed demographics (see **Table 2**, **Table 3**). The study found small but significant differences in CIPS and RSES between married and unmarried students according to the Mann-Whitney *U*-test. Median (minimum–maximum) CIPS were: single 60 (27–100), and married 47 (42–66), $p = 0.026$. Median (minimum–maximum) RSES were: single 19 (2–30), married 24 (19–30), $p = 0.040$.

One-way multivariate analysis of variance (MANOVA) was performed to assess one or more mean differences between various demographics (gender, marital status, previous degree, North American nationality, GCC nationality, pre-clinical, age below 21 years, year of course and domestic student status) and measures of IP and self-esteem. Preliminary tests were conducted to check for multicollinearity, multivariate normality, absence of multivariate outliers, homogeneity of variances; the results indicated that there were no serious violations of the MANOVA assumptions. Prior to conducting follow-up ANOVAs, the homogeneity of variance assumption was tested for CIPS and RSES. Based on Levene's *F*-tests, the homogeneity of variance assumption was considered satisfied ($p > 0.05$). Scheffe's *post hoc* test was used for multiple group comparisons. There was a significant difference between domestic students (Bahraini) and international students, Wilke's $\Lambda = 0.97$, $F_{(2,284)} = 4.40$,$p = 0.01$. There was a significant difference between domestic students and international students for RSES, $F_{(1,285)} = 8.3$, $p < 0.01$), with domestic students (Mean = 20.3 ± 5.1) scoring higher than international students (mean = 18.5 ± 5.6). Further, there was a significant difference between geographical regions [GCC, North American

TABLE 2 | Mean student's scores on the clance impostor phenomenon scale and frequency of imposterism.

		Score		Imposter frequency	OR for imposter
	N (%)	Mean (SD)	*p*-value	*N* (%)	
Overall	290	60 (13.5)		131 (45.2)	
Gender					
Male	119 (41.0)	59 (13.4)	0.129	46 (38.7)	1.57 (0.97–2.53)
Female	169 (58.3)	61 (13.5)		84 (49.7)	
Not reported	2 (0.7)				
Total	290 (100.0)				
Age					
<21	145 (50.0)	60 (12.7)	0.766	63 (43.4)	1.18 (0.74–1.88)
>21	143 (49.3)	60 (14.3)		68 (47.6)	
Not reported	2 (0.7)				
Total	290 (100.0)				
Marital status					
Unmarried	277 (95.5)	61 (13.4)	0.040	129 (46.6)	0.23 (0.03–1.99)
Married	6 (2.1)	49 (9.3)		1 (16.7)	
Not reported	7 (2.4)				
Total	290 (100.0)				
Previous educations					
No degree	248 (85.5)	61 (13.4)	0.152	118 (47.6)	0.53 (0.25–1.13)
Degree	34 (11.7)	57 (14.0)		11 (32.4)	
Not reported	8 (2.8)				
Total	290 (100.0)				
Year of study					
First	49 (16.9)	60 (12.8)	0.279	21 (42.9)	
Second	63 (21.7)	60 (12.4)		28 (44.4)	
Third	32 (11.0)	56 (12.8)		9 (28.1)	
Fourth	86 (29.7)	60 (13.8)		39 (45.3)	
Fifth	60 (20.7)	62 (15.0)		34 (56.7)	
Total	290 (100.0)				
Place in the program					
Pre-clinical	144 (49.7)	59 (12.6)	0.154	58 (40.3)	1.48 (0.93–2.36)
Clinical	146 (50.3)	61 (14.3)		73 (50.0)	
Total	290 (100.0)				
Domestic or international					
Domestic	130 (44.8)	59 (13.8)	0.139	51 (39.2)	1.57 (0.98–2.51)
International	157 (54.1)	61 (13.3)		79 (50.3)	
Not reported	3 (1.0)				
Total	290 (100.0)				
Geographical region					
GCC	166 (57.2)	59 (14.1)	0.387	71 (42.8)	
North America	44 (15.2)	60 (13.2)		21 (47.7)	
Others	77 (26.6)	62 (12.4)		38 (49.4)	
Not reported	3 (1.0)				
Total	290 (100.0)				

OR, odds ratio; SD, standard deviation.

and "others" (i.e. non-GCC and non-North American)] when considering jointly the variables CIPS and RSES. Wilke's $\Lambda = 0.96$, $F_{(4,566)} = 2.68$, $p = 0.03$. There were significant differences between GCC students, North American students and others for RSES, $F_{(2,284)} = 4.7$, $p = 0.01$, with GCC students (mean $= 20.0 \pm 5.3$) scoring higher than North American students (mean $= 19.4 \pm 5.3$) and others (mean $= 17.7 \pm 5.5$). *Post-hoc* ANOVA revealed a significant difference

TABLE 3 | Mean student's scores on the Rosenberg's Self-Esteem Scale and frequency of low self-esteem.

		Score		Low self-esteem frequency	OR for low self-esteem
	N (%)	Mean (SD)	*p*-value	*N* (%)	
Overall	290	19 (5.4)		54 (18.6)	
Gender					
Male	119 (41.0)	20 (5.6)	0.325	24 (20.2)	1.17 (0.64–2.13)
Female	169 (58.3)	19 (5.3)		30 (17.8)	
Not reported	2 (0.7)				
Total	290 (100.0)				
Age					
<21	145 (50.0)	20 (5.0)	0.439	21 (14.5)	0.59 (0.32–1.08)
>21	143 (49.3)	19 (5.9)		32 (22.4)	
Not reported	2 (0.7)				
Total	290 (100.0)				
Marital status					
Unmarried	277 (95.5)	19 (5.4)	0.042	54 (19.5)	1.03 (1.00–1.05)
Married	6 (2.1)	24 (4.6)		0 (0.0)	
Not reported	7 (2.4)				
Total	290 (100.0)				
Previous educations					
No degree	248 (85.5)	19 (5.4)	0.396	48 (19.4)	1.39 (0.51–3.78)
Degree	34 (11.7)	20 (5.6)		5 (14.7)	
Not reported	8 (2.8)				
Total	290 (100.0)				
Year of study					
First	49 (16.9)	19 (5.6)	0.788	11 (22.4)	
Second	63 (21.7)	20 (4.4)		6 (9.5)	
Third	32 (11.0)	20 (4.9)		5 (15.6)	
Fourth	86 (29.7)	19 (6.0)		19 (22.1)	
Fifth	60 (20.7)	19 (5.7)		13 (21.7)	
Total	290 (100.0)				
Place in the program					
Pre-clinical	144 (49.7)	20 (4.9)	0.459	22 (15.3)	0.64 (0.35–1.17)
Clinical	146 (50.3)	19 (5.9)		32 (21.9)	
Total	290 (100.0)				
Domestic or international					
Domestic	130 (44.8)	20 (5.1)	0.004	16 (12.3)	0.44 (0.23–0.83)
International	157 (54.1)	18 (5.9)		38 (24.2)	
Not reported	3 (1.0)				
Total	290 (100.0)				
Geographical region					
GCC	166 (57.2)	20 (5.3)	0.010	25 (15.1)	
North America	44 (15.2)	19 (5.3)		8 (18.2)	
Others	77 (26.6)	18 (5.5)		21 (27.3)	
Not reported	3 (1.0)				
Total	290 (100.0)				

OR, odds ratio; SD, standard deviation.

between GCC student and others but no difference between GCC students and Northern American students for self-esteem scores only. No other significant differences were found using multivariate analysis.

DISCUSSION

This study explored the relationship between IP and self-esteem amongst medical students in a European medical college campus

situated in the Arabic speaking Kingdom of Bahrain. CIPS were higher among students with low self-esteem. We found no significant gender differences in IP in this cohort. Similarly, we found no differences in IP between: age groups (<21 and >21 years of age), previous experience in higher education, year of study or domestic vs. international student status. Domestic-status and citizenship of a GCC country was associated with self-esteem.

IP was first described in highly performing women (7). Subsequent studies have shown IP to affect both genders equally in the professional setting (8). However, studies among medical students have demonstrated female gender to be associated with IP (1, 24). The present study found no such associations with gender. Major professional or educational transitions are crucial periods when IP is likely to occur (2, 25), particularly in the third-year (classroom to clinic) transition (1, 2, 24). The present study found no significant differences in CIPS between the years of study, including the critical third-year. We found a small but statistically significant difference in CIPS between married and unmarried students. However, the number of married students ($n = 6$) was relatively low. Henning et al., had shown that married medical students had less distress than their single counterparts (1), and it has been suggested that marriage might act as a buffer against distress (35).

Multiple factors may interplay to explain the relationship between self-esteem and IP. The development of impostor traits may stem from innate predispositions (7, 36), familial and developmental. These include personality traits (e.g., neurotic personality traits, perfectionism etc.,) that are linked to perpetuating feelings of low self-esteem (37).

Students from GCC countries and North America had relatively high self-esteem. These two categories are well defined geopolitically. In contrast, our category of "other" (i.e., non-American, -Canadian or -GCC nationalities) was geographically and socially very diverse. The interrelationships between culture, nationality, self-esteem and personality have previously been commented upon. Fulmer et al. (29), explored the concept of "person-culture match" which predicts that "when a person's personality matches the prevalent personalities of other people in a culture, culture functions as an amplifier of the positive effect of personality on self-esteem" (29). Students who are raised in GCC countries share many cultural features and ideals and have shared historical backgrounds. Abdulkhaliq et al. (16), studied self-esteem amongst college students in four different Arab countries and reported self-esteem to be higher in students from countries with high per-capita incomes. This reflects our findings of high self-esteem among students from economically advanced countries. Further, issues of race and ethnicity may also be important in understanding the differences in the levels of self-esteem and impostor traits. Bernard et al. studied the effect of racial identity on impostor traits in minorities and concluded that a high sense of racial identity generally confers protection against developing impostor traits (5). Although, our study did not examine ethnicity as a subgroup, it is postulated that non-GCC students may experience feelings related to being a racial minority while studying in Bahrain. This may contribute toward levels of self-esteem.

Our findings highlight the importance of identifying individuals with IP in order to optimize their learning experiences and professional progression. Clance and Imes recommended frequent, specific feedback as a solution for those who doubt their abilities (38). Future investigations may focus on relating IP to "educational safety" and learning in non-judgmental settings. Eliminating unhealthy competitiveness in campus culture and creating environments where students are supported educationally and personally may reduce IP (39). International medical colleges should be attentive to the needs of minorities in order to reduce IP and allow diversity to be a universal asset to the educational experience (40, 41).

Limitations of this study include our use of convenience sampling of medical students who may not represent the full student body. The timing of the study overlapped with the examination preparation period, and so attendance of the classes was lower than expected. Minimal demographic data were collected for non-respondents preventing us from assessing the degree to which selection bias might have occurred. As this is a cross-sectional study, no causal conclusions can be made. The subgroups of married students and post-graduate students had relatively low numbers of participants.

Low self-esteem was found to be a predictor of IP with medical students. Female students were no more likely than males to display characteristics of IP. Previous university experience, year of study on the medical program and age did not significantly affect measures of IP. Domestic student status and citizenship of a GCC or a North American country affected self-esteem. Foreign/international students may benefit from targeted support to address students' self-esteem and its negative consequences on professional performance and personal wellbeing. International medical colleges should implement general support measures for domestic and international students. These measures should be aimed at making the general culture of the college more acceptable to students from diverse backgrounds, particularly for non-citizens of the country in which the campus is located.

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 Research Ethics Committee of RCSI Bahrain. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

MN and SF: conceptualization and visualization. SF: data curation, formal analysis, and validation. MN, NH, MZ, AZ, and YM: investigation. MN, NH, and MZ: methodology, project administration, resources, and supervision. MN, NH, MZ, and SF: writing–original manuscript. MN, NH, MZ, AZ, YM, and SF: writing–review and editing. All authors contributed to the manuscript and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fmed.2022.850434/full#supplementary-material

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Medical Student Experiences of Uncertainty Tolerance Moderators: A Longitudinal Qualitative Study

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Introduction: Uncertainty tolerance (UT), a construct explicating individuals' response to perceived uncertainty, is increasingly considered a competency for effective medical practice. Lower UT among physicians is linked with negative outcomes, including less favorable attitudes toward patient-centered care, and increased burnout risk. Despite decades of research, as yet few have engaged methodological approaches aiming to understand the factors that may influence medical students' UT (so-called moderators). Such knowledge, though, could inform teaching practices for fostering learners' skills for managing uncertainties. Accordingly, we asked *"What factors do medical students in their clinical years perceive as moderating their perceptions of, and responses to, uncertainty?"*

Methods: We conducted a qualitative study with forty-one medical students in clinical years at an Australian medical school, with data collected throughout 2020. Participants described their experiences of uncertainty through both in-semester reflective diary entries ($n = 230$) and end of semester group or individual semi-structured interviews ($n = 40$). Data were analyzed using a team-based framework analysis approach.

Results: Four major themes of UT moderators were identified: (1) Individual factors, (2) Sociocultural factors, (3) Academic factors and (4) Reflective learning. Aspects of individual, sociocultural and academic factors were perceived as having either positive or negative influences on students' perceptions of uncertainty. By contrast, reflective learning was described as having a predominantly positive influence on students' perceptions of uncertainty, with students noting learning opportunities and personal growth afforded through uncertain experiences.

Conclusions: As healthcare becomes increasingly complex, a future challenge is equipping our medical students with strategies and skills to manage uncertainties. Our study identified multiple moderators of medical students' UT, key among them being reflective learning. We also identified UT moderators that contemporary and future medical educators may be able to harness in order to develop learner UT as a healthcare graduate attribute, especially through teaching practices such as intellectual candor. Further research is now required to evaluate the impact of proposed educational interventions, and to develop effective assessments of students' skills for managing clinical uncertainties.

Keywords: uncertainty, tolerance, moderator, medical student, medical education, qualitative

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INTRODUCTION

Despite significant advances in medical knowledge and evidence-based practice throughout the 20th century, uncertainty remains an inherent and pervasive aspect of healthcare practice (1). Recently, the COVID-19 pandemic has further underscored the potential magnitude and importance of healthcare-related uncertainty, and the need for healthcare professionals to possess skills for managing these implicit uncertainties (2). Uncertainty tolerance (UT), a construct encompassing how individuals perceive and respond to uncertainty across their cognitions, emotions and behaviors (3), is therefore increasingly considered a necessary attribute for medical graduates (1, 4, 5).

UT may be considered a future protecting skill for healthcare professionals, as advances in medical technology supersede human data processing abilities. For example, healthcare is increasingly engaging artificial intelligence (AI) in applications such as diagnosis, decision making and patient education (6, 7). AI functions in a realm of pattern recognition, categorization and precision (7), and has been found to have limited capacity to tolerate uncertainty (8, 9). Healthcare is, however, typically complex and ambiguous, and may not be easily reduced to simple categories (10). Thus, to prepare for this technology-laden healthcare landscape, future healthcare professionals may benefit from developing UT skills in order to better interrogate AI outputs for potential uncertainties, and facilitate working alongside AI.

Presently, research demonstrates important links between physician and medical student UT with healthcare-related outcomes (11). Lower UT is associated with negative outcomes such as increased healthcare resource use and more paternalistic patient care attitudes (11–13), whereas higher UT appears to be protective against declining attitudes toward underserved patient populations (14). The clearest association between physician and medical student UT is, however, with their own psychological wellbeing, with lower UT associated with higher rates of psychological distress and risk of burnout (11, 15). Within the uncertainties of the pandemic context and reports of largescale healthcare worker burnout and resignation (16), better understanding medical students' UT, and how this can be developed as a graduate attribute, is timely.

The integrative model by Hillen et al. (3) provides a contemporary and wide-ranging conceptual framework for researching UT. Within the model, a *stimulus* is the underlying source of uncertainty, and is defined in terms of ambiguity, probability and complexity. Thus, terms such as "tolerance for ambiguity", which are also used within medical education research, may be considered subordinate to the UT construct. Hillen et al. (3) do highlight, however, that clear conceptual differences between UT and tolerance for ambiguity were unable to be identified.

Following *perception* of uncertainty, an individual *appraises* and *responds* to uncertainty across cognitive, emotional and behavioral response domains. *Moderators* may then act to influence either the perception of or the responses to uncertainty, and are categorized as (a) stimulus characteristics, (b) individual characteristics, (c) situational characteristics, (d) cultural factors, and (e) social factors, but are not further defined by Hillen et al. (3). The inclusion of moderators within the model aligns with recent research supportive that UT is (at least in part) a modifiable state, whereas early research typically conceptualized UT as an immutable personality trait (17, 18). UT moderators represent a potentially valuable avenue to explore in the context of medical education, as these moderators could spur curricular innovations designed to support medical students to develop UT needed for their future practice (4, 19). As yet, however, research aiming to understand UT moderators within this context has yielded somewhat limited insights, which may be partly due to the research methods heretofore engaged.

Historically, there was a reliance on UT scales to study moderators (11). These studies typically focused on students' demographic factors and training stage as potential moderators, yielding rather inconsistent results (11). For example, more advanced stages of training were found to be associated with lower UT (20, 21), higher UT (21–24), as well as no significant differences in UT (13, 25). Results regarding age and gender as moderators of medical student UT are also inconsistent (11). A recent meta-analysis of UT scale reliability indicated significantly lower reliability among populations of medical students compared to physicians, as well as high levels of heterogeneity in sub-analyses (26). These findings, respectively, suggest that inconsistent results pertaining to UT moderators could relate to imprecise results among medical students, and that there are likely to be moderators of UT impacting findings beyond those assessed by primary studies (26).

By contrast, qualitative studies exploring medical students' UT are beginning to build evidence for moderators related to experience, teaching practices, peer relations and reflective writing (19, 27–30). Several studies describe a shift in students' perceptions of and responses to uncertainty, from earlier absolutist views on medicine, toward an acceptance of uncertainty as a feature of clinical practice as training progresses. This suggests that gaining experience as a medical student may moderate UT, although studies are limited to preclinical contexts (19, 27, 28).

Within the context of preclinical anatomy education, our prior research identified UT moderators pertaining to teaching practices and peer relations (19). Educators who acknowledged the presence of uncertainty and outlined the evidence-base explaining multiple possible answers were described as facilitating students' UT, whereas educators who engaged in didactic approaches that failed to address subject matter uncertainties were described as impeding UT (19). Relating to peer relations, working within a team wherein students were able to share responsibility for their uncertainty was described as aiding students' UT (19). Thus even within the context of anatomy, which is often perceived in certain terms (27, 28), educational approaches were described as moderating and developing students' UT (19). Within the clinical context, however, there is limited knowledge of moderators of medical students' UT. A study by Nevailainen et al. (29) with medical students in their first clinical year aimed to explore students' experiences of uncertainty and how these

developed over time. Although this study did not purposefully aim to identify UT moderators, the authors did note that the reflective writing students participated in as part of study data collection may be beneficial in supporting students to cope with uncertainty.

As such UT research is yet to purposefully explore the breadth of moderators as experienced by medical students within the clinical education context. Identifying UT moderators may help pave the way to develop educational interventions that better prepare medical graduates for the uncertainties implicit in modern and future clinical practice, and help mitigate the negative impacts that lower UT may have for medical students and physicians, and the patients in their care. Therefore, we asked "*What factors do medical students in their clinical years perceive as moderating their perceptions of, and responses to, uncertainty?*"

METHODS

Study Design

This study, focused on UT moderators, forms part of a larger research project exploring clinical years medical students' experiences of uncertainty (31). Engaging a social constructionist paradigm (32, 33), we undertook a qualitative, longitudinal research (34–36) project at an Australian medical school. Data collection methods included participants completing both reflective diary entries, and semi-structured interviews (individual and/or group) about their experiences of uncertainty throughout the 2020 academic year (**Figure 1**). Methods specific to the present study are detailed here. Further details including the full semi-structured interview protocol are described in Stephens et al. (31).

Context

The medical course at the study institution provides entry pathways for students both directly following secondary schooling ("direct entry"), and after completion of an undergraduate degree ("graduate entry"). Both entry streams accept students enrolling domestically and internationally. Although direct and graduate entry students are separated for an initial preclinical phase, the streams combine for the penultimate 3 years of the course constituting the clinical phase. The location of students' clinical placement sites includes metropolitan, suburban, regional and rural areas, ranging from primary to quaternary care settings. All students graduate with a Bachelor of Medical Science and Doctor of Medicine (MD).

Sampling and Recruitment

For the present study, students were purposively sampled from the first (year "3B") and final (year "5D") years of the clinical phase, during which students are primarily placed within hospital settings. Our prior research exploring UT among preclinical students identified that transitions in education are a key stimulus for uncertainty (19). Students in year 3B are in the midst of a transition from campus-based learning to learning within the healthcare context, whereas students in year 5D are preparing for the transition to practice. We, therefore, anticipated that the transitional contexts experienced by these year levels may be particularly favorable for researching UT moderators.

Following institutional ethics approval (Project ID 20933), we recruited participants through messages disseminated via the course learning management system. In addition, G.C.S. conducted in-person and Zoom (version 5, Zoom Video Communications, San Jose, CA, USA) recruitment drives. A total of 41 students were recruited (23 in year 3B, 18 in year 5D), among which 35 completed all eight stages of the study (see "Data Collection"). Following completion of study consent, participants answered a brief demographics survey. This revealed that the majority of participants identified as women (68%), were in the direct entry stream (85%), and enrolled domestically (83%). The mean age of commencement of medical school was 19.1 years. A small majority of students identified as non-religious (56%), and the dominant ancestral groups identified were East Asian (41%), European (24%) and South Asian (22%). Participant demographics were thus generally reflective of the broader student cohort at the study institution.

Information Power

Using the concept of information power (37, 38), we explored whether we achieved appropriate sampling to answer our research question. We considered our sample size adequate to achieve information power for several reasons (37, 38). Firstly, our study aim was relatively narrow, focusing on UT moderators. Secondly, our population of clinical years medical students was specific to our research question. Thirdly, our data analysis was informed by existing theory on UT (3). Finally, we had a rich interviewer-participant dialogue that developed over time.

Data Collection

Relationship Between Researchers and Researched

G.C.S. led communication with participants across all stages of data collection, and made herself known to participants in her role as a medical education doctoral candidate. M.D.L. had previously taught and assessed many participants in their preclinical anatomy education. As this could represent a power imbalance potentially impacting how students present themselves to a former teacher, all data were de-identified prior to analysis by M.D.L (as well as M.S.). None of the authors were involved in teaching or assessment of students during or following the study period.

Reflective Diary Entries

Participants were asked to complete a minimum of six reflective diary entries during the study. These were spaced such that participants submitted their diaries 3 times per semester at approximately six-week intervals (**Figure 1**). Participants were provided with three options for diary format (audio recorded, typed or handwritten) to facilitate a range of reflective preferences (39). Prompts for the diaries were purposefully broad. Students were asked to describe scenarios from clinical placement, or experiences as a medical student more generally, in which they felt 1. Uncertain and 2. Certain. The "uncertain" prompt was designed to solicit data pertaining to UT, whereas the "certain" prompt was included to capture

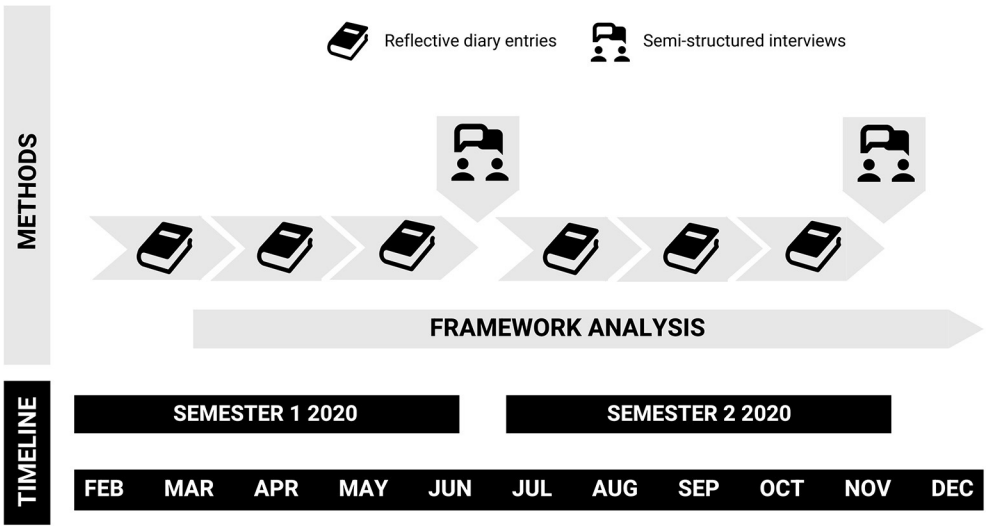

FIGURE 1 | Overview of study methods and timeline. Participants described their experiences of uncertainty through in-semester reflective diary entries, and discussed their experiences through end of semester individual or group semi-structured interviews. Framework analysis of data began following the collection of the first diary entry, and continued throughout the remainder of the study.

further contextual details about how students perceived certainty versus uncertainty, and the factors moderating these perceptions. Preliminary data analysis identified that some students described their chosen scenarios without further reflection, which we addressed by seeking clarification from students regarding omitted details (compliant with ethics). As such a brief framework for reflection (the *"What? So what? Now what?"* approach (40)) was provided to students at the start of the second diary period, although it was emphasized that this recommendation was only a suggestion of one style in which to structure a reflection. At the conclusion of the study, participants had completed a total of 230 diary entries, representing 178,308 words. Of these, 170 were typed, 50 audio-recorded and 10 hand written. The shortest diary was 188 words, and the longest 5,119, with a mean of 775 words per diary. A summary of diary entries according to type, year level and gender of participants is provided in **Table 1**.

TABLE 1 | Number of diary entries submitted according to year level, diary type and participant gender.

Year level	Diary type	Participant gender	Number of entries
3B	Typed	Woman	64
		Man	11
	Handwritten	Woman	8
		Man	0
	Audio	Woman	30
		Man	17
5D	Typed	Woman	55
		Man	40
	Handwritten	Woman	2
		Man	0
	Audio	Woman	3
		Man	0

Individual and Group Interviews

At the end of each semester, students had the option of participating in either an individual or group interview according to their preference and/or availability. Both approaches were engaged to further explore potential moderators that were identified through preliminary analysis of diary entries, facilitating crystallization of our findings (38). This dual approach of individual and group interviews was used for methodological and practical (i.e. scheduling and participant availability) reasons. Individual interviews facilitated in-depth responses and understanding of individual perspectives, whereas group interviews allowed participants to interactively share, compare and contrast their experiences with those of their peers (41). Both approaches utilized the same semi-structured interview protocol (31), and were all facilitated by G.C.S by Zoom due to social distancing restrictions in effect during the study period, as well as the geographical distance between participants' placement sites. Following our experiences in other research projects using Zoom, group interviews had a maximum of four participants, as we found that engagement was difficult to maintain with larger groups.

Interview questions were developed following early stages of the iterative analysis of diary data to ensure that we more deeply explored participants' perspectives of UT moderators, and that our developing codebook (see below) was reflective of these. Participants were first asked *"In your experiences of uncertainty, are there any factors that have impacted your experience of uncertainty either positively or negatively? These might be to do with the people involved, the setting or features of the situation*

TABLE 2 | Average interview duration according to study time point, year level of participants, and type (individual or group).

Time point	Year level	Type	Number	Average duration
1	3B	Individual	3	00:52:53
		Group	6	01:05:44
	5D	Individual	7	00:48:10
		Group	4	01:02:43
2	3B	Individual	5	01:03:23
		Group	6	01:23:02
	5D	Individual	5	00:54:41
		Group	4	01:21:16

The number of interviews in each category are also provided. Time point 1 corresponds to the end of semester 1, and timepoint 2 to the end of semester 2.

TABLE 3 | Overview of the thematic structure of results.

Uncertainty tolerance (UT) moderators	
Theme	**Subtheme**
1. Individual factors	a) Experience
	b) Personal characteristics
	c) Sense of purpose
	d) Social comparison
2. Sociocultural factors	a) Teaching behaviors
	b) Placement inclusivity
	c) Healthcare professional cultures
3. Academic factors	a) Assessment
	b) Orientation
	c) Faculty communication
4. Reflective learning	/

itself, but could be anything you can think of that has changed your experience of uncertainty in some way." Further questions were guided by participants' responses, with specific prompts added about potential moderators identified in participants' diaries where required. These prompts related to potential moderators included the influence of experience, personal characteristics, other people, assessments, and approaches to teaching and learning (including reflective learning) (31). The protocol included deidentified quotations from diaries to spark further discussion as needed, however these were infrequently required.

Ultimately, we completed 20 individual interviews (10 per semester, ranging in length between 32 min and 1 h 24 min) and 20 group interviews (10 per semester, ranging in length between 55 min and 1 h 28 min). Average duration by interview type, student year level and timepoint are provided in **Table 2**, with a further breakdown of each interview and demographics of participants provided in **Supplementary Material 1**. Together, the interviews resulted in 414,708 words of data or approximately 42 h of recordings.

Data Analysis

We analyzed all data using reflective, team-based framework analysis (42). Our analysis was undertaken with the Hillen et al. (3) integrative model as our initial conceptual framework, and was abductive in nature (43). Herein we oscillated between deductive (i.e., applying the integrative model to our dataset to aid our understanding of participant UT) and inductive approaches (i.e., building theory on UT moderators within the context of clinical years medical students. Framework analysis involves five steps: 1. Familiarization, 2. Identifying a thematic framework, 3. Indexing, 4. Charting and 5. Mapping and interpretation. Familiarization commenced with receipt of the first round of diary entries, and was revisited at each stage of data collection. All diary entries were read or listened to by G.C.S., with a subset of diaries (about three per time point) and interview transcripts also read by M.S. and M.D.L. Each author noted their initial impressions, which were shared and discussed at fortnightly (G.C.S. and M.D.L.) or monthly (all authors) meetings. Stage 2 commenced with G.C.S. drafting a codebook with preliminary theme names, definitions and illustrative quotations. Multiple drafts and revisions of the codebook were reviewed and edited by all authors. Stage 3 then involved G.C.S. coding the entirety of the dataset, using NVivo (version 12; QSR International, Melbourne, Australia). Progress and challenges with coding were discussed in regular meetings (all authors), with further refinements to the thematic framework agreed to when needed. Charting then involved all authors discussing the data as themes, and making further refinements to the thematic structure. Finally, mapping and interpretation involved exploring patterns in thematic dominance, linking themes to our research question, and comparing our findings with existing research. This step was finalized through the process of writing and editing the results and discussion sections of the present paper.

Team Reflexivity

Following establishment of the research team, we engaged in a team reflexivity exercise (44). This enabled us to understand each other, and our orientations toward the proposed research. Although we all identified as social constructionist researchers, we were diverse in regard to gender, career discipline and stage, and prior experience researching UT and medical students. By way of background, G.C.S. is a graduate of the same medical school as the present study and was undertaking the present research as part of her doctoral studies, M.S. is an education researcher with a background in science education, and M.D.L is an anatomy educator and medical education researcher who originally trained as a cell biologist. By understanding each other's backgrounds and how this shaped our knowledge and beliefs about UT, we were able to challenge each other's assumptions about UT moderators throughout the process of data analysis. Thus, our reflexivity continued throughout the research, and helped ensure the rigor of our data analysis.

RESULTS

An overview of the thematic structure of our results is provided in **Table 3**. We identified four broad moderator themes described by participants: (1) Individual factors (2) Sociocultural factors, (3) Academic factors, and (4) Reflective learning. Each of these themes is described in association with illustrative quotations

from participants, for whom we have designated pseudonyms for the purposes of identity protection.

Individual Factors

These were self-identified factors which clinical-years medical students described as influencing their UT. Subthemes encompassed students' (a) experiences, (b) personal characteristics, (c) sense of purpose, and (d) social comparison.

Participants described their medical student *experience* as having a dominant influence on their UT, with the accumulation of clinical experience acting as an aid to navigating future experiences of uncertainty:

> *"[Uncertainty in medicine] gets easier with time and experience. And as students, we've only had…three years of clinical experiences…whereas…most of the doctors have had like, decades of it. And they still experience uncertainty, but it's that [clinical] experience and past experiences, which help and guide us the most." Nisha, Year 5D, Group Interview.*

Experience was described both in terms of gaining experience with medicine and healthcare in general, as well as in relation to practicing specific clinical skills. Although experience in general was described as facilitating students' UT, the moderating influence of specific clinical skills-based experiences varied according to students' perceptions. For some, practicing skills could facilitate UT development. Alternatively, experiences of inconsistent performance seemed to hinder some students' development of UT. A typical example was *"failing"* to complete a procedural skill despite prior success:

> *"One scenario in which I felt uncertain was my inconsistency in being able to cannulate patients. I had ended the previous rotation able to do straightforward cannulations in patients with good veins. The patients I encountered on this rotation however often had worse veins that were not as easy to cannulate... It was disheartening for me to come off my previous rotation with some confidence in my ability to cannulate and suddenly missing almost every cannulation I attempted." Pallavi, Year 5D, Diary.*

This negative experience was sometimes described alongside hesitation in approaching skill development opportunities in the future, whereas other students perceived similar failures as inherent to the learning process:

> *"Even when say you're uncertain in doing the procedure, and it doesn't end up working in the end, you know that you've walked away with more experience and most of the time your supervisor will give you some tips so that you're more prepared for your next experience." Alice, Year 5D, Group Interview.*

In this way, experience as a moderator of UT is conceptualized not only in quantitative terms, but is also related to the qualitative nature of an individual's particular experiences and their perceptions of outcomes.

Personal characteristics students described in their diary entries and interviews as influencing their UT included demographic, personality traits, and mental health factors. Students described a wide array of demographic factors moderating their UT, including their living arrangements, employment status, relationship status, medical school enrolment intermissions, and the location of their familial home in relation to the study institution. Amongst these factors, some had a variable influence on students' UT depending on individual student perceptions (e.g. living with other students or alone, employed or not), whereas others were described exclusively as hindering UT (e.g. location of the students' familial home outside the state of the study institution, being in a relationship, and having intermitted during medical school). For example, living alongside fellow students was described as facilitating UT through sharing and learning from others' experiences, but was also described as enabling the negative aspects of *social comparison* (further described below):

> *"But now that I'm like, literally in the same house, it's much harder to distance myself… I'm sort of force fed, like, my friends' study habits, I don't want to see them but like, I have no choice but to see them and like when you see them, you have no choice…to like, compare yourself…it's hard to sort of figure out where you should be sitting in the middle of that…so that's definitely been something I'm uncertain of." Toby, Year 3B, Group Interview.*

Personality traits and mental health factors were described only in relation to negative impacts on UT with students specifically describing the influence of burnout, introversion and anxiety on their management of uncertainty:

> *"I tend to be of a more anxious personality type. So, when I feel those emotions [related to uncertainty], I tend to think of them more as like my anxiety coming up…it's almost like I start to panic…I really want to get out of this situation…And my thoughts just basically start to go everywhere, in every direction. It doesn't make sense, it's very irrational…it's just a whole whirlwind of like, anxiety type emotions." Violet, Year 3B, Group Interview.*

In contrast to negative impact of these personality factors, students described that possessing and fulfilling a *sense of purpose* facilitated UT by motivating them to navigate uncertainties:

> *"I think having purpose definitely is a beneficial factor for…dealing with uncertainty… it reminds you of the bigger picture that if…you are feeling uncertain, your purpose reminds you …that you're really here for a bigger reason." Nisha, Year 5D, Group Interview.*

Students described finding their purpose in a variety of ways, including focusing on their career path in medicine, identifying the need to learn to care for their future patients, being helpful to their clinical team, acting in patients' best wishes, and maintaining their personal values within the context of healthcare. Purpose relating to personal values included discussion of social justice issues (particularly equity in healthcare access) and values rooted in religious beliefs, with these values often underscoring students' motivation to study medicine. Maintaining these values was described as being able

to provide a sense of guidance and certainty for students despite the uncertainty surrounding them:

> *"I actually am having quite a bit of difficulty identifying moments or scenarios during which I felt certain. However, I do feel certain about my passion for women's health and my values rooted in intersectional feminism. I am grateful to have the opportunity to speak with women on a daily basis and be privileged enough to hear their stories and it was during those times of GP [general practice], when I was truly connecting with patients, that I felt the most certain… When I feel this way decision making is much easier and my overall confidence is increased." Emily, Year 5D, Diary.*

The final individual student factor reported as impacting students' UT was that of *social comparison*, or the process of thinking about others in relation to oneself as a means of making sense of one's current or future position (45). This was chiefly described in relation to one's peers and near-peers. Whilst this could facilitate UT for some participants (e.g. adopting uncertainty management strategies observed in others), this subtheme predominately appeared to hinder UT. Here participants focused on differences with peers whom they perceived as having access to advantageous learning opportunities (e.g. placed at clinical sites believed to have a better quality of education), or who appeared to outperform them academically. This could lead to students doubting their own learning abilities:

> *"One of the students in my group, he is absolutely amazing…And it is really hard to not to compare myself to him. So, I'm like, wow, I am next to this amazing person who knows so much more. Why don't I know that much? What am I doing wrong?" Bianca, Year 3B, Individual Interview.*

In this way, social comparison could amplify students' uncertainties about learning, and sow doubt about their abilities to become a successful doctor in the future.

Sociocultural Factors

Sociocultural factors described by students as influencing their uncertainty were (a) teaching behaviors, (b) placement inclusivity, and (c) healthcare professional cultures.

Teaching behaviors were described as either facilitating or hindering students' UT depending on the educators' approach. Medical educators were identified by students as spanning the continuum of career stages from near-peer medical students to senior clinicians. Teaching behaviors described as facilitating UT included role-modeling UT, scaffolding knowledge (including selective didactic teaching), encouragement, constructive feedback, acceptance of mistakes and setting learning goals and expectations. For example, acceptance of mistakes seemed to facilitate UT by allowing students to distance themselves from negative emotions associated with uncertainty, and refocus their attention toward uncertainty as part of the learning process, whereas setting learning expectations provided students with a framework for managing learning uncertainties:

> *"I did have a clinical bedside tutor and in their first session with us…they were just like, 'okay, I really want to set expectations of how I want this teaching to go… that this is a space where you can make mistakes… I want to figure out…what point in your journey you're at, because I'm a consultant and I'm so far from that now.' So, I think that's positive because it … gave us some certainty around expectations and also how to navigate the times when we were uncertain." Leena, Year 3B, Group Interview.*

Role-modeling UT was described through educators exposing their thought processes, dilemmas and failures [i.e. intellectual candor (46)] about uncertainty in medicine. Intellectual candor can be used to invite reciprocal vulnerability from students', build trust, and drive learning within professional settings (46). Within the present study, intellectual candor seemed to allow students to appreciate the inherent uncertainties of medical practice, and build confidence that they can and will learn to manage these:

> *"[The surgical registrar] was asking me why he wasn't cutting here … I said, 'I didn't know' and he was like '…it's because there's a chance of cutting the inferior epigastric [artery] if you cut here…Ask me why I know that?' And I was like, in my head…'Oh, so you're going to tell me 'I knew this when I was a third year' or something', and he was like, 'Oh no, when I was reg somewhere else, I actually cut it and since then, I've made sure that I don't.' And so, I kind of felt like him offering that to me was actually like, look, I didn't know as well and I paid a price and that's why I'm teaching you this…I think for him to actually like reveal a personal flaw or maybe something like that was actually quite generous, but also made me feel like oh okay, everyone doesn't know things." Cathy, Year 5D, Individual Interview.*

Despite the many positive teaching behaviors described, students also experienced a variety of behaviors perceived as hindering their UT. These behaviors included singling out students from a group to answer questions, didactic teaching as a standalone pedagogical approach, acts of learner humiliation, false assumptions about students' prior learning, and inadequate supervision:

> *"One of the probably biggest factors [that impact uncertainty] is…supervision. So, the current rotation…it's a very busy rotation...I found…the busier the people in the team you're with, the less time they have to direct you in the right way. So, then you show up uncertain and if there's no one there to kind of guide you because they're extremely busy, that just…kind of snowballs it." Christopher, Year 5D, Individual Interview.*

When analyzing teaching behavior patterns according to the educator's career stage, we identified that positive behaviors were described in relation to teaching by near-peer medical students, junior doctors and senior doctors. However, teaching behaviors described as hindering UT were more typically described in relation to senior doctors. Students described the cognitive and social congruence (47) of near-peers and junior doctors as reasons why these educators could be of particular assistance to navigating uncertainties:

"I think, a…really big factor that has helped alleviate uncertainty for me have been my [year 5D student] mentors…I think just having these senior mentors…who know their way around and have been in our shoes really helps, and the fact that they're kind of closer in age and in…their journey to us compared to like, big consultants, really helps them like relate to us." Linda, Year 3B, Group Interview.

Placement inclusivity encompassed whether students perceived their experiences as shared or isolated (typically in relation to their peers), and whether they felt included or excluded from their clinical team on placement (typically in relation to junior doctors). Inclusion and active involvement within a clinical team was described as facilitating UT, and could be achieved through simply addressing students by name and acknowledging their presence on ward rounds within the medical record:

"The HMO [house medical officer] would put my last name next to theirs in the patient notes, and would introduce me to the patient by name. It was such a simple thing to do but it made me immensely more comfortable in learning from them and asking questions – without feeling like a burden or like I was unwanted." Ainsley, Year 3B, Diary.

Conversely, exclusion from the clinical team included instances of students being ignored and/or actively excluded from typical placement opportunities such as ward rounds. This served to amplify students' uncertainty about learning on placement, as they felt they too much of a *"burden"* on their clinical team to discuss uncertainties.

Whereas placement inclusivity centered on the students' perceptions related to small teams of individuals encountered on placement, *health professional cultures* more broadly described the customary behaviors of different health professional groups that students encountered. Specific cultural aspects described by students influencing UT were the hierarchies within medicine, and the tribalism between different healthcare professional microcultures. Medical students' perceived inferior hierarchical status within medicine could compound their uncertainties, wherein students described questioning their own knowledge or perceptions when these differed to that of a senior:

"It's sort of come down to…me sort of like questioning people who are senior to me…There was another instance the other day where our [general surgery registrar] went into a patient's room and called the patient one name when it was a different name on the list…he went through the whole consult, telling this patient that … he had multiple [pulmonary embolisms]…he only noticed right at the end, that he was actually talking to the wrong patient…so I'm like, maybe I'm the one who's wrong… maybe it's the list…that's wrong, because obviously this the reg seems really confident." Aarush, Year 5D, Group Interview.

In healthcare tribalism, the differing beliefs and values held by different healthcare professional groups (e.g. physicians versus surgeons, doctors versus nurses) also served to compound students' uncertainty about learning within the relatively unstructured clinical placement context:

"Our tutor has also given instructions such as 'don't ask the nurses as they overprotect their patients', which makes it more difficult when no doctors seem to be free or around for us to speak to." Linda, Year 3B, Diary.

Concerningly, a culture perpetuating the discrimination of minority and marginalized people was described by some students, with this influencing some students' UT. Descriptions included students' observations of healthcare professional-patient interactions, as well as students' own experiences as subjects of discrimination. These *"vulnerable"* patient and student groups thus had to contend with navigating the compounded uncertainties of institutions and culture constructed by and for those with greater privileges:

"It's mostly been sort of an issue of racism…that I've experienced…Sticking up for myself …[is] something that definitely I do not feel comfortable doing, that I definitely feel uncertain about doing in the hospital environment…There was an instance on the wards the other day that a patient was…unintentionally kind of racist...and the reg played it off…I kind of had to just bite my lip and not say anything…there's even been instances where… I've been called sort of racist terms by staff in the hospital as well…it doesn't feel nice not being able to stand up for yourself in the hospital environment." Aarush, Year 5D, Group Interview.

A culture of social inclusion facilitating UT (i.e. theoretical converse of culture perpetuating the discrimination of minority and marginalized people) was not identified within the data.

Academic Factors

Academic factors pertained to moderators enacted at the level of medical school programs and their administration. Moderators described by students included (a) assessment, (b) orientation and (c) faculty communication.

The influence of *assessment* on UT was divisive for students. Some students described assessments as facilitating UT by providing structure to guide them through learning uncertainties, whereas others felt the objective nature of assessments impeded their ability to engage with the uncertainties of clinical medicine. Indeed, the lack of summative assessments in Year 5D was described by some students as facilitating engagement with clinical uncertainty:

"Without the stress of exams looming over our heads…I think I am finally enjoying the "art of medicine" (where previously I would hyper focus on the "science of medicine" because exams). This year, I have found that I better embrace the ambiguous [and] uncertain situations as I am less driven to be learning just for the sake of an assessment." Chara, Year 5D, Diary.

Provision of an *orientation* to clinical placements appeared to vary between clinical sites. When formal placement orientation was provided, this was described as reducing the perceptions of uncertainty related to learning within unfamiliar placement contexts, and facilitating capacity to manage uncertainties related to learning clinical medicine:

"What [our placement administrator] tried to do is… give us a tour of the [emergency department] to like help orientate us and little things like that have taken away a little bit of the uncertainty…And they sent a whole document at the start of the rotation talking about the different roles of the different areas and what the roster is. And they really helped to take away a lot of the uncertainty and so now it's…I think it's just the right amount of uncertainty now… where you feel like you have that space to grow and that space to learn." Olivia, Year 5D, Group Interview.

When formal orientations were omitted, some students described initiating their own peer-to-peer orientations, including handover document development and communication via group messaging applications. This self-directed approach to orientation also appeared to facilitate UT, as students managed their placement uncertainties by sourcing information from peers who had previously completed the same placement.

Students described that the style of *communication* from those in the faculty (i.e. medical school and clinical site leaders and administrators), and whether this was perceived as supportive of students, served to moderate their UT. This sub-theme was particularly described within the context of pandemic-related impacts to placements. Knowing that they were supported by the faculty seemed to facilitate students' UT, even in the face of significant and enduring uncertainties. A cornerstone indicative of support was frequent communication interpreted as conveying the primacy of students' educational interests:

"To have faculty support and to know that they had our backs despite all the uncertainty was very reassuring, even as I understood that the situation was very fluid. This encouraged me and allowed me to feel supported and reassured on an academic level, and ultimately gave me enough peace to make difficult decisions." Patrick, Year 5D, Diary.

By contrast, infrequent, untimely and conflicting communication from faculty was perceived as unsupportive of students, and could magnify students' uncertainties about possible disruptions to learning and assessments. This was especially the case when communication from faculty differed from messages students received from other health professional staff working at students' placement sites:

"There is a lot of confusion, in the sense that directives we as students are receiving are quite mixed. [The university] has standardized it recently, so that the clinical school you are associated with dictates things, however, the head nurse, the consultant, registrar and other staff that you work with do provide directives…[that]…can be mixed." Ali, Year 5D, Diary.

Reflective Learning

Although the primary role for the research diaries was to explore clinical students' experiences of uncertainty, the way in which participants described their experiences suggested that the reflective process was, itself, moderating UT. The role of reflection as a moderator was further supported by students through their interview responses. Reflections appeared to influence students' perceptions about past uncertainties, as well as future uncertain scenarios. Dominant reflections described by students involved *"reframing"* uncertain scenarios by taking the focus away from negative associations with uncertainty, and instead focusing on ways in which uncertainty could be beneficial:

"I kind of enjoyed being able to write out the diary entries. It's sort of forced me to look back on things and look back on what I've gained…from a rotation, or what I haven't gained and need to carry into the next rotation…So… I thought it's actually been beneficial for me as well to be able to reflect on that uncertainty and really think about it in, you know, in terms of uncertainty as opposed to just failings." Pallavi, Year 5D, Individual interview.

The predominant way in which students reflected on uncertainty was in terms of identifying learning opportunities facilitated by uncertainty. Students recognized that although uncertainty could be uncomfortable, it was inherent to learning and the practice of medicine:

"Uncertainty is quintessential to our learning now, as it pushes us to learn and find out things. I mean, the only way to learn is to not know, and I want to be both comfortable in not knowing, while still wanting to reduce the amount of things I don't know." Harrison, Year 3B, Diary.

Reflections on uncertainty also discussed identifying personal growth and increasing the capacity to take appropriate steps in the face of future uncertainty. Students described that contending with uncertainties developed their confidence and resilience within healthcare contexts:

"I think I have become more resilient throughout the year… So, when I was bit uncertain about things, or felt a bit kind of insecure in a moment, I would kind of regroup, think and just continue on, or come up with a plan B." Natalie, Year 3B, Individual Interview.

There was, however, a darker side to reflection described by some students, including rumination and a sense of regret. Ruminating on uncertainty involved a persistence or amplification of negative responses to uncertainty that students recalled feeling in the moment of uncertainty:

"I feel like sometimes my uncertainty gets, like, amplified because I have a tendency to like, overthink things, like after the situation and like, ruminate about things. So, yeah, in some ways, I feel like it, I've become more uncertain, like the further it becomes from [the uncertain situation]." Victoria, Year 5D, Group Interview.

Students who described regret on reflection seemed to perceive their uncertainty in terms of inadequacies or subpar performance in a learning encounter. Unlike positive reflections, this regret was not countered with a sense that the uncertain experience could be of benefit in some way:

"I definitely beat myself up a bit if the outcome isn't necessarily good, because all you can think is I should have done better. I knew the answer to that, or I know what I should have done in that scenario. Why do I know that now? Why didn't I think about

that 5 minutes ago? All those sorts of feelings." Raimon, Year 3B, Individual Interview.

These negative reflections were less typically described by students, with the dominant pattern we identified being that reflective learning facilitated UT. Furthermore, this facilitation could occur despite recalling negative responses (e.g. worried, overwhelmed) experienced at the time of students' initial uncertainty.

DISCUSSION

We purposefully explored UT moderators as perceived by medical students in their clinical years. In doing so, we identified a broad range of moderators, encompassing *individual factors, sociocultural factors, academic factors,* and *reflective learning.* Our findings both refine and extend the Hillen et al. (3) model within the context of clinical medical students. Hillen et al. (3) list the moderator categories of (a) stimulus characteristics, (b) individual characteristics, (c) situational characteristics, (d) cultural factors and (e) social factors, but have otherwise not defined nor further described these terms. We chose to use the term *individual factors* instead of individual characteristics to imply a broader range of moderators within this theme, as the individual factors we identified encompassed both demographic characteristics, and other facets of students' experiences and character. Within our data and the real-world healthcare environment perceived by students, separating social and cultural factors was difficult, thus we combined these within *sociocultural factors. Academic factors* is perhaps a more specific moderator of relevance to our study context, but may incorporate aspects of situational or stimulus characteristics from Hillen et al. (3).

Reflective learning does not clearly align with any of the Hillen et al. (3) model categories, and thus constitutes an extension to the existing model. This moderator represents an important potential avenue for moderating UT in the medical student context, as reflective skills can likely be developed through educational interventions. Based on their work within the context of medical students in their first clinical year, Nevailainen et al. (29) describe that reflective writing may be a "powerful tool" for students' professional development as it concerns uncertainty. Our findings further extend this by supporting the role of *reflective learning* across written as well as audio reflections, thereby providing flexible options for students.

Amongst our identified moderators and their subthemes, many were described as having a variable influence on students' UT, either facilitating or hindering UT depending on specific student perceptions and contexts. This differs from existing research that typically only describes moderators in terms of being associated with one or the other of higher or lower measured UT. For example, prior research typically describes experience as a moderator in terms of quantifiable experience gained (e.g. number of years in practice), and demonstrated inconsistent results regarding whether UT increased or decreased with experience (11). In our data, experience could either facilitate or hinder UT, depending on an individuals' perceptions. Notably, an experience perceived negatively (e.g. *"failure"*) could hinder UT, effectively trumping previous experience gained. Thus, describing experience only in black-and-white quantifiable terms is likely insufficient to fully understand this moderator, as our research suggests that the nature of these experiences additionally influences UT.

Although our research supports UT as a modifiable state, questions do remain regarding the possibility of a trait level component to UT (i.e. a relatively stable and consistent pattern of response to uncertainty over time). Inherent differences in UT traits between individuals could explain the differing perceptions students had about some moderators (e.g. assessment), and why some students tended to ruminate upon reflection. In this way, trait level UT could be conceptualized as an additional *personal characteristic* influencing students' UT, or act as a set point around which moderators are able to exert an influence. Critically, however, our data supports the notion that students perceive that their UT can be moderated with the assistance of medical educators and educational institutions.

Suggestions for Clinical Education

Many of the moderators we identified may have potential implications for clinical education (**Figure 2**). Crucially, *reflective learning* appears to have the potential to powerfully influence clinical students' UT in a manner that may help counter other moderators with a negative influence. For example, engaging with *reflective learning* may benefit clinical students who perceive negative experiences related to uncertainty, allowing these to be reframed into *learning opportunities*. The clinical students in our study valued the repeated, formative nature of the reflective diary entries, the flexibility to choose their reflective medium, and the ability to reflect on and share their experiences through interviews. More generally within medical education, reflective learning is known to assist in developing skills for lifelong self-regulated learning, and for managing the complexities of practice (39). Prior research also suggests that the benefits of reflective learning may be maximized by avoiding summative assessment of reflections, as apprehensions related to assessment may impede students' engagement in the reflective process (48). Although our research demonstrates that reflection on uncertainty was predominantly a positive experience for students, the risk of negative reflections such as rumination suggests that reflective learning should ideally include provisions for supportive/pastoral care.

The positive reflections identified in our study could serve as specific prompts for clinical students to use in a guided reflection. For example, clinical students could be asked "what did you *learn* from uncertainty in this scenario?" and "how can this experience make you more *confident* or *build resilience* for similar scenarios you may encounter in the future?" Reflecting on the role of *social comparison* and *purpose* related to uncertainty may also prove beneficial topics. As sharing reflections can be challenging and leave clinical students open to potential loss of face, one approach could be to engage the use of an anonymized discussion forum (19). Our own prior research into UT in preclinical settings revealed that such approaches facilitated preclinical student engagement with discussion topics, as well as their UT development (19).

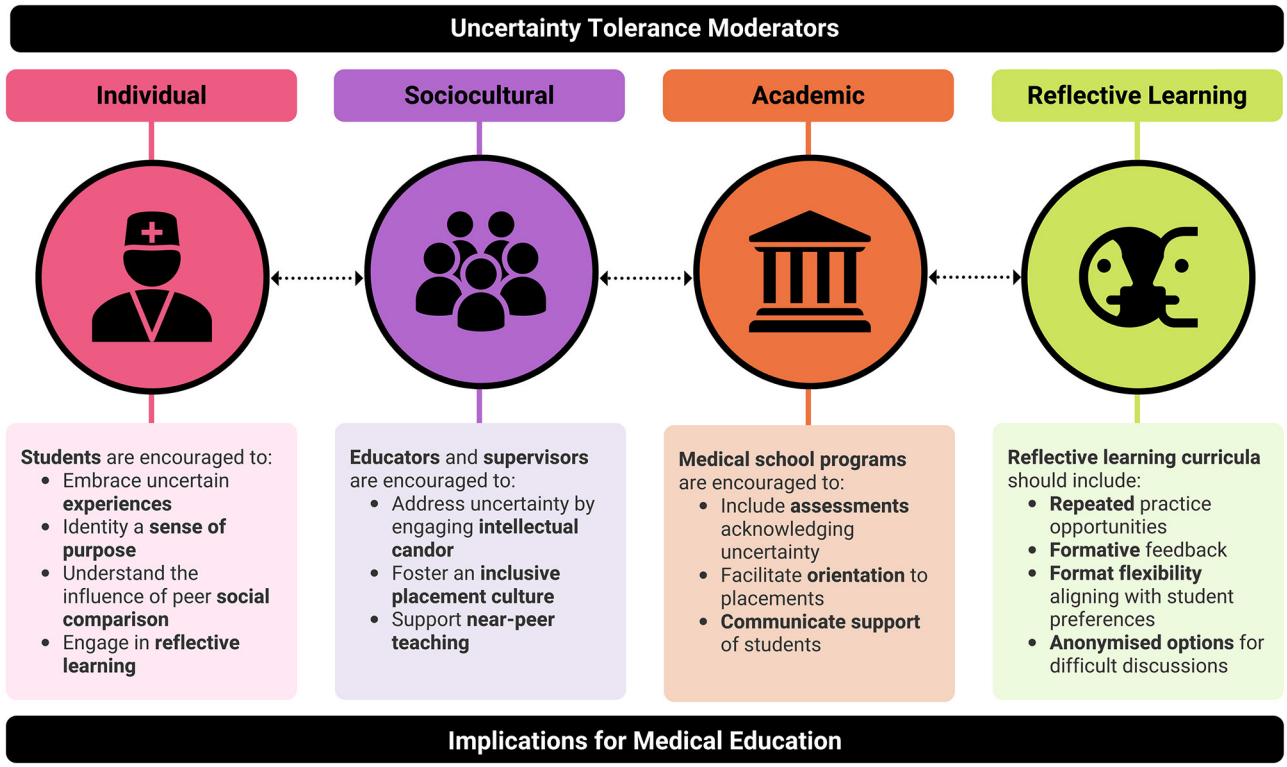

FIGURE 2 | Uncertainty tolerance (UT) moderator themes and suggested translations to clinical education. Dotted arrows between themes indicate that successful development of medical students' UT should ideally involve interventions that cut across all aspects of medical education.

Also related to reflection within the context of medical education, we identified that educators who practice intellectual candor (46) may also powerfully impact clinical students' UT. The examples of intellectual candor described by clinical students typically involved educators reflecting on past experiences of uncertainty, including when they were students themselves. In this way, intellectual candor may have helped to break down the perceived lack of cognitive and social congruence between clinical students and more senior clinicians. In order to build clinical students' UT, these educators then continued to discuss their thought processes regarding how they constructively managed uncertainty. Thus, the practice of intellectual candor by educators seems to develop clinical students' appreciation for the pervasiveness of uncertainty in healthcare, and build confidence that they will learn to manage these.

The variable influence of *assessment* on learner UT identified in this study raises questions about how educators can balance the benefits of assessments that drive learning, whilst minimizing the described negative impacts of assessment on UT. One possible solution warranting further research may be pass/fail grading. When compared to tiered grades, pass/fail assessments may be associated with improved student wellbeing without adverse impacts on academic performance (49). When combined with regular, formative supervisor feedback, pass/fail assessments are linked with intrinsic motivation for patient care, and a sense of learner agency (50). This approach may be ideal for balancing students' motivation for and engagement with patient care uncertainties, with sufficient feedback on their performance to guide learning. Of note, the assessments experienced by participants in this study were not specifically designed to evaluate students' skills for managing uncertainty. In future, medical educators may need to devote greater attention to incorporating issues of uncertainty within assessments. We would recommend approaches that avoid "single best answers", and instead focus on the range of considerations needed to arrive at a preferred solution. Clinical case discussions, where the focus of the assessment is on process and reasoning, and not a single answer, may be an ideal approach to facilitate this.

Finally, discussion of *orientation* and faculty *communication* moderators highlight the role these more administrative aspects of medical education can play in helping students navigate uncertainty. Our research suggests that reducing administrative uncertainties, and communicating support of students through their uncertainties, aids students' capacity for managing uncertainty related learning clinical medicine. To ensure orientation programs appropriately address students' needs as well as build skills for managing uncertainty related to frequent rotations during postgraduate training, an ideal approach may be to combine educator supervised approaches alongside facilitation of peer-to-peer handovers.

Although our study was conducted within the context of clinical years students, many of our suggestions may also be helpful for preclinical students, especially where moderators may allow early years students to build skills in preparation for the uncertainties of clinical placements (e.g. *reflective learning*).

Implications for Future Research

In addition to exploring and evaluating how proposed interventions may impact learner UT, future research may also turn to exploring the nuances of moderators and their reported variable impacts. Researchers may need to engage a variety of methodologies, and explore the perspectives of others involved in students' education (e.g. medical educators, clinical supervisors and faculty leaders). For example, think-aloud protocols could be used to deeply explore students' experiences of uncertainty as they engage with uncertainty stimuli, and learning analytics could provide data approximating students' actual responses to uncertainty. Further research is also needed to explore UT moderators in a wider range of medical education settings (e.g. postgraduate training, continuing professional development), and develop assessment strategies that balance evaluation of learning medical knowledge, with skills for managing the uncertainties of clinical practice.

Study Strengths and Challenges

Key strengths of our study that helped ensure the rigor of our work include our attention to information power (37) and the relationship between researcher and researched (32), the breadth and depth of our data which facilitated the crystallization of our findings (38), the engagement of existing UT theory (3), and our reflexivity throughout the research project (51). A challenge we encountered was the pandemic context and interruptions to student placements. Although this may have limited findings related to moderators within the healthcare environment, the substantive uncertainty stimulus provided by the pandemic may have brought uncertainty to the forefront of participants' minds and indeed facilitated discussion of moderators. As the pandemic represents a globally shared stimulus of uncertainty, this may aid in the transferability of our findings to other medical schools and students experiencing similar uncertainties (52).

CONCLUSIONS

Given the inherent ambiguity, complexity and indeterminacy of healthcare, managing uncertainty remains a critical attribute for medical graduates (1, 4). Our research identified a broad range of moderators perceived by medical students in their clinical years as influencing their UT. Critically, these moderators suggest approaches to teaching and learning that may be engaged by medical educators in order to develop students' UT. Ultimately this work highlights potential areas for exploring educational interventions that may aid in preparing medical graduates for the changeable and uncertain future of healthcare practice.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because the raw data cannot be shared outside the authorship team due to ethical restrictions. Sharing of de-identified data sets supporting coding and analysis may be shared in limited circumstances and depending on compliance with ethical approvals. Requests to access the datasets should be directed to michelle.lazarus@monash.edu.

ETHICS STATEMENT

This study involving human participants was reviewed and approved by the Monash University Human Research Ethics Committee (MUHREC). The participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

Funding for this study was obtained by ML. Participants were recruited by GS and ML. All data were collected and present article was drafted by GS. All authors contributed to the design of the study, analysis, interpretation of data, critically reviewed and edited subsequent drafts of the article, and gave their approval for the publication of the final version.

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"Could You Work in My Team?": Exploring How Professional Clinical Role Expectations Influence Decision-Making of Assessors During Exit-Level Medical School OSCEs

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Decision-making in clinical assessment, such as exit-level medical school Objective Structured Clinical Examinations (OSCEs), is complex. This study utilized an empirical phenomenological qualitative approach with thematic analysis to explore OSCE assessors' perceptions of the concept of a "prototypical intern" expressed during focus group discussions. Topics discussed included the concept of a prototypical intern, qualities to be assessed, and approaches to clinical assessment decision-making. The thematic analysis was then applied to a theoretical framework (Cultural Historical Activity Theory—CHAT) that explored the complexity of making assessment decisions amidst potentially contradicting pressures from academic and clinical perspectives. Ten Australasian medical schools were involved with 15 experienced and five less experienced assessors participating. Thematic analysis of the data revealed four major themes in relation to how the prototypical intern concept influences clinical assessors' judgements: (a) Suitability of marking rubric based on assessor characteristics and expectations; (b) Competence as final year student vs. performance as a prototypical intern; (c) Safety, trustworthiness and reliability as constructs requiring assessment and (d) Contradictions in decision making process due to assessor differences. These themes mapped well within the interaction between two proposed activity systems in the CHAT model: academic and clinical. More clinically engaged and more experienced assessors tend to fall back on a heuristic, mental construct of a "prototypical intern,"

to calibrate judgements, particularly, in difficult situations. Further research is needed to explore whether consensus on desirable intern qualities and their inclusion into OSCE marksheets decreases the cognitive load and increases the validity of assessor decision making.

Keywords: medical education, clinical assessment, cultural historical activity theory, objective structured clinical examinations, prototypical intern

INTRODUCTION

The assessment of clinical, communication, and practical skills is an important component of health professions education for both feedback provision and informing progress decisions. Learners are placed and observed in a variety of settings—teaching facilities, simulation centers, and "real world" practice—to ensure that learning outcomes are achieved. Expectations of learners evolve through programs, with the focus changing from individual components (e.g., taking a history, measuring blood pressure, examining a body system) to more integrated comprehensive tasks that require focus on presentations, diagnostic reasoning, and management plans. Marking sheets may include checklists, rating scales for individual items or competencies, global scores and free-text comments. Assessors are a diverse group, including people in various combinations of academic and clinical roles, in different clinical specialties, and with different levels of experience as clinicians and assessors. Their assessments often rely on relatively brief observations of performance to inform judgements, drawing on both stated learning outcomes and their own experiences and expectations of good clinical performance (1).

Significant variability in clinical assessor judgements has been reported (2–5). However, variations often persist despite assessor training and standardized station design (6–8), raising concerns about cognitive bias in assessor judgments. Cognitive biases, also known as "heuristics," are cognitive short cuts used to aid our decision-making (9). Studies have shown that clinical decision-makers are at risk of error due to bias but often lack insight into their own biases (10). There are various causes of bias, and these include learned or innate biases, social and cultural biases, and environmental stimuli (11). This highlights a need for greater understanding of the cognitive processes of clinical assessors to inform strategies that enhance fair and robust judgements. Our previous research showed that judging candidate performance is complex, cognitively challenging and mentally demanding, particularly when borderline performance is observed in an "exit" Objective Structured Clinical Examination (OSCE) (12). In this "grey" zone of candidate performance, assessors used academic institutional marking criteria as a "safety blanket" to guide judgement, but also used additional criteria that were not necessarily explicit in the marking sheet, based on professional expectations (candidate demeanor and patient safety). The emergence of the concept of a "prototypical" intern (in Australia and New Zealand, this is a first postgraduate year medical graduate working under supervision in teaching hospitals) suggested that calibration was guided by a rapid, internal cognitive process based on a mental construct of assessors' expectations of a new medical graduate working in their clinical team.

In educational psychology this construct is known as a heuristic cognitive process, conscious or unconscious, whereby "rule of thumb" judgement decisions are made, possibly neglecting some presented information (13–15). This mental "shortcut" is faster and reduces cognitive complexity when working memory is overloaded by time pressure or increased complexity and is also more likely in experienced assessors who recognize patterns more quickly (14, 16, 17). Applying this concept to our previous study, assessors appeared to use a representativeness heuristic to consider "how much does the observed clinical performance of a senior medical student compare with what I expect of a 'prototypical' intern" (12)? Such representational heuristics may be influenced by assessors' roles and experiences, contrast effects, use of inference, working memory effects, different interpretations of behaviors, predisposition to consider a particular perspective (e.g., of the learner or patient), different pre-existing frames of reference, exposure to different learner cohorts, and the examiners' own clinical skills and perceptions of task difficulty (18–21).

So far, exploratory studies on assessor cognition have focused mainly on workplace-based assessments (WBAs), usually involving learners performing authentic tasks in clinical settings (5, 22–25). These studies consistently find that assessor judgements are complex (5, 23, 25–27). Examiner decision-making in OSCEs has been less researched, yet OSCEs remain a popular clinical assessment format despite the trend toward WBA and the challenges imposed by the recent COVID-19 pandemic. Whereas, WBA requires assessors to interpret the clinical case and set specific expectations within a marking framework, OSCE assessor judgements are guided by prescribed expectations and scoring criteria provided via the mark sheet by educators for more time-limited, standardized and pre-scripted encounters. This may require assessors to adapt their expectations of learner performance according to situational constraints. This paper reports a further exploration of the cognitive processes of exit level OSCE assessors with a primary aim of exploring how the prototypical intern concept influences clinical assessors' judgements in senior medical student OSCE. The secondary aim was to explore the complexity of making OSCE assessment decisions amidst potentially contradicting pressures from academic and clinical perspectives. Two specific research questions have been developed to address these aims—(1) How does the prototypical intern concept influence clinical assessors' judgements in senior medical student OSCE?

(2) how do OSCE assessors balance academic (focussing on achieving graduate outcomes) and professional (being suitable for work in a clinical team) expectations when assessing senior medical students?

METHODS

Study Context and Design

This research was informed by the interpretivist paradigm, which is a relativist ontology with a subjectivist epistemology (28). Interpretive paradigm focuses primarily on recognizing and narrating the meaning of human experiences and actions (29). In the interpretive paradigm, knowledge is relative to particular circumstances (historical, temporal, cultural, subjective) and exists as multiple interpretations of subjective experiences of reality (28). Empirical phenomenological qualitative approach was the methodology used to explore the concept of a "prototypical intern" from the assessors' perspectives (30). Phenomenology aims to explain the nature, essence and veracity of phenomena with the aim of understanding the complexity of the participant's lived experiences (31). Empirical phenomenology produces explanations that are grounded in the subjective experiences of the participants with an understanding of why and how things happen (30). This is expressed as a theory—a set of interrelated concepts that must be grounded in the meaningful experiences of the participants studied (30, 32).

We focused on exit-level OSCEs in Australian and New Zealand medical schools within the Australasian Collaboration for Clinical Assessment in Medicine (ACCLAiM) network. Their medical programs are mapped to a national medical graduate competencies framework and have similar integrated, outcomes-based curricula and OSCE processes, including some shared stations (33–35). This study was approved by the James Cook University Human Research Ethics Committee (H6833) and accepted by all participating universities.

Participant Recruitment

All thirteen ACCLAiM member schools were invited by email in November 2020 to purposefully recruit both experienced and less experienced assessors from their OSCE examiner pools. For consistency, an experienced assessor was defined as having five or more years of post-specialty training clinical practice, experience in assessing senior medical students and/or junior doctors, and a record of consistent and reliable scoring. Ten schools agreed to participate, providing a list of 39 assessors (25 experienced, 14 less experienced) who were invited by email to participate, supplied with an information sheet and provided written consent.

Focus Group Sessions

Focus group discussions (FGDs) were conducted to enhance exchange and clarification of participants' viewpoints by exploring how and why they think in a particular way (36). Semi-structured questions (see **Supplementary Material 1**) were developed by the research team based on the literature and their experience, focusing on responses and ideas surrounding the "prototypical intern" concept (12). FGDs had durations of 45–60 min and were conducted between December 2020 and April 2021, hosted on an online video-conferencing platform and facilitated by three of the authors (RBH, BMA and KDS). Sessions commenced with verbal confirmation of consent. Questions were used to open discussions or probe emerging issues more deeply. Discussions were recorded and transcribed verbatim by a professional transcription service. Participants were de-identified and differentiated by sex, level of examining experience and a participant ID. Data collection and analysis occurred concurrently and ceased after five FGDs as responses were no longer revealing new information.

Data Analysis

There were two stages of analysis. The first involved the use of inductive thematic analysis with emerging themes identified, based on the tenets of Braun and Clarke (37). This was aimed at understanding how the prototypical intern concept influences clinical assessors' judgements in senior medical student OSCE. The second stage involved the application of the findings from the thematic analysis to a theoretical framework that could explore the complexity of making OSCE assessment decisions amidst potentially contradicting pressures from academic and clinical perspectives. This analytical approach aided the positioning and contextualization of an applicable theory into the research (38).

We chose the third-generation cultural historical activity theory (CHAT) developed by Engeström (39, 40) because it provides a robust framework for analyzing professional work practices (41). CHAT has been applied widely in education research (42–46) and in medical education to investigate students and health professionals' knowledge of patient safety (47), patient care (48–50) and the consistency of OSCE examiner judgements and implications for examiner training (51). The framework has also been utilized to explore the authenticity of OSCEs, their impact on learning and the judgements of WBA assessors (48, 52).

The value of CHAT is that it develops "conceptual tools for understanding dialogue, multiple perspectives and voices, and networks of interacting activity systems" (53), centered on three core ideas: (1) humans act collectively, learn by doing, and communicate in and via their actions; (2) humans make, employ, and adapt tools of all kinds to learn and communicate; and (3) community is central to the process of making and interpreting meaning—and thus to all forms of learning, communicating, and acting within the context of a community (39, 54–56). This facilitates a systematic, multi-dimensional approach for exploring a comprehensive set of dynamic factors (41) that in this study relate to assessor judgements. The primary unit of analysis is an activity system (39), a network of sociocultural elements, with complex mediational structures, that shape the collective actions of individuals who are motivated to achieve a goal (57–59). The common elements within an activity system are subject, object, instrument, outcome, rules, division of labor and community (39, 54). The framework explores interactions between each of these elements both within and between two Activity Systems,

(AS) (48, 52) which were assigned as academic (AS1) and clinical (AS2).

Transcribed data were analyzed according to framework elements using NVivo version 12 software (QSR International, Melbourne, Australia). This approach utilizes both inductive and deductive analytical techniques and entails six stages: (1) Reading and re-reading the textual data to familiarize oneself with the content, (2) Identifying, devising, or refining a thematic framework to facilitate data analysis, (3) Indexing the data to corresponding themes, (4) Charting the identified themes (5) Mapping, and (6) Interpreting the themes generated (60). The coding process described by Meijer et al. (50) was utilized in which codes belonging to different parts of the CHAT-model and contradictions within and between the AS were created, reviewed and, if necessary, revised throughout the analysis. The coding process was completed by two authors (BM-A and RH), confirmed by two other authors (SS and KD'S) and discrepancies were resolved in a consensus meeting.

RESULTS

Participants' Characteristics

A total of 20 assessors participated in the five FGDs, each with between 3 and 6 participants. The number of participants per group was kept low to foster rich FG discussions. There were 7 females and 13 males with, respectively, 8.4 and 14.8 mean years of clinical experience (range 1–45 years). Fifteen were experienced assessors (5 females and 10 males) and 5 less experienced (2 females and 3 males), almost all in dual roles as academics engaged in medical education as well as clinical practice. Less experienced assessors were all clinicians, although one also held an associate lecturer role. All participants were coded by their level of experience (Experienced or Less experienced; Exp or Less), sex (Male or Female; M or F) and an individual participant number. Details of the participants' characteristics are shown in **Supplementary Material 2**.

Thematic Analysis Findings

Thematic analysis of the FGD transcripts revealed four major themes in relation to how the prototypical intern concept influences clinical assessors' judgements in senior medical student OSCEs. These themes are (a) Suitability of marking rubric based on assessor characteristics and expectations; (b) Competence as final year student versus performance as a prototypical intern; (c) Safety, trustworthiness and reliability as constructs that require assessment; and (d) Contradictions in decision making process due to assessor differences.

Suitability of Marking Rubric Based on Assessor Characteristics and Expectations

Participants demonstrated a good understanding of their roles as OSCE assessors within AS1 and the requirement of compliant use of the marking criteria proforma to assess students' clinical performance.

> "For the OSCE, from my experience, there's a proforma, there's specific questions and there's marking attached to it, and then there's always a clear description. So essentially, when I'm assessing a student using that proforma, I will follow what's written" Exp-F-P09

Participants reported knowing that they had to complete both the checklist and global rating scales of the marking rubric and claimed to understand the rationale for adhering to the criteria, despite sometimes experiencing a personal cognitive dissonance with the rubric.

> "I feel like my job as an assessor in OSCEs is to follow the assessment sheet and follow the criteria fairly closely. And I have been in situations when I've felt that the assessment criteria didn't necessarily reflect what I would expect an intern to be capable of. And so, have provided feedback after the assessment that I felt that, you know, perhaps the assessment criteria, were more pitched at a fourth-year level rather than a fifth-year level or something like that. But I felt that because their criteria for consistency across examiners that it's really important to stick to them." Exp-F-P07

However, when engaging with the marking criteria to assess the students, participants also believed that the listed criteria did not necessarily reflect all aspects of the expected performance. At this point, they felt that there were relevant elements of subjectivity from their clinical experience, and they had their own personal views about expected standards that related to their clinical work environment.

> "But even just reflecting on our OSCE about a month ago, yeah, examiners still have different views, personal views about what they think the minimum standards should be, despite how the committees…adjudicate as to what is the minimum standard. So, there's always going to be some difference there." Exp-M-P05

Competence as Final Year Student vs. Performance as a Prototypical Intern

The concept of the "prototypical intern" was applied as the assessors began to critically appraise and compare the final-year medical students' performance to that of their junior doctors/interns in the clinical work environment. For most assessors, the comparison between the final year medical student and the prototypical intern happened intuitively, where the student was mentally placed into the AS2 environment for evaluation.

> "When we're assessing in that final year in the clinical assessments, to my mind, we are explicitly telling students and other examiners, that the level we are setting the assessment at is: will you in the next few months be able to work as a PGY1 doctor, and be able to give me a reasonable differential diagnosis and some initial management steps?" Exp-M-P13

> "When I think of how to examine these students, I do also think as to what I expect…a standard intern to be. It's a bit easier because I was an intern two years ago. So, it's quite fresh in my mind as to the standard that I was at, and what my peers were at.

> And then last year, for six months, I was a tutor for sixth year medical students. So, I had a good grasp as to what level they were at, as they were just reaching the end of their internships. And so, looking at that cohort, and teaching them each week, I was able to know what I thought the average graduate should be at." Less-F-P15

> The concept of the prototypical intern was used to make judgements at all levels of performance—excellent, borderline or failing student. Interestingly, the ideal of a prototypical intern has been around for a long time.

> "My views are pretty similar to Exp-M-P14. And they probably began about 30 years ago, when I was an undergraduate at XXX university. And we were told…as we neared the final examinations, the way we would be assessed is as an intern, and we would not pass if we harmed or killed the patient. Otherwise, we're pretty well, right. And that's something that has probably stuck with me all the way along. I tend to use it, if I'm assessing someone, really for a fail. And I say, "Okay, have they caused harm to that patient, as an intern, or has it been worse?". And if that is the case, which is rare, but if it is, then I'll give a clear fail. If I think it's something that, you know, can be addressed, and requires some, you know, remedial education or something, then I know that a borderline is going to get them a supplementary exam and they can study harder. So, for me, it's similar. But it's the distinction between a clear failure as regards to pass/fail" Exp-M-P16

> "So when I mark the student, I would think of an intern that is safe, and minimally competent, at the level, and above expectation, is obviously above the level of intern, a minimally competent intern." Exp-M-P06

However, one assessor did not support the idea of using the prototypical intern as the yardstick, finding it unfair for final year students who had yet to experience the intern year.

> "The only fair way we can assess them is where they are in the course. I don't think there's any way we can be building into our system, some second guessing about…what they're going to be like in a year's time. That's just not fair. I think the only way it's fair to do that is to say, this is a fifth-year medical student, and you judge them at the level of your expectations of a fifth-year medical student. All sorts of things could happen in the next year." Exp-M-P2

Other assessors agreed that it was unfair to judge final year medical students at the level of an intern but attempted to provide a rationale for doing the comparison and described seeking evidence of foundational learning on which internship performance could be constructed.

> "And so I think when it comes specifically to final year fifth year XXX University OSCEs, I do have that picture of when they're that first day intern, how will … this intern do? When it comes to final year OSCEs, I feel like I interact with a fair number of interns in ED, and I kind of have this idea of what an intern should know when they first come onto the floor." Less-F-P18

> "Yeah. But if you're looking at things that would concern you about a student progressing, okay, I agree with the notion that we're not looking for perfection, but we're looking for evidence, if you like, of something that's already there, rather than something that might need to be added on in turn, and I'm thinking more of a skill rather than content" Exp-M-P01

Safety, Trustworthiness, and Reliability as Constructs That Require Assessment

Assessors often looked for the professional behavior characteristics of a good intern in candidates' performances. While most of these qualities are not readily assessable in an OSCE, and thus tend not to feature in marking rubric, they still influenced examiner judgements. The criteria that assessors considered during their judgements included important professional behaviors such as good communication, safe practice, trustworthiness, reliability, and insight into one's own limitations and scope of practice.

> "We're all wanting that registrar, or that student, or an intern whose knowledge isn't as good. But we'll trust them, we'll be more confident with them. If the knowledge isn't good, then that's easily fixed. If they're not trustworthy…then that's really an issue. But how do you test that in an OSCE?" Exp-F-P03

> "I tend to be looking at qualities in a student and that hypothetical intern that I have in mind is the one that I would trust, to work for me. And I'd be able to trust the information they were giving me; I'd be able to trust that they got the information that they should have got. And I would be sort of, I'd be able to rely on that. And I'd expect to then go and see the patient with them or separately, and to be able to see something that was consistent with that." Exp-M-P01

It was recognized that unconscious positive bias toward candidates of perceived similarity to self may also influence assessor judgements, as a cognitive overlay to the prototypical intern construct.

> "I imagine we, even if it's just subconsciously, make judgements on how they dress, how they walk, how they talk, how much they're like us because we will probably favor them positively if we think they're like us. How well they interact with the patients, how polite we feel they are, what it is that makes them safe or what makes them unsafe, how prepared we feel they are all probably goes into whether or not we think that they're a responsible and trustworthy candidate." Less-F-P18

Assessors also acknowledged the role of other health professionals and health service consumers in the AS2 system and integrated these perspectives into their judgements of candidate performances. The assessors expected students to demonstrate an understanding of the professional and interprofessional relationships that exist within the clinical environment. Less experienced assessors, in particular, valued the input of the simulated patients (SP) in making judgement about students' performance.

"I always also try to get a gauge of what the SP or the patient felt overall as well to see their thoughts because you know they've been doing this for years and they've seen many different students compared to us, that's also a good gauge I think." Less-M-P19

"Where a lot of their problems come from is, as Less-M-P17 alluded to, [when they think]"Well, I'm the doctor." They won't listen to the nurse; they won't escalate things." Exp-M-P16

Contradictions in Decision Making Process Due to Assessor Differences

Assessors identified some areas of conflicting views. This mainly related to the conflicting expectations between activity systems. The assessors felt that faculty is focused on performance on the day, while assessors are more concerned with the general character of the final year medical students and their suitability to fit into the medical team in the clinical environment.

"One of the things that our [postgraduate specialty] college exam stressed was to avoid the term borderline, because it allowed the examiner to sit on the fence. And so, we tried to make the examiner be a little bit more specific, just below or just above, but don't use the term borderline. And that's something that I've held, personally, in assessing a student's overall competency. Try and work out what it is that makes them safe or what makes them unsafe but avoid borderline." Exp-M-P05

"We use below expectation [and] at expectation. And that's really interesting. I hadn't reflected on this before. But I think that does bring in what's the expectation? So, if you're using that sort of language, it probably does encourage [if] the expectation is intern level or…graduate, ready to graduate into final year. So, I hadn't thought about that before. But now I think about it when I see those words in a marking rubric for the global score, it does point my attention to what's my expectation? So, it probably does encourage the use of the prototypical intern." Exp-F-P07

Participants also flagged possible differences between male and female assessors as well as junior and experienced assessors; assessors marking stations inside or outside of their particular discipline and among postgraduate specialty college assessors.

"And one of the things that I've had to do in my [postgraduate specialty] College job, as chair of examiners, is to actually sit with the cohort of examiners as a co-examiner to see what the discrepancy is. And you are absolutely right that the younger examiners, and often the women, the younger women examiners are tougher than the old men. And it really is something I think examinations have to take into account that the old retirees often [have] soft touches. And they will, because of their experience of having seen mistakes made and rectified, they will be a bit more lenient. So, I think we do have to be careful about examiner variability." Exp-M-P05

"But one of the interesting things we're finding is that it's more junior examiners, who might only be three or four years out themselves that seem to have much higher standards of the students. And those of us who've been around for a bit longer seem to be a little bit more willing to tolerate maybe poor performances." Exp-F-P04

"We've got all sorts of examiners and obviously some [postgraduate specialty] colleges and disciplines rely more on OSCE than others. And I do notice that the colleges who do use OSCEs if we have some of their examiners who are familiar with the college exams come to examine, they tend to be a bit more hawkish. So, they do, I think, bring their expectations over. I think it's almost unavoidable." Exp-M-P10

"At medical school level, it's sometimes difficult to get examiners who have enough knowledge of the subject to do a comfortable OSCE. I'm comfortable with general medicine, I'm comfortable with pain medicine. I am a neurologist. And I've noticed that my co-examiners who are not neurologists let some things through that I would object to." Exp-M-P05

"It's difficult to get the examiner line-up the level that we are expecting. So obviously, we have the specialists in that particular discipline doing the examination in that OSCE station, they will expect more as Exp-M-P05 mentioned… because they are the specialists in that discipline. And they will always argue saying, but the student won't be exposed to the same scenario in year four, so, we need to set the bar high enough to be an exit-level." We will then remind them, the student will still improve their communication skills, their history taking skills, examination skills." Exp-M-P06

To improve the examiner decision making process, the participants suggested the use of calibration sessions and well-defined performance descriptors.

"Great descriptors are really important. For example, I'm working in intensive care [and] don't have interns. They have to be PGY [postgraduate year] two, three, and have to be good to get to ICU. So, without good descriptors, I probably wouldn't know what the expected level is going to be." Exp-F-P09

"We have a breakout for each station and all the examiners on one station have anywhere from 30 to 40 minutes to discuss that station to go through it in detail. And usually, we have the person leading that as one of the academics who has helped at least quality assure, if not write, the OSCE so that it can be standardized, and you can thrash out some of those questions about what we're actually looking for. And I think that's a useful approach." Exp-F-P04

"Perhaps having kind of explanatory dot points as to what an excellent candidate would be. And then you know what [a] very poor or definite fail is…Then the examiner can …they had a few excellent qualities, but they did miss some, and therefore I'll put them…not quite there. Rather than explaining each individual one, just giving them a bit of a sense as to… what they could do to move them further in one direction than the other." Less-F-P15

Application of CHAT: Interactions Within and Between the Activity Systems

The identified themes mapped well within the interaction between two proposed activity systems in the CHAT model: academic and clinical. In relation to how the CHAT can further explain and structure these perceptions, we present OSCE assessor judgements as an interaction within and between

two activity systems (AS)—AS1 "academic" and AS2 "clinical," which function independently but collaborate to produce an outcome. The interactions commenced in AS1 with the Subject (assessor) engaging with the marking rubric (Mediation Tool 1), provided by the academic faculty (Community 1), based on internal interactions with faculty requirements (Rules 1) and the organization of the community (Division of Labor 1), with the aim of facilitating judgement on demonstration of competence (Object 1) by final year medical students. At this point, should the assessor feel there is a misalignment of the marking criteria (Instrument 1) with their expected performance standards from AS2 elements (Object 2—demonstration of safe clinical practice, Rules 2; Community 2; Division of Labor 2; and Instrument 2), the subject (assessor) proceeds to mentally adjust Instrument 1 (OSCE marking criteria) to create a shared object—capability of the medical student to transition as a safe, reliable and trustworthy junior member of the clinical team, based on the concept of the "Prototypical Intern" that is better aligned with their expectations. **Figure 1** summarizes the application of CHAT to our thematic analysis.

The academic AS1—the medical program—focuses on curriculum development and delivery, specific learning outcomes, assessment tasks, mark sheets and progress decisions, whereas the clinical AS2 focuses on global application of knowledge and skills in authentic clinical practice. The activity system of authentic clinical practice is different in almost every respect to the academic system, but assessor decision-making requires an interaction between two AS because learners are transitioning from one to the other and the assessors work in both systems. The subject in the clinical practice AS is a practitioner whose object is to care for patients. However, when this practitioner is called into the academic AS to serve as an assessor, the object in this AS is to observe and make progression judgement on the level of competence demonstrated by learners. These manifestly divergent goals/ objects in the two activity systems create tensions and contradictions for the subject. While the OSCE is focused on written rules of standardization as indicated in the marking rubric, the assessors prefer to focus on unwritten but fundamental rules and values that are core to authentic, safe and trustworthy clinical patient care.

DISCUSSION

This study uses the CHAT as the theoretical framework to contribute new knowledge to understanding the decision-making processes of assessors during clinical assessment of candidates at a major professional transition point—graduating from a primary medical degree course to entering the workforce. Clinical assessors make judgements that combine, to a varying extent, two interacting sets of roles and experiences that have different origins. The academic construct is the achievement of agreed, expected, graduate learning outcomes; in contrast, the clinical workplace construct is the ability to successfully work within professional settings. The former is reliant on knowledge, skills and behaviors represented in marking sheets in several scheduled, controlled assessment events, one of which is the OSCE. Academic progress decisions are informed by combining assessment data from many assessment events, converting a series of "snapshots" to a "low frame-rate" moving image. The clinical workplace construct is reliant on respect, organization, reliability, teamwork, and trustworthiness exhibited over time. Clinical assessors form impressions of what constitutes a "safe" junior doctor, a "prototypical intern," through personal clinical experience of working with graduates. These impressions may be shared by close colleagues but different to those in other fields of health care, producing a form of cognitive bias that is likely based on a combination of "signal" and "noise." This may provide an implicit set of "rules" that reflects "noise" and necessitates adaptation of the academic marksheet. When candidate performance is "borderline," time is pressured or the assessor is more experienced, this characteristic heuristic, "how would this person fit into my clinical team?" is likely to be relied upon as a benchmark, either consciously or unconsciously, merging rules and influencing resulting judgements. The application of CHAT explained the intricacies and contradictions that may occur within OSCE assessor decision-making.

This study explains how assessors in certain circumstances fall back on the clinical workplace experience to influence judgements about candidates. The extent of the influence may depend on the balance of academic and clinical experiences of individual assessors. Predominantly, clinical assessors may respect the academic rules, but over-ride them or merge them with clinically informed rules. This may explain why some assessors add components to checklists, add data points to rating scales and provide negative feedback to faculty on marksheets content. Another position may be that the more academic and less clinically relevant the marksheet, the more assessors may follow clinical logic in making decisions on clinical performance—overriding the marksheet criteria. The dominance of one or other activity system may also explain why examiner training appears not to be effective and why "doves" and "hawks" are difficult to change. "Debiasing" training is becoming popular to improve clinical reasoning, but success may be elusive (61). It may also explain the popularity among clinicians of the concept of Entrustable Professional Activities (EPAs), which adopts a more holistic view of performance (62). Of particular interest is that assessors strongly held the notion that clinical performance was more than just the sum of its parts, and that professional behaviors and identity (e.g., trustworthiness, safety, and reliability) were the most highly valued attributes in candidates—over and above just the taught content. Further, assessors believed that these attributes could be judged in an OSCE station. While our participants framed their "prototypical intern" characteristics around some relatively objective professional traits such as safety, other traits e.g., trustworthiness introduce the possibility of an underlying source of cognitive bias. Halo effects derived from superficial perceptions of the similarity of candidates to assessors may be able to falsely inflate feelings of trustworthiness and thus increase the inter-rater variability when using the construct. Additionally, the assessors were seeking and interpreting performance evidence based on their existing beliefs and expectations within the heuristic of the "prototypical intern" during the OSCE,

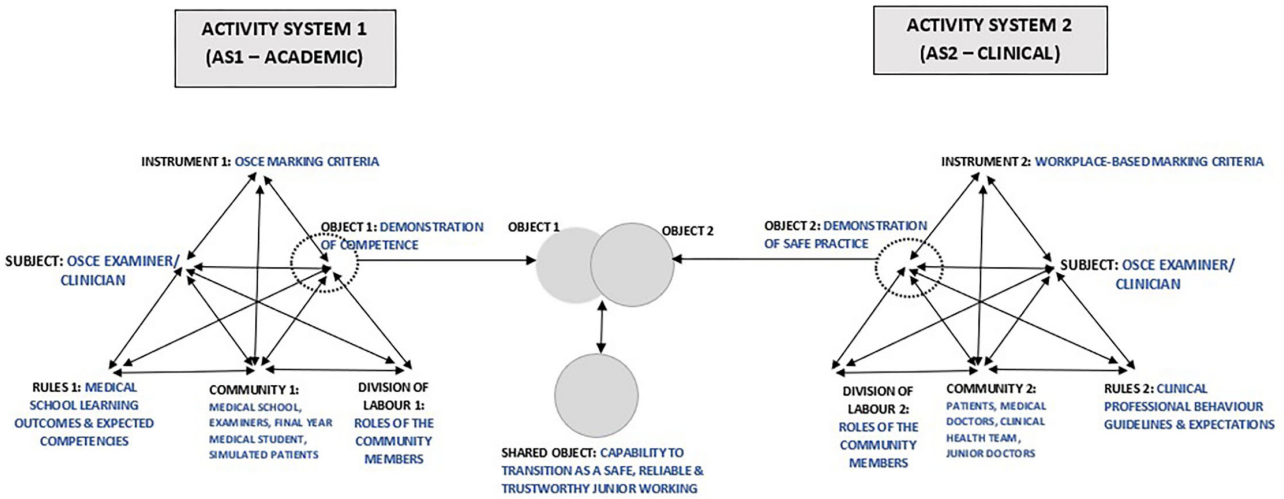

FIGURE 1 | CHAT in the final year clinical OSCE.

implying confirmation bias (63). Future research exploring the finer details of the individual components of the prototypical intern construct e.g., what constitutes "trustworthiness," would provide greater insights into these potential sources of bias.

The relevance of this theory to other forms of clinical assessment, or clinical assessment at course levels other than the graduating cohort, cannot be determined from this study. The analogy may be stronger for exit assessments for other health professionals, where clinicians are assessors in an OSCE-like event. The model may be less relevant to WBA, where the clinical workplace activity system is likely to dominate, even though relatively low failure rates and the "failure to fail" phenomenon have been reported (64). Although the prototypical intern concept may be less relevant to OSCE than WBA because of standardization of encounters and marksheets, acknowledging, and discussing prototypical intern qualities in standard setting may help drive fairer assessment. We believe that the contradictions have not been resolved, but rather clarified, potentially assisting further research. There may not be a "final" theory, but a clear message emerges: assessor judgements balance potentially conflicting perspectives that should be acknowledged and discussed in assessor training, standard setting, and calibration. Future research should investigate the identified contradictions.

There are implications for both marksheet design and assessor training. Marking rubrics may reflect what learners are "taught" but not necessarily the expectations of their imminent clinical service roles, suggesting a potential disconnect between achieving program learning outcomes and working in the clinical environment. The OSCE may currently present patient care as a set of individual tasks, whereas healthcare is being conceptualized increasingly as a team activity (65). Would marksheets that are more aligned with clinician constructs improve utility and compliance amongst predominantly clinical assessors? Should assessor training always include group discussion of how academic and clinical workplace constructs align as part of a more explicit "de-biasing" exercise? Should improving the fidelity of OSCEs to better reflect interprofessional healthcare teams not be possible, OSCEs may be better used as assessment "hurdles" that complement an increased emphasis on workplace-based assessment methods. These findings support calls for a review of the role of the OSCE as a clinical assessment tool (52).

LIMITATIONS

Less experienced assessors were less represented because they were more difficult to recruit to interview sessions due to less flexible workload in their clinical service and specialty training requirements and a preference by medical schools for utilizing experienced assessors where available. Therefore, the perspectives of less experienced assessors may be under-represented. "Volunteer bias" is also possible, where assessors who follow medical school examiner training guidelines volunteered to be a part of this study—and "rogue examiners" did not volunteer. Hence, the statement that assessors usually followed institutional rules and guidelines for the OSCE may be overrepresented in this work. Additionally, the authors are insider researchers, and this could serve as potential bias, however, trustworthiness and credibility of the findings were enhanced through member checking and analytical group confirmations.

CONCLUSION

Clinical assessment judgements in exit-level medical school OSCEs are complex, with individual assessors balancing perspectives from two different but interacting constructs that overlap and compete. The first is that of the academic system which is more task-oriented, emphasizing knowledge, skills

and behaviors, based on achieving agreed graduate outcomes. The second is that of the clinical workplace, where graduates will soon have defined roles and responsibilities within a clinical team. The balance of the influence of these activity systems on judgements varies for individual assessors. Less experienced assessors tend to follow the academic rules listed in marksheets. More clinically engaged and more experienced assessors tend to fall back on a heuristic, mental construct of a "prototypical intern," to calibrate judgements, particularly, in difficult situations. This heuristic is based on personal clinical experience and discussions with workplace peers, emphasizing professional attributes and trust, and may lead to a form of confirmation bias, that dominates thinking when candidates are "borderline;" time is pressured; or assessors are more experienced. Further research is needed to explore whether designing assessment marksheets and assessor training to more closely align the two systems decreases the cognitive load and increases the validity of assessor decision making. Designing marking frameworks should consider the possible introduction or amplification of unconscious biases. Further, assessor training may benefit from explicit "de-biasing" by aiming to increase awareness of a heuristic that is shared by assessors and caution against over-reliance on this strategy, thereby reducing unconscious bias.

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 human participants were reviewed and approved by the James Cook University Human Research Ethics Committee under Permit H6833. In addition, all participating schools obtained ethics approval from their local Ethics Committee. The participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

BM-A, RH, and KD'S conceived the study and conducted the focus groups. BM-A, KJ, RH, KD'S, and SS advised on data analysis and interpretation. BM-A, RH, KD'S, SS, AC, and RT contributed to writing the original draft of the manuscript. All authors facilitated collection of data, reviewed, edited, and accepted the final version of the manuscript.

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Gender Matters: Understanding Transitions in Surgical Education

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Introduction: Diverse transitions are elemental to medical career trajectories. The effective navigation of such transitions influences a sense of belonging and wellbeing, positive relationships, and good engagement and attainment within new contexts. Using Multiple and Multidimensional Transitions (MMT) theory as an analytical lens, this paper aims to answer the research question: "What gendered transitions do female surgeons experience, and how do these gendered transitions impact them?"

Methods: We conducted a qualitative study drawing on narrative inquiry, with face-to-face and online semi-structured interviews with 29 female surgeons across nine surgical specialities in Ireland and Scotland. This paper is part of a larger study including male surgeons, other colleagues and patients of female surgeons. The female surgeons in this paper were purposively sampled using maximum variation sampling across several levels (consultants, trainees and middle-grade doctors), as well as six who had transitioned out of surgery. Framework analysis was employed to interrogate the interview data.

Results: Five overarching types of transitions were identified across surgical education but only three of these transitions—work, culture and health—were primarily experienced by female surgeons (not male surgeons so were considered gendered), thereby impacting social, academic, and psychological domains. The remaining two types of transition—education and geography—were seemingly experienced equally by female and male surgeons, so are beyond the scope of this paper focused on female surgeons' gendered experiences.

Conclusion: This novel qualitative study drawing on MMT theory illustrates how multiple gendered transitions interact and impact female surgeons across the surgical education continuum. Aligned with MMT theory, family members and others are also purportedly affected by female surgeons' transitions. Healthcare educators, leaders and policymakers need to better understand gendered transitions and their impacts to improve support for female surgical trainees on their educational journeys.

Keywords: gender, transitions, surgical training, surgical education, surgical career

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INTRODUCTION

Transitions in medical education are extensively cited in the literature, explained through different models and theories, including Multiple and Multidimensional Transitions (MMT) theory and several of Vygotsky's theories (1–6). Of particular interest to medical educators are transitions from preclinical to clinical medical student (4, 7), from final year medical student to doctor (8–10), and from specialist trainee to consultant (11, 19). While the focus has been on transitions across different stages of training, very little has been published on surgical education transitions, considering the multiplicity and multidimensionality of transitions and their interrelations with female gender.

Multiple and Multidimensional Transitions Theory

Jindal-Snape (1) first introduced MMT theory in educational contexts to better understand transitions. Looking at international students' transitions, Jindal-Snape suggested that transitions were many and multidimensional, with the physical, human and social environment playing key roles in transition experiences. MMT theory highlights the multiple domains involved in transitions, including physical, cultural, psychological and social. Jindal-Snape highlights that individuals will experience transitions, for example, moving to a new organisation (affecting their physical domain) or transitions related to relationships with colleagues, patients, family and friends (affecting their psychological and social domains). Whilst one domain might remain constant, others can be in a state of flux, and these multiple domains create complex interrelationships. MMT theory also states that individuals' transitions can trigger transitions for their significant others and vice-versa (12). Moreover, a change in one domain often triggers changes in other domains, e.g., a change in working relationships with colleagues in the social domain may trigger positive and negative changes in the psychological domain.

Medical Transitions

Transitions are individual, social and contextual processes (13). Westerman and Teunissen [(14), p. 372] define a medical transition as "a period of change in which medical students or doctors experience a discontinuity in their professional life space forcing them to respond by developing new behaviours or changing their professional life space to cope with a new situation." Only a few recent studies in healthcare have used MMT theory to better understand medical transitions. These include a Scottish study of the trainee-to-trained doctor transition, including the development of a conceptual model of the trainee-trained doctor transition (15, 16, 19), an Australian study exploring new healthcare graduates' transitions (17) and an English study exploring new doctors' transitions to practice utilising participant-voiced poetry (18). Most relevant to the current paper, Gordon et al. (16) developed the Transition-To-Trained Doctor (T3D) model to reflect the complexity of how doctors experience trainee-trained doctor transitions, taking into account various personal and professional domains and contexts. MMT theory argues that transitions are complex, iterative and affect other changes. A related study by Gordon et al. (5) identifies multiple intersecting transitions triggered by the pandemic in multiple contexts, challenging the notion of transitions as simple and linear. While Gordon et al. (16, 19) hinted at the importance of gendered transitions in their longitudinal case study of a female surgeon who was transitioning through surgical training (trainee doctor) to consultant (trained doctor), none of these studies thus far have specifically examined the impacts of the female gender on these transitions. There is a lack of literature on gendered transitions and hence the importance of further exploring female gender in this paper.

Female Gender and Surgical Training

One of the most significant changes for women in surgery in the twenty-first century is increased numbers of women studying medicine, with women typically making up at least 50% of graduating medical school classes (20). However, the number of women pursuing surgical careers is still very low, with causative explanations including gender-based bullying, gender discrimination, harassment, and lack of mentoring and role models in surgical practice (21–25). In addition to these barriers, studies have identified transition challenges for female surgical trainees. Multiple types of transitions experienced by female surgeons include temporal (e.g., into higher education, clinical learning, clinical practice and clinical leadership) and spatial (e.g., urban-rural, clinician-academic) (26). There are also transitions at the individual, interpersonal and organisational levels. For example, a change in one's health can trigger a non-normative life transition leading to changes in identity, status, interactions and relationships, beliefs and values, requiring substantial psychosocial and cultural adaptation (1, 12). Indeed, recognising that one type of transition is probably one of many experienced by trainees is important. Demonstrating this multidimensionality, research across the medical education continuum has shown that transitions impact the individual, interpersonal relationships, careers and the system, resulting in raised stress levels, negative emotions and burnout (27, 28). With these multiple and multidimensional elements of transitions, it has been shown that doctors cannot be fully prepared for the transitions into all aspects of their work (29).

STUDY AIMS AND RESEARCH QUESTIONS

This study addresses research gaps identified in the literature on gendered transitions for female surgeons. It offers novel insights by exploring in-depth interviews with female surgeons as they reflect on *all* transitions, not one specific transition at a specific stage of training, as other research has tended to do (15, 16, 18, 19). Furthermore, the current paper is speciality-specific, focusing on surgical educational transitions, and it includes transitions across surgical speciality training to consultant level, as well as female surgeons transitioning out of surgery rather than only at the start or end of training. It is a multi-country study (Ireland and United Kingdom) and adopts a novel gender- and

TABLE 1 | Participant characteristics.

Characteristics	Female surgeons
Country:	
Ireland	7
Scotland	22
Ethnicity:	
White	23
Middle Eastern	2
Asian	4
Age range:	
30–39	15
40–49	11
50–59	3
Speciality	
Breast surgery	4
Colorectal surgery	2
General surgery	4
Orthopaedic surgery	4
Paediatric surgery	2
Plastic surgery	8
Transplant surgery	2
Upper gastrointestinal surgery	1
Vascular surgery	2
Level of training	
Consultants	8
Trainees	13
Staff grade*	2
Transition out of surgery	6

**Staff grade doctors have permanent positions as middle-grade doctors. They work under consultants and must have more than 6 years' experience in a speciality (www.bma.org.uk).*
Male surgeons' characteristics can be found in Offiah (42).
Participants provided their self-identified gender, and all participants in the larger study identified as either female or male.

transitions-focused lens. Using MMT theory as an analytical lens, this paper aims to answer the research question: "What gendered transitions do female surgeons experience, and how do these gendered transitions impact them?"

MATERIALS AND METHODS

Study Design

We used a qualitative study drawing on narrative inquiry, with face-to-face and online semi-structured interviews underpinned by social constructionism, which asserts that people construct meaning as they interact with their worlds (30). The study draws on MMT theory (1) as the analytical lens to explore female gendered transitions across the surgical training continuum.

Context

This study was conducted within surgical specialities in Ireland and Scotland. Within Scotland in the United Kingdom, the surgical training programme involves completing a 2-year core surgical training, with trainees' progress being monitored regularly, and completion of the programme depending upon satisfactory outcomes at the Annual Review of Competence Progression (ARCP). An interview follows this to enter the specialist training programme of 4–6 years, depending on the surgical subspecialty. In comparison, Ireland's National Surgical Training Programme runs an 8-year training programme. The first two years (similar to the Scottish system) consist of six months of general surgery, 6 months within another speciality in the first year, and speciality-specific rotations in the second year. Trainees are assessed via the Competency Assessment and Performance Appraisal (CAPA) throughout the two years. The remaining six years of training is focused on surgical subspecialty training. At the end of the training, trainees are awarded a Certificate of Completion of Specialist Training in both countries, allowing them to become surgical consultants. In both Scotland and Ireland, training occurs within a public healthcare system, where care is free at the point of delivery.

Sampling and Participants

Participants were purposively sampled employing maximum variation sampling from six hospital groups in Ireland and seven health boards in Scotland (31). We recruited participants through emails, posters, snowballing, and through a clinical reference group (see "Acknowledgments" section). Twenty-nine female surgeons from Ireland and Scotland participated in this study. The maximum variation sampling helped to identify diverse views and experiences (32). For example, female surgeons are more likely to work in certain surgical specialities like paediatrics, obstetrics and gynaecology, and plastics (33–36). In contrast, male-dominated specialities include orthopaedics, neurosurgery and thoracic surgery (37–41). Therefore, it was essential that recruitment included participants from various specialities to explore diversity across both female- and male-dominated surgical specialities. **Table 1** illustrates the range included in this study across nine different surgical specialities in both countries, interviewees' different grades and training stages. We received ethical approval from six sites in Ireland and one overarching approval in Scotland.

Data Collection

Data collection occurred between November 2016 and April 2019, as part of a wider study involving 60 interviews with female and male surgeons (only female surgeons' data are presented in this paper), female and male colleagues (e.g., anaesthetists, nurses and physician associates), and male and female patients. **Table 1** provides the demographics of female surgeons only [as they are the focus of this paper; the demographic characteristics of all sixty participants can be found in Offiah (42)]. A semi-structured approach to interviewing was adopted with the same researcher (GO) conducting all interviews. GO used a narrative interview method to elicit participants' experiences. Participants were initially asked to recount their surgical education journeys, from their undergraduate medical education to postgraduate training and, where relevant, to consultant surgeons. **Table 2** provides an example of questions used. All interviews were audio-recorded with permission, and audio files were transcribed. Participants were assigned unique identifiers to maintain their anonymity.

TABLE 2 | Questions used during interviews.

Questions used in the narrative interview
Please tell me the story of your life as a surgeon beginning with your medical training from medical school to postgraduate training and where relevant to surgeon consultant. Please include all events and experiences that have been important to you personally.
Please describe your own most memorable stories of these key experiences along your surgical path.

Participant numbers for our current study provided sufficient *information power* given that we collected 36h of rich, in-depth interview data (43). The study had a focused aim (i.e., to explore female stakeholders' lived experiences of gender in surgery), tight sample specificity (i.e., female surgeons), use of established theories [i.e., MMT theory (1)], high-quality researcher-participant dialogue via in-depth interviewing and an in-depth, team-based approach to data analysis (43, 44). Appraisal of information power was conducted throughout the analysis process, beginning with SS and CER reviewing three initial interviews, with interviewing technique affirmation and feedback provided to author GO to further enhance interview dialogue.

Data Analysis

The dataset was analysed using a five-step Framework Analysis approach (45), including familiarisation, framework development, indexing, charting and mapping. We (GO, SS, CER, and SC) participated in this inductive process, beginning with identifying key themes within a subset of data. Listening to audios and reading transcripts, GO coded the entire data using NVivo, with SS, SC, and CER checking portions of coding. The team discussed and agreed upon new themes and sub-themes identified through the analytic process. The final framework was written and defined in an 18-page coding document (available on request from the corresponding author), which comprised five themes based on *what* participants said and one theme based on *how* events were narrated. As mentioned above, the data were examined cross-sectionally through the lens of MMT theory (1).

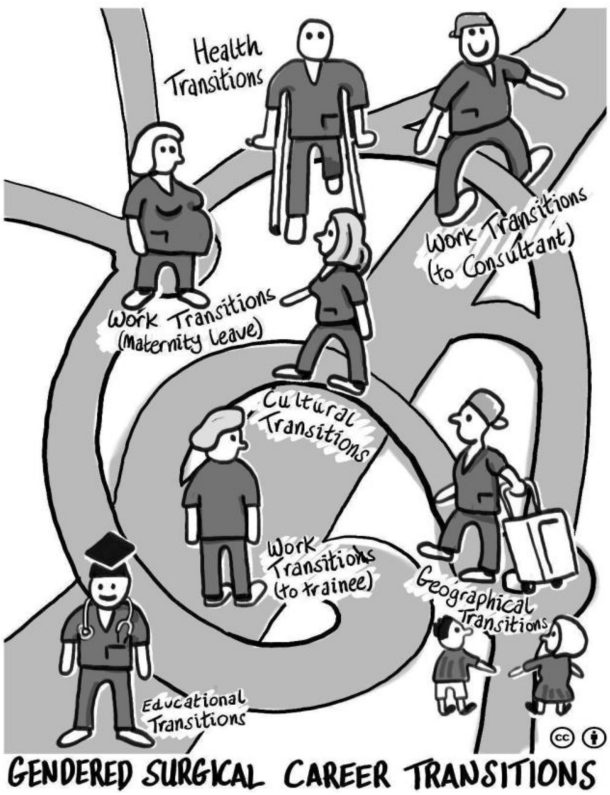

FIGURE 1 | Illustration of multiple transitions.

Qualitative Rigour

We established rigour through ensuring team reflexivity, internal coherence and crystallisation. A team reflexivity exercise enabled us to better understand research team members' perspectives, thereby contributing to a more rigorous analysis process (46). The first author of this paper is a female surgeon of colour. Our analysis team of three other researchers included two further females and one male. Two of our four-person team have clinical backgrounds, and two are non-clinical health professions education experts. We range in our levels of experience with qualitative methodologies and gender research (one expert, two intermediates, one novice). Internal coherence, an essential element of research quality, refers to the alignment between ontology, epistemology, methodology and methods in qualitative research (47). We achieved this internal coherence by ensuring alignment between our relativist ontology, constructionist epistemology, interpretivist qualitative methodology, and narrative interview methods. Finally, crystallisation embraces multiple realities and its use ensures methodological rigour within qualitative approaches. For this study, crystallisation ensured data completeness by highlighting the authors' positionality within the research, the bringing together of multiple theories, multiple researchers, and reflexivity (48).

RESULTS

Transitions were identified as individual, social and contextual processes in our Scottish and Irish data. The female surgeons described numerous transitions triggered by their surgical training, identifying these as the most challenging within their medical career trajectories, with gender having considerable impacts on their surgical training and careers. Five overarching themes related to transitions were identified from our framework analysis, three of which were highly gendered for females (work, culture and health), as they were only narrated by females and not male surgeons in our larger study. The two

remaining transitions (education and geography) did not appear gendered for females as they were reported by male *and* female surgeons, and are therefore outside the scope of this paper focusing on gendered transitions for female surgeons [see (42) for an articulation of male surgeons' experiences]. The three female gendered themes presented in this paper are interrelated (despite being presented separately) because one type of transition often triggers another type of transition, e.g., work transitions trigger cultural transitions; health transitions trigger work transitions, etc. See **Figure 1** for a visual representation of all five transition themes.

GENDERED WORK TRANSITIONS FOR FEMALES

Gendered work transitions were the primary theme identified from our data relevant to this paper. Four key female gendered work transitions were identified: maternity leave transitions; transitions to part-time training/working; leadership transitions; and transitions out of surgery. Drawing on MMT theory highlighted how participants depicted transitions in multiple contexts, including workplace, home, education and their role as surgeons, as noted by illustrative quotes below.

Maternity Leave Transitions

Returning to work post-maternity leave was challenging for many female surgeons, especially considering the requirement to maintain surgical competence despite being absent from the surgical workplace, sometimes for 6–12 months. Several female trainees expressed concerns about post-maternity transitions to work given colleagues' high expectations of their performance. One female surgeon narrated her challenging transition from maternity leave into surgical practice and her professional life as a surgeon more broadly:

> "I have to say yeah, coming back after maternity leave, I can remember holding the retractors thinking, "What am I doing here?" Really having very little to talk to with other people and feeling like an absolute fish out of water. . . You know, moving from childcare 24-h a day to. . . holding retractors [Surgical instruments used for exposure]. It's a very difficult time, I think that transition, coming back in after being out for a year with family. I imagine that a lot of female doctors would be lost in that transition." ID36, Scottish Female Staff Grade Surgeon, Aged 40–49.

This female surgeon narrates the complex nature of transitions between motherhood and professional life as a surgeon. Other female surgeons reported this new mother-surgeon transition as difficult, impacting other aspects of their lives (e.g., perceptions of their new identity as a mother) and their family's lives (e.g., impacts on relationships with family or the additional need to cater for childcare to fit the family situation). Post-maternity leave, there was the additional transition of childcare, with very little support from the surgical system, demonstrating the sacrifices required throughout females' surgical training and the negative impacts on female surgeons (e.g., missing their children growing up as they have to work long hours), their children (e.g., constant moving of schools or childcare to accommodate surgical training) and careers (e.g., surgical cultures valuing presenteeism could be problematised for a working mother).

Part-Time Training/Working Transitions

Several female surgeons described transitions to part-time training (or working), explaining the challenges of no longer being full-time trainee (or surgeon). This transition often intersected with other transitions for surgical trainees (e.g., having babies) and their colleagues (e.g., increased workloads). In addition, working part-time meant that trainees were only present on certain weekdays, creating significant impacts around team-working, including rapport-building with colleagues and colleagues' behaviours towards them, such as being excluded from team activities:

> "In the beginning, even though we had a lot of hours, I still felt like I was a valued member of the team and that I was respected and that I felt part of it, and I think as I have gone on through my career, I have been feeling less like that, and that is an issue, and I don't know whether that is being less than full time." ID26, Scottish Female Surgical Trainee, Aged 30–39.

Female surgeons undertaking part-time training highlighted the multidimensional impacts involving the individual (e.g., impact on their self-confidence) and their families, their colleagues (e.g., relationships within the team) and the surgical system. While working part-time afforded trainees more time with their families, it negatively affected their own work-life, as well as their families, colleagues and the surgical system itself. For example, while some female trainees appreciated the positive nature of part-time work, the negative impacts of part-time training included disrespect from colleagues, lower salary, not being perceived as a full member of the team and extending the length of training.

Leadership Transitions

Many participants discussed expected transitions to becoming surgical consultants. These transitions involved moving to senior roles, either within the same or new workplaces. Female surgeons identified dealing with new workplace transitions (e.g., new systems) on becoming consultants and with changing expectations. In addition, female surgeons narrated the challenges of decision-making in applying for consultant roles, given the impacts such a role would have on their personal and family lives:

> "I'm coming to the point where applying for consultant posts or going onto another fellowship. . . where I would love to just be able to do a fellowship in (names local city). . . But that means that my husband has a year of single parenting in front of him. . . after all these years of training, all this time of moving. He's built up another business, and it's just coming to fruition. So, he's not at all impressed with

that idea of me going somewhere else. I have to make a decision against my career." ID54, Scottish Female Surgical Trainee, Aged 40–49.

This female trainee explicated her decision-making processes in her impending transition to consultant and potential negative impacts on her family life. Her need to consider her husband's business and him potentially single parenting their children offers a stark example of the complex nature of leadership transitions, where female surgeons' careers impacted significant others' transitions.

Transitions Out of Surgery

Six interviewees reported having resigned from surgery and thus narrated transitions to different specialities. Several of these female surgeons were near the end of their training. They reported challenges with work-life balance in their surgical training and a lack of support from senior surgeons as reasons for leaving surgery, indicating systemic causes of surgical attrition:

"I miss being in the theatre with the nurses at 2:00 a.m. doing an appendix. I didn't miss being unsupported with complex operations. . . The hours never really bothered me. I work as many hours now as I did then. The lack of support is, I think, that was maybe. . . the final nail in the coffin." ID80, Irish Resigned Female Surgeon, Aged 30–39.

This female ex-surgeon does not problematise expected presenteeism (e.g., long hours), common to surgery, but rather the lack of support, illustrating her transitions intertwining psychological and social dimensions. In this example, she employs strong emotional and metaphoric language *("final nail in the coffin"*) to express the psychological factors triggering the death of her surgical career. Another female ex-surgeon narrated the challenges she faced as a surgical trainee, which contributed to her resigning from surgery. She reported the negative influences on her family life (she was pregnant, had another little child at home and was asked to move to the south of the country for training). She described being offered a surgical training position but declined it due to the multiple transitions required within the training programme and the potential negative impacts on her family life. Participants within this cohort often narrated their needs for supportive networks as they tried to manage the impact of these work transitions.

GENDERED CULTURAL TRANSITIONS FOR FEMALE SURGEONS

Several female surgeons reported transitioning to more western countries, impacting their personal and professional identities. Female surgeons who identified as International Medical Graduates (IMGs) described experiencing multiple cultural transitions, such as transitioning to westernised cultures of independence and away from more collectivist societies. Their talk emphasised the cultural and psychological changes resulting from contacts with different cultural groups and their members, some of which were positive:

"It didn't matter [in Ireland] if you are dressed conservatively or dressed in a more liberal way, as long as you were doing the right thing and taking the right decisions, and that really impressed me, especially coming from a country where you are judged for simple things from your appearance to whether you speak too much English (laughs)." ID38, Irish Female Surgeon Staff Grade, Aged 40–49.

While this example is positive, other female IMGs narrated challenges adapting to new societies (e.g., the need to understand workplace norms to progress their careers) and the negative impacts on their personal (e.g., perceptions of racism in the work environment) and professional lives (e.g., the inability to secure a numbered training post). Adapting to cultural differences was a significant challenge for these female doctors as they transitioned from their countries. Other female participants noted their experiences of struggling to secure a surgical post as an overseas doctor because of the perceived discrimination within the system, for example, a white male candidate getting jobs ahead of a more experienced female surgeon of colour.

GENDERED HEALTH TRANSITIONS FOR FEMALES SURGEONS

Female surgeons' health triggered other transitions in their lives and careers, impacting their professional identities. Some female surgeons reported the challenges of watching peers progress while unwell and being discriminated against because of their health conditions, adversely affecting their surgical training transitions.

"I became unwell about 3 years before I was due to become a consultant. And then found myself unable to work full-time because I had complications after surgery. So, I worked 4 days a week, initially doing on-calls and then not doing on-calls. I then [had another health event], even worse at that point. Still stayed on doing 4 days a week but watched all my peers getting ahead of me. Things weren't going very well with how people were treating me because I was called the 'the part-time woman' who refused to do on-calls, so that made life a bit difficult." ID31, Scottish Resigned Female Surgeon, Aged 40–49.

Health transitions often necessitated work transitions like working part-time and not doing on-call rather than fulfilling the traditional expectation of full-time working and doing on-calls (presenteeism mentioned earlier). This powerful quote from a female ex-surgeon described how her health transitions adversely affected her surgical training transitions. She reported the challenges of being treated unfavourably compared with her peers. Interestingly, this quote clarifies how her health transition necessitated her work transitions, working part-time rather than full-time. As well as indicating her health stressors, this quote also illustrates associated sociocultural stressors, including discrimination. These transitions are therefore interrelated. As a result of her ill health, she worked four days a week, which led to peers getting ahead of her and negatively impacting her chances of becoming a consultant. Our findings demonstrated that ill health in female surgeons triggered life transitions, leading to

TABLE 3 | Recommendations for educators, leaders and policymakers based on themes.

Educators should:	Leaders should:	Policymakers should:
Provide educational interventions for female surgeons returning to surgery after maternity leave to re-build their surgical competencies	Offer support/mentorship to female surgeons returning to surgery after maternity leave, and recalibrate their expectations of returning surgeons' performance	Ensure that females returning to surgery after maternity leave can access flexible working/training arrangements and childcare
Provide flexible options (e.g., online/blended learning) for educational interventions to ensure accessibility for female part-time surgical trainees	Respect part-time female surgeons' working hours and ensure they are included fully in surgical teams despite working part-time	Ensure that part-time trainees are not discriminated against for training/working part-time and that their performance is judged based on achievement relative to opportunity
Provide bespoke leadership education interventions to female surgeons including gendered leadership issues	Be mindful of the impacts of becoming a female surgical consultant on trainees' personal lives including significant others such as partners and children	Consider developing affirmative action recruitment policies for consultant surgeon posts to prioritise local female surgeons
Provide bespoke educational interventions to female surgeons changing training pathways including identity issues	Offer support/mentorship to female surgeons leaving surgery	Consider developing exit interview policies for women leaving surgery to better understand and improve surgical cultures for female trainees
Provide bespoke educational interventions to female surgeons changing countries, especially where cultural diversity exists between home-host countries	Respect female surgeons from other countries with different cultures and ensure they are included fully in surgical teams	Ensure that internationally qualified female surgical trainees are not discriminated against based on their cultural backgrounds, and consider developing affirmative action recruitment policies for consultant surgeon posts to prioritise cultural diversity
Provide educational interventions focusing on health and wellbeing for female surgeons experiencing physical and/or mental health problems or disability	Respect female surgeons experiencing ill health and ensure they are included fully in surgical teams	Ensure that female surgeons with ill health are not discriminated against, and can access flexible working/training arrangements if required, as well as adequate access to personal leave

changes in their identity (for example, becoming a patient rather than a surgeon), their work-life (for example, the need to give up work or work part-time), their career (being left behind as their colleagues progress), and the negative socio-emotional impacts on the female surgeon.

DISCUSSION

Summary of Key Findings

Our study asked what gendered transitions female surgeons experience and the impacts of these transitions. We found that female surgeons' multiple intersecting transitions were identified at different stages of training, challenging the notion of transitions as simple and linear. We adopted MMT theory to develop a holistic understanding of the complex multiple and multidimensional nature of transitions. Female gendered work, cultural and health transitions illustrated the sacrifices female surgeons made, with decisions severely impacting female surgeons' careers as they tried to juggle family life, work-life and achievement of competencies. One transition often triggered other transitions, leading to a spiral of challenges for female surgeons.

Comparison With Existing Literature

Our findings were reasonably consistent with existing literature, indicating transitions across the continuum of surgical training (4, 7–11, 16, 19), and with impacts on the individual and significant others (1). While some studies have previously explored the use of MMT theory as an analytical lens (5, 15, 16), our study was the first to use MMT theory to explore the multiplicity and multidimensional nature of female gendered transitions in surgical education.

Our study findings reported the socio-emotional impacts of leadership transitions on female surgeons when taking up senior roles as consultants. They showed a range of challenges for female surgeons at the consultant level, leading to several resigning very close to the end of their training. This is aligned with other literature, showing that unpreparedness for consultant positions and new clinical and non-clinical responsibilities (e.g., management, financial issues, and supervision) can lead to stress and burnout in doctors of all genders (27, 49, 50). While our study shows the impacts of transitions on females and their interpersonal relationships, other studies have shown unpreparedness for medical and generic competencies required for senior roles.

To our knowledge, our study is unique in that it is the first to explore the lived experiences of females who have left surgery. These participants reported the need for strong support networks. Several female surgeons reported how their transitions out of surgery interacted with their transitions to new medical careers. The need for mentorship for surgical trainees in decision-making around careers is consistent with the literature, which has reported that lack of social support influences women's decisions to quit (21). However, we cannot make further comparisons with the literature because of limited research exploring gendered transitions in ex-surgeons.

Interestingly, numerous IMGs talked about the cultural transitions they experienced moving to work in Ireland and Scotland, necessitating integrating into new cultures. Previous research studies have described the need for cultural flexibility as a valuable attribute for adaptability to workplace changes in western cultures (51). Many doctors struggle with transitions to new workplaces, but IMGs have to make two major *shifts* in terms of (1) professional socialisation and (2) acculturation. IMGs have to learn the values, norms, and beliefs of the

new society they are moving into and those of the medical profession as defined in the *new* country (52). Our study is novel in that it explored these issues for female IMGs through a gendered surgical lens.

Health transitions also triggered multiple and multidimensional life transitions, affecting surgical trainees' self-confidence. These findings are consistent with Jindal-Snape's work showing that some life transitions are not only triggered by health transitions but by a combination of other environmental factors (12). Our findings on female surgeons' health transitions uniquely identified impacts on career progression and self-confidence. Importantly, our research shows that multiple transitions are individual, social and contextual processes, and further research needs to consider more the impacts of health transitions on female surgeons' family members and colleagues, leading to burnout, compassion fatigue and secondary traumatic stress disorder (53, 54).

Methodological Strengths and Limitations

We believe our study is the first to explore female gendered transitions and their impacts on diverse female surgeons from several surgical specialities, and drawing on MMT theory. A methodological strength of our study is that it explored conceptualisations in two healthcare systems, noting that we did not find any differences in female surgeons from these two countries. We employed a team-based approach to facilitate rigorous data analysis and interpretation of data. While there was diversity in the number of specialities represented, the sample size from each speciality was small, so it was impossible for us to explore any patterns by specialty. In addition, the sample sizes for the different subgroups (for example, female surgeons of colour, female ex-surgeons, etc.) were small, also prohibiting us from exploring patterns in our data.

Study Implications

This study has both educational and research implications. Our key findings highlight female gendered multiple and multidimensional interacting transitions, as well as a multiplicity of impacts on self and others. Based on these findings, there is a need for educators, leaders and policy makers to understand the multiplicity of transitions and their impacts to firstly raise awareness. To minimise negative impacts, there is a need to develop and evaluate surgical transition interventions for surgical trainees and leaders (for example, by addressing female gendered transitions to senior roles). Policymakers need to develop services to meet female surgeons' unique needs (for example, family-friendly structures and intercultural needs) as they transition through their surgical careers (see detailed recommendations aligned with the themes in the implications framework in **Table 3**). Regarding research implications, while our data collection explored participants' surgical education journeys from a biographical narrative perspective, it did so from an interview at one snapshot in time. Therefore, further longitudinal investigation into the gendered transitions of female surgeons would be valuable to better understand in-the-moment changes across the surgical education journey to inform gender-related policies and practices. Indeed, longitudinal qualitative research considers time as fluid and accommodates changes in lived experiences through time (55). Finally, although our study identified female surgeons who transitioned out of surgery, female surgeons of colour, and female IMGs who transitioned to Ireland and Scotland for work, we had small numbers, so further research would benefit from a more thorough investigation of these under-represented groups.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article cannot be made available by the authors, because they do not have ethical approval to share these data. Further inquiries can be directed to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the East of Scotland Research Ethics Committee (16/ES/0082), Galway University Hospital (C.A. 1697), The Adelaide and Meath Hospital, Dublin [2017-02 CA (16)], St. James Hospital, Dublin (Expedited approval), Sligo University Hospital (Expedited approval), University Hospital Limerick (064/17), and Beaumont Hospital (17/30). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

GO, SS, SC, and CR designed the study. GO obtained ethical approval, recruited the participants, collected the data, and wrote the manuscript. GO conducted this research as part of her Ph.D. at the Centre for Medical Education, University of Dundee, with SS, SC, and CR as her supervisors. All authors were involved in data analysis, edited, and commented on various iterations of the manuscript.

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SYSTEMATIC REVIEW
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Medical Humanities Education and Its Influence on Students' Outcomes in Taiwan: A Systematic Review

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Background: Medical education has emphasized the importance of integrating medical humanities training into the curriculum to benefit medical and nursing students' future practice, featuring in the list of national funding priorities for healthcare education research in Taiwan for many years. However, the extent to which this drive has resulted in medical humanities training, what rationales underpin its inclusion, and its efficacy is largely unknown. This study aims to address these issues across medical humanities programs within the Taiwanese context.

Methods: We conducted a systematic review. Inclusion criteria included studies in English or Mandarin reporting outcomes of medical humanities courses in healthcare education settings in Taiwan between 2000 and 2019. We searched across five electronic databases (PubMed, Embase, ERIC, PsycInfo, Web of Science), following PRISMA guidelines. The Best Evidence Medical Education (BEME) Global Scale and Kirkpatrick Levels are used for identifying the strength of evidence.

Results: 17 articles were extracted from the 134 identified. Intrinsic and instrumental rationales for the inclusion of medical humanities education were common, compared with epistemological-based and critical-based approaches. Several positive impacts were identified in relation to participation including modification of attitudes, knowledge, and skills. However, the highest level (i.e., unequivocal) of evidence characterized by effects on students' behaviors or ongoing interaction with colleagues and patients is lacking.

Conclusion: Findings suggest that although medical humanities education is widely implemented in Taiwan, no clear consensus has been reached regarding the rationale for inclusion or how it is localized from Western to Asian contexts. Future research still needs to explore the long-term impact of medical humanities education for medical and nursing students and its impact on patient care.

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Keywords: medical humanities, medical students, nursing students, medical education, systematic review, curriculum

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INTRODUCTION

While advances in scientific and technical knowledge have contributed to considerable progress in medicine and health, it has been argued that clinical practice remains as much an art as science (1–3). This perspective has contributed to the development of the field known as the *medical humanities* which support and inspires the application of the humanities for teaching medical and nursing students. The inclusion of the medical humanities into medical curricula has to date been driven by four key rationales: *instrumental*, *intrinsic*, *critical,* and *epistemological* (3). Despite this range of rationales for its inclusion, there remains a lack of consensus regarding the impact and value of the medical humanities in terms of fulfilling its expected roles in medical curricula. Furthermore, reviews of the medical humanities have assumed a predominately western perspective, ignoring how the medica humanities are developed and implemented more globally (4–13). The aim of this systematic review is therefore to partially fill this gap in the literature by ascertaining the different rationales for delivering medical humanities programs in an Asian context, specifically Taiwan, and the extent to which it is effective to those ends.

What Is Medical Humanities?

Although there is no consensus for the definition of the medical humanities, it commonly includes an interdisciplinary perspective that draws on both creative and intellectual methodological aspects of disciplines such as anthropology, art, bioethics, drama and film, history, literature, music, philosophy, psychology, and sociology (14, 15). And while there have been multiple attempts to define what is meant by the term *medical humanities* (9, 15–19), conceptualizations tend to cluster under four key rationales: *instrumental*, *intrinsic*, *critical,* and *epistemological*. Thus, the intrinsic (or non-instrumental) rationale focuses on the potential counterbalancing effect of bringing a humanistic perspective into the curriculum (17), whereas the instrumental (or practical) rationale emphasizes the knowledge, skills, and attitudes that are directly related to clinical practice (e.g., communication, empathy, narrative competence, etc.) (3, 17). The critical rationale utilizes the humanities to bring an analytical and questioning lens to education and health practices (7, 20, 21). Finally, the epistemological rationale aims to explain how the humanities disciplines, and their methods of inquiry, are fundamental to medical pedagogy and practice (22, 23).

Efficacy of the Medical Humanities

In an era of outcome-based education, and to justify the expense of its inclusion, it is important for the medical humanities community to address the need for empirical evidence of its effectiveness (7). Research suggests that benefits for the inclusion of the medical humanities in undergraduate medical curricula comprise enhanced empathy, cultural awareness, observational skills, teamwork, reasoning, listening, self-reflection, communication skills, and reduced stress (24–26). However, evidence for any positive long-term impact for medical students themselves, and ultimately for patient care, is sparse (7).

About the Systematic Reviews

This study, to our knowledge, is the first systematic review to focus on the relative effectiveness of nationwide medical humanities programs. It is also unique in its inclusion of both Taiwanese undergraduate and postgraduate medical and nursing curricula, as well as in its attempt to ascertain the extent to which the previously identified rationales for the medical humanities are present in this context. In doing so we ask the following research questions (RQs):

RQ1: How are the medical humanities defined in Taiwan and what rationales are used for their inclusion in medical and nursing curricula?
RQ2: What types of medical humanities interventions are employed in the Taiwan medical and nursing curricula?
RQ3: How are the medical humanities outcomes assessed across Taiwan's medical and nursing curricula?
RQ4: On what type of evidence is the successful delivery of the medical humanities in Taiwan based?
RQ5: To what extent are medical humanities curricula successful in delivering specific outcomes?

METHODS

We conducted a systematic review focusing on medical humanities education interventions in medical and nursing education in Taiwan. We used the Best Evidence Medical Education (BEME) Global Rating Scale and Kirkpatrick-based outcomes (Online **Appendix 2**) to evaluate the strength of the evidence.

BEME is defined as: "the implementation by teachers and educational bodies in their practice, of methods and approaches to education based on the best evidence available." BEME can be considered as a spectrum ranging from 100% opinion-based education where there is no useful evidence, to 100% evidence-based education where there is adequate evidence (27).

The Kirkpatrick (1996) model (28), additionally, can provide techniques for appraisal of the evidence for any reported training program and could be used to evaluate whether such training program is likely to meet the needs of requirements of both organizers (teachers, university, hospital) and participants (students'). There are 4 levels in this model to evaluate training comprising *reaction (1), learning (2), behavior (3),* and *results (4)*. The first level of evaluation, *reaction*, typically involves trainees completing a post-course evaluation of their impressions of the program. Such evaluation does not measure what participants have learned, but gauges the interest, motivation, and attention levels of participants. The second level, *learning*, involves measuring what participants have learned in terms of both knowledge and/or skills. Learning evaluation can include trainees participating in written assessments or role-plays to demonstrate their skills. This level of evaluation allows

Abbreviations: BEME, Best Evidence Medical Education; Embase, Excerpta Medica database; ERIC, Education Resources Information Center; RQ, Research Question; PRISMA-P, Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols.

participants to demonstrate their understanding of specific skills and/or knowledge within the learning program. The third level is *behavior* or performance. This involves assessment of the trainee's ability to use their newly learned knowledge or skills in the workplace. This level of evaluation attempts to determine whether participants (who may already have demonstrated acquisition of specific skills and/or knowledge) use their new skills when they return to the work environment. The fourth level, described as *results*, is a measure of the impact that the training has had overall, including financial or morale impacts. This might include improvement in, for example, staff–resident interaction, decreased incidents of challenging behavior, and staff turnover (28).

Context

This study focused on the implementation of medical humanities into undergraduate medical and nursing education curricula in Taiwan (note, in nursing education the term "medical humanities" is also used). Specifically, in Taiwan, most medical and nursing schools adopt definitions of the medical humanities that have been developed in Anglo-American contexts, such as the mission statement developed by New York University (NYU), which defines medical humanities as "an interdisciplinary field of humanities (literature, philosophy, ethics, history, and religion), social science (anthropology, cultural studies, psychology, sociology), and the arts (literature, theater, film, multimedia, and visual arts) and their application to healthcare education and practice" (18, 29). Following reviews by the United States National Committee on Foreign Medical Education and Accreditation in 1998, Taiwan's medical schools initiated curricular reform in 2002. Specifically, they prescribed humanities education for entering medical and nursing students compared to that required in the United States (30, 31).

Search Strategy

Our systematic review was executed in two phases: first, we searched electronic databases; second, the authors then manually searched reference lists for relevant articles. Articles in the first phase were obtained from the following electronic databases: PubMed, Embase, ERIC, PsycInfo, and Web of Science (See **Appendix 1**). We limited our search to articles published from 2000 onwards, to align with the development of the medical humanities in Taiwan (30, 31). Once we reached a consensus about the search terms, one author (HBL) ran an initial search (December 1, 2018), which was repeated a second time (May 31, 2019). After removing duplicates, 134 articles remained. Following this, we examined the reference lists of these articles for further relevant sources. We also examined the works cited in previous systematic reviews on medical humanities education in Taiwan to identify any additional articles that could be relevant to our research questions and within the range of our study criteria.

Article Selection

All researchers independently identified relevant articles for full-text review in Endnote by scanning the titles and abstracts on the basis of the inclusion and exclusion criteria set out in **Box 1**. As this systematic review focused on the undergraduate curricula, research conducted with continuing students [trainees], post-graduate students [trainees], and professional nurses [medical practitioners] and non-degree courses/further professional training (continuing education) were excluded. We limited the lower-range of publication to the year 2000 as medical education is a relatively new field in Taiwan, with focussed funding beginning in 2007 (32). Furthermore, during the past 20 years the Medical Humanities have become a focus of this funding, resulting in a rise in related publications in 2016 (32). We limit the languages to English and Mandarin for two reasons. First, these are the languages that Taiwanese education researchers in the medical humanities and medical education fields mainly use for publication. Second, while it might be possible that researchers use other languages (i.e., French), it is impossible for our team to read them as we have no expertise in this. Finally, there studies are geographically limited to Taiwan. Studies of other geographic locations will be excluded. BLH conducted a full-text analysis for eligibility. Seventeen studies reporting on medical humanities education in Taiwan were included in the final analysis. **Figure 1** contains a PRISMA flow diagram of the search and selection process.

BOX 1 | Inclusion and exclusion criteria.

Inclusion criteria

- Date range: 1st January 2000 - 31st May 2019
- Population: Medical Student [Clerk, Intern], Medical Teacher [Trainer, Educator], Nursing Student, Nursing Course, Medical School [College, University], Medical Course
- Exposure: Medical Humanities, Narrative Medicine, Health Humanities,
- Outcome: Participants' inter-professional collaboration skills, patient-centered decision on professional issues, Participants' cognition on medical humanities, Participants' improvement of doctor-patient communication, cultural competence, critical thinking and in-field clinical performance after medical humanities training
- Language: English, Mandarin
- Geographic location: Taiwan
- Setting: Medical School [College, University], Nursing School, Hospital
- Study design: All studies with empirical data

Exclusion criteria

- Date range: Before 1st January 2000
- Population: Continuing Student, Continuing Trainee, Professional Nurse
- Exposure: Continuing Education, Post-graduate Student
- Language: Other than English and Mandarin
- Geographic location: Other than Taiwan
- Study design: Systematic reviews or reviews

Data Extraction Process

Data extraction comprised the following process: We managed the coding of articles in ATLAS.ti (version 8.0) software. After all seventeen studies were imported to the library, BLH screened them once again to ensure all inclusion and exclusion criteria had been applied correctly. Following this, the coding began: noting firstly the author(s) name(s), year of publication, and language. A second-team member (CDH) double-checked the database. BLH then coded for study design, research period, stages of the training, type of participants, research specific outcomes, and other specific information required to answer the

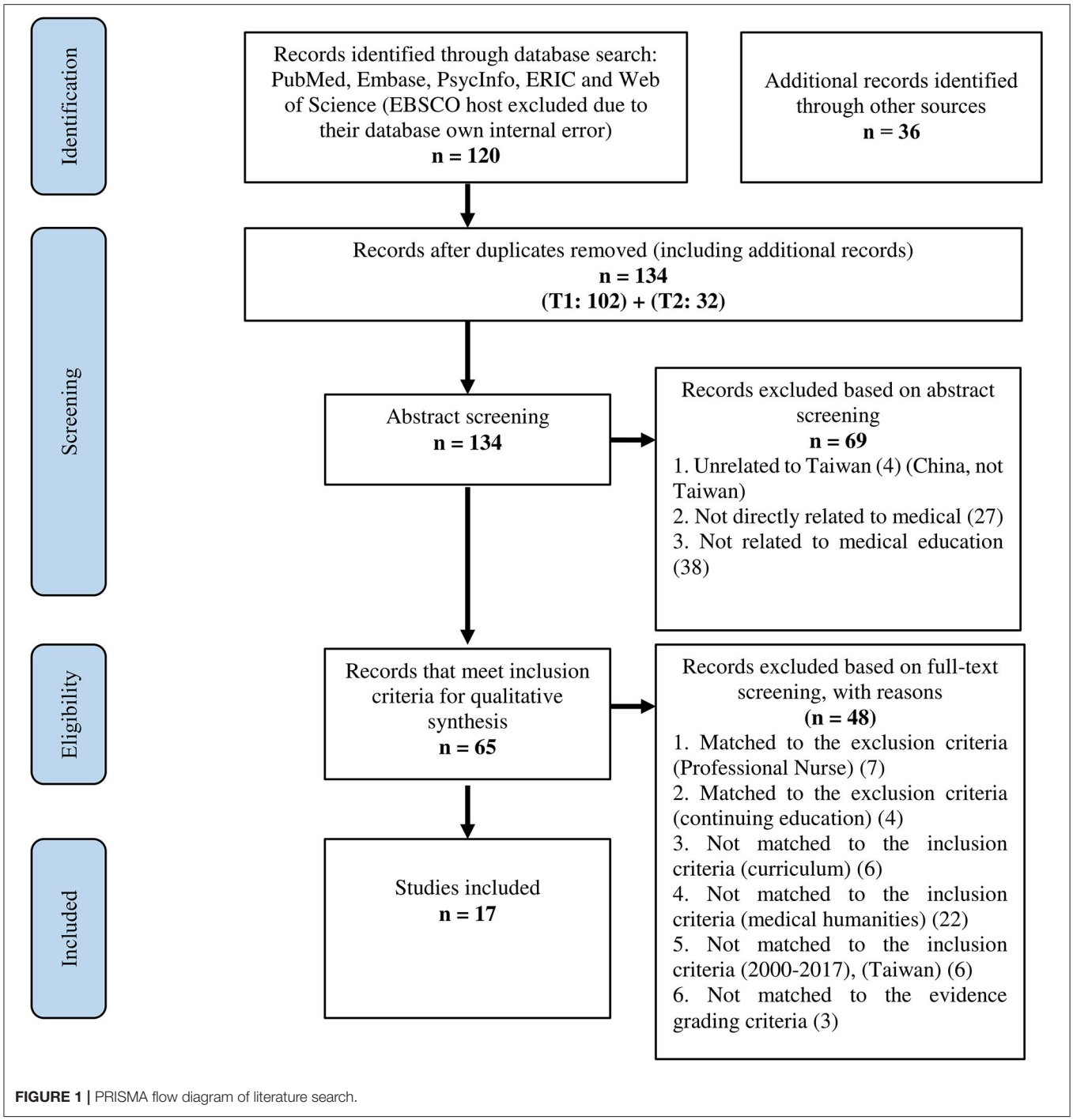

FIGURE 1 | PRISMA flow diagram of literature search.

research questions. Another team member (LVM) then checked the ATLAS.ti database as an independent review, in addition to whole-team discussions on process during our regular meetings online and on-site. Discussions regarding the rationales used for medical humanities inclusion in the curricula taken within each article occurred online, via emails. Discrepancies were communicated and resolved. Evidence grading was undertaken by BLH who categorized articles according to the Best Evidence Medical Education (BEME) Global Rating Scale and Kirkpatrick-based outcomes (Online **Appendix 2**). The same researcher then sent this analysis to all co-authors for independent verification. Once this step was completed, all co-authors discussed and compared their scores, determined agreement, and resolved any disagreements.

To answer the key research questions, data were deductively coded according to the following criteria: (1) presence and origin of definitions for medical humanities; (2) rationales for implementation of the medical humanities (outlined earlier).

RESULTS

We present the main body of our results section according to the research questions. In terms of study participants, we note that fourteen articles comprised only medical students as participants and two articles had both medical and nursing students (33, 34) creating an interdisciplinary team. Only one study (35) included a diversified and interdisciplinary team of participants including medical, nursing, economics, chemistry, mechanical engineering and architecture, mathematics, life science and informatics students'. It should also be noted that there were no studies with patients as participants. Specific details of each paper are included in **Tables 1**, **2**.

RQ1: How Is the Medical Humanities Defined in Taiwan and What Rationales Are Used for Their Inclusion in Medical Curricula?

Most of the studies applied Western definitions of the medical humanities. In particular, six ($n = 6$; 35.30%) (26, 36–40) used solely the New York University's medical humanities definition. Eight studies ($n = 8$; 47,05%) (24, 33–35, 41–44) applied other Western definitions from one or more of the following countries: USA, UK, Spain, Romania, Australia, or organizations such as World Federation for Medical Education, WHO and EU. A minority of studies ($n = 3$; 17.65%) did not clearly specify the definition they used (25, 45, 46).

In terms of rationales for applying the medical humanities to medical and nursing education, we identified studies that could be classified into the four rationales (as outlined earlier) (3), albeit to varying degrees. In terms of specific emphases (though noting some overlap), nine articles highlighted evidence relating to the instrumental rationale (24–26, 33, 37, 39, 40, 43, 45). Articles classified as drawing on the instrumental rationale frequently stated explicitly that their pedagogical aims were to use arts as a tool to develop students' competencies as physicians, such as increased empathy and cultural sensitivity (24–26, 43), enhancing students' listening and communication skills (26), and facilitating cooperation with students' in other departments (25, 33). However, other articles classified under this rationale highlighted the importance of specific effects that were felt or gained by students' through the program, such as increasing their task responsibility (37, 39, 40, 43, 45), social interaction and trust (40, 43), and self-development and reflection (37, 45).

Six articles were classified according to an intrinsic rationale (35, 36, 41, 42, 44, 46). Most of these articles explicitly introduced the humanities perspective according to (1) the three principles of primacy of patients' welfare, autonomy and social justice (42); (2) the relationship between "detachment" and "concern" (36), facilitating an understanding about the meaning of sickness and death in life (35), and learning through a "silent mentor" (body donation) to develop positive attitudes toward death (41). While three other articles emphasize the potential counterbalancing effects of the humanities in the medical curriculum (42, 44, 46), thus aiming to facilitate a more patient-focused student (42) and greater understanding of the ethical dimension of clinical practice (44, 46).

Only one article was classified to the critical rationale (34): valuing and applying the humanities' methods of interdisciplinarity, rather than simply drawing on narrative texts as sources of patient or practitioner perspectives. Here, differences among groups toward interprofessional communication and collaboration were drawn out (34). For example, drawing on evidence from interview participants the authors argue that an "interprofessional PBL curriculum would be a good and feasible approach for students' to foster communication and collaboration skills for solving inter-professional conflicts of value" (p.506).

The epistemological rationale was also represented by a single paper (38). In this paper, the humanities are used to represent characteristic ways of understanding and reasoning which are highly relevant to medical practice, with a focus on the particular, tolerance of ambiguity, and access to others' perspectives. To illustrate, the authors argue that "literature forces us to think in a way that we in the medical field may not be accustomed to… opens new doors, new worlds, worlds of metaphors and hyperboles, similes and symbolism. … [and] creates a personal connection between the reader and the characters" (p.477).

RQ2: What Types of Medical Humanities Interventions Are Employed in the Taiwan Medical Curricula?

For articles based on the instrumental rationale, exposure to visual arts (24, 26), narrative/storytelling (37, 45), reflective writing practice and feedback (43), exposure to elderly community care practice (33, 40), fieldwork (39) and a course (44) were employed as interventions. Exposure to elderly community care practice or fieldwork is used by Tsai (40), Yang et al. (33) and Chen and Chou (39). The aim here is the promotion of empathy and communication, as well as inter-collaboration skills of medical/nursing students.

Within the intrinsic articles, fieldwork (42), memorial ceremony (41) and a course (35, 36, 44, 46) were used as interventions to increase awareness primarily related to ethical issues and participants' own human nature. Specifically, courses here can vary from a series of sessions to a single workshop. A course intervention was also used in the critical article (34). Here, a series of sessions were employed to intervene, discuss and help students' solve ethical professional dilemmas. The epistemological-based article (38) reported an intervention that comprised an integrated course in psychiatry and literature that was used to show how the humanities disciplines, and their methods of inquiry, are fundamental to medical pedagogy and how it can increase students' performance in medical professional skills training.

TABLE 1 | Extraction of medical humanities sources of definitions, types of interventions, intentions and the relevance of the researches to Taiwan's medical humanities education.

Reference	Medical humanities definition source	Rationale (s)	Type of intervention	Intention	Relevance to humanities
Yang et al. (26)	USA	Instrumental	Exposure to visual art	To increase empathy, cultural awareness, observational skills, better team-work, communication skills and stress reducing.	Students' will have to understanding arts through persons and context within it
Tsai (40)	USA	Instrumental	Expose to elderly community care practice	To increase social trust and change the relationship with patients	Incorporating the concept of "doctor as mediator in the changing relationship with patients"
Yang and Yang (24)	USA & Germany	Instrumental	Exposure to visual art	To increase empathy and sensitivity	Students' will have to understanding arts through persons and context within it
Wong et al. (42)	USA & EU	Intrinsic	Field work after informal and formal humanities training	To see the importance of several ways of learning medical humanities informally.	Field work with its interaction with real patients made the course more authentic to the students'
Wang et al. (45)	Not specified	Instrumental	Narrative/Storytelling	To enhance medical care students sense of meaning in life and critical thinking capacity	Cultivating professional and humanistic attitude
Tseng and Lin (36)	USA	Intrinsic	Course	To make a change in the way of thinking/participants' emotion	Cultivating professional and humanistic attitude
Lin et al. (43)	USA and Canada	Instrumental	Reflective writing practice and receiving feedback from mentor	To increase participants' clinical observation skills, empathetic listening skills, interpersonal and communication skills, and problem-solving abilities	Letting students' have a diversified, flexible thinking understand patients' perspective better
Kan et al. (35)	USA and UK	Intrinsic	Course	To explore the importance of life perspectives such as philosophies of life, which should help them treat end-stage patients with more humanistic passion	Students' are asked to think about life and death from humanistic viewpoint
Huang et al. (37)	USA	Instrumental	Narrative/Storytelling	To increase empathy and be more human-focused	The importance of "medicine as an art for human healing" is raised.
Fan et al. (38)	USA	Epistemological	Course	Integrated course in psychiatry and literature to increase medical students' grades in the later psychiatry courses	Training medical students' to think in a humanistic way, compared to the traditional clinicians' ways.
Yang et al. (33)	Australia	Instrumental	Exposure to elderly community care practice	To increase empathy, communication and collaboration skills	Responding to patient emotions and strengthening the patient-physician relationship to increase the social trust
Liao and Wang (25)	Not specified	Instrumental	Reflective writing practice and receiving feedback from mentor	To enhance students' empathy, facilitate interdisciplinarity and connect patients' diseases to social/cultural contexts	Literature as a vehicle for exploring what it means to be humane
Cheng et al. (44)	USA and World Federation for Medical Education	Intrinsic	Course	To make participants value the profession more	Solving the lack of commitment to the profession of several professionals currently due to bad relationship with patients
Chen and Chou (39)	USA	Instrumental	Field practice program	To improve medical intellectual and communication skills and also for developing humanitarian nature in medical professionals.	Educating the history of medicine with authentic stories so that students' will be more cognitively human-focused.
Chiou et al. (41)	UK, Romania, Spain and Hungary	Intrinsic	"Silent mentor" (death human body) initiation ceremony	To see higher humanistic consideration in participants	Strengthening student's medical humanity and learning attitudes
Tsai et al. (46)	Not specified	Intrinsic	Course	To increase ethical decision making	The humanities perspective of palliative care
Lin et al. (34)	WHO	Critical	Course with problem-based learning, lectures and feedback	To increase students' inter-collaboration and problem-solving skills	Creating a better inter-collaboration between future nursing and medical professionals so that they will agree on the ethical decision making and values

TABLE 2 | Extraction of constructs and assessments in Taiwan medical curricula, research methodologies used and participants of Taiwan's medical humanities articles.

Reference	Construct	Assessment	Participant	Methodology
Yang et al. (26)	Participants' understanding of people and arts in contexts	Participants' written records and clinical teachers' direct observation and notes on students' discussions	Medical students	Qualitative, observation and the written feedback from students'
Tsai (40)	Students' community in-field practice and the community development	Participants' self-assessment of achievements in communication skills	Medical students	Qualitative, observation, quasi-longitudinal
Yang and Yang (24)	Participants' understanding of people and arts in contexts	Participants' empathy development after the course via faculty observation and their discussions	Medical students	Quantitative, questionnaire, pre-tests and post-tests
Wong et al. (42)	Students' performance during internship after informal learning model	Students' behavior, observations of senior colleagues and educators, and their intentions of learning	Medical students	Qualitative, field notes and interview analysis
Wang et al. (45)	Participants' critical thinking competence and awareness on sense of life	Triad of attention, representation, and affiliation in their close reading and reflective writing, along with a summary or description.	Medical students	Quantitative, questionnaire, pre-tests and post-tests
Tseng and Lin (36)	Students' experiences and attitudes about death	Students' responses to interview questions about the experience and their coping strategies	Medical students	Qualitative, Semi-structured, focus group interviews, Observation
Lin et al. (43)	Participants' word usage	Reflective narratives	Medical students	Quantitative, questionnaire, pre-tests and post-tests
Kan et al. (35)	Participants' emotions toward the death	Unscheduled short tests and reports on field trips	Medical students, nursing students, non-medical/nursing related students'	Qualitative, report and written assignment
Huang et al. (37)	Students' perceptions about the narrative medicine activity and its progress model	Clinical stories in their narrative writing assignments in different ways, such as story-telling or poetry-reading	Medical students	Quantitative, cross-sectional questionnaire, pre-tests and post-tests
Fan et al. (38)	Socioeconomic status, mental health and physical health, academic performances	Students' mental and physical health, academic grades and faculty observation	Medical students	Quantitative, quasi-longitudinal, baseline survey, students' academic performance scores
Yang et al. (33)	Participant's listening and communication skills	Meeting to share opinions/feelings on the services offered, final reports on achievements and difficulties, solutions to problems, progress made, issues and ways to improve the course	Medical students and nursing students	Qualitative, interview analysis, observation
Liao and Wang (25)	Students' empathy, critical thinking, and reflective writing	Reflection per week, discussion forum and presentation	Medical students	Quantitative, questionnaire, pre-tests and post-tests
Cheng et al. (44)	Students' knowledge regarding medical ethics and laws, and doctor-patient communication	Students' improvement of knowledge on medical ethics and laws, and doctor-patient communication	Medical students	Mixed quantitative and qualitative, questionnaire, pre- and post-test and written feedback collection
Chen and Chou (39)	Communication competence and humanitarian nature	Participants' cognition of medical history and guiding presentation	Medical students	Quantitative, questionnaire, pre-tests and post-tests
Chiou et al. (41)	Participants' emotions toward the death	Responses to questions love and care of participants toward patients	Medical students	Quantitative, questionnaire, pre-tests and post-tests
Tsai et al. (46)	Students' knowledge of palliative care and their beliefs concerning ethical decision-making in palliative care	Responses to questions about knowledge of palliative care and to questions about ethical decision-making in palliative care	Medical students	Quantitative, cross-sectional survey, pre-tests and post-tests
Lin et al. (34)	Students' attitude toward interprofessional collaboration	Students' self-assessments on their confidence and attitude toward interprofessional collaboration after the course, and multi-perspective written texts on professional issues	Medical students and nursing students	Quantitative, cross-sectional survey, pre-tests and post-tests

RQ3: How Are Medical Humanities Outcomes Assessed Across Taiwan's Medical Curricula?

The outcomes of medical humanities interventions are assessed via a range of methods. Self-assessments about participants' medical humanities skills development/professional development (5), faculty observation (47), and scheduled and unscheduled tests at different points within the study (35, 38). Specifically, five articles (26, 33, 37, 43, 45) assessed learning via written assignments including self-reflection and feedback (26), reflective writing (33, 43), narrative writing (37, 45).

As for the evaluation of participants' medical humanities skills development/professional development, while self-assessment of students' own perceptions on their development was used in two articles (34, 40), two papers reported assessing medical humanities constructs via quantitative questionnaire responses objectively (39, 46). Furthermore, participants' narratives were used to assess the appreciation of the medical humanities (36, 41, 43, 44). In addition, faculty observations of student's discussions (for assessment), empathy, professional behavior, intentions for learning or cognitive skills, and mental or psychological health of students, was also used (24, 26, 38, 40, 42). Finally, two articles assessed medical humanities constructs via scheduled and unscheduled tests at different points within the study (35, 38).

RQ4: On What Type of Evidence Is the Successful Delivery of the Medical Humanities in Taiwan Based?

We considered the type of research study that was undertaken. In terms of methodology, two studies used mixed methods with pre-test and post-test outcomes and collection of written feedback (26, 44). Five articles (33, 35, 36, 40, 42) applied a variety of qualitative data collection methods. For example, participant observation (33, 40), field notes (42), semi-structured focus group interviews (36), and one-to-one interviewing (33). Ten articles drew on quantitative methods comprising pre- and post-test questionnaires (24, 25, 34, 37, 39, 41, 43, 45, 46) and a combination of a baseline survey and students' academic performance scores (38). Additionally, two articles utilized quasi-longitudinal studies (38, 40). Tsai (40) conducted a curriculum assessment focusing on essential background knowledge and methodology during 2 years (Stage 1), and a program akin to community health building camp volunteer training (Stage 2). Fan et al. (38) used a quantitative, quasi-longitudinal, cross-sectional study over 3 years. At the time of entrance to medical school (first year), these students completed a thorough baseline survey with questions related to their socioeconomic status, mental health and physical health. Students' academic performance including medical school grade point averages (GPAs), merits, demerits, medical school admissions interview scores, and scores on the national entrance examination were also collected. Merit and demerit points were a supplementary evaluation system, provided by faculty for positive or negative student behaviors respectively. Students then had the option of taking the "Psychiatry and Western Literature" course during their first year of medical school, resulting in two groups of students (those taking, and those not). Following completion of the fourth year, researchers examined the baseline data for statistically significant differences between the two groups.

RQ5: To What Extent Are Medical Humanities Curricula Successful in Delivering Specific Outcomes?

In this section we report on the extent to which the included studies met the quality criteria using the BEME Strength of Evidence Scale (48), rating them as either level 1, 2, 3, or 4 accordingly. In doing so we took into account a number of factors, such as the **Quality** of the research evidence available, the **Utility** of the evidence, the **Extent** of the evidence, the **Strength** of the evidence, the **Target** or outcomes measured, and the **Setting** or context. **Table 3** provides an overview of our strength of the evidence classifications, noting that some studies cut across different levels due to multiple measures. We structure the main body of this section by commenting on the level at which they measured outcomes (according to Kirkpatrick's criteria) and the relative success of these outcomes. Again, articles cut across these levels according to the measurements commented upon.

Evidence of Measurable Outcomes (Based on Kirkpatrick's Model)

We now consider the outcome levels for each of the articles, noting that some studies addressed more than one outcome at different levels (see **Table 4**).

Level 1: Reactions and Response

All articles addressed level one outcomes reporting student reactions and responses to medical humanities courses (24–26, 33–46). Participants overwhelmingly reported that the medical humanities courses/programs they experienced might be useful in facilitating their awareness of the humanistic element of medical and nursing professions. Cheng et al. (44), BEME level 3, provides a typical example. Participants enjoyed the training, which related to their needs in the medical education context and organization, and considered it an effective use of their time. In Fan et al. (38), BEME level 3, reported that students recognized the difficulties of learning psychiatry traditionally and how the use of literature can combat these impediments: using the literature to probe human nature and the inner mind of someone with lived experience of mental illness. The intervention not only made psychiatry more accessible but also more appealing.

Level 2a: Modification of Attitudes or Perceptions

Six studies [all BEME levels 3 and 4, except 1 study with level 1 of Kan et al. (35)] reported modification of attitudes or perceptions in treating patients in a more humanistic way (33, 37, 40, 41) or creative study (35) and fresher mind in critical thinking (38). Three of these provided community experiences for students with outcomes consistently demonstrating improvement in terms of patient respect and reflective practice. One study provided a narrative medicine program with the outcome not only being a greater improvement in respect and reflective practice but also higher empathy for many participants. However, not all participants developed equally. For example, one study

TABLE 3 | BEME strength of the evidence summary.

BEME strength of evidence level	Articles
1: An absence of any clear and significant changes	Three studies: research used the JSPE to measure empathy (24), the CLIWC (Chinese version of Linguistic Inquiry and Word Count) to measure the psychological process on reflective writing (43), and course assessment (35). All failed to find any significant differences as a result of the study.
2: Weak/ambiguous results, although trends identified	Four studies: results suggest that participants are aware of the medical humanities, developed some new skills and/or changed their attitudes toward the importance of medical humanities. However, no specific action or significant evidence of application to real clinical settings is identified (34, 36, 39, 46).
3: Results are sufficiently robust to form a basis for conclusions.	Five studies: in particular, these articles suggest that students took action to improve their treatment quality toward patients, applying a humanistic approach toward them (33, 38, 40, 42, 44). Data also suggests that students' behaviors and thoughts change (as specified in level 2). However, research designs did not include pre-/-post-test, or measurements to ascertain any significant impact on the quality of patient treatment.
4: Results are clear and very likely to be valid.	Five studies: articles reported post-test scores suggesting that medical/nursing students treated their patients more humanistically as a result of the interventions (25, 26, 37, 41, 45).
5: Unequivocal results: reserved for research with clear impact, typically associated with post-test scores and/or successful stories of patient treatment long-term.	No studies: all included articles had a relatively short period of training (often one semester) and the absence of post-test surveys to measure long-term impact.

evaluating a narrative medicine program with medical students learning Traditional Chinese Medicine and those learning Western Medicine found that self-development and reflection were more favorable for the Traditional Chinese Medicine student group than for the Western Medicine group (37). Another, focusing on creating a higher awareness of the sense of life, reported that their program contributed to helping medical students gain more mature attitudes toward death and decreased negative emotions toward cadavers (41), it also drew the learning model for medical students in manners dealing with people or clients and matters and attitudes toward difficulties. Finally, one study reported that students gained a greater respect for service, the efforts made by their teachers, the importance of being a volunteer, and the enthusiasm of social interaction through interacting with the elderly community (33).

In terms of improvement in perceptions about study, specifically, in Fan et al.'s study (BEME level 3) in which the post-course outcome comprised students' grades in their fourth-year general psychiatry performance, it was found that students who had attended the course had scores that were significantly higher compared to those who did not. The authors attributed this to a more creative and fresher mind in critical thinking (38).

The second study used an experimental, non-randomly controlled design with a field visit, group writing report, and group assignment as the interventions (35), and was classified as a BEME level 1. At the end of the course, students demonstrated greater creativity in terms of responding to their report-writing remit by using formats such as pictorial storybooks, conversations between a father and a son and movie scripts rather than adopting the more traditional report-writing genre.

It should also be noted that there were some articles (BEME level 1) that sought to achieve level 2a outcomes, including (24, 43, 46) but the results did not show the expected improvements. In particular, two articles (24, 46) used course interventions for medical students, however, their goals of improvement of empathy score and ethical decision-making remained low.

TABLE 4 | Quality of evidence and evidence of measurable outcomes.

References	Kirkpatrick-based outcome levels	BEME strength of evidence scale
Yang et al. (26)	1, 2b	4
Tsai (40)	1, 2a, 2b	3
Yang and Yang (24)	1	1
Wong et al. (42)	1	3
Wang et al. (45)	1	4
Tseng and Lin (36)	1	2
Lin et al. (43)	1	1
Kan et al. (35)	1, 2a	1
Huang et al. (37)	1, 2a	4
Fan et al. (38)	1, 2a	3
Yang et al. (33)	1, 2a, 2b	3
Liao and Wang (25)	1, 2b	4
Cheng et al. (44)	1	3
Chen and Chou (39)	1	2
Chiou et al. (41)	1, 2a	4
Tsai et al. (46)	1	2
Lin et al. (34)	1,	2

Level 2b: Modification of Knowledge and Skills

Four studies were categorized at this level (across BEME levels 3 and 4) in which participants demonstrated modifications in terms of clinical treatment knowledge and skills via relevant humanities activities, such as critical thinking (25, 26), reflective writing, teamwork, cultural awareness, observational skills (26), empathy, or empathic communication (25, 26, 33, 40). The study by Liao and Wang (25), classified at BEME level 4, measured changes in medical students empathy, critical thinking, and reflective writing skills, finding significant differences in aspects of all three domains. In addition to the data on students' reactions to a visual arts program reported under Kirkpatrick Level 1 above, Yang et al. (26) also drew on instructors' notes

and evaluations to conclude that students were better able to identify and describe protagonists' emotions following multiple discussions with peers and instructors. The other two studies explored the impact of service-learning and community work on medical students clinical skills: Tsai (40) reported an increased capacity for self-reflection and knowledge of caring for and communicating with vulnerable people, while Yang et al. (33), BEME level 4, noted an increased capacity in students to engage with their communities and work collaboratively on such projects.

Level Three: Behavioral Change

There were no articles in our review that aligned with this level.

Level Four: Change in Organizational Practice or Patient Outcomes

There were also no articles in our review that aligned with this level.

DISCUSSION

Our findings suggest that all four rationales outlined in the literature (3) are represented in medical humanities studies relating to Taiwan. However, instrumental and intrinsic rationales dominate over critical or epistemological. This is unsurprising as critical and epistemological rationales are relatively recent perspectives taken up in global medical humanities scholarship (3). This distinction is also reflected in the way the Medical Humanities have been introduced into the Taiwanese curricula, with an emphasis on "first generation" perspectives (13) as either being an antidote to medical science or a way of developing "softer" skills (e.g., communication). Furthermore, this might also be due to the difficulty of Taiwanese educators adopting a critical perspective, questioning the orthodoxy of medicine, the roles of patients vs. caregivers, and separating biology and culture. These ideas can conflict with the traditional values of a Confusist nation. As Taiwan begins to mature with its work in this area, there is considerable scope for expanding research on the medical humanities to include the critical and epistemological perspectives as well.

Similarly, narrative/storytelling, coursework, and fieldwork are the most frequently employed interventions when incorporating the Medical Humanities into Taiwanese medical curricula. Again, we feel that this reflects the nascent nature of the field in Taiwan. As the Medical Humanities gain more traction in the country and become part of the core curricula educators will likely seek out more novel approaches, such as seen in the few studies which explored the use of community-based experiences, exposure to art, and the "silent mentor" program (**see Table 1**). As for exposure to visual art, for example, by using facilitated group discussion of an art image, Shapiro et al. (49) demonstrated that an approach of visual thinking strategies appeared to increase team building as medical interns worked together, challenging each other to form a cohesive idea about the art form studied. Dolev et al. (50) found improved visual diagnostic skills in medical students who participated in art observation workshops through systematic visual training using representational paintings. According to Shapiro et al. (49), students' can develop skills in emotional recognition and cultivate empathy in arts-based conditions. It is suggested that seeing is defined not only as observation of physical signs and features but also as a process of understanding the person and context. Stress reduction for medical professionals through an arts-in-medicine program has also been demonstrated. Indeed, we believe that, by critically examining their rationales for including the Medical Humanities in their curricula, including what is covered and understood by the term Medical Humanities itself, Taiwanese educators will develop their educational repertoire, and consider including culturally sensitive art forms (e.g., traditional, Aboriginal and folk art), bringing them closer to understanding the "other" and human suffering.

Ways Medical Humanities Outcomes Assessed in Taiwan's Medical Curricula

Our review found that medical humanities outcomes in Taiwan are assessed in a variety of ways, including (and in approximate order of frequency): self-assessments; written methods such as assignments, reflective writing and clinical/field reports; faculty observation/judgment; and content tests or presentations. Other studies used alternative measures, such as academic grades, clinical notes, course surveys, interviews, and a mental health survey. The frequency of self-assessments or reports is reflected in the predominance of outcomes at Level 1 on Kirkpatrick's model (see below for further discussion). On one level, this plurality of methods suggests that Taiwanese medical schools have implemented medical humanities education quite comprehensively. However, it may also suggest a continuing search for appropriate and valid methods of assessing what is recognized as challenging skills and outcomes to assess (17, 51, 52). It should also be noted that these assessment methods were frequently described by the clinical teachers themselves and may not accord with the perspective of those who directly received such assessments: namely, students, clerks, and interns.

Quality of Evidence and Evidence of Measurable Outcomes

The majority of studies in this review reported findings based on participant reactions to the intervention, that is, Level 1 of Kirkpatrick's model. A small number of studies reported a higher level of outcomes (Levels 2a, 2b), although no study was found which claimed observable changes in the students' themselves in terms of application to daily life after their newly acquired knowwledge/attitude, and at organizational or patient levels. In terms of strength of evidence, there was a spread of studies across Levels 1-4 of the BEME strength of evidence scale, with many using either quantitative or qualitative methods, rather than the approaches necessary for a Level 4 classification, such as mixed methods, diversified participant groups, and more longitudinal and better-aligned assessments such as portfolios. Furthermore, the focus of most of the studies were participants' attitudes, feelings, and knowledge about intended learning outcomes, with few aiming to elicit or evaluate broader changes in participants' real behaviors or impact.

The overall strength of evidence and levels of outcomes of these studies lead us to two broad conclusions: first, students have generally learned the expected skills in accordance with common goals and purposes of the medical humanities as outlined by course designers; second, students generally appreciate the goals and purpose of the course they have taken. While stronger conclusions relating to changes in organizational or patient outcomes are not warranted at this stage, these are nevertheless positive results for the relatively recent adoption of medical humanities in Taiwan. This is also consistent with Ousager and Johannessen (7) findings that most papers on the medical humanities report on participants' reactions and responses to the interventions. Taiwanese studies in the medical humanities are no different in terms of this focus, which likely represents the inherent challenge of assessing interventions whose purported effects are arguably significantly "downstream." In other words, the desired impacts are hard to measure, hard to attribute to the intervention, and likely influenced by multiple factors (51–53).

Conceptualizations of the Medical Humanities

Finally, we found a dominance of western definitions of the medical humanities being used in the studies we reviewed. While a useful definition in practical curricular terms, the reliance on western conceptualizations of the medical humanities may have an unintended consequence in overly constraining notions and applications of the medical humanities in non-western contexts. This may be problematic, as it often emerges in practice in a "quasi-Western" form through the use of Western cultural artifacts (via history, philosophy, literature, and art), potentially marginalizing local expressions of cultural diversity not only for patients and society but also for clinical practitioners and students' themselves (13). It is thus important that Taiwan's medical scholars and practitioners be open to refining and articulating their ideas about the medical humanities which may be more clinically and pedagogically appropriate to their culture, society, and values.

Review Limitations and Strengths

We acknowledge several limitations of our study. Firstly, the lack of clear articulation or attribution of definitions of medical humanities in many studies has meant that details of the curricular intervention were not always clear, so we adopted an inclusive approach. Similarly, the lack of explicit rationales for the use of the medical humanities in many studies meant that we as authors have had to infer what these might be from the details provided of the curriculum, and our inferences may not accord with the (unstated) intentions of the educators. Finally, as we did not search the gray literature (for example, medical school evaluations or conference proceedings) our study may not have identified all potentially relevant studies of the medical humanities outcomes, particularly with the practice of medical humanities in Taiwan.

Despite these limitations, we believe our study offers important insights, such as data on the alignment between the expected outcomes of medical humanities education and the actual outcomes, as reflected in the relevant academic literature. This focus has enabled us to confirm that most evaluations of the medical humanities continue to target student perceptions or knowledge while identifying some studies which do appear to address higher outcome levels and/or provide a stronger basis for claims of impact. At the same time, our focus on a specific national context has enabled us to provide a relatively comprehensive survey of the outcomes and practices related to a relatively homogeneous curriculum, an important factor for a highly contextual educational domain as reflected by medical humanities pedagogy.

CONCLUSIONS

Medical humanities education appears to be growing in importance in Taiwan and the results of this systematic review reflect this development. Nevertheless, a clear and locally produced consensus about the nature and practice of the medical humanities in the Taiwan context remains to be reached. There is also considerable scope to expand the focus of research in the medical humanities from intrinsic and instrumental rationales to critical and epistemological rationales for its adoption in medical education. The main approaches and interventions for delivering the medical humanities in Taiwan include narrative/storytelling, coursework, and fieldwork, along with several other related interventions. The ways medical humanities outcomes are assessed in Taiwan's medical curricula are currently heavily dependent on soliciting the students' perspective. In line with the higher levels of the BEME strength of evidence scale, more diversified participants' backgrounds, mixed methods, and assessments aligned with the outcomes of interest are recommended to produce more compelling evidence of the impact of medical humanities programs. Similarly, studies exploring higher-level outcomes according to Kirkpatrick's model would further advance our understanding of the impact of medical humanities curricula, in particular, the long-term impacts of medical humanities education for the medical students, practitioners to patients, and patient care remain unclear. Longitudinal studies thus should also be encouraged as they should provide clearer evidence of participants' behavioral change. Finally, future studies which broaden the evidence base, such as interviews with clinicians, policymakers, and patients, should shed more light on the implementation and evaluation of humanities education in medical schools.

DATA AVAILABILITY STATEMENT

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

AUTHOR CONTRIBUTIONS

BLH, C-DH, and LVM contributed to the development of the study, analysis and interpretation of the data, writing, reviewing and finalizing of the manuscript. K-SC and S-CC participated in the study conceptualization, analyzed the data, and critically

revised the manuscript. NC participated in the interpretation of the data and critically revised the manuscript. YSM participated in the analysis and interpretation of the data and critically revised the manuscript. All authors read and approved the final version of the manuscript.

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SUPPLEMENTARY MATERIAL

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Health professional student's volunteering activities during the COVID-19 pandemic: A systematic literature review

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Background: The Coronavirus Disease 2019 (COVID-19) crisis has forced health and education services to use additional human resources, such as health professional students. Students in the health professions, particularly those in the medical field, can participate in a variety of voluntary activities, both directly and indirectly in health services. The aim of this review was to determine the affecting factors, types of activity, and benefits of undertaking a volunteering role by the health professional student.

Methods: A systematic review of health professional student volunteering during the COVID-19 pandemic was conducted using seven databases: Epistemonikos, ProQuest, Scopus, EBSCOhost, JSTOR, Cochrane Library, and PubMed. This literature search included published articles from March 2020 through to December 2021 using the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) 2020 guidelines.

Result: We included 41 studies that met the selection criteria that assessed the factors and specific programs related to health profession students' volunteering involvement during the COVID-19 pandemic era. The most frequently observed supporting factor of the eagerness to be a volunteer was the feeling of moral responsibility (such as social dedication, sense of duty, and care), potential learning opportunities, personal interest, and financial compensation. Factors that contributed to a person's refusal to participate in a volunteer position were the fear of COVID-19 itself (such as transmission, risk of being infected, and personal identification as a risk group).

Conclusion: The review of available literature has shown that understanding the motivation and barriers to the willingness of health professional students to volunteer and the impact of volunteering activities on their future lives is a key for supporting them.

KEYWORDS

health professional student, volunteer, COVID-19, pandemic, medical student

Introduction

The Coronavirus Disease 2019 (COVID-19) pandemic spread globally, creating a public health and safety crisis. The impact was felt in almost every facet of life, such as health and education services. Due to heavy workloads, health workers were at risk of developing psychological issues such as depression, anxiety, severe stress, and fatigue (1). The COVID-19 pandemic also had an impact on the learning system for students, particularly those in the health professions, by shifting from face-to-face to online learning (2).

In this unprecedented era, e-learning may be an ideal option (3). However, it seems more applicable to preclinical phases of medical education, which are lecture-based. In contrast, clinical stages of medical education oblige students to work in interdisciplinary teams to practice their newly acquired clinical abilities while learning about the healthcare system. Therefore, the shift to e-learning may not facilitate clinical skills and competency acquisition during this stage (3, 4). However, it is understandable that medical schools had to postpone clinical clerkships to reduce student exposure, flatten the curve, and protect healthcare workers during the pandemic due to a lack of personal protective equipment (PPE) (5).

Due to the COVID-19 problem, healthcare services were forced to use additional human resources, such as students from the healthcare professions. This phenomenon was due to the increased pressure on healthcare facilities, caused by the rise of new cases, shortage of doctors, and increased prevalence of burnout among health professionals (6). Students in the health professions, particularly those in the medical field, could participate in a variety of voluntary activities, both directly in health services (triage, admissions wards, hospital clinics, emergency departments, and diagnostic laboratories) and indirectly (call centers, community contact tracing, and community education) (7). The breaks from clinical rotations also provided opportunities for students to engage in academic writing, improve their understanding of critical appraisal abilities, conduct clinical trials, and learn about data analysis (5, 8).

The clinical setting participation varied across different countries and academic institutions. China, Italy, and the United Kingdom integrated medical students into their healthcare systems or graduated them earlier (9, 10). Other countries, such as South Korea and the United States, canceled clerkships to limit patient contact (11, 12). To participate in volunteer work, a student had to be provided with sufficient training, knowledge about their competence, strict supervision, and an adequate supply of PPE (13).

Health professional students volunteered to help the community, profession, and people overcome by COVID-19. From the students' perspective, this activity was oriented to express loyalty to the health profession, and strengthen a professional sense of belonging (14). However, some students hesitated to volunteer due to various uncertainties, which could cause sleep problems, stress, persistent feelings of discomfort, dread, and anxiety (15). Volunteering offers several educational and social benefits, such as acquiring new skills in real-time data gathering, efficient communication with communities and public health groups, and social media monitoring (16). Therefore, it can help medical students prepare for their future careers as doctors (17). Due to this phenomenon, we conducted a systematic review to determine the motivating factors, barriers, types of activities, and benefits of health professional students volunteering activity during the COVID-19 pandemic.

Method

Search strategy

We utilized the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) recommendations for conducting this literature review (18). Before conducting the literature search, the study protocol was approved by all team members. We searched seven databases, including Epistemonikos, ProQuest, Scopus, EBSCOhost, JSTOR, Cochrane Library, and PubMed (Medline *via* PubMed), for published articles from March 2020 through December 2021 that assessed the factors and specific programs related to health profession students' volunteering involvement during the COVID-19 pandemic era. Hand-searching was also undertaken by examining the references of the selected articles to identify relevant publications that were not indexed in the previously described databases. This step utilized Google Scholar and journals with predominant publications related to health professional education, namely the British Medical Journal (BMJ), BMJ Open, and BMC Medical Education.

We used the following keywords in searching the literature: [(medical student OR health student OR health professional student OR online education OR online teaching OR medical school OR health institute) AND (COVID-19 OR SARS-CoV-2 OR severe acute respiratory syndrome OR nCOV OR coronavirus OR pandemic OR outbreaks OR global crisis) AND (knowledge OR attitude OR practice OR volunteer OR reinforcing factors OR enabling factors OR experience OR opportunity) AND (health education OR health promotion OR health problems OR health support OR hospital OR triage OR tracing OR screening OR monitoring OR disease transmission OR drug administration OR health administration OR disease prevention)]. Two reviewers (TU and DA) searched the databases independently. We did not register our search strategy on the International Prospective Register of Systematic Reviews (PROSPERO) to prevent unwanted delay and allow the data collection process to start immediately.

Study selection

We selected qualitative and quantitative (cross-sectional and cohort) studies that assessed the factors and particular programs relevant to the volunteering activity undertaken by health profession students during the COVID-19 pandemic (such as medical, public health, and nursing students). We only used peer-reviewed (excluding the preprints) full-text articles written in English to ensure data accuracy. Articles in the form of literature reviews, case studies, case-control, clinical trials, protocols, conference abstracts, news, editorials, and posters, as well as articles analyzing non-health professional student populations, were excluded. We also decided to exclude studies that explored pooled student populations. Three reviewers (TPU, MGS, and KMNN) independently screened titles and abstracts with semi-automatic processes using Rayyan QCRI, online software for abstract and title screening (19). The duplicates detected by this software were eliminated. Then, the discussion regarding any disagreements related to the title and abstract screening or full-text assessment was undertaken to reach a consensus. From the 1,239 articles obtained, 266 were removed due to duplications. We identified 162 papers for full-text and reference eligibility examination. In the final stage, 41 studies met the inclusion requirements for data synthesis (**Figure 1**).

Data extraction and synthesis

Data were extracted and synthesized from the selected studies. Three reviewers (TPU, MGS, and KMNN) extracted relevant information from each study individually, while one author (RAS) with experience in the medical education discipline reviewed the extracted data.

Each article was assessed for quality, such as authorship, years, country, health professional student populations, data collection methods, and key findings. Key findings related to the number of students who were willing to volunteer, motivating factors, benefits of volunteering, obstacles faced, and types of activity were all extracted. Both qualitative and quantitative data were obtained. Risk of bias analysis was determined by using the National Institutes of Health (NIH) Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies checklist (20). The assessment of quality was not used to exclude the studies.

Result

Characteristics of included studies

The main characteristics of the included studies are summarized in **Supplementary Table 1**. The sample size ranged from 12 to 10,433 health professional students (medical and other healthcare professions). Included studies predominantly employed medical students as their study population (31/41; 75.6%), whereas one study also using dental students (21) as their subject population. Seven studies (22–28) (17.1%) included multiple health student disciplines (e.g., public health, nutrition, midwifery, in addition to medical students), while three studies (29–31) (7.3%) exclusively recruited nursing students. Our analysis also covered a wide range of regional distributions, with two studies (32, 33) having a global distribution of respondents. The continents where most of the research originated were Europe, Asia, and America, with 34.1%, 26.8%, and 24.4% distributions, respectively. Meanwhile, Africa had a lesser distribution, with four studies (21, 29, 34, 35) (9.8%) included.

The total number of participants summed from all included studies was 37,000. Fifteen of the 41 studies (36.6%) included students from more than two institutions. The majority of the included studies (85.3%) were cross-sectional in design. Other observed types of study included qualitative and cohort studies, with 12.2% and 2.4%, respectively. Data were mainly taken from the primary source through an online questionnaire or survey (32/41 studies; 78.0%).

Study quality

We used the National Institutes of Health Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies to assess the likelihood of bias in cross-sectional or cohort studies (**Figure 2**). Bias in research questions, study demographics, study participation (response rate), recruiting bias, and outcome measures were low (**Figure 3**). There was a moderate risk of bias since only 26.8% of studies explained the adjustment of their sample size. Meanwhile, a high risk of bias in measuring exposures of interest before outcomes and sufficient timeframes to detect an effect was detected. This phenomenon is mainly related to a large proportion of cross-sectional studies, which only collect data (both exposure and outcome) simultaneously. Only 4.9% of studies measured and accounted for potential confounders, thus mostly having a high risk of bias. Overall, the included studies posed a moderate risk of bias, with an approximately equivalent share between low and high risk of bias studies.

Factors affecting health profession student willingness of participating as volunteer

Twenty-three papers (56.1%) reported factors impacting health profession students' desire to volunteer during the COVID-19 pandemic. Seventeen (41.5%) studies focused solely on the medical student population. Meanwhile, six others

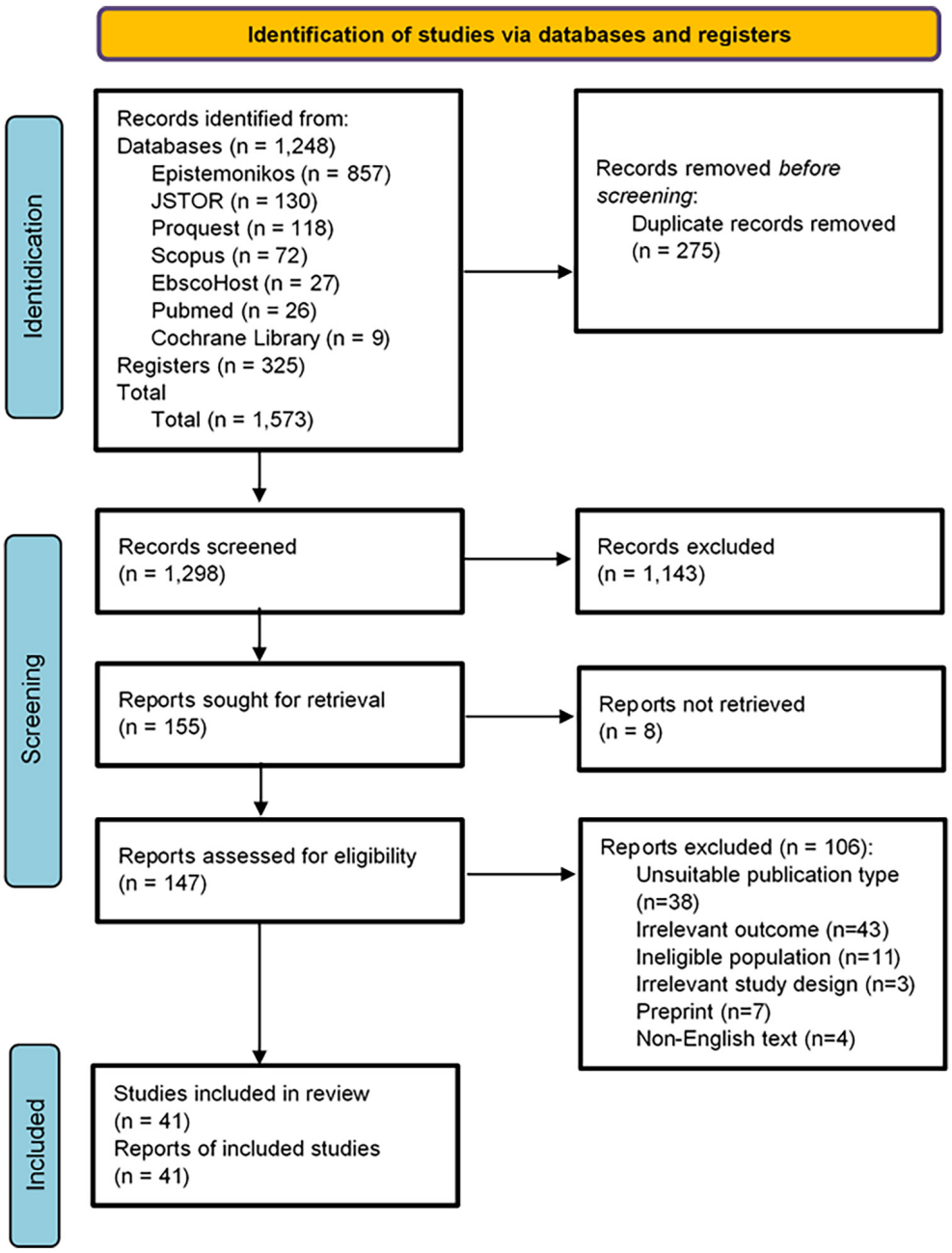

FIGURE 1
PRISMA 2020 flow diagram of search and data extraction.

concentrated on a wider variety of health professional or nursing students. Fourteen studies (34.2%) found a willingness to volunteer ranging from 19.5 to 91.5% (32, 36). However, the actual implementation of this willingness was only observed in a lesser proportion (6.5–67.9%) (25, 37–40), and their readiness level was still low (18.6–58.6%) (32, 38, 41).

The most frequently observed supporting factors for the eagerness to volunteer were: moral responsibility (social dedication, sense of duty, and care), potential learning opportunities, personal interest, provision of adequate PPE, parental support, level of expertise, knowledge, and financial compensation. Lazarus et al. stated that the most significant demographic factors influencing willingness to volunteer were being male, residing in the central part of the country, pursuing education in a public institution, and previous volunteering activity ($p < 0.05$)

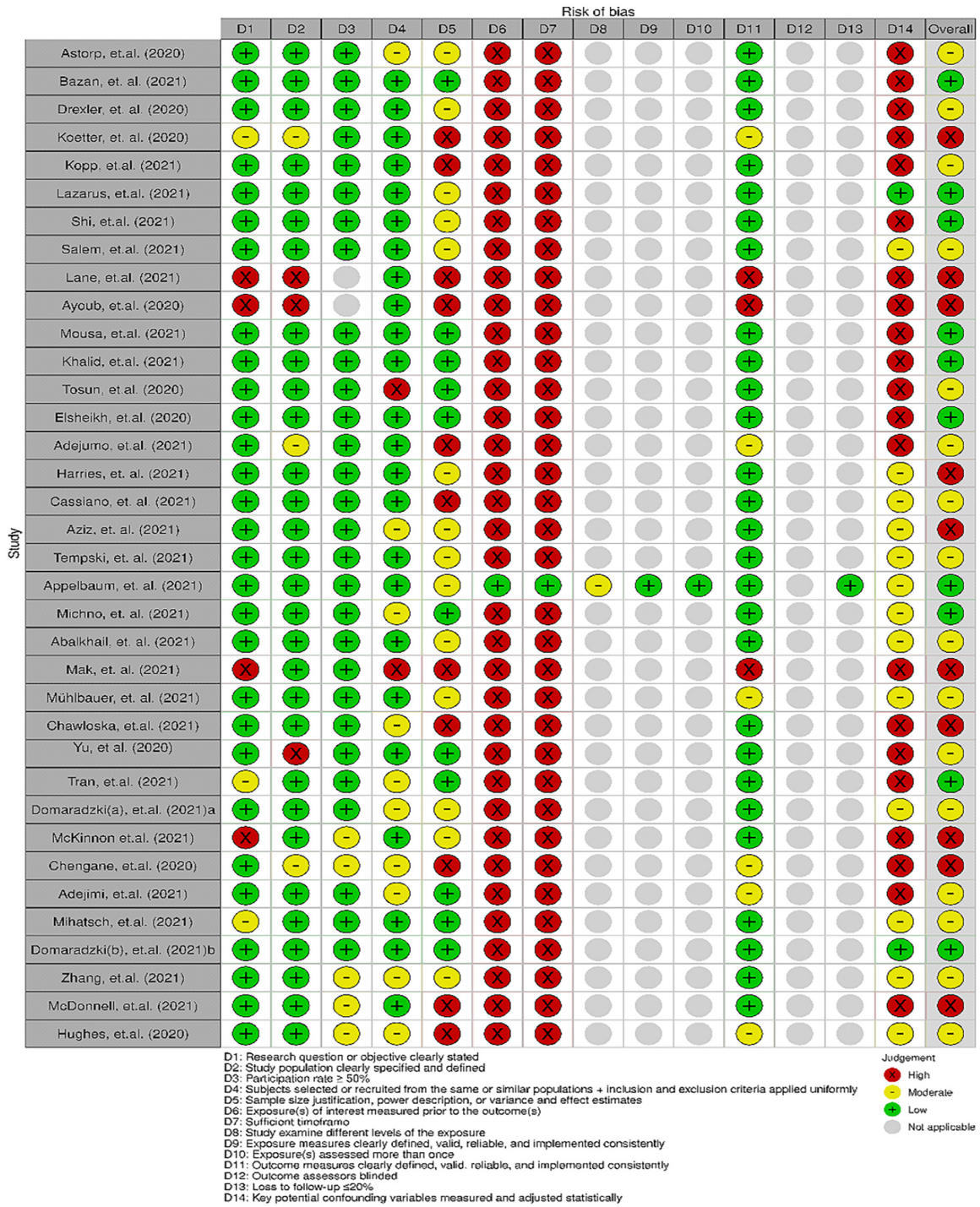

FIGURE 2
Individual study risk-of-bias assessment using National Institutes of Health Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies checklist.

(41). A chain-mediation analysis of this phenomenon outlined four essential topics: altruistic motivation, prosocial encouragement, self-moral cognition, and reward (42). Included studies showed that in terms of gender, female students (21, 24, 39, 43, 44) were more likely to be involved in the pandemic control and volunteering than males (35, 40, 41), with a willingness proportion of 60.2% (female) vs. 52.3% (male).

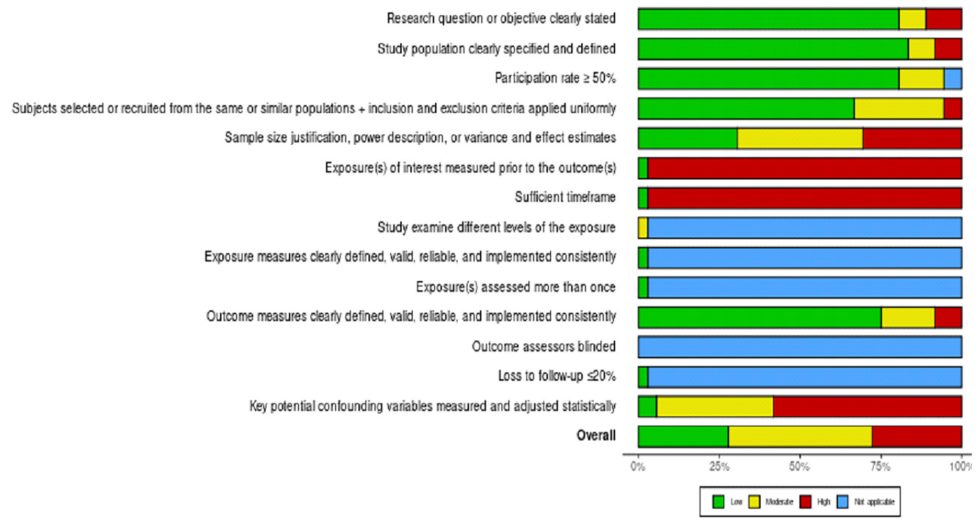

FIGURE 3
Overall risk of bias on the National Institutes of Health Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies checklist.

Some studies also uncovered elements that led to an individual's rejection of participating in a volunteer position. The critical factor was the threat of SARS-CoV-2 infection (such as transmission, risk of being infected, and personal identification as a risk group). A scarcity of PPE and the unavailability of a definitive treatment were cited as probable causes of this problem (41). Other observable characteristics included the uncertainty of their academic activity (due to a lack of time for reading, studying, and exams) (45, 46), fear about unfulfilling the volunteer task (associated with qualifications insufficiency) (7, 34), and coming from a lower-middle-income family (41). Another study found that personal perceptions of not being needed by the organization or institution and parental rejection may influence students' unwillingness to participate in a volunteer program (34).

Types of volunteering activity

Nine studies described the types of volunteering activities carried out by health professional students during the pandemic (7, 8, 22, 25, 27, 39, 46–48). The activities can be broadly divided into nine different categories, defined as hospital works (triage, admission wards, and emergency room) (7, 25, 27, 46), call center and administration (7, 27, 39, 46), epidemiological aspects (contact tracing, testing) (22, 47, 48), online or remote consultation (regarding COVID-19 or non-COVID-19 cases, using phone or internet) (46–49), laboratory-related works (47), food and/or PPE supply (27, 39), mentoring juniors (39), public education (such as countering hoaxes) (48), and in research programs (8). Some students also reported participating in more than one type of volunteering activity (7, 39).

Benefits of volunteering activity

Fourteen studies revealed the benefits of participating as a volunteer during the current pandemic from the health professional students' perspectives (7, 8, 16, 17, 22, 24, 27, 28, 46, 47, 50–53). The most frequently mentioned advantage was to learn and practice, especially to give real aid and explore evidence-based medicine (8, 16, 17, 22, 24, 28, 47, 53). Other benefits included collaborating with non-physicians (8, 22, 47), strengthening communication skills and empathy (8, 16, 17, 22, 24, 50, 54), knowing more about the healthcare system and costs (22), developing leadership and time management (24, 47, 52), helping other people (social benefits) (16, 17, 24, 28, 51), getting recognition (from friends, other healthcare workers, patients, etc.) (7, 46), providing an interactive learning platform (49), receiving financial compensation (52), and experiencing a research atmosphere (8). Following the positive impression of volunteering activity, three studies found a high level of willingness (73.2–94%) among health professional students regarding participation in the future (7, 49, 53). Regarding mental issues associated with volunteering, four studies found that student volunteers had low psychological stress (40, 44, 51, 55). The prevalence of anxiety and depression was lower among volunteering students than non-volunteering ones, indicating that it positively influenced general psychological wellbeing (40, 51).

Discussion

The COVID-19 pandemic has made substantial changes in social life. Due to societal constraints during this pandemic,

most of the included studies in this review relied heavily on primary data collected *via* online questionnaires or surveys. This method mainly provides quick, easy, and economical way to obtain large samples (56).

The current COVID-19 pandemic has pushed everyone to contribute. As future healthcare providers, health professional students are regarded as those with the closest capability to assist (57). This review analyzed health professional students' willingness to volunteer in pandemics, in addition to their motivation, benefits, and obstacles to volunteering. Health professional students' desire to participate as volunteers are influenced by moral responsibility, personal interest, social dedication, prosocial motivation, self-cognition, and learning opportunities. The majority of health professional students were willing to fight the pandemic (41, 46). The previous studies in Ireland also showed that the majority of health professional students would volunteer during pandemics (58).

There were various reasons for health professional students' eagerness to volunteer during the COVID-19 era. A shortage of medical personnel and sense of duty were the main reasons supporting the students' willingness to volunteer (41). Gender, volunteering experience, types of academic institution, place of living, and family income had higher scores for willingness and readiness to volunteer (41, 59). Female students were more likely than male students to volunteer in pandemic control (60.2 vs. 52.3%). This finding is consistent with previous research, which found that women were more inclined to volunteer because of their nurturing, generous, and empathetic nature, but for a shorter period than male participants (60, 61). Moreover, health professional students with high prosocial motivation were more likely to engage in volunteer behavior during a pandemic crisis (42). This is in accordance with the findings from the previous studies that showed that increases of prosocial motivation lead to increases in either work or volunteering behavior (62).

Most of the students indicated that volunteering activities provided direct benefits such as gaining a sense of giving direct aid, building professional experience, and developing collaboration skills (7). This may be due to health-related activities influencing health professional students to contribute (63). These findings are consistent with the previous studies (64–66). Thus, giving motivation to the health professional students to contribute as volunteers in this pandemic era became crucial. Another advantage of volunteering is that it helped prevent mental-health problems during this uncertain time. Volunteering was also linked to improved mental wellbeing (67).

On the other hand, some barriers may be experienced by health professional students discouraging them from participating in volunteer work during COVID-19. Fear for their own health, the lack of a treatment, and the fear of harming patients were key factors limiting their willingness to volunteer (41). Health profession students responded that their safety while working was a priority (45). As a result, the regulation on this topic appears to be necessary as a prerequisite (7). Fostering volunteerism among medical students requires the joint effort of the government, non-profit organizations, hospitals, and medical colleges (42). Government and all-level organizations should contribute to create extensive job opportunities and platforms for medical students to generate volunteer services, as well as to build a sustainable incentive system to encourage medical students to engage in volunteer behavior to serve society (42). Training and education were related to update the safety recommendations (68). Hospitals should give the training sessions and theoretical prequalification before health professional students start activity in volunteering (45). The university should provide clear protocols and guidance for volunteering activities (45). Senior colleagues should further address and support safety during clinical work (45).

Health professional students can undertake many activities to contribute in the response to the COVID-19 pandemic. Nine studies included in this review assessed the form of activities that health professional students undertook to fight the pandemic. The activities can be broadly divided into nine different categories, defined as direct patient care (7, 25, 27, 46), call center and administration (7, 27, 39, 46), epidemiological aspects (22, 47, 48), online consultation (46–49), laboratory-related works (47), equipment supply (27, 39), mentoring juniors (39), health promotion and education (48), and in research programs (8). Some students also reported being involved in more than one type of volunteering activity, such as in patient's triage and admission wards (7, 39). This is important in increasing public knowledge and awareness, supporting healthcare facilities, and evidence-based practice regarding the COVID-19 pandemic (7, 17, 69).

Our work provides an exclusive systematic review of volunteering activities undertaken by health profession students during the COVID-19 pandemic. The previous research, although also emphasizing volunteerism and readiness in the case of a pandemic, is mainly tracked back to past scenarios, therefore, explaining different pandemic or disaster situations. Furthermore, during the COVID-19 pandemic, we evaluated the determining factors, types of activities, and advantages of volunteering (which was exclusively done in this systematic review). Moreover, this study employed a larger population of health professional students (medical and other healthcare professions) than previous research (only inclusive of medical students) (70).

Although the majority of medical students were willing to voluntarily support the care system during the pandemic, only a small proportion of them had adequate readiness to practice (41). This is in agreement with the findings of previous research in Germany, which revealed relatively

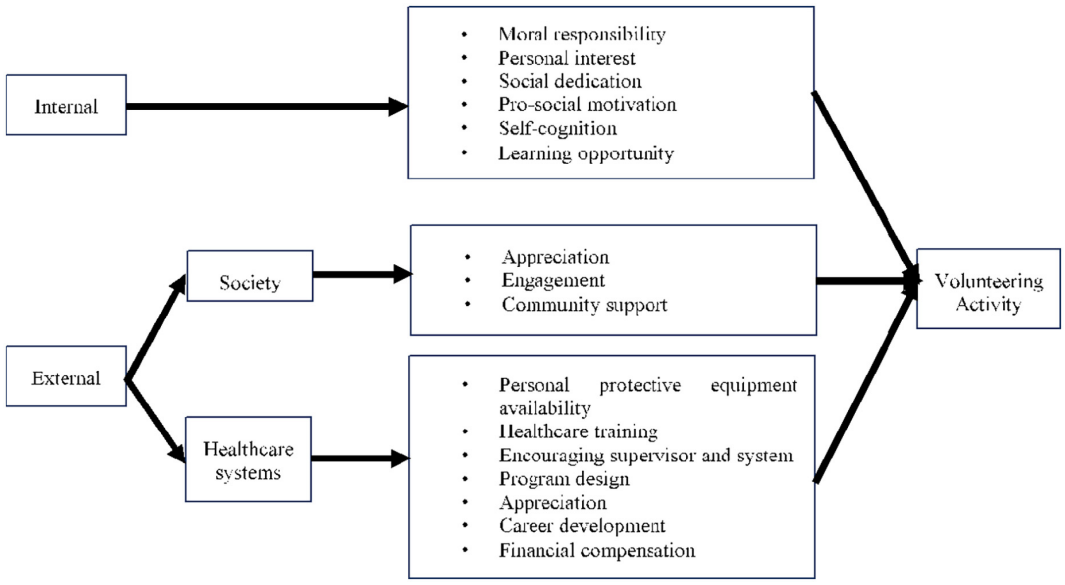

FIGURE 4
Proposed Model of Volunteering activity in Health Professional Students.

low degrees of practice preparedness (58). This means that further preparations are required to ensure that they have sufficient knowledge and skills (57). The experience of volunteer service and the impact on healthcare students' life were identified (71). They were able to work for a longer period, more hours in addition to displaying a higher level of satisfaction and confidence, and when given adequate encouragement and valued by medical staff (46, 63). Volunteering activity can provide the opportunity to learn and practice skills in collaboration, communication, and health systems' science (22).

There are some limitations found in this systematic review. The number of samples was highly variable (the smallest was 12, and the largest was more than 10,000). The study with a small sample size may not represent all health professional students. Moreover, many studies had a moderate risk of bias due to their cross-sectional design (attributed to insufficient observation) and lack of confounder adjustment. The heterogeneity of the outcome measures changed the pattern of this review. Due to large geographical distribution, there may be cultural disparities among them, although it is helpful to picture a global phenomenon of volunteering in health professional students. The scope of this review is broad enough because it discusses the motivation and barriers to the willingness of health professional students to volunteer, the types of volunteering activities that health professional students can undertake, and the impact of volunteering on their future lives. We also developed a proposed model of volunteering activity in health professional students to summarize the findings (**Figure 4**).

Conclusion

The review findings highlight the affecting factors, types of activity, benefits, and obstacles of undertaking a volunteering role by health professional students during the COVID-19 pandemic. Understanding the motivation and barriers to the willingness of health professional students to volunteer and the impact of volunteering activities on their future lives is a key for supporting them. Additional studies with larger sample sizes, equal sample distribution, and with adjustment of confounders related to COVID-19 volunteering by health professional students are needed.

Data availability statement

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

Author contributions

TPU, DA, MGS, KMNN, and RAS: literature review concept design and literature search. TPU, DA, and RAS: figures and tables. RS: reviewed each extracted data. All authors contributed in the analysis and interpretation of data, drafting of manuscript, and approval of the final 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/fmed.2022.797153/full#supplementary-material

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Applications of social theories of learning in health professions education programs: A scoping review

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Introduction: In health professions education (HPE), acknowledging and understanding the theories behind the learning process is important in optimizing learning environments, enhancing efficiency, and harmonizing the education system. Hence, it is argued that learning theories should influence educational curricula, interventions planning, implementation, and evaluation in health professions education programs (HPEPs). However, learning theories are not regularly and consistently implemented in educational practices, partly due to a paucity of specific in-context examples to help educators consider the relevance of the theories to their teaching setting. This scoping review attempts to provide an overview of the use of social theories of learning (SToLs) in HPEPs.

Method: A scoping search strategy was designed to identify the relevant articles using two key concepts: SToLs, and HPEPs. Four databases (PubMed, ERIC, ProQuest, and Cochrane) were searched for primary research studies published in English from 2011 to 2020. No study design restrictions were applied. Data analysis involved a descriptive qualitative and quantitative summary according to the SToL identified, context of use, and included discipline.

Results: Nine studies met the inclusion criteria and were included in the analysis. Only two SToLs were identified in this review: Bandura's social learning theory ($n = 5$) and Lave and Wenger's communities of practice (CoP) theory ($n = 4$). A total of five studies used SToLs in nursing programs, one in medicine, one in pharmacy, and two used SToLs in multi-disciplinary programs. SToLs were predominantly used in teaching and learning ($n = 7$), with the remaining focusing on assessment ($n = 1$) and curriculum design ($n = 1$).

Conclusions: This review illustrated the successful and effective use of SToLs in different HPEPs, which can be used as a guide for educators and researchers on the application of SToLs in other HPEPs. However, the limited number of HPEPs that apply and report the use of SToLs suggests a potential disconnect between

SToLs and educational practices. Therefore, this review supports earlier calls for collaborative reform initiatives to enhance the optimal use of SToLs in HPEPs. Future research should focus on the applicability and usefulness of other theories of learning in HPEPs and on measuring implementation outcomes.

Systematic Review Registration: https://www.researchregistry.com/browse-the-registry#registryofsystematicreviewsmetaanalyses/registryofsystematicreviewsmeta-analysesdetails/60070249970590001bd06f38/, identifier review registry1069.

KEYWORDS

social learning theory, social cognitive theory, communities of practice, health professions education, teaching, assessment, curriculum

Introduction

Health professions education (HPE) is the field of expertise applied to the education of health care practitioners which caters to the specific requirements of students and is used to develop, implement, and evaluate all aspects of health professions curriculum (1). Acknowledging and understanding the theories behind the learning process is important in optimizing learning environments, enhancing efficiency, and harmonizing the education system (2), since theory and practice are inextricably linked and mutually inform each other (3, 4). Understanding learning theories helps academics and researchers recognize the nature of knowledge acquisition and how to measure learning outcomes. This improved perception will enhance the scholarship of teaching and the understanding of educators within various contexts, namely teaching, curriculum development, mentoring, academic leadership, and learner assessment (5). Furthermore, it will help learners recognize their learning processes and ultimately assist in enhancing their learning outcomes (6). Learning theories can be implemented, based on appropriateness, in learning processes at individual, group or community levels and in various forms of educational activities (7).

In health professional education programs (HPEPs), learning theories are not regularly and consistently implemented, which has resulted in accreditation bodies dictating educational agendas (8), variation in the extent to which learning theories are used in HPEPs, and ultimately a potential disconnect between learning theories, curriculum design, outcome evaluation, and educational practices (9). This is also evidenced by an unfamiliarity among educators inadequately trained to apply theories in a range of contexts with various learner characteristics (5, 6, 10–12). Mukhalalati and Taylor provide an easy-to-use summarized guide of key learning theories used in HPEPs with examples of how they can be applied. The guide aims to assist healthcare professional educators in selecting the most appropriate learning theory to better inform curricula design, teaching strategies, and assessment methods, which in turn reflects on learner experience (13). There is a paucity of literature reviewing the use of learning theories in HPE, the majority of this being generally descriptive, explaining different learning theories and potential HPEP application. For example, little has been reported about the use of learning theories or active learning strategies in e-learning for evidence-based practices (14), or making suggestions for utilizing the conceptual aspects of learning theories in the identification and implementation of effective practices for evaluating teaching practice (15). With a focus on the significance of health professions educators' professional development, using learning theories to enhance teaching skills, particularly in clinical settings (16), the extant literature does not provide clear guidance, for example via the provision of examples of practical application and how these conceptual frameworks might advance the scholarship of teaching and learning in HPEPs. Therefore, health professions education scholars recommend conducting more research into the influence of implementing learning theories on core education components of the HPEPs, namely: curriculum design, content development, teaching, and assessment (13, 17). Such research aims to demonstrate the benefits of implementing learning theories and pedagogies in HPEPs, ultimately reducing the gap between learning theories and educational practices (17).

Social theories of learning (STolLs) play an important role in the design and implementation of HPEPs (2, 10, 18). STolLs integrate the concept of behavioral modeling and focus on social interaction, the person, context, community, and the desired behavior as the main facilitators of learning (19). The use of STolLs in HPEPs varies possibly due in part to a lack of awareness of available STolLs and a paucity of specific in-context examples to help educators consider the theories relevant to their teaching situation. STolLs include zone of proximal development, sociocultural theories, Bandura's social learning and social cognitive theories (SLT and SCT), situated cognition, and communities of practice (13, 20–25). Zone of

proximal development is defined as "the distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with a more capable peer" (26). According to sociocultural theories, learning and development are embedded within social events and take place as a learner interacts with other people, things, and events in a collaborative setting (26). Bandura's social learning theories (SLTs), i.e., SLT and SCT, stress the necessity of observing, modeling, and mimicking other people's behaviors, attitudes, and emotional reactions such that environmental and cognitive variables interact to impact human learning and behavior (18, 25). Situated cognition theory asserts that learning occurs when a learner is doing something in both the real and virtual worlds, and hence learning takes place in a situated activity with social, cultural, and physical settings (27). Community of practice "are groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly" (28).

To date, no study has examined the application of SToLs in HPEPs and the nature of their use. Consequently, this scoping review aims to examine the application of SToLs in HPEPs. The specific objectives are to (1) identify the SToLs applied to HPEPs, and (2) examine how SToLs are applied to learning and teaching processes in HPEPs.

Method

Protocol and registration

This study adopted a scoping review approach involving exploring and documenting the breadth of knowledge and practice in the investigated topic (29). The protocol for this scoping review was registered at RESEARCH REGISTRY [https://www.researchregistry.com/browse-the-registry#registryofsystematicreviewsmeta-analyses/registryofsystematicreviewsmeta-analysesdetails/60070249970590001bd06f38/] with the number [reviewregistry1069]. This scoping review is compliant with the PRISMA statement for scoping reviews (PRISMA-ScR) (30).

Eligibility criteria

The main focus of this review was to identify articles that describe the applications of SToLs in undergraduate or postgraduate teaching and learning processes. The eligibility criteria included primary research studies that were electronically available in their entirety, published in English during the last 10 years (i.e., 2011–2020), and that reported the use of a SToL, namely: zone of proximal development, sociocultural theories, Bandura's SLTs, situated cognition, and communities of practice.

Primary research articles should report the use of SToLs explicitly and as a central theme, and a description of how SToLs were applied in HPEPs should be mentioned in order to be included in the study. No restrictions were applied to the study design. Primary research studies that used a theory other than the determined ones, mentioned SToLs only in the introduction, or used SToLs for data analysis, and/or as a theoretical framework, rather than as an intervention or an application in HPEP teaching and learning processes, were also excluded. Moreover, articles published more than 10 years ago were not included. Based on the authors experience in this field and on their extensive review of the literature, the scarcity of research that applies SToLs to undergraduate and postgraduate HPE became apparent (8, 9, 31). An initial testing search was conducted with no timeframe boundaries, to refine the search strategy and conduct a comprehensive review. Despite returning a significant number of records, initial screening indicated the irrelevance of the vast majority of studies. Therefore, the authors decided to restrict the timeframe to 10 years to reflect the most recent application of SToLs in HPE and the growth and volume of knowledge related to teaching and learning. Article types other than primary research literature (e.g., reviews, editorials, letters, opinion articles, commentaries, essays, preliminary notes, pre-print/in process, and conference papers) were also excluded from this review because such applications are usually reported in primary research articles. Theses and dissertations were also excluded because they risked being less scientifically rigorous due to a lack of peer-review and being unpublished in commercial journals (32).

Information sources

The search strategy was developed by a multidisciplinary team. This included academics (BM, FH, ME, and SE) with expertise in pharmacy, healthcare professions education, learning theories, and systematic review studies, and an academic research and instruction librarian (AB) with expertise in health science, education, pharmacy, and medical databases. A search of the electronic literature was performed by AB in December 2020 and January 2021, using PubMed, ERIC, ProQuest, and Cochrane databases. Two key concepts (SToLs, HPEPs) were combined using the Boolean connector (AND). Keywords used in the social learning theories concept search included: "social learning theories," "social theories of learning," "social cognitive theories," "zone of proximal development," "sociocultural theories," "situated cognition," "community/communities of practice." Keywords for this concept were combined using the Boolean connector (OR). Keywords used to search for the HPEPs concept included "healthcare professional education," "health care professional

education," "medical program education," "pharmacy program education," "health sciences program education," "nursing program education," "midwifery program education," "nutrition program education," "dietician program education," "biomedical program education," "physiotherapy program education," "physical therapy program education," "occupational therapy program education," "radiation therapy program education," "public health program education," and "dental program education." Keywords for this concept were combined using the Boolean connector (OR). Keywords were matched to database-specific indexing terms and applied based on each database as appropriate.

Search

The PubMed database was searched on December 22, 2020, implementing date (i.e., 2011–2020) and language (i.e., English only) filters, resulting in 689 articles. The following search strategy was used: "social learning theor*"[Title/Abstract] OR "social theor* of learning"[Title/Abstract] OR "social cognitive theor*"[Title/Abstract] OR "zone of proximal development"[Title/Abstract] OR "situated cognition"[Title/Abstract] OR "sociocultural theor*"[Title/Abstract] OR communit* of practice[Title/Abstract] AND Education[MeSH Terms] OR healthcare professional education[Title/Abstract] OR health care professional education[Title/Abstract] OR health sciences program education[Title/Abstract] OR nutrition program education[Title/Abstract] OR diet* program education[Title/Abstract] OR biomedical program education[Title/Abstract] OR physiotherapy program education[Title/Abstract] OR physical therapy program education[Title/Abstract] OR occupational therapy program education[Title/Abstract] OR radiation therapy program education[Title/Abstract]. Completed search strategies for other databases are presented in Supplementary material 1.

Selection of sources of evidence

Two investigators (BM and FH) conducted the title and abstract screening for the identified articles from the search strategy outlined above after duplicates and any clearly irrelevant articles had been removed. Full-text screening was conducted initially by two investigators (BM and MJ) who assessed the eligibility of the studies independently. Further multiple rounds of full-text reviews were performed by four investigators (BM, SE, MJ, and FH) to ensure that studies directly relevant to the objectives were included in this review. Disagreements were resolved by consensus via meetings and discussions.

Data charting process and data items

An extraction sheet was designed to tabulate data from the included articles using a Microsoft Excel® spreadsheet. The extracted data included: (1) article information (title, author(s), year of publication, and journal name), (2) setting information (setting, organization name, whether the organization was public or private, and country), (3) research information (objective, design, HPEP), (4) theory information (name of the theory, context of application, description of how the theory was applied, the outcomes assessed, and methods of analysis), (5) outcome information (number of participants involved, intervention provided, duration of intervention, overall outcome and recommendations, and reported limitations related to the theory), and (6) the applicability to other disciplines. The context of the SToLs application includes teaching and learning (strategies used to deliver and receive educational content in clinical or non-clinical settings, etc.), curriculum development (learning objectives, planning of teaching strategies, program evaluation, etc.), or assessment (development, validation, and administration of assessment activities, etc.). The data extraction sheet was piloted by two investigators (BM and MJ) using four sample articles included in this review. Based on successful piloting, complete data extraction was done by four investigators (BM, FH, ME, and SE).

Critical appraisal of individual sources of evidence

The included studies were not evaluated for quality or critically appraised because of methodological heterogeneity among studies. However, this lack of quality evaluation and critical appraisal aligns with the general standards of scoping reviews (33).

Synthesis of results

Descriptive numeric analysis was used to summarize data retrieved from the included articles according to the proportion of (1) articles per discipline, (2) SToLs applied, and (3) contexts in which SToLs were used. Moreover, the analysis of the data involved conducting a narrative description of the included articles by two independent investigators (MJ and FH). Consensus was reached on the basis of the analyzed data.

Results

Out of 5,303 articles retrieved from databases, 247 were duplicates and hence removed (Figure 1). Following the title

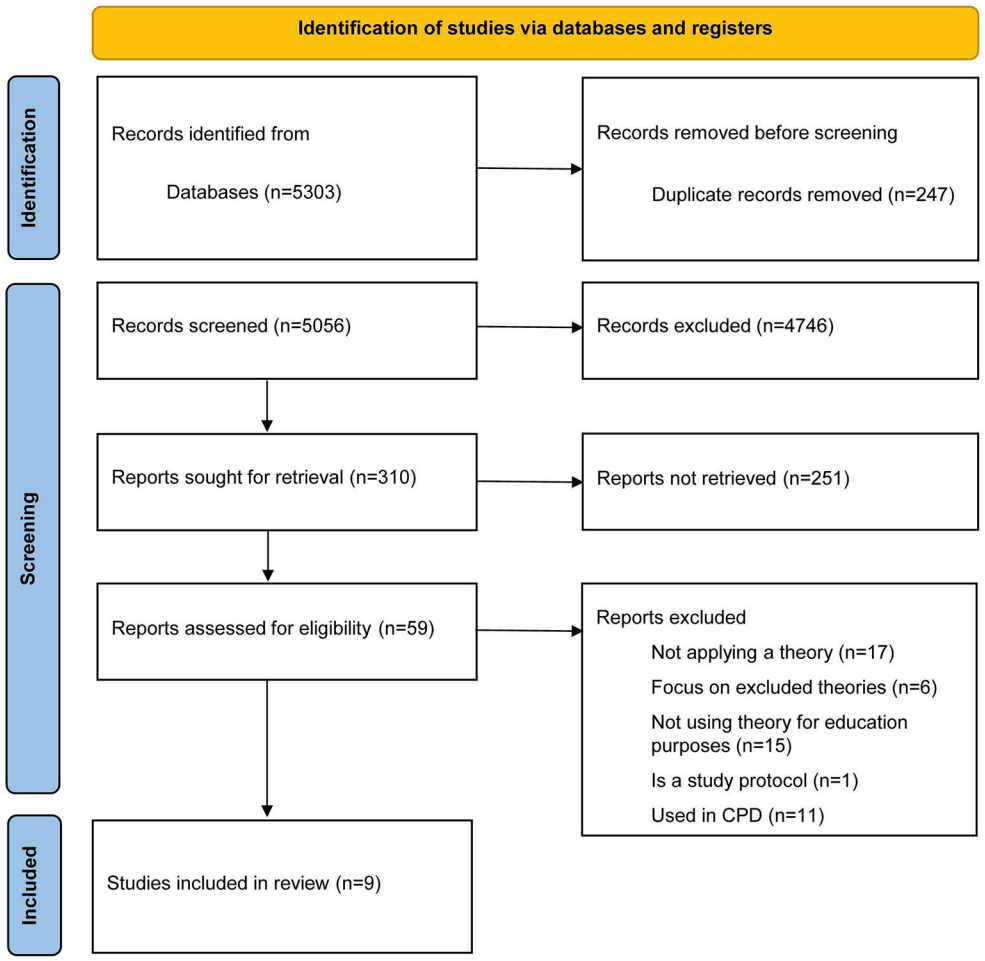

FIGURE 1
Prisma flow diagram.

and abstract screening of 5,056 articles, 310 articles were eligible for full-text screening. Primary reasons for exclusion include: article types other than primary research literature (e.g., review articles, description of a theory, editorial letters, commentaries, protocols), thesis or dissertations, articles that described the use of theories other than SToLs, articles that did not implement SToLs or did not implement them in undergraduate or postgraduate education (e.g., implemented them for faculty development), articles that focused on other professions and not on health professions, and articles that used SToLs for data analysis purposes. Other reasons for exclusion included manually detected duplicates. A total of nine articles were qualified for inclusion and were used to inform this scoping review.

Characteristics of included studies

Of studies published between 2013 and 2019, two studies were conducted in the USA (34, 35), three in Australia (36–38), and one study in each of these countries: Sweden (39), Canada (40), Scotland (41), and Italy (42). A total of five studies used Bandura's SLTs (34, 36–38, 40), while four used Lave and Wenger's CoP theory (35, 39, 41, 42). Three studies used a qualitative research methodology (39–41), two studies used quantitative research methodology (37, 42), and three studies used a mixed-method design (35, 36, 38). The remaining study, educational innovation, focused on describing the implementation of a teaching strategy (34). A total of five studies used SToLs in nursing programs (34, 38, 40–42), one

in medicine (39), one in pharmacy (37), and two were multi-disciplinary, including: paramedicine, psychology, nutrition and dietetics, nursing, public health, medicine, and other HPEPs (35, 36). Seven studies used *SToLs in teaching and learning* (34, 36–39, 41, 42), *one in assessment* (40), *and one in curriculum design* (35). The included studies covered a total of 1,780 participants (i.e., undergraduate students, residents, clinical teachers, and healthcare professionals) (Table 1).

Bandura's SLTs

Five studies in this scoping review focused on utilizing Bandura's SLTs in the teaching, learning, and assessment of health professions students (34, 36–38, 40). The use of Bandura's SLTs in the included studies suggested its advantages in improving students' self-efficacy and confidence, collaborative learning, learning experiences and future teaching experience and career research intentions.

In 1977, Bandura proposed an SLT based on a series of human behavioral studies (24). According to Bandura, learning takes place in social settings and occurs not only through an individual's own experiences, but by observing the actions of others and their consequences (24, 43). Social learning is also referred to as observational learning because learning takes place as a result of observing others (i.e., models), which Bandura's previous studies demonstrated as a valuable strategy for acquiring new behaviors (44). Bandura and his colleagues continued to demonstrate modeling/observational learning as a very efficient method of learning (44). Bandura's theorizing of the social development process later incorporated motivational and cognitive processes into SLT (44). In 1986, Bandura renamed his original SLT to SCT to emphasize the critical role that cognition plays in encoding and the performance of activities (44, 45). SCT suggests that learning occurs in a social context with a dynamic and reciprocal interaction of the person, environment, and behavior (25). The core constructs of SCT include modeling/observational learning, outcome expectancies, self-efficacy and self-regulation (25, 44). Bandura's observational learning consists of four stages: (1) attention: learners see the behavior they want to reproduce, (2) retention: learners retain the behavior they have seen entailing a cognitive process in which learners mentally rehearse the behavior they wish to replicate, (3) reproduction: learners put the processes obtained in attention and retention into action, and (4) motivation: learners imitate the observed behavior through reinforcement (direct, vicarious or self-reinforcement).

Based on Bandura's argument that human behavior is learnt via interactions with, and modeling of others in social contexts, Carroll et al. (36) applied the four stages of observational learning to investigate the effectiveness of GoSoapBox, a student response system (SRS). The study proved the effectiveness of this online tool in stimulating discussions on controversial topics, improving learning experiences and in-class engagement among paramedic, psychology, nutrition and dietetics, nursing, and public health students.

Carter et al. (37) focused on the self-efficacy, outcome expectancy and social influence components of SCT to develop and test a model that evaluates undergraduate pharmacy students' intentions to pursue a higher pharmacy practice research (PPR) degree. The authors suggest that educators must provide links between practice and research and increase student self-confidence to undertake PPR, thereby increasing interest in this as a future career path. This is because exposure alone has minimal influence on a student's interest in PPR as a career.

Irvine et al. (38) explored self-regulated learning (SRL), a learning model situated in SCT, strategies utilized by final year nursing students in both their approaches to learning and practical teaching sessions (peer-teaching). The study findings support the use of SRL in nursing education, as highlighted by the high level of motivational behaviors and learning strategies reported among undergraduate nursing students in their approach to learning and their roles as peer-teachers.

Kennedy et al. (40) used the construct of self-efficacy to develop and psychometrically assess a scale that examines undergraduate nursing students' self-efficacy practice competence, assist educators in determining the level of education that students receive, as well as their level of confidence and advocacy for positive changes.

Furthermore, Koo et al. (34) indicated that implementing a self-efficacy construct to develop a formative standardized patient experience allowed nursing students to develop the concepts of inter-professional collaborative communication, and enhanced their problem-solving and communication skills, as well as their clinical competency.

Lave and Wenger's theory: Communities of practice (CoP)

The CoP theory consists of three key components: the domain (the common interest among all members), the practice (the implicit and explicit knowledge shared), and the community (made up of mutually beneficial interactions between experts and learners leading to learning, engagement, and identity development) (10, 46–48). All the articles retrieved in this review described a CoP as a group of people who share similar characteristics and collaborate toward a common goal, therefore enhancing mutual learning through sharing relevant knowledge and fostering the development of a shared identity. Three of the studies implemented CoP theory with a focus on teaching and learning among health professions students, and one with a focus on HPEP curricula design. All studies indicated that implementing the CoP learning theory enhanced student learning, collaboration, and identity.

TABLE 1 Characteristics of the included studies.

Author year country setting	Objective	Design	Level professions (*n*)	Theory used application and intervention duration	Overall study outcomes /effectiveness of the intervention	Limitations strengths recommendations
Carroll et al. (36) Australia University	To explore engagement of students to response systems such as GoSoapBox and explain its contribution to the learning process	Explanatory Sequential mixed method	Undergraduate Paramedic, psychology, nutrition, dietetics, nursing, and public health ($n = 350$)	SLT in teaching Implemented the four stages of observational learning of Bandura's SLT • Attention: students initially watched and assessed the interactions and contributions of the cohort leaders • Retention: more critical evaluations were made about what was working and what was not • Reproduction: participation in the discussion was encouraged • Motivation: expose to a variety of models which are not available in traditional classroom format. Duration: one semester	The use of SLT in investigating the effectiveness of GoSoapBox proved that it is a valuable tool for stimulating conversations and debates on controversial topics, such as gender, religion, and politics The SLT framework found that students gained the ability to participate in discussions which may lead to sustained learning and improved critical thinking	• Although anonymity encouraged discussion, but also created unsafe learning environment for marginalized students • Discussion component of GoSoapBox was the best component to students' learning, followed by Polls and social questions and answers. • GoSoapBox use requires a code of conduct outlining appropriate behavior to ensure safe spaces, minimize distraction, and increase learning
Carter et al. (37) Australia University	To develop and test a model, based on SCT, of final-year students' intending to undertake a higher degree in PPR after graduation	Quantitative questionnaire	Undergraduate Pharmacy ($n = 386$)	SCT in teaching and developing a model A hypothesis was generated from SCT which suggested that a person's motivation to undertake a particular activity may be influenced by their self-efficacy and outcome expectancy Final year students in the final week of the semester undertook a survey to investigate interest in Pharmacy	Pharmacy practice educators have role in influencing students' undertaking PPR as a career Exposure to PPR appears to have little influence on students' perceptions of PPR as a career To increase pharmacy students' selection of PPR as a career path, pharmacy practice educators need to provide links between research and practice	• Used a structural efficacy model to test the hypothesis in a cross-sectional study Generalizability of findings is limited The direction of influence between self-efficacy and outcome expectancy requires some consideration Convergent validity is absent • Mentoring programs in PPR are recommended

(Continued)

TABLE 1 Continued

Author year country setting	Objective	Design	Level professions (*n*)	Theory used application and intervention duration	Overall study outcomes /effectiveness of the intervention	Limitations strengths recommendations
				practice research after graduation Duration: 1 week		Longitudinal study is warranted
Irvine et al. (38) Australia University	To determine SRL strategies used by final year students.	Concurrent mixed methods study (questionnaire and interviews)	Undergraduate Nursing students (*n* = 319)	SCT and self-regulated learning in teaching SRL is a learning model situated in SCT and considers learners as active participants in their learning process with the ability to monitor, manage, and regulate specific parts of their cognition, motivational behaviors, and surroundings • Used a questionnaire that reliably measures the 15 scales of Pintrich's social cognitive model of SRL In the qualitative part, an analysis protocol was used, a theory guided approach, using question prompts linked to theoretical categories of SRL Duration: one semester	High levels of motivational and learning strategies were used by students in their approach to learning, and in their roles as near-peer teachers Learning strategies were associated with higher- order learning A dyadic approach in peer teaching can support metacognitive-shared regulation and identify how self-doubt may affect NPTs' performance	• Limited generalizability and data integration • Significance of incorporating SRL in the undergraduate nurse curriculum to enhance students' performance and promote confidence in their future teaching opportunities in clinical settings
Kennedy et al. (40) Canada University	To develop and psychometrically assess the Nursing Competence Self-Efficacy Scale (NCSES)	Quantitative questionnaire	Undergraduate Nursing students (*n* = 252)	Self-efficacy and SCT in assessment A 22 item NCSES was developed to measure nursing students' self-efficacy for practice competence based on Bandura's SCT theory: • The wording in the stem of each item used phrases	A scale with evident construct validity, internal consistency reliability, and test–retest stability reliability Can be used to examine undergraduate nursing students' self-efficacy practice competence, assist educators in determining the	• Relevance of the NCSES in other countries is not yet determined • Valid and reliable scale • Further psychometric assessment of the scale is warranted Qualitative studies in relation to curriculum initiatives or

(Continued)

TABLE 1 Continued

Author year country setting	Objective	Design	Level professions (*n*)	Theory used application and intervention duration	Overall study outcomes /effectiveness of the intervention	Limitations strengths recommendations
				that are concerned with the perceived capabilities and not with the intention • Used a 9-point response format to increase discrimination, Duration: 6 weeks	level of education that students receive, as well as assess novel curriculum interventions targeted at improving students' self-efficacy	adaptations based on SCT, will increase the current understanding of the construct of interventions targeted at improving students' self-efficacy
Koo et al. (34) USA University	To develop a formative standardized patient experience.	Descriptive study	Undergraduate Nursing students ($n = 30$)	Self-efficacy and SCT in teaching Used to guide the development of simulated clinical experiences to allow learners to develop collaborative self-efficacy by sequentially participating in two simulated clinical scenarios. Students participated in observational learning by seeing their classmates participate in these two scenarios as inter-professional teams Duration: not mentioned, but was completed in the final semester	Students' self-efficacy was developed through incremental mastery experiences by repeating the clinical scenarios on more than one occasion Problem-solving and communication skills, and clinical competency were improved Interdisciplinary collaboration and IPE were promoted	• No objective assessment was conducted • This intervention can be utilized as a teaching tool to develop IPE that can be replicated in a simulated clinical setting and facilitate collaborative practices among health professional students and faulty • learning objectives and simulation scenarios needed to be revised • Facilitating faculty, standardized patients, and collaborating professionals should have adequate training for the scenarios and provide constructive feedback to students
Alsiö et al. (39) Sweden Hospital and academia	To explore HCP experiences of implementing clinical education of medical students in CoP	Qualitative research (Focus groups)	Practice Assistant nurses, nurses and physicians ($n = 35$)	CoP in teaching Creating teams to enhance student engagement, participation in practice education and to develop	CoP stimulate individual learning, and enhance clinical work Implementing student education at a hospital stimulate learning	• Study conducted in one healthcare context • Rich and trustworthy data generated from the focus groups

(Continued)

TABLE 1 Continued

Author year country setting	Objective	Design	Level professions (*n*)	Theory used application and intervention duration	Overall study outcomes /effectiveness of the intervention	Limitations strengths recommendations
				learning activities for the students informed by set learning objectives to reach a common goal Duration: not mentioned	among staff and was effective for structural development in CoP Opportunities for inter-professional interaction and reflection are vital to successfully implement a new student in CoP	• The need for clinical education opportunities in many countries is increasing. Therefore, the support for staff engagement when implementing education of medical students in CoP needs to be explored
Molesworth et al. (41) Scotland University	To explore how students perceive biosciences in the curriculum.	Qualitative focus groups and interviews	Undergraduate Nursing students (*n* = 7)	CoP in teaching Understanding students' perceptions of how bioscience education is used in practice during their clinical placements which represents CoP. Students were interviewed after the first and second year of being involved in CoP Duration: 2 years	Three themes emerged: Bioscience learning within practice, incorporating bioscience knowledge into practice and bioscience knowledge and perceived competence Authors recommend using CoP (practice setting) to reinforce and teach students the biosciences (theory)	• A study that is limited in scale • Shine a light on students' perspectives of bioscience in practice • Research is required into the role and effectiveness of bioscience-related learning within practice settings
Portoghese et al. (42) Italy University	To expand the knowledge of the CoP in the healthcare setting by analyzing students' perception of respect they were shown during their clinical placements	Quantitative questionnaire	Undergraduate Nursing students (*n* = 188)	CoP in teaching The clinical practice component of nurse education programs represents an example of a CoP setting where nursing students acquire and advance in the knowledge and skills of nursing CoP was used to describe the practice setting and understand the student experiences Duration: not mentioned	Feedback and support received from members CoP, and quality of student-tutor relationship showed significant effects on students' perceived respect Social situation might influence students' perceptions of respect while examining nursing students in a CoP	• Lack of questionnaire validation Limited generalizability Cross-sectional study • Use of quantitative data in CoP research • Longitudinal-type investigation is needed to observe changes of the students' perceptions relating to the role of CoP as working and learning context for clinical practice

(Continued)

TABLE 1 Continued

Author year country setting	Objective	Design	Level professions (*n*)	Theory used application and intervention duration	Overall study outcomes /effectiveness of the intervention	Limitations strengths recommendations
Chen et al. (35) USA University	To describe the HPE Pathway program development, curriculum, and initial program outcomes by focusing on the pathway's CoP approach to supporting career development of students as future educators	Mixed method (quantitative program evaluation and qualitative email survey)	Undergraduate and Practice medical students, residents, and fellows, learners from other HPE schools. ($n = 71$)	CoP in teaching through course requirements, learners engage and work with members of the educator CoP. Pathway instructors (health professions educators) are faculty members who model a breadth of educator careers to help learners imagine personal trajectories. Then learners completed mentored educational projects Duration: 5 years	Learners gained knowledge and skills for continued engagement with CoP educators, confirmed their career aspirations, joined an educator-in-training community (engagement/imagination), and disseminated via scholarly meetings and peer-reviewed publications (alignment) Learners identified engagement with the learner community as the most powerful aspect of the pathway.	• HPE Pathway provides a robust example of employing a CoP framework to developing health professions educators

CoP, Community of Practice; HCP, Healthcare professionals; HPE, Health professions education; SCT, Social cognitive theory; SLT, Social learning theory; SRL, Self-regulated learning; NCSES, Nursing Competence Self-Efficacy Scale; NE, Nutrition Educator; NPT, Near peer teaching; PPR, Pharmacy practice research; RN, Registered nurses.

Alsio et al. (39) found that when CoP theory was used to create teams of practicing nurses, physicians, and undergraduate medical students with the mandate of developing learning activities during their clinical placements, learning was stimulated through self-reflection and consideration of their perspectives during patient interactions. Further, inter-professional reflection was vital for successful introduction of new students into a CoP and was effective for structural and cultural development. Moreover, staff and students' awareness of their roles and responsibilities facilitated their motivation to participate in the CoPs implementation.

Similarly, Molesworth et al. (41) and Protoghese et al. (42) explored the experiences of undergraduate nursing students regarding their application of the CoP theory during clinical placements. Both studies argued that CoP helped students to integrate their theoretical learning of bioscience into practice (41), and to advance their existing clinical knowledge (42). Moreover, application of bioscience knowledge within a CoP facilitated effective inter-professional relationships (41). Additionally, students perceived that they received more respect, support, and feedback while learning within a CoP (42). This further emphasizes the significance of mutual engagement and the collaborative relationship component of the CoP theory in enhancing student learning (42).

Furthermore, Chen et al. (35) used CoP theory in a curricular design for the HPEP aimed at helping undergraduate medical students, residents, fellows, and learners from other HPE schools to develop their identities as future health professions educators. The program has demonstrated its effectiveness in providing learners with the knowledge and skills to realize their career aspirations. It also enhanced learners' enthusiasm for teaching and increased their interest in educational leadership, innovation, and research.

Discussion

This scoping review attempted to provide an overview of how SToLs have been used in the teaching and learning of HPEPs over the last decade. This review highlighted some interesting findings that, collectively, may provide insights into how educational practices in HPEPs are shaped and influenced by learning theories.

Bandura's SLTs

Bandura's SLTs were applied predominantly in teaching and instruction strategies within the HPEPs. This review demonstrated the application of Bandura's observational learning model in the form of in-class integrated collaborative learning activities through an online tool for improving learning experiences and engagement (36). It is argued that observational learning provides a faster and safer approach to learning complicated patterns of behavior than trial and error, making it consistent with and suitable for HPE (7, 49). Self-efficacy, defined by an individuals' assessment of their capacity to perform given tasks or activities and achieve specified goals (50), was the most highlighted construct in the included articles. This can be explained by Bandura's argument that self-efficacy is central to social learning because it significantly impacts a wide range of human endeavors, including developmental and health psychology, education, and in the workplace (19). The findings suggest that the self-efficacy construct is beneficial to the learning outcome, particularly in simulation contexts, as demonstrated in the review conducted by Lavoie et al. (51). This aligns with previous literature about the self-efficacy construct indicating that individuals with stronger self-efficacy for certain tasks are more motivated to execute them (50, 52). Furthermore, the self-efficacy construct was used to develop an assessment tool that evaluates students competence and confidence level and advocacy for positive changes as they become professional nursing practitioners (40). In this context, it is worth mentioning that assessment tools based on self-efficacy found in previous health-related literature are task-specific (53, 54). Previous literature has also argued that feelings of confidence among medical students are associated with competence and proficiency (55, 56), and lack of confidence leads to nurses leaving the profession (57). Moreover, clinical educators' self-efficacy and confidence are critical to their ability to carry out their teaching and training responsibilities as they affect student achievement and patient outcomes (58).

Lave and Wenger's CoP theory

In this review, CoP theory was mainly employed in the teaching and learning of health professions students, educators, and providers to improve learning, collaboration, and identity. However, as highlighted by Hörberg et al. (59), it would be better used to identify team challenges and provide more meaningful interventions. It is noteworthy that none of the included studies highlighted any long-term benefits of CoP, aligning with Allen et al.'s (60) argument that there is a paucity of health professions studies exploring the long-term effect of CoP on individuals and the relevance to educational outcomes. Additionally, several studies in healthcare education and practice indicated the scarcity of studies that focus on the development and assessment of CoPs (10, 61, 62).

This review highlights a scarcity of research focusing on the application of SToLs in the development, validation, and conduction of assessment activities within HPEPs. Only one study used the self-efficacy construct to develop a tool for assessing student competence (40). This is consistent with a recent literature review suggesting that SToLs are not applied in performing assessment activities compared to other learning theories, such as humanistic theories or motivational models (13). This is despite evidence of the utility of CoP learning theory in planning and implementing effective assessment measures in the PharmD program (20).

The current review suggests that the application of SToLs in designing HPEPs' curricular content, learning objectives, syllabus or influencing educational competencies is also not common. In this regard, Mukhalalati and Taylor proposed a novel CoP theory-informed framework that can be used in designing a new HPEP to reduce the disconnect between the educational practice and learning theories (10). The authors suggest key components to consider when developing a CoP-based curriculum, including but not limited to, complementing formal with informal learning, transferring tacit knowledge to explicit knowledge through socialization and externalization, re-contextualizing knowledge, and aligning students' learning needs to learning activities (10). These components are compatible with several SToLs and claimed to be applicable in various HPEPs (10).

An important observation in this review was the exclusion of a large number of retrieved articles because they failed to inform how SToLs are implemented in the educational practices and in delivering educational goals (63), or because they aimed to use SToLs as a lens to explore HPEPs teaching and learning practices, or as a theoretical framework to conceptualize or analyze HPE research data (64–66). This aligns with previous research that highlighted the significance of using theories to enhance research rigor and its relevant outcomes (67). However, it is suggested to use learning theories to critique HPE and guide its advancement initiatives (68, 69). Furthermore, several excluded studies utilized SToLs for healthcare professionals continuing professional development (70–75), which seems to be a common application of SToLs. Although examining SToLs utilization in continuing professional development activities was not the aim of conducting this review, this aspect is extremely important as it indirectly influences students who will ultimately become health care professionals. Collectively, the small number of included eligible studies in this review that applied SToLs in HPEPs suggests disconnect between SToLs and HPEPs educational practices. It is argued that it is challenging for HPEPs educators to apply the educational theories because they received

minimal or no educational training about their significance and implementation (5). Therefore, as recommended by previous research, a collaborative reform initiative should be enacted to enhance the optimal use of SToLs in educational practice and examine the applicability and usefulness of other theories of learning in HPEP (20). Moreover, this review did not include studies from Africa, Eastern Mediterranean, and South-East Asia, suggesting that exploratory and experimental educational research utilizing various learning theories are highly warranted in these regions.

Strengths and limitations

This review explored SToLs use in HPEPs and provided a valuable overview for educators in a broad range of health education fields. Studies included were conducted in various countries which further enhanced the results' applicability to other contexts. However, a number of limitations should be acknowledged when interpreting the findings of this review. For example, this review was limited to only four databases and to the last decade, potentially missing relevant articles in other major databases such as Scopus and Web of Science and those published before 2011. Moreover, as is inherent to scoping reviews, a quality assessment for the included articles was not conducted necessitating caution in interpreting conclusions. Additionally, since SToLs can be categorized and named differently, this might inadvertently result in the omission of relevant articles.

Conclusions

This review provides an overview of the application of SToLs in HPEPs from 2011 to 2020. Only two SToLs were identified in this review: Bandura's SLT and SCT; and Lave and Wenger's CoP theory. Bandura's four-stage model of observational learning, as well as self-efficacy construct, were applied in the included studies. CoP theory was mainly employed to improve learning, collaboration, and identity, whilst SToLs use was predominantly focused on teaching and learning with less focus on assessment and curriculum design. This review demonstrated a limited number of HPEPs applying and reporting an application of SToLs despite the significance of the social aspect of learning concepts in those theories and within HPEP. This suggests a potential disconnect between SToLs and HPEP educational practices. Nonetheless, this review illustrated the successful and effective implementation of StoLs in various HPEPs, which is applicable to other HPEPs. Finally, this review supports the call for collaborative reform initiatives to optimize the use of StoLs in HPEPs educational practices. Future research should focus on the applicability and usefulness of other theories of learning in HPEP and investigate the long-term outcomes of theory implementation.

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/s.

Author contributions

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

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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

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