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Opportunities and challenges of interprofessional collaboration and education, volume II

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Published in
Frontiers in Medicine

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ISSN 1664-8714
ISBN 978-2-8325-6296-3
DOI 10.3389/978-2-8325-6296-3

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Opportunities and challenges of interprofessional collaboration and education, volume II

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Citation

Thistlethwaite, J., Müller-Schilling, M., Breitbach, A. P., Gilbert, J. H. V., Ali Mohammed, C., Schlosser, S., eds. (2025). *Opportunities and challenges of interprofessional collaboration and education, volume II*. Lausanne: Frontiers Media SA. doi: 10.3389/978-2-8325-6296-3

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frontiers | Frontiers in Medicine

TYPE Editorial
PUBLISHED 16 April 2025
DOI 10.3389/fmed.2025.1598331

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OPEN ACCESS

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RECEIVED 23 March 2025
ACCEPTED 27 March 2025
PUBLISHED 16 April 2025

CITATION
Thistlethwaite JE, Gilbert J, Breitbach AP, Ali Mohammed C, Müller-Schilling M and Schlosser-Hupf S (2025) Editorial: Opportunities and challenges of interprofessional collaboration and education, volume II. *Front. Med.* 12:1598331. doi: 10.3389/fmed.2025.1598331

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Editorial: Opportunities and challenges of interprofessional collaboration and education, volume II

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KEYWORDS

interprofessional, interprofessional education, interprofessional collaboration, teamwork, interprofessional practice, interprofessional learning

Editorial on the Research Topic
Opportunities and challenges of interprofessional collaboration and education, volume II

This is the second collection of articles for the Research Topic: opportunities and challenges of interprofessional collaboration and education. The 12 papers showcase the diversity of interprofessional approaches to health care challenges influenced by the local context including healthcare and education systems and resources. Five contributions come from Germany due to the strong support for interprofessional education (IPE) through its planned integration into the national medical curriculum. Additionally, an expanding interprofessional network is currently forming. IPE research and initiatives receive funding from organizations such as the Robert Bosch Foundation, further driving its development in Germany.

Many universities and jurisdictions have adopted the language of competency-based education (CBE) for interprofessional education (IPE). Competence may be defined succinctly as what health professional graduates should be able to do in clinical practice (1). In their Perspective, Williams et al., provide guidance for healthcare institutions seeking to implement effective IPE for students. They emphasize the importance of preparation to be "team ready" on graduation. The article acknowledges ongoing challenges in healthcare education but offers practical solutions based on the authors' extensive experiences. The goal is to create sustainable interprofessional curricula that enhance collaboration among future healthcare professionals and minimize negative impacts of professional stereotypes.

Once an interprofessional program has defined its competencies, attention turns to the means of assessing these. There are increasing numbers of tools and instruments developed for such assessment. Brownie et al.'s scoping review focuses on tools used for self- and peer assessment. It describes 20 studies and 12 tools, discussing the strengths and weaknesses of each. The paper is a useful resource for educators but highlights the need for a consensus approach to assessment, particularly to support learning effectively.

To achieve interprofessional competencies for subsequent health professional practice, relevant learning activities are required. These may be in the formal curriculum, or informal and extra-curricular activities developed by the learners themselves. Hirsch et al. at the University of Birmingham (UK) studied the impact of an innovative IPE student society, the Knowledge and Skills Exchange (KASE), on participants' subsequent experience as health professionals. Through interviews, the authors identified positive perceptions around themes of interprofessional communication, teamworking, patient-centered care, leadership and organizational skills, confidence and resilience. These findings align with research that early exposure to IPE, relevant to the context of students' lived experience, can have a positive impact on their professional practice including team collaboration, the quality of care provided and job satisfaction, all of which have been shown to contribute to improved health outcomes (2–6).

Formal learning includes interprofessional training wards (IPTW), i.e. functioning inpatient wards staffed by students working collaboratively under supervision. These wards continue to be evaluated as authentic interprofessional clinical activities. Three papers from Germany focus on IPTWs. Schlosser-Hupf et al. looked at the cost-effectiveness of an internal medicine IPTW, an important evaluation as costing health professional education is difficult and rare (7). The A-STAR IPTW at University Hospital Regensburg was compared to conventional wards. The research analyzed 7,244 patient cases examining economic outcomes and clinical performance. This study demonstrates that IPTWs can be economically viable while providing quality care, even during challenging periods like the COVID-19 pandemic. The authors suggest these findings provide a compelling rationale for broader implementation of such wards as platforms for educating future healthcare professionals. Schwarz et al. report on an IPTW in neonatology at a Munich hospital that had a positive impact on IPL and self-assessment of competencies. Emphasizing the importance of training in interprofessional facilitation, Müller et al. in Freiburg developed and evaluated a faculty development program for medical residents engaging with an IPTW.

IPE is thriving in parts of Africa. The African Interprofessional Education Network (AfriPEN) works of the sub-Saharan region hosted its 4th conference in 2023 on the topic: Are we making a difference in Africa (8)? Helping to answer this question Nawagi et al. present an evaluation of one African interprofessional initiative: the AFREhealth-FAIMER IPECP student elective exchange program. The African Forum for Research and Education in Health (AFREhealth) and the Foundation for the Advancement of International Medical Education and Research (FAIMER) supported this program for 13 institutions in 10 African countries. Students participated in a six-week virtual clinical interprofessional learning activity based on r case studies. While the evaluation findings are short-term, they do indicate the value of this type of cross-country activity contributing to skill development for collaborative practice. The authors advocate for longitudinal studies to examine how IPL translates into behavior change and practice.

IPE for the development of an interprofessional identity is being increasingly recognized globally. Reinders et al. explore the extended professional identity theory (EPIT) as a framework for fostering interprofessional identities that complement individual professional identities. The authors consider how through integrating interprofessional identity formation with skill development and environmental adaptability, EPIT enhances collaboration in diverse professional settings. The discussion highlights EPIT's potential in Türkiye, particularly in advancing IPE, university engagement, and collaborative strategies while addressing local challenges.

IPECP continues to be important for health professionals following qualification. Fleischmann et al. implemented an interprofessional approach to improve medication management for patients with inflammatory bowel disease (IBD). The findings of this prospective study demonstrated that integrating pharmaceutical expertise into IBD care significantly improves patient satisfaction, reduces medication-related concerns, and enhances medication safety. The authors advocate for routine medication reviews to optimize therapeutic outcomes and better integrate patient perspectives into clinical practice.

The outcomes of IPECP are being researched not only in terms of patient care but also effects on health professional wellbeing. Ruttmann et al. examined the relationship between interprofessional collaboration and psychological distress among healthcare professionals during the COVID-19 pandemic at a German university hospital. The monocentric cross-sectional study was conducted during the initial pandemic wave and involved 299 healthcare professionals. It highlights the vital role of enhanced interprofessional collaboration in strengthening healthcare professionals' psychological wellbeing during crises. The authors emphasize the need to foster collaborative environments and integrate IPE to help build resilience in healthcare teams. Professional wellbeing and patient outcomes are also affected by organizational culture. While the survey instrument developed by Rietdijk et al. to assess self-perceived open organizational culture was validated in a hospital pharmacy, it has the potential to be employed in interprofessional practice settings.

The development and use of applications (apps) for health professional learning on mobile devices are becoming more widespread. Seelandt et al. evaluated the impact of an evidence-based debriefing app on anesthesia team performance. The researchers observed anesthesia teams during two complex inductions, with teams using the Zurich Debriefing App between procedures. This small pilot study indicates that the app enhances anesthesia team performance, particularly through senior physicians' reflective contributions. The researchers note that the app offers a resource-efficient way to integrate debriefing into clinical practice, potentially improving interprofessional team functioning and patient safety.

Opportunities and Challenges of Interprofessional Collaboration and Education II presents diverse perspectives from education and practice. It provides evidence that the interprofessional field is growing in maturity and rigor. Researchers must continue to move from studies that are narrowly defined in single experiences to exploring interventions across multiple contexts, over time and situated in authentic experiences. This will provide added insight into how IPECP impacts all learners throughout the continuum of health professional education and practice in addition to patient/client outcomes.

Author contributions

JT: Writing – review & editing, Writing – original draft. JG: Writing – review & editing. AB: Writing – review & editing. CA: Writing – review & editing. MM-S: Writing – review & editing. SS-H: Writing – review & editing.

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.

The author declared that they were an editorial board member of Frontiers, at the time of submission. This had no impact on the peer review process and the final decision.

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frontiers | Frontiers in Medicine

TYPE Original Research
PUBLISHED 10 April 2024
DOI 10.3389/fmed.2024.1292608

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OPEN ACCESS

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RECEIVED 11 September 2023
ACCEPTED 18 March 2024
PUBLISHED 10 April 2024

CITATION
Ruttmann K, Albaladejo-Fuertes S, Lindenberg N, Kunst C, Mehrl A, Kindl V, Gülow K, Schlosser-Hupf S, Schmid S and Müller M (2024) Relationship between interprofessional collaboration and psychological distress experienced by healthcare professionals during COVID-19: a monocentric cross-sectional study. *Front. Med.* 11:1292608. doi: 10.3389/fmed.2024.1292608

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Relationship between interprofessional collaboration and psychological distress experienced by healthcare professionals during COVID-19: a monocentric cross-sectional study

Kirstin Ruttmann[1,2]*, Sheila Albaladejo-Fuertes[1], Nicole Lindenberg[3], Claudia Kunst[1], Alexander Mehrl[1], Vera Kindl[1], Karsten Gülow[1], Sophie Schlosser-Hupf[1], Stephan Schmid[1] and Martina Müller[1]

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Background: Since the onset of the COVID-19 pandemic, global healthcare systems have faced unprecedented challenges, leading to significant psychological distress among healthcare professionals. Recognizing the importance of enhanced interprofessional collaboration in alleviating this burden, as emphasized by the World Health Organization in 2020, we investigated whether such collaboration could mitigate staff psychological distress during crises. To our knowledge, no study has yet explored the role of interprofessional collaboration as a resilience factor in crises.

Methods: For this monocentric cross-sectional study at a German university hospital, we examined the relationship between the quality of interprofessional collaboration and the psychological distress of healthcare professionals during the initial pandemic wave. We employed validated mental health instruments, such as the GAD-7 and PHQ-2, to assess anxiety and depressive symptoms. Additionally, custom-designed questionnaires evaluated "Pandemic-Associated Burden and Anxiety (PAB; PAA)" and interprofessional crisis management experiences. A novel "Interprofessional collaboration and communication (IPC)" assessment tool was developed based on international competency frameworks, demonstrating strong reliability.

Results: The study involved 299 healthcare professionals (78.6% in direct contact with COVID-19 patients). Moderate levels of PAB/PAA were reported. However, a significant proportion experienced clinically relevant anxiety, as indicated by GAD-7. Negative IPC perceptions correlated with higher levels of psychological distress. Linear regression analysis showed associations between interprofessional collaboration and anxious and depressive symptoms, and pandemic-related burden.

Conclusion: Our findings highlight the vital role of enhanced interprofessional collaboration in strengthening the psychological well-being of healthcare professionals during crises. The study underscores the need to foster a collaborative environment and integrate interprofessional education for resilience.

KEYWORDS

interprofessional collaboration, interprofessional communication, interprofessional education, COVID-19 pandemic, mental well-being of healthcare professionals, mental health of health professionals, interprofessional collaborative practice, internal medicine

1 Introduction

The global COVID-19 pandemic has particularly emphasized the significance of interprofessional patient care (1), imposing considerable strain on healthcare systems and teams globally, initially reported from China (2, 3). Early data highlighted pandemic-related distress that could exacerbate mental health vulnerabilities for both the general population and healthcare professionals (4, 5). Especially during the early stages of the pandemic, mental symptoms such as anxiety and depression, along with pandemic-specific concerns, were evaluated (2). Specifically, staff directly involved in caring for COVID-19 patients experienced heightened psychological distress compared to their colleagues without direct exposure (6). While the psychological burden on healthcare professionals during the pandemic was generally found to be less severe than that experienced by the general population in most countries, there were clear international indications of increasing fatigue and dissatisfaction among these professionals approximately 2 years into the pandemic (6). Organizational key risk factors contributing to heightened psychological vulnerability included working in a university hospital, poor collaboration with colleagues, disruptions in daily routines (7), and a lack of organizational support (8).

In early 2020, the World Health Organization (WHO) issued recommendations urging leaders to mitigate psychological distress among healthcare professionals to enhance resilience (9). Particular emphasis was placed on strengthening interprofessional communication as a critical protective measure against psychological distress (10). Healthcare staff represent one of the most valuable resources during challenging crises, deserving protection. This includes not only safeguarding their physical health but also implementing approaches to promote mental well-being, thereby retaining resilient staff within clinical institutions and healthcare systems.

The call for enhanced interprofessional collaboration in healthcare predates the pandemic but has gained increased significance in its context of jointly addressing the crisis. However, prior to the COVID-19-related health crisis, only a small number of specific literature and empirical studies existed regarding the correlation between interprofessional collaboration and the manifestation of psychological distress in personnel during crises (11), including research related to coping with Ebola outbreaks (12). A limited number of pre-pandemic studies utilizing scoping reviews and qualitative analyses have shed light on interprofessional collaboration within mental health crisis response systems and intensive care unit dynamics during medical crises (13, 14). Furthermore existing literature suggested that deficient interprofessional collaboration correlated with lower job satisfaction, increased burnout prevalence, and higher job turnover rates, while strong collaboration, notably between physicians and nurses, appeared to be a potential protective factor against such distress (11, 15, 16). However, there are research gaps regarding the transferability of findings to large-scale societal crises like pandemics, larger study populations, psychometric control variables, and generalizability to both healthcare professionals and non-medical professionals in the healthcare sector.

Since 2019, the Department of Internal Medicine I at the University Teaching Hospital of Regensburg, Germany, has comprehensively integrated interprofessional collaboration into clinical practice through shared board meetings, case discussions, ward rounds, and joint teaching offerings. Additionally, an interprofessional training ward was established in the department to enhance team communication skills, which has been evaluated. At the onset of the pandemic, additional regular interprofessional briefings were initiated in each COVID-19 unit to ensure efficient information dissemination between managers and staff, along with pandemic-specific interprofessional teaching units.

The approach is grounded in the international definition of interprofessional collaboration within clinical settings, extending to educational environments where professionals from diverse disciplines come together to teach and learn collaboratively (17). This should foster a culture of interdisciplinary collaboration and knowledge exchange, crucial for ensuring seamless operations and facilitating smooth workflows through effective communication. Key elements that are essential for successful collaboration include open communication, smooth information flow, and patient-centered workflow coordination among various professional groups (17).

In summary, the COVID-19 pandemic has underscored an urgent need for effective measures to address psychological distress among healthcare personnel. Prioritizing the well-being of healthcare staff is essential for effectively managing daily clinical routines during a global pandemic. Despite the growing significance of interprofessional collaboration in healthcare, there remains a substantial research gap regarding its specific impact on the psychological health of staff during times of crisis. With the comprehensive interprofessional team approach established and the

immediate implementation of WHO strategies to enhance extended interprofessional communication (see Supplementary Table 1), we had optimal access to evaluate these recommendations. To fill this gap, this study aims to explore whether there is a relationship between the quality of interprofessional collaboration and the onset of psychological distress among healthcare professionals during the initial months of the COVID-19 pandemic. Building upon this premise, our hypothesis suggests that intensified interprofessional collaboration and communication, perceived positively by those involved, may have served as protective measures against the onset of psychological distress among healthcare staff during this period. The present study aims to contribute to explaining potential correlations between interprofessional collaboration and crisis management and mental health. The findings of this research provide a basis for drawing conclusions regarding both proactive and crisis interventions within this context, as well as for future crises. The objective is to support interprofessional personnel and enhance their resilience.

2 Materials and methods

2.1 Background and objectives

The study, titled "Psychological Aspects of Interprofessionalism During the COVID-19 Pandemic" (PsyCoV-study), was conducted at the University Teaching Hospital of Regensburg in Germany. This hospital gained prominence for its role in treating acute COVID-19 patients during the initial phases of the pandemic. Specifically, the study examined the association between interprofessional collaboration, crisis management, and various mental health indicators, including pandemic-related burden, pandemic-associated anxiety, general anxiety levels, and depressive symptoms (see Supplementary Figure 1). The hospital administered a high volume of Extracorporeal Membrane Oxygenation (ECMO) therapies. In light of the extraordinary circumstances during the pandemic, characterized by the scarcity of comparable nationwide facilities capable of integrating both an interprofessional collaboration framework and a specialized intensive care center for COVID-19 patients, we made the strategic choice of adopting a monocentric approach.

2.2 Study design and sampling approach

Employing a monocentric, nonrandomized survey within a cross-sectional design, we aimed to investigate the relationship between interprofessional collaboration and the psychological distress experienced by healthcare staff during the initial wave of the pandemic. Additionally, our investigation carries an exploratory nature, as we seek to uncover potential novel insights and patterns within this domain. This approach enabled a comprehensive exploration of key factors influencing mental health indicators.

To ensure maximum coverage and representation within our study cohort, we conducted a census of all members of the interprofessional team during the survey period. We invited 775 employees to participate via paper-based questionnaires in order to maximize the representativeness of our sample and facilitate a thorough analysis of the study variables.

2.3 Data collection

Ethical clearance was obtained from the ethics committee of the University of Regensburg, ensuring adherence to European data protection standards. Data collection occurred between April 27, 2020, and May 12, 2020. Before the commencement of the survey, participants provided consent via paper-based forms. Strict anonymity was maintained throughout the survey process to protect participants' privacy and confidentiality.

2.4 Participant inclusion criteria and classification approach

Included in the study were all employees from various professional groups within the defined areas who provided care for COVID-19 patients. Excluded were employees under the age of 18 years. The survey covered four general medical wards specializing in internal medicine, two intensive care wards specializing in internal medicine and anesthesiology, and functional areas such as the laboratory and endoscopy unit.

We engaged healthcare professionals, including physicians, nurses, physiotherapists, medical students who served as volunteer assistants for nurses following a specific training, and other allied professionals such as laboratory technologists, scientific staff, administrative personnel, and ward assistants who provided support in non-patient-facing activities. Distinctions were made between frontline healthcare workers, known to face elevated risks of infection and psychosocial stress, and second-line workers, who may experience lower infection risks but could still encounter stress due to organizational dynamics (2).

Furthermore, distinctions between medical and nonmedical staff (categorized as others with or without patient contact) within departments and interprofessional teams may yield insights into previously unexplored risk and stress factors for these groups. This nuanced approach facilitated a comprehensive assessment of the pandemic's impact on interprofessional teams, potential protective aspects of interprofessional collaboration, and the formulation of targeted support measures for employees.

Due to data protection considerations, a more detailed classification based on participants' departments, specific roles, or additional qualifications within the teams was not feasible. This requirement was imposed to prevent traceability and maintain participants' anonymity.

2.5 Procedures

We employed several validated mental health instruments, including the German versions of the Generalized Anxiety Disorder Scale-7 (GAD-7) and the Patient Health Questionnaire-2 (PHQ-2), both of which are freely available for clinical and scientific purposes.

2.6 GAD-7, "Generalized Anxiety Disorder 7-Item Scale"

The GAD-7 covers the major diagnostic criteria for generalized anxiety disorder outlined in both DSM-IV and ICD-10. The German

version of the GAD-7 was translated and validated by Löwe et al. (18) and exhibited robust internal consistency (Cronbach's alpha = 0.89) and strong construct validity, as evidenced by its correlations with other anxiety scales. Scores on the GAD-7 range from 0 to 21, with a cutoff point of 15 indicating severe GAD. Items are rated on a 4-point Likert scale: (0) represents "not at all," (1) "several days," (2) "more than half the days," and (3) "nearly every day." For comparison with a norm sample from Germany, we referred to the reference value of $M = 2.95$, SD = 3.41 (18).

2.7 PHQ-2, "Patient Health Questionnaire-2"

To screen for depression, we utilized the Patient Health Questionnaire-2 (PHQ-2), an ultrashort version of the Patient Health Questionnaire-9 (PHQ-9), which focuses on the two main symptoms of major depression as outlined in DSM-IV (19). Similarly, the German version of the PHQ-2 was translated and validated by Löwe et al. (20) and displayed strong internal consistency (Cronbach's Alpha = 0.83) and construct validity, showing significant correlations with other depression measures. The PHQ-2 score ranges from 0 to 6, with scores of 3 or higher likely indicating a major depressive disorder. For comparison with a norm sample from Germany, we used the reference value of $M = 1.4$, SD = 1.3 (20).

It should be noted that for both psychometric instruments, the GAD-7 and the PHQ-2, the comparisons with the German norm sample represent the general population before the pandemic. The selection of such a reference population facilitated a comprehensive evaluation of the mental health of our personnel at the onset of the crisis and enabled us to understand the implications of the situation.

2.8 Comprehensive assessment of the COVID-19 pandemic impact: "Pandemic-Associated Burden," "Pandemic-Associated Anxiety," and "Interprofessional Crisis Management"

In addition to employing standard measures, our questionnaire encompassed three distinct categorical sets of items: (1) "Pandemic-Associated Burden (PAB)," (2) "Pandemic-Associated Anxiety (PAA)," and (3) "Interprofessional Crisis Management (IPM)" experience. These categories were carefully selected to provide a comprehensive assessment of various facets of the pandemic's impact.

Given the absence of pre-existing validated questionnaires tailored to these specific categories, customized questions were developed specifically for this study following an exploratory approach. Furthermore, owing to the acute crisis and regulations limiting the number of staff to be surveyed to minimize workload burdens, conducting a large-scale validation study was not feasible. Before data collection commenced, an expert panel conducted a face validation procedure to ensure the questionnaire's clarity, address any potential errors or ambiguities, and confirm its relevance and appropriateness for the target audience. Subsequently, these questions underwent a meticulous review by a panel of hospital staff ($n = 10$). We ensured that the participants represented as wide a range as possible of professions, roles, and levels of experience. Adjustments to the wording of certain elements were made based on the feedback received during this pilot testing phase, aimed at improving the questionnaire's clarity and effectiveness.

For "Pandemic-Associated Burden (PAB)," "Pandemic-Associated Anxiety (PAA)," and "Interprofessional Crisis Management (IPM)," we employed a sum score method to combine individual item scores into composite scores, enabling statistical analysis and interpretation of their respective performances. These scores are presented below their respective scales.

Three distinct categorical sets of items were included:

1 "Pandemic-Associated Burden (PAB)": Participants were queried about "Pandemic-Associated Burden (PAB)" (see Supplementary Table 2). This section aimed to capture burdens at various levels, including organizational, societal, and personal. Items addressed concerns such as the flow of information in hospitals regarding the handling of the COVID-19 pandemic, the frustration of patients toward the healthcare system, and fear of infection. The self-assessment of PAB consisted of 16 items rated on a 6-point Likert scale, ranging from "low" (1) to "high" (6). The average cumulative score for PAB was 54, ranging from 16 to 96.
2 "Pandemic-Associated Anxiety (PAA)": Participants were also queried about "Pandemic-Associated Anxiety (PAA)" (see Supplementary Table 2). Similar to PAB, this section aimed to assess anxieties related to the pandemic. Items addressed fears at organizational, societal, and personal levels. PAA consisted of 4 items rated on a 6-point Likert scale, ranging from "low" (1) to "high" (6). Both sets of categorical items were developed based on feedback from an interprofessional expert panel, with stressors described early in the pandemic by Lai et al. (2) serving as references. The average cumulative score for PAA was 14, ranging from 4 to 24.
3 "Interprofessional Crisis Management (IPM)" experience: The IPM section focused on experiences and perceptions of interprofessional collaboration during the crisis. Participants detailed their involvement in interprofessional support services such as briefings, team meetings, and specific training sessions (see Supplementary Table 3). This section consisted of 3 items regarding involvement and 2 items regarding perceptions, all rated on a 4-point Likert scale, ranging from "very poor" (4) to "very good" (1). The average cumulative score for IPM was 12.5, ranging from 5 to 20.

2.9 "Interprofessional Collaboration and Communication (IPC)"

Additionally, perceptions of the quality of interprofessional collaboration and communication during the pandemic were assessed. To facilitate measurement, we developed an assessment tool for interprofessional collaboration and communication, abbreviated as "IPC" (see Supplementary Table 4). To the best of our knowledge, no existing tool appropriately assesses interprofessional collaboration among experienced healthcare professionals providing care to adults in times of crisis. For operationalization, we followed international competency frameworks related to interprofessionality (21).

We integrated characteristics such as "shared team goals," "coordinated team approach," "role clarity," "equal communication," "shared decision-making," and "mutual support" (21). The IPC assessment consisted of 9 items, with an additional item addressing satisfaction levels. These were rated on a 4-point Likert scale: (4) "very poor," (3) "rather poor," (2) "rather good," (1) "very good." The average cumulative score for IPC was 22, ranging from 9 to 36.

Due to ethical considerations regarding employee protection during multiple surveys in an extraordinary crisis, a pre-test validation study for IPC could not be conducted. Therefore, we utilized the main study to assess and validate both the validity and reliability of the instrument. A Cronbach's Alpha value of 0.925 indicates a high inter-item correlation within the IPC scale, demonstrating strong internal consistency. The high reliability, along with other indicators of construct validity (such as KMO, Bartlett's Test, factor loadings, and explained total variance), suggests that our scale effectively measures the intended construct and provides reliable measurements.

Covariates included professional groups (physicians, nurses, ward assistants, medical students, physiotherapists, and others), gender, age group, marital status, weekly working hours, as well as contact with COVID-19 patients (clinical and non-clinical), and involvement in patient care tasks (direct or indirect). Gender information was not provided by two participants.

The assessment of psychological burdens across all tools was based on self-assessment, as was the evaluation of interprofessional collaboration and communication and interprofessional crisis management.

3 Statistical analysis

A power analysis was performed to estimate the necessary sample size. The significance was set at a level of $\alpha = 0.05$, and a value of 0.95 was assumed for the statistical power. For t-tests included in the analysis, assuming a mean effect size of $d = 0.5$ and a not grossly unbalanced group distribution ($k = 1$), a necessary sample size of n1 = 88 and n2 = 88 ($n = 176$) was calculated. With regard to the χ^2-tests, it was assumed that they would have a mean effect size of $w = 0.3$ with df = 5 degrees of freedom. This results in a necessary sample size of $n = 220$. The planned multiple linear regression analysis was estimated with $k = 10$ predictors and a mean effect size of $f = 0.15$. This results in a necessary sample size of n = 148. The ANOVA planned as part of the evaluation is estimated using k = 5 groups with a mean effect of $f = 0.25$. The resulting necessary sample size is $n = 211$. This results in a necessary sample size of $n = 220$ across all tests.

Descriptive statistics, including means, standard deviations, medians, and 95% confidence intervals, were calculated for demographic characteristics and variables, such as "Interprofessional Collaboration and Communication (IPC)," "Pandemic-Associated Anxiety (PAA)," "Pandemic-Associated Burden (PAB)," "Patient Health Questionnaire-2 (PHQ-2)," and "Generalized Anxiety Disorder-7 (GAD-7)." Pearson correlation analyses were conducted to examine associations between continuous variables. One-sample t-tests were employed to compare sample means with normative values. Linear regression analyses were performed to assess the relationship between interprofessional collaboration and mental symptoms, with GAD-7 and PHQ-2 serving as dependent variables, and dimensions of interprofessional collaboration as independent variables. Wilcoxon rank tests were utilized to evaluate differences in psychometric scales across subgroups, with gender, place of assignment, and profession considered as grouping factors. Chi-square tests were employed to explore associations between categorical variables and clinical abnormalities within subgroups. One-way ANOVA tests were utilized to investigate differences in IPC and "Interprofessional Crisis Management (IPM)" across various professional groups. Additionally, Kruskal-Wallis tests were conducted to accommodate non-normally distributed data where applicable. The significance level was set at $p < 0.05$ (two-tailed). Statistical analyses were performed using IBM® SPSS Versions 13.0 and 26.0.

4 Original results

A total of 299 healthcare professionals participated in the survey, yielding a response rate of 38.6%. Of these respondents, 22 were physicians (7.4%), 175 were registered nurses (58.5%), 43 were medical students (14.4%), 23 were other staff with direct contact with patients (7.7%), and 26 were other staff without contact with patients (8.7%). Out of the total, 235 (78.6%) were in direct contact with COVID-19 patients and were categorized as "frontline," whereas 62 (20.7%) were not in direct contact, falling into the "second-line" category. The average weekly work hours were 35.6 (10.16) with a range of 8–80 h.

The average total scores for "Pandemic-Associated Anxiety (PAA)" and "Pandemic-Associated Burden (PAB)" were $M = 3.07$ (SD = 1.01) and $M = 2.82$ (SD = 1.03), respectively, with a maximum possible score of 6 points. These scores correspond to an intermediate level of distress. For the general cohort, the average sum score of the GAD-7, which assesses generalized anxiety, was $M = 5.21$, SD = 4.63, out of a possible 21 points. This translates to a low level of clinically relevant anxiety.

However, 139 participants (48.3%) had scores indicating a clinically relevant level of anxiety, falling at least in the "mild" range of 5 points in the total score of 21. The proportion of participants with a moderate likelihood of an anxiety disorder (using a GAD-7 cutoff of 10) was 17.4%. The average summative score for the PHQ-2, which evaluates depressive symptoms of major depression, was $M = 1.49$, SD = 1.43, out of a possible 6 points for the general cohort. Thus, the result of this summative score was not indicative of a clinically significant presence of depression.

However, in 60 cases (20.3%), the scores were at a clinically relevant level, falling within the range of 4–6 points. Established psychometric instruments, such as GAD-7 and PHQ-2, demonstrated significant correlations with our newly established questionnaires. Specifically, the GAD-7 showed a correlation with the "Pandemic-Associated Anxiety (PAA)" score (r = 0.531, $p < 0.001$), the "Pandemic-Associated Burden (PAB)" score (r = 0.679, $p < 0.001$), and depressive symptoms as measured by the PHQ-2 ($r = 0.737$, $p < 0.001$).

Compared to reference values from a norm sample of the German population, there was a significant difference in the GAD-7 scores across the entire sample, with a mean difference of 2.262 ($t(287) = 8.284$, $p < 0.001$). However, no significant difference was observed for PHQ-2 ($t(294) = 1.174$, $p = 0.241$). Notably, the group of nonmedical staff without patient contact showed the most pronounced differences, with a mean deviation (MD) of 3.746 (t (22) = 4.352, $p < 0.001$), while the nursing staff also exhibited substantial differences

10.3389/fmed.2024.1292608

TABLE 1 Mean values and standard deviations of depressive and anxiety symptoms by demographic characteristics.

Mean values (M) and standard deviations (SD) regarding depressive and anxiety symptoms (GAD-7; PHQ-2) by demographic characteristics of the sample							
				PHQ-2		GAD-7	
		N	(%)	*M*	(SD)	*M*	(SD)
Male		87	29.1	1.221	(1.392)	4.276	(4.533)
Female		212	70.9	1.612	(1.444)	5.617	(4.629)
Age	<18	2	0.7	4.000	(2.828)	8.500	(4.950)
	18–25	67	22.9	1.478	(1.330)	5.448	(4.577)
	26–30	67	22.9	1.576	(1.436)	4.892	(4.610)
	31–40	67	22.9	1.652	(1.534)	5.923	(5.203)
	41–50	41	14.0	1.600	(1.516)	4.919	(4.310)
	>50	49	16.7	1.041	(1.274)	4.396	(4.211)
Single		123	42.1	1.620	(1.490)	5.393	(4.798)
In a relationship		169	57.9	1.407	(1.406)	5.050	(4.557)
Frontline		235	79.1	1.545	(1.431)	5.383	(4.729)
Second-line		62	20.9	1.274	(1.450)	4.373	(4.135)
Physicians		22	7.6	1.045	(1.253)	4.409	(4.306)
Medical students		43	14.9	1.023	(1.123)	4.465	(4.339)
Nurses		175	60.6	1.626	(1.511)	5.399	(4.953)
Others with contact		23	8.0	1.261	(0.964)	4.545	(3.377)
Others without contact		26	9.0	1.885	(1.705)	6.696	(4.128)

PHQ-2 (0–6), GAD-7 (0–21).

with an MD of 2.449 ($t(167) = 6.409$, $p < 0.001$). Both groups reported the highest levels of anxiety in our sample. Interestingly, medical students (MD = 1.515; $t(42) = 2.290$, $p = 0.027$) and nonmedical staff with patient contact (MD = 1.595; $t(21) = 2.216$, $p = 0.038$) also showed deviations from the norm, but these were more moderate. In contrast, physicians' scores did not significantly deviate from the norm (MD = 1.459; $t(21) = 1.589$, $p = 0.127$), demonstrating they reported low levels of anxiety. For more detailed insights into the distribution of psychological burden across different demographic characteristics, refer to Table 1, which provides an analysis based on PHQ-2 and GAD-7 scores.

Within teams, the quality of communication with other professionals was most frequently rated as "good" (on a scale of 1–4; $M = 2.02$, SD = 0.77, 95% CI [1.93, 2.11]). The question regarding whether interprofessional collaboration improved during the pandemic was most often rated as "somewhat true" on a scale of 1–4; $M = 2.42$, SD = 0.99, 95% CI [2.29, 2.53].

However, for the "Interprofessional Collaboration and Communication (IPC)" scale, which ranged from 9 to 36, the mean score was 18.26 (SD = 5.82). This score corresponds to the experience of good team collaboration across various professional groups. Figure 1 shows the relationship between psychological distress and perceived quality of Interprofessional Collaboration and Communication (IPC). Subfigure (a) displays GAD-7 scores by IPC quality, while Subfigure (b) shows PHQ-2 scores. Subfigures (c, d) depict Pandemic-Associated Anxiety (PAA) and Pandemic-Associated Burden (PAB), respectively. Figure 2 illustrates GAD-7 scores by professional groups, providing insight into anxiety levels across different professions. Figure 3 presents PHQ-2 scores by professional groups, highlighting the prevalence of depression symptoms among various professions.

Regarding interprofessional briefings, 184 participants (62.8%) reported attending briefings within the past 4–6 weeks. Of these, 55 (18.8%) attended once, 19 (6.5%) weekly, and 47 (16.0%) daily. Both the flow of information within the organization and support for personal expertise were most frequently rated as "rather low." Specifically, for a scale ranging from 1 to 4, the mean value was 3.43 (SD = 1.54, 95% CI [3.26, 3.61]) for the flow of information, and 3.40 (SD = 1.47, 95% CI [3.23, 3.57]) for support of personal expertise. This was despite the organization's dedicated efforts to inform and support staff expertise. Importantly, negative evaluations of "Interprofessional Collaboration and Communication (IPC)" correlated with higher scores on the "Pandemic-Associated Burden" (PAB; $r = 0.362$, $p < 0.001$) and the "Pandemic-Associated Anxiety" (PAA; $r = 0.335$, $p < 0.001$). This suggests a relationship between perceived poor interprofessional collaboration and heightened psychological distress resulting from the pandemic.

As revealed by linear regression analysis, the assessment of "Interprofessional Collaboration and Communication (IPC)" was associated with the expression of both anxious symptoms (GAD-7) and depressive symptoms (PHQ-2) ($R^2 = 0.120$, $F(9,217) = 3.277$, $p = 0.001$; $R^2 = 0.168$, $F(9,220) = 4.944$, $p < 0.001$). Similarly, IPC was associated with the expression of "Pandemic-Associated Anxiety" (PAA; $R^2 = 0.148$, $F(9,222) = 4.286$, $p < 0.001$) and "Pandemic-Associated Burden" (PAB; $R^2 = 0.167$, $F(9,222) = 4.945$, $p < 0.001$). Anxiety symptoms as measured by the GAD-7 were most strongly influenced by the sub-items IPC-9, which represents "mutual support of team members" ($\beta = -0.235$, $p = 0.014$), and IPC-7, which stands for "open

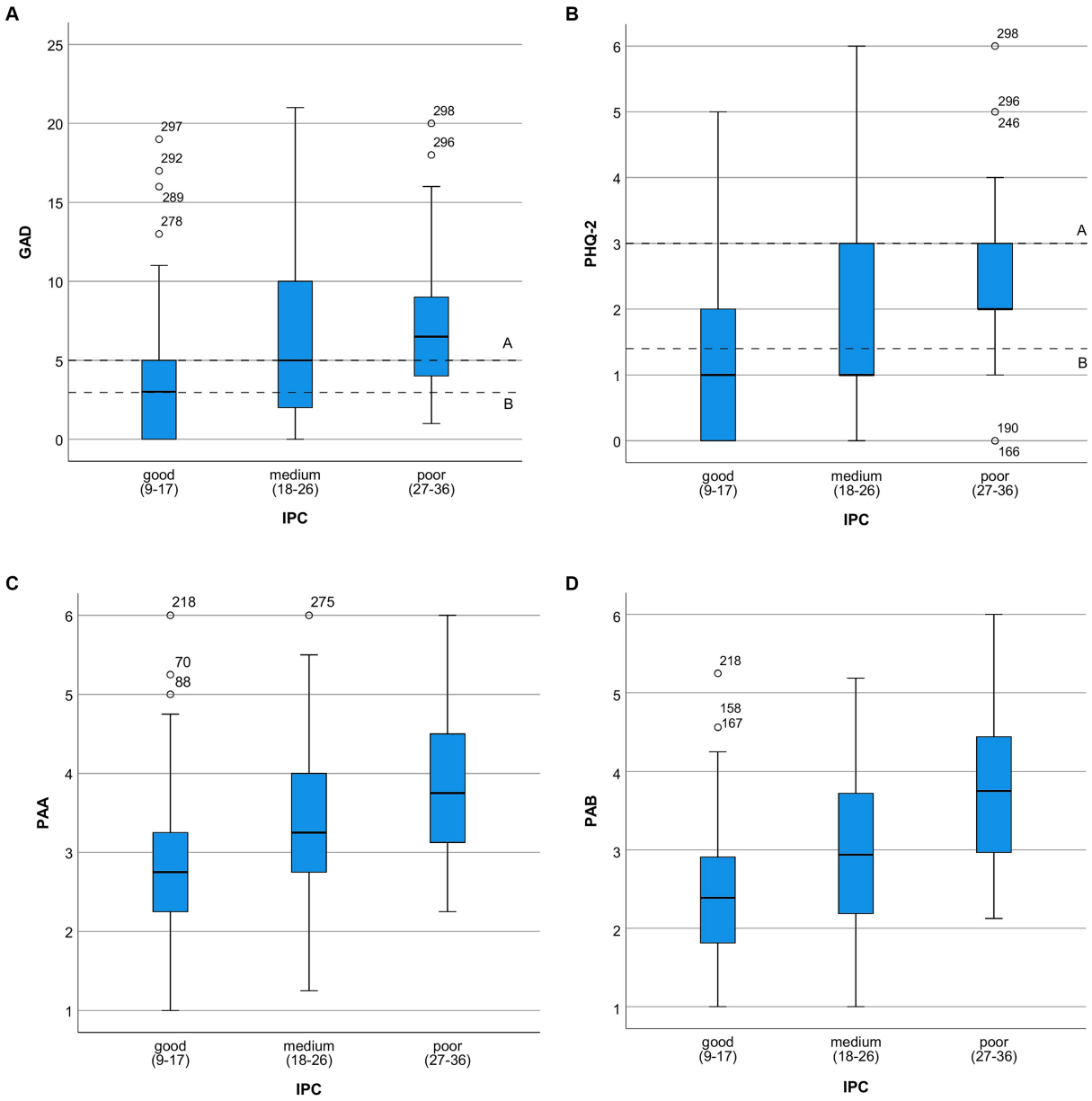

FIGURE 1
Degree of psychological burden in relation to the perceived quality of IPC. **(A)** Distribution of GAD-7[1] scores by perceived quality of interprofessional collaboration and communication (IPC)[2]. [A = cut off ≥5; B = reference value of the normal population in Germany (before the pandemic)]; [1]0–4, minimal anxiety; 5–9, mild anxiety; 10–14, moderate anxiety; 15–21, severe anxiety; [2] Sum score, 9–36; **(B)** Distribution of PHQ-2[1] scores by perceived quality of interprofessional collaboration and communication (IPC)[2] [A = cut off ≥3; B = reference value of the normal population in Germany (before the pandemic)]. [1]PHQ-2 (0–6); 0–2 none; 3–6 hint for depression; [2] Sum score: 9–36; **(C)** Degree of middle Pandemic-Associated Anxiety (PAA)[1] in relation to perceived quality of interprofessional collaboration and communication (IPC)[2]. The distribution of the frequencies of IPC[1] with PAA; [1]1–6 ascending; [2]Sum score, 9–36; **(D)** Degree of middle Pandemic-Associated Burden (PAB)[1] in relation to perceived quality of interprofessional collaboration and communication (IPC)[2]. [1]1–6 ascending; [2]Sum score, 9–36.

communication in the team" ($\beta = 0.215$, $p = 0.023$). There was also a trend towards an association with the sub-item IPC-5, representing "clarity about shared goals in the team" ($\beta = 0.179$, $p = 0.052$).

"Pandemic-Associated Anxiety (PAA)" and depressive symptoms as measured by PHQ-2 were most strongly associated with the item "open communication in the team" (IPC-7) (PAA; $\beta = 0.200$, $p = 0.032$ and PHQ-2; $\beta = 0.167$, $p = 0.016$). Similarly, assessments of "Interprofessional Crisis Management (IPM)" were associated with the expression of both anxious symptoms (GAD-7) and depressive symptoms (PHQ-2) ($R^2 = 0.108$, $F(5,180) = 4.370$, $p = 0.001$; $R^2 = 0.097$, $F(5,184) = 3.941$, $p = 0.002$).

Additionally, IPM assessments correlated with the expression of "Pandemic-Associated Anxiety" ($R^2 = 0.145$, $F(5,186) = 6.323$, $p < 0.001$) and "Pandemic-Associated Burden" ($R^2 = 0.130$, $F(5,186) = 5.542$, $p < 0.001$). Anxiety symptoms according to GAD-7 were most strongly associated with sub-items "preparation for patients with COVID-19 infection was well organized within the team" (IPM-3) ($\beta = 0.240$, $p = 0.013$) and "additional teaching

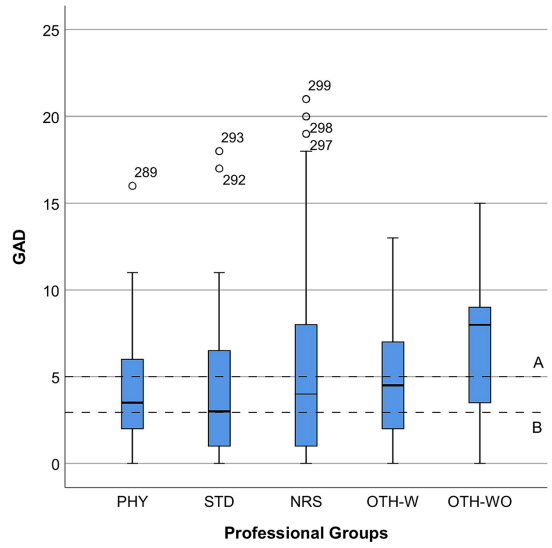

FIGURE 2
Distribution of GAD-7 scores by professional groups. PHY, physicians; STD, students; NRS, nurses; OTH-W, others with patient contact; OTH-WO, others without patient contact.

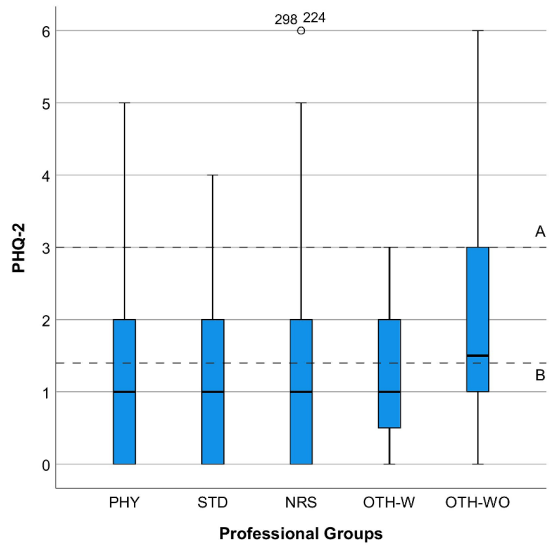

FIGURE 3
Distribution of PHQ-2 scores by professional groups. PHY, physicians; STD, students; NRS, nurses; OTH-W, others with patient contact; OTH-WO, others without patient contact.

opportunities and training opportunities" (IPM-2) ($\beta = -0.204$, $p = 0.035$). PAA was associated with sub-items "preparation for patients with COVID-19 infection was well organized within the team" (IPM-3) ($\beta = 0.205$, $p = 0.029$) and "team rounds" (IPM-1) ($\beta = -0.187$, $p = 0.039$), while depressive symptoms were associated with sub-item IPM-3 ($\beta = 0.209$, $p = 0.031$).

There was no evident impact of the information flow in the department on any of the psychological distress scores (GAD, PHQ-2, PAA, PAB) as indicated by the following F-statistics: $F(5,284) = 1.292$, $p = 0.268$; $F(5,289) = 1.886$, $p = 0.097$; $F(5,292) = 1.458$, $p = 0.203$; $F(5,292) = 2.185$, $p = 0.056$.

The frequency of interprofessional briefings demonstrated a significant protective effect against the expression of depressive symptoms ($F(4,288) = 2.505$, $p = 0.042$), indicating a statistical association rather than a causal relationship. However, no effect was observed on anxious symptoms as measured by GAD-7, "Pandemic-Associated Anxiety (PAA)," or "Pandemic-Associated Burden (PAB)" ($F(4,282) = 1.593$, $p = 0.176$; $F(4,290) = 1.859$, $p = 0.118$; $F(4,292) = 1.700$, $p = 0.150$). Training designed to enhance professional skills demonstrated a significant reduction in the expression of "Pandemic-Associated Anxiety (PAA)" ($F(5,289) = 3.064$, $p = 0.010$) and showed a trend towards reduced expression of depressive symptoms ($F(5,286) = 2.237$, $p = 0.051$). Table 2 offers insights into the correlation between IPC, mental symptoms, and the overall quality of interprofessional collaboration, and Table 3 shows the correlation between IPM strategies and psychological distress during the pandemic.

Based on results from a Wilcoxon rank test, the female gender was identified as a significant risk factor for psychological distress in several measures (GAD-7: $Z = -2.690$, $p = 0.007$; PHQ-2: $Z = -2.427$, $p = 0.015$; PAB: $Z = -2.819$, $p = 0.005$), but not for PAA ($Z = -0.762$, $p = 0.446$). Frontline activities also emerged as significant risk factors for some measures of psychological distress (PAA: $Z = -3.299$, $p = 0.001$; PAB: $Z = -3.529$, $p < 0.001$) but not for GAD-7 ($Z = -1.422$, $p = 0.155$) or PHQ-2 ($Z = -1.575$, $p = 0.115$). For a breakdown of psychological distress by gender, consult Table 4 for detailed information. Table 5 provides detailed information on psychological distress, as well as perceptions of IPC and IPM, categorized by frontline and second-line roles.

Furthermore, there were observed differences in psychological strain across occupational groups (GAD-7, $\chi^2(4) = 5.792$, $p = 0.215$; PHQ-2, $\chi^2(4) = 9.162$, $p = 0.057$; PAA, $\chi^2(4) = 17.620$, $p = 0.001$; PAB, $\chi^2(4) = 14.772$, $p = 0.005$). Table 6 contrasts the psychological distress and perceptions of IPC and IPM across various professional groups, offering insights into the disparities observed.

Regarding clinically relevant anxiety (GAD-7), significant differences were observed between genders ($\chi^2(1) = 6.582$, $p = 0.010$) and professional groups ($\chi^2(4) = 9.768$, $p = 0.045$), but not between age groups ($\chi^2(5) = 4.548$, $p = 0.473$) or activities corresponding to frontline or second-line ($\chi^2(1) = 0.136$, $p = 0.771$).

As shown by a one-way ANOVA, professional affiliation influenced the assessment of IPC and IPM in the total sample (IPC; $F(4, 225) = 2.761$, $p = 0.029$; IPM; $F(4, 184) = 2.810$, $p = 0.027$). However, *post hoc* tests revealed no significant difference between the professional groups. There was only a trend towards significance in the Bonferroni test between nursing ($M = 18.987$, SD = 6.186) and medical students ($M = 16.030$, SD = 3.687) with a mean difference of -2.957 ($p = 0.081$). This suggests that healthcare professionals with different professional affiliations may benefit from enhanced IPC.

5 Discussion

Our study aimed to comprehensively investigate the challenges faced by healthcare professionals during crises, particularly

TABLE 2 Pearson correlation between interprofessional collaboration and communication items (IPC) with mental symptoms and the overall evaluation of interprofessional collaboration.

Pearson correlation between items of IPC communication and collaboration with mental symptoms (correlation coefficients)				
	PHQ-2	GAD-7	PAB	PAA
Communication with other professional groups	0.220**	0.184*	0.286**	0.188*
Decisions on patient care are made collaboratively	0.209**	0.160	0.265**	0.260**
Team members are working hand in hand	0.239**	0.233**	0.315**	0.271**
Different steps of care are well coordinated with each other	0.262**	0.202*	0.349**	0.277**
The goals of the interprofessional team are clear	0.219**	0.209**	0.277**	0.249**
Team members know their roles	0.314**	0.189*	0.305**	0.234**
Team members communicate openly with each other	0.313**	0.246**	0.356**	0.312**
Team members are assuming responsibilities	0.318**	0.202**	0.346**	0.297**
Team members help each other solve problems	0.187*	0.113	0.270**	0.208**
All in all, I have rated the interprofessional collaboration in my unit as inadequate	0.232**	0.189*	0.273**	0.238**

Pearson correlation between Items of IPC communication and collaboration with an evaluation of interprofessional collaboration in general (correlation coefficients)	
	Overall rating of interprofessional collaboration
Communication with other professional groups	0.701**
Decisions on patient care are made collaboratively	0.712**
Team members are working hand in hand	0.668**

This table displays the Pearson correlation coefficients between items assessing IPC and various mental symptoms, including PHQ-2 (depressive symptoms), GAD-7 (anxious symptoms), Pandemic-Associated Burden (PAB), and Pandemic-Associated Anxiety (PAA). Additionally, correlations between IPC items and the overall evaluation of interprofessional collaboration are presented. Significance levels: *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

emphasizing the role of interprofessional collaboration and communication in hospital settings. Conducted during the initial wave of the COVID-19 pandemic in Germany, our study reveals a significant association between perceived interprofessional collaboration and mental symptoms, indicative of psychological distress, reported by healthcare professionals at a university teaching hospital.

5.1 Psychological distress observed in the cohort

Specifically, our study cohort primarily comprised frontline medical professionals directly involved in bedside care for COVID-19 patients, representing 78.6% of the participants. Although the cohort exhibited mild anxiety levels, with a mean GAD-7 score of 5.21, this represented a noticeable increase compared to anxiety levels in the general population before the pandemic (18). On the contrary, depressive symptoms, as assessed by the PHQ-2, were relatively low; however, 20.3% of respondents reported clinically relevant symptoms. Furthermore, additional analysis using specially designed questionnaires revealed moderate levels of "Pandemic-Associated Anxiety (PAA)" and "Pandemic-Associated Burden (PAB)." Both were positively correlated with anxiety symptoms, suggesting a connection between overall elevated anxiety and "Pandemic-Associated Burden and Anxiety (PAB; PAA)." General anxiety is often linked with fear, and it includes worries, avoidance, or unfounded fears. These results underscore the importance of a deeper understanding of the relationship between stress-induced anxiety and burden in an extraordinary crisis situation. Therefore, clinical institutions should cultivate sensitivity to recognize and be attentive to mental stressors and symptoms, enabling the provision of targeted interventions both proactively and in times of heightened stress.

5.2 Vulnerabilities and gender disparities

Of note, employees in nonmedical roles, such as administrative staff or ward assistants without direct patient contact, exhibited the highest levels of anxiety, as reflected in the GAD-7 scores, mirroring the anxiety levels found in the general population during the pandemic (22). This could potentially be attributed to a lack of pandemic-related knowledge and professional experience in

addressing health challenges. The significant burden on collaborators without patient contact should remind leaders of the necessity for proactive crisis preparation and team-based crisis communication tailored to the recipients.

As described in previous studies, the exposure to patients with COVID-19 infection, particularly frontline activity, was confirmed as a significant risk factor for the development of pandemic-associated distress in our overall cohort (2, 23). In our study, nurses were found to be particularly vulnerable to psychological distress during the pandemic, especially those directly involved in frontline patient care. This heightened vulnerability may stem from the fact that nurses, who predominantly constitute this group, have the most frequent and closest contact with patients infected with COVID-19. It is important to note that women generally have a higher prevalence of depression and anxiety disorders within the population compared to men (24, 25).

In contrast, medical students working alongside nurses in our sample did not exhibit exceptional distress. This suggests that they likely benefited from structured interprofessional collaboration and a smooth transition to practice. Nevertheless, teams must pay special attention to volunteers within clinical routines (26). Across various medical professions, physicians demonstrated the highest level of resilience during the pandemic, likely due to their training and experience in handling high-pressure situations, resulting in the lowest degree of mental symptoms on average.

These findings highlight the importance of implementing tailored support strategies targeting specific demographic and occupational groups, including nonmedical staff. Gender- and workplace-sensitive approaches must be given attention, as they are deemed crucial aspects in promoting mental health, particularly in light of the heightened risk of negative psychological reactions among female frontline workers (2, 6, 23).

5.3 Role of interprofessional collaboration and team support in relation to psychological well-being

With our study, we were able to provide important insights that effective team communication and clearly defined goals have proven to be crucial factors in alleviating psychological stress among healthcare professionals. In contrast, inadequate communication and uncertainty regarding team goals have been identified as significant risk factors for heightened anxiety and stress-related burdens during the pandemic.

Encouragingly, collaborative decision-making processes and perceived team support have been associated with positive collaborative experiences (17, 27, 28). Additionally, we have identified supplementary team factors that influence team management. Individuals who have felt that their teams were ill-prepared for

TABLE 3 Correlation between Items of Interprofessional Crisis Management (IPM) and mental symptoms.

	PHQ-2	GAD-7	PAB	PAA
Lack of additional team meetings to share information (COVID-19 pandemic)	−0.170*	−0.124	−0.191*	−0.249**
Lack of additional teaching and training activities (COVID-19 pandemic)	−0.216**	−0.240**	−0.265**	−0.207**
Preparation for patients with COVID-19 infection was poorly organized within the team	0.210**	0.201*	0.258**	0.301**
Interprofessional collaboration is poorer in the COVID-19 pandemic than before	0.163	0.119	0.184*	0.228**
Making use of the services (0/1)	−0.092	−0.058	−0.028	−0.046

This table presents the Pearson correlation coefficients between various items of IPM and mental symptoms, including depressive symptoms (PHQ-2), generalized anxiety symptoms (GAD-7), Pandemic-Associated Burden (PAB), and Pandemic-Associated Anxiety (PAA). The correlations were calculated to assess the relationship between crisis management strategies and psychological distress during the COVID-19 pandemic. Significance levels: *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

TABLE 4 Gender differences in mental symptoms and Interprofessional Collaboration and Communication (IPC).

	Male		Female			
	M	(SD)	*M*	(SD)	*Z*	*p*
GAD-7	4.276	(4.533)	5.617	(4.629)	−2.690	0.007
PHQ-2	1.221	(1.392)	1.612	(1.444)	−2.427	0.015
PAA	3.033	(1.003)	3.095	(1.014)	−0.762	0.446
PAB	2.607	(1.053)	2.927	(1.011)	−2.819	0.005
IPC	18.579	(6.428)	18.115	(5.528)	−0.488	0.626
IPM	12.846	(2.539)	12.039	(2.904)	−1.644	0.100

This table displays the mean (M) and standard deviation (SD) for various mental symptoms and interprofessional collaboration scales, and Interprofessional Crisis Management (IPM) stratified by gender. Differences between genders were assessed using the Wilcoxon rank test, with reported Z-scores and corresponding *p*-values. GAD-7 General Anxiety Disorders (0–21); PHQ-2 Patient Health Questionnaire (0–6), PAA Pandemic-Associated Anxiety (1–6), PAB Pandemic-Associated Burden (1–6), IPC Interprofessional Collaboration and Communication (9–36), IPM Interprofessional Crisis Management (5–20).

TABLE 5 Disparities in mental symptoms and Interprofessional Collaboration and Communication (IPC) between frontline and second-line roles.

	Frontline		Second-line			
	M	(SD)	*M*	(SD)	*Z*	*p*
GAD-7	5.383	(4.729)	4.373	(4.135)	−1.422	0.155
PHQ-2	1.545	(1.431)	1.274	(1.450)	−1.575	0.115
PAA	3.177	(1.054)	2.698	(0.720)	−3.299	0.001
PAB	2.939	(1.061)	2.407	(0.788)	−3.529	0.000
IPC	18.226	(6.026)	18.355	(4.557)	−0.170	0.865
IPM	12.350	(2.721)	12.074	(3.339)	−0.495	0.621

The table displays the statistical analysis conducted using the Wilcoxon rank test to assess differences in psychometric scales and IPC between frontline and second-line roles. Mean values (M) and standard deviations (SD) are presented alongside Z-values and *p*-values for each scale. GAD-7 General Anxiety Disorders; PHQ Patient Health Questionnaire, PAA Pandemic-associated Anxiety, PAB Pandemic-Associated Burden, IPC Interprofessional Collaboration and Communication, IPM Interprofessional Crisis Management.

TABLE 6 Comparison of mental symptoms, Interprofessional Collaboration and Communication (IPC), and Interprofessional Crisis Management (IPM) across professional groups.

	PHY		STD		NRS		OTH-W		OTH-WO			
	M	(SD)	*M*	(SD)	*M*	(SD)	*M*	(SD)	*M*	(SD)	CHI^2	*p*
GAD-7	4.409	(4.306)	4.465	(4.339)	5.399	(4.953)	4.545	(3.377)	6.696	(4.128)	5.792	0.215
PHQ-2	1.045	(1.253)	1.023	(1.123)	1.626	(1.511)	1.261	(0.964)	1.885	(1.705)	9.162	0.057
PAA	3.068	(0.897)	2.779	(0.858)	3.261	(1.072)	2.699	(0.760)	2.660	(0.907)	17.620	0.001
PAB	2.574	(0.916)	2.384	(0.779)	3.010	(1.082)	2.657	(1.029)	2.839	(1.002)	14.772	0.005
IPC	16.529	(5.363)	16.030	(3.687)	18.987	(6.186)	15.600	(4.695)	18.556	(6.307)	11.065	0.026
IPM	13.526	(2.836)	13.308	(2.323)	12.290	(2.797)	12.000	(2.867)	10.417	(2.275)	11.030	0.026

Statistical analysis was conducted using the Kruskal-Wallis test to compare mean scores across professional groups for each psychometric scale and scale of interprofessional collaboration, and Interprofessional Crisis Management (IPM). Mean (M) and standard deviation (SD) values are reported for each scale. Additionally, the Chi-square test was utilized to examine associations between professional groups and psychometric scales. GAD-7 General Anxiety Disorders; PHQ-2 Patient Health Questionnaire, PAA Pandemic-Associated Anxiety, PAB Pandemic-Associated Burden, IPC Interprofessional Collaboration and Communication, IPM Interprofessional Crisis Management; PHY physicians, STD students, NRS nurses, OTH-W others with patient contact, OTH-WO others without patient contact.

patients with COVID-19 infections have been more likely to report depressive symptoms and anxiety. This higher anxiety was associated with negative perceptions of "Interprofessional Collaboration and Communication (IPC)." In this context, it can be inferred that elevated anxiety might detrimentally impact both the perception of interprofessional teamwork and the capability to collaborate. On the other hand, lower anxiety and depression levels might enable individuals to work more effectively and efficiently within a team (29). Our analysis demonstrates that negative evaluations of interprofessional collaboration/communication show a moderate yet noteworthy correlation with both "Pandemic-Associated Burden" ($r = 0.362$, $p < 0.001$) and "Pandemic-Associated Anxiety" ($r = 0.335$, $p < 0.001$). In a practical context, these findings imply that if professionals across various disciplines view collaboration and communication negatively, they are more likely to encounter heightened levels of stress and anxiety associated with the pandemic. Despite the moderate correlation strength, the potential influence of fostering interprofessional collaboration and communication on the psychological well-being of healthcare staff is evident.

Our findings highlight the critical importance of interprofessional communication and team support for promoting employee mental well-being during periods of crisis (17). Effective team communication and clearly defined goals were identified as pivotal factors in alleviating psychological distress among healthcare professionals. Conversely, inadequate communication and ambiguity regarding team objectives emerged as significant risk factors for heightened overall anxiety and "Pandemic-Associated Anxiety (PAA)."

5.4 Role of interprofessional crisis management in relation to psychological well-being

Furthermore, our study underscores the effectiveness of "Interprofessional Crisis Management (IPM)" interventions, such as interprofessional briefings and training sessions, in reducing anxiety and depressive symptoms among staff. These findings emphasize the importance of proactive crisis preparation and ongoing professional development initiatives in fostering resilience and mitigating pandemic-induced stress.

In our survey, over half of the staff reported participating in interprofessional briefings, with 22.5% doing so daily or at least once a week. Training aimed at enhancing professional skills significantly impacted the severity of anxiety in the context of the pandemic, highlighting its crucial role in interdisciplinary crisis management at the organizational level. Regarding effective crisis management, factors such as collaborative management and clarification of roles and responsibilities within teams have previously been identified as essential strategies in high-pressure environments (12, 27, 30). Correspondingly, inadequate professional support during the

COVID-19 crisis was linked to increased psychological distress in at least two studies (27, 30). These factors were corroborated in our study.

5.5 Summary of the central findings of our study

In conclusion, our study underscores the value of robust interprofessional collaboration, emphasizing open communication, defined team goals, and shared decision-making in enhancing resilience among healthcare professionals during challenging times (17). Our study not only highlights the value of strong interprofessional collaboration and communication but also underscores the paramount importance of fostering rigorous interprofessional approaches to strengthen the well-being of healthcare staff amidst crises (1). Notably, a suboptimal perception of Interprofessional Crisis Management (IPM) emerged as a risk factor for depressive symptoms and inadequate team communication correlated with heightened risks of anxiety, depressive symptoms, and increased pandemic-induced stress.

With our study, we addressed a gap in the literature. When examining the literature to contextualize our findings within the work of other authors, there are indications of the effects of interprofessional collaboration on staff outside of pandemics and crises. For instance, Vermeir et al. (31) found a positive correlation between satisfaction with communication and nurses' job satisfaction. This manifested in reduced turnover intentions and a decreased risk of burnout. Subsequently, Labrague et al. (32) described interprofessional collaboration as a mediator between nurses' work environment and job satisfaction. Our findings support these assertions, insofar as positively rated interprofessionalism can contribute to increased well-being for the staff, particularly for the nursing group. Amidst a major crisis such as the COVID-19 pandemic, some research has identified interprofessional collaboration or teamwork as apotential protective factor among others, influencing the mental strain experienced by healthcare professionals. However, the relationships and individual impacts have not yet been investigated as a standalone research question concerning crisis management and mental well-being (33, 34).

5.6 Implications and recommendations for practice in the post-pandemic era

Based on our findings, we strongly advocate for healthcare leaders to prioritize interprofessional initiatives aimed at supporting staff well-being and optimizing patient care. Implementing tools such as interprofessional briefings and education programs can serve as invaluable resources for promoting resilience and enhancing competent crisis management in healthcare settings. Looking ahead to future crises, proactive initiatives are needed to address these challenges. One such initiative could entail the establishment of interdisciplinary task forces comprising professionals from diverse healthcare disciplines. These task forces, akin to rapid response teams, would collaborate to devise comprehensive strategies for stress management, communication enhancement, and teamwork promotion across various departments. By bringing together experts from different fields, such task forces can facilitate the swift implementation of evidence-based practices and innovative solutions to emerging challenges. Regular interprofessional huddles or debriefing sessions, led by task force members, serve as effective means to enhance real-time communication and problem-solving among team members, thus promoting a cohesive approach to patient care.

As a relatively quick and low-threshold program, the University Teaching Hospital of Regensburg is implementing stress managers post-pandemic. These stress managers have undergone a certified training program. They are embedded within the teams to provide on-site counseling, interventions, and training for interprofessional staff, all aimed at stress prevention. Furthermore, investment in cross-disciplinary training programs focused on honing interprofessional collaboration skills, conflict resolution techniques, and shared decision-making abilities can equip staff with the requisite tools and competencies to function effectively as a cohesive team.

By fostering a culture grounded in mutual respect, trust, and collaboration, healthcare institutions can harness the collective expertise of multidisciplinary teams to tackle intricate challenges and optimize patient outcomes (31). Embedding interprofessional collaboration principles into organizational policies, protocols, and performance evaluations further underscores the significance of teamwork and collaboration in attaining shared objectives. Ultimately, prioritizing rigorous interprofessional approaches empowers healthcare institutions to cultivate resilient, cohesive teams proficient at navigating crises with balance and empathy. Such approaches must be integrated into healthcare curricula and teaching methodologies, ensuring that future healthcare professionals are equipped with the necessary skills for effective collaboration and crisis management (35).

5.7 Limitations of the study and need for future research

While our study has provided valuable insights, it is important to acknowledge several limitations. First, there is the issue of selection bias due to voluntary participation, which may have led to sample distortion as individuals who chose to participate may possess different characteristics or opinions compared to those who did not. Extending our findings to other hospital settings requires consideration, as various contextual factors such as the hospital's organizational structure, geographical location, and specific operational dynamics may influence outcomes differently. Additionally, the underrepresentation of physicians in our sample may limit the generalizability of our findings and introduce bias in interpretation, as their perspectives and experiences may not have been adequately accounted for. Despite these limitations, our decision to conduct a direct comparative analysis between physicians ($n = 22$) and nurses ($n = 175$) was based on the relevance of both groups to our research interests and their potential influence on the variables under investigation. Physicians and nurses operate in similar clinical environments and often share overlapping tasks directly related to the variables under study. The results of this comparison can provide crucial insights that are relevant for both theoretical advancement and practical application, particularly in clinical settings where these two professional groups collaborate closely and complement each other.

Furthermore, the absence of pre-existing anxiety level data among participants before the COVID-19 pandemic complicates the interpretation of our results, as other factors outside the pandemic context may have influenced the measured anxiety levels. For an external assessment of the burden of psychological symptoms in our study population using the PHQ-2 and GAD-7, we opted for a reference population consisting of a norm sample from the German population before the pandemic. During the initial wave of the pandemic, while much of the world implemented lockdown measures and many hospital workers transitioned to remote work, our sample of healthcare professionals, including allied health practitioners, continued to operate in clinical settings without clear medical guidelines, vaccines, or established treatment options. Due to the high prevalence of ECMO therapies and the associated significant burden, as well as the numerical imbalance in professional subgroups (such as a higher number of nurses compared to physicians), direct comparisons with other healthcare professionals from studies are prone to bias and challenging to interpret. The utilization of a norm sample from the pre-pandemic German population enabled us to contextualize our findings and assess the psychological impact on our cohort.

Moreover, our study was monocentric and not a randomized controlled trial, which could impact the generalizability and causal inferences of our findings. We also lacked information on participants' specialty areas or potentially more stressful activities, such as ECMO therapy, although we differentiated between frontline and second-line roles.

Furthermore, our study did not compare the "Interprofessional Collaboration and Communication (IPC)" instrument, developed specifically for this study, with another assessment tool, potentially impacting the validity of our measure. While such a comparison is not obligatory to establish the validity of our instrument, it could strengthen its reliability and robustness. Similarly, the same assumption applies to the self-designed questionnaires concerning "Pandemic-Associated Burden (PAB)," "Pandemic-Associated Anxiety (PAA)," and "Interprofessional Crisis Management (IPM)," which are grounded in literature-based evidence and the guidance of an expert panel.

Our investigation reveals moderate correlations between the quality of "Interprofessional Collaboration and Communication (IPC)" and the scores for "Generalized Anxiety Disorder-7 (GAD-7)," "Pandemic-Associated Anxiety (PAA), and Burden (PAB)" (all $p < 0.05$) in our sample. These findings suggest that improved IPC is associated with a reduced degree of psychological distress during the pandemic. This relationship is moderate most likely due to the overall moderate levels of psychological distress and the influences of the sample sizes with respect to the different subgroups of healthcare workers. This connection sheds light on the complex interactions between IPC and psychological impacts during the pandemic. While strong correlations indicate robust associations, moderate and weak correlations provide valuable insights into these intricate relationships, highlighting the need for further investigation and targeted interventions to support healthcare professionals during times of crisis. In the overall scope of the study results, it is also important to note that the cross-sectional nature of our study limits our ability to infer long-term effects.

Moving forward, it is imperative for future research to explore the comparative validity of IPC with established instruments, conduct multicentric studies with randomized controlled designs, and collect comprehensive mental health data. This includes measurements of anxiety levels, depression levels, and other relevant psychological factors. To confirm our results, it is crucial that future studies examine and further elucidate the complex interplay between the quality of interprofessional collaboration and psychological well-being, quantified using validated psychometric tests.

6 Conclusion

Our study, with its focus on interprofessionalism, underscores the necessity for healthcare institutions to sensitively address the needs and requirements of all team members, whether medical or nonmedical staff. This is crucial because during daily routines and especially amidst periods of high workload and crises, all members contribute to overcoming challenges and ultimately delivering outstanding patient care. Such approaches could significantly contribute to strengthening the resilience of interprofessional healthcare teams and mitigating turnover rates attributable to psychological distress. By prioritizing rigorous research and evidence-based interventions aimed at improving mental health outcomes, healthcare organizations can create supportive environments that enhance job satisfaction and overall well-being. Thus, investing in strategies to support the psychological strength and adaptability of interprofessional teams is essential for fostering a sustainable and thriving healthcare workforce.

Data availability statement

The datasets presented in this article are not readily available due to privacy considerations for the surveyed employees. Requests to access the datasets should be directed to Kirstin.Ruttmann@ukr.de.

Ethics statement

In this study, strict adherence to applicable data protection policies has been ensured to safeguard participant confidentiality. Particular attention has been paid to ensuring non-attribution to individual participants. These measures are crucial to maintaining anonymity and upholding ethical standards.

Author contributions

KR: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Validation, Visualization, Writing – original draft. SA-F: Conceptualization, Investigation, Methodology, Project administration, Writing – review & editing. NL: Data curation, Formal analysis, Validation, Writing – review & editing. CK: Data curation, Supervision, Validation, Writing – review & editing. AM: Investigation, Writing – review & editing. VK: Writing – review & editing. KG: Conceptualization, Project administration, Supervision, Writing – review & editing. SS-H: Writing – review & editing. SS: Investigation, Supervision,

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Funding

The author(s) declare that no financial support was received for the research, authorship, and/or publication of this article.

Acknowledgments

We express our sincere gratitude to all interprofessional teams from the COVID-19 units at the University Hospital of Regensburg who, during the novel COVID-19 pandemic and the associated tremendous workload, volunteered to participate in the survey. Their willingness to participate contributes significantly to our understanding of interprofessional teams and their needs in crisis management. This, in turn, enables us to learn valuable lessons for future crises.

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.2024.1292608/full#supplementary-material

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frontiers | Frontiers in Medicine

TYPE Original Research
PUBLISHED 26 July 2024
DOI 10.3389/fmed.2024.1427061

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RECEIVED 02 May 2024
ACCEPTED 03 July 2024
PUBLISHED 26 July 2024

CITATION
Seelandt JC, Schneider J, Kolbe M and Grande B (2024) Effective debriefings in the clinical setting: a pilot study to test the impact of an evidence based debriefing app on anesthesia care providers' performance. *Front. Med.* 11:1427061. doi: 10.3389/fmed.2024.1427061

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Effective debriefings in the clinical setting: a pilot study to test the impact of an evidence based debriefing app on anesthesia care providers' performance

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Background: Debriefing enhances team learning, performance, and patient safety. Despite its benefits, it's underused. To address this, we developed an evidence-based debriefing app.

Methods: This pilot study, conducted at a Swiss hospital, evaluated team performance during two anesthesia inductions using the Team Performance Scale (TPS). Following the first induction, teams engaged with the Zurich Debriefing App, with debriefing sessions meticulously recorded for subsequent evaluation. To mitigate bias, raters underwent comprehensive TPS training. The debriefings were analyzed through the DE-CODE framework. We utilized paired t-tests to examine performance improvements and linear regressions to assess the impact of reflective statements on performance, moderated by psychological safety.

Results: Team performance significantly improved from the first to the second induction (t (9) = −2.512, p = 0.033). Senior physicians' (n = 8) reflective statements predicted post-assessment TPS scores (R^2 = 0.732, p = 0.061), while consultants (n = 7) and nurse anesthetists (n = 10) did not. Interaction analysis revealed no moderation effects, but a main effect indicated the significance of senior physicians' reflective statements.

Conclusion: This pilot study confirms the efficacy of the evidence-based debriefing app in enhancing anesthesia team performance. Senior physicians' reflective statements positively influenced performance; however, no moderation effects were observed. The study highlights the potential of debriefing apps to streamline and enhance team debriefing processes, with significant implications for improving clinical practice and patient safety. Further research is needed to validate these findings on a larger scale and optimize the integration of debriefing into routine clinical practice.

KEYWORDS

self-debriefing, reflective statements, team learning, team performance, debriefing application

Background

Healthcare debriefings have the potential to enhance team learning and team performance in *ad hoc* teams. They reduce errors and improve patient safety (1, 2). It is a guided conversation among clinicians that aims to explore and understand the relationships among events, actions, thought and feeling processes, and performance outcomes of a clinical situation (3–7). A core element of debriefings is promoting experiential learning and thus reflecting/shared reflection which in turn may allow the development of strategies that can be applied in future performance episodes (8–12). Kolb's Experiential Learning Theory posits that learning is a process where knowledge is created through the transformation of experience, following a cyclical model comprising four stages: Concrete Experience, Reflective Observation, Abstract Conceptualization, and Active Experimentation. This theory emphasizes that effective learning involves actively engaging in experiences, reflecting on them, conceptualizing the insights gained, and then applying these insights in practice (13). Debriefings are likely to be a suitable learning infrastructure (14, 15), particularly for *ad hoc* teams in healthcare with their temporal instability (16). While the potential of debriefings is increasingly recognized (17, 18) and empirical studies have demonstrated their benefits (19–21), they are still underutilized (15, 22, 23). Research has demonstrated that debriefings are only seemingly easy to conduct. In fact, they require a number of challenging conversational skills (24) and knowledge about team functioning (3, 21) which may be discouraging and requires the exploration of ways to help start and conduct debriefings (17). Also, research on organizational behavior suggests that many assumptions exist that may prevent healthcare personnel from engaging in debriefings. The so called "debriefing myths" include debriefing only when disaster strikes, debriefing is a luxury, senior clinicians should determine debriefing content, and debriefers must be neutral and nonjudgmental (1). These myths offer valuable insights into why current debriefing practices are *ad hoc* and not embedded into daily unit practices (1).

Different tools for conducting debriefings in the clinical setting exist for either hot [immediately after an event (4)] or cold [delayed hours to weeks after an event (4)] debriefings. These tools have in common that they have a similar framework and structure (5) but all of them lack a systematic analysis of the interaction between debriefers and participants namely how actions of debriefers relate to actions of participants; they mostly do not illuminate the debriefing process nor do they focus on specific questions to trigger participants' double loop learning.

We therefore aimed to develop an evidence-based dynamic debriefing tool that contains evidence for the immediate effectiveness of selected debriefing and participant communications (6).

We have also tried to address the assumptions about debriefings mentioned above and why debriefings are rarely performed in the clinical setting. For example, the moderator of the debriefing is recommended, and participants are given a selection of topics to talk about in the debriefing (e.g., leadership, team coordination, speak up, team communication). In addition, participants are guided through the debriefing while using the debriefing app; for each phase of the debriefing, participants receive suggestions for effective question and they can also access current research results on selected crisis resource principles.

The objective of this observational pilot study was to test the impact of an evidence based debriefing app on anesthesia care providers' performance. Based on team science and debriefing literature, we hypothesized that using the debriefing app in between two complex induction of anesthesia will enable team members to reflect and thus improve the performance of the second induction. Specifically, we tested the following hypotheses: (1) Team performance during anesthesia induction assessed by the Team Performance Scale (TPS) will increase after the debriefing and (2) the more reflective statements are verbalized during debriefings, the better the team performance is during the second induction for senior consultants, consultants, and registered anesthesia nurses, respectively. This relationship is moderated by psychological safety. Reflective statements were assessed via behavior observation and *in situ* behavior coding rather than relying on self-reports (7–9).

Methods

The respective ethics committee determined this study to be exempt KEK-ZH-Nr. 2013-0592.

Study design and inclusion/exclusion criteria

Data collection for this study took place at a central care-providing hospital in Switzerland. The participants included 10 male and 12 female anesthesia care providers. We observed participants performing complex inductions of general anesthesia in teams of 2 or 3. After the first induction, the participants used an app to debrief themselves, followed by a second complex induction of general anesthesia, which we observed again. Inductions were performed in the anesthesia induction room adjacent to the theater. Debriefings were conducted in a separate room immediately after the induction, facilitated by another anesthesia team that relieved the original team for this purpose.

Participants were recruited over 5 months for anesthesia in thoracic, visceral, vascular, or neurosurgery. Inclusion criteria included patients with an ASA classification of two or higher, requiring a central venous catheter, arterial catheter, thoracic epidural catheter, or double lumen tube, and complex patient positioning (e.g., prone or side position) (10). The exclusion criteria were anesthesia inductions in patients with an ASA classification 1 and 2, without extended monitoring or complex positioning. The anesthesia inductions included general anesthesia with and without thoracic epidural anesthesia, and all cases were elective surgical procedures. The teams consisted of one anesthesia consultant, one registrar, and one registered anesthesia nurse.

The anesthesia inductions took place in a designated induction room. After the placement of a thoracic epidural catheter, the usual steps such as preoxygenation, pharmacological induction, and pharmacological stabilization of blood pressure (within the usual range) were carried out.

Data collection

Data were collected anonymously. Participants were informed about the study both verbally and through written documents, and

written informed consent was obtained. Patient characteristics (age, physical status, ASA classification), type of surgical procedure, monitoring, duration of anesthesia induction, intubation method, and patient positioning were extracted from the patient file and anesthesia protocol. The debriefings were videotaped.

During inductions of anesthesia, team members were observed and assessed using the Team Performance Scale (TPS). The TPS analyzes the roles and responsibilities of team members and focuses on effective communication (11).

The TPS has been used as surrogate for the quality of the anesthesia induction. Raters were consultant anesthesiologists and anesthesia nurses with years of professional experience. All raters participated a two-hour rater training. The training included general information about the study purpose, a structured introduction into the rating systems and the observation method and rating of one videotaped induction of anesthesia using TPS under the direct guidance. To assess interrater reliability, two additional videotaped anesthesia inductions were evaluated. Training was considered complete if agreement between trainees and expert coders (Intraclass Correlation Coefficient) was.70 for both instruments indicating good interrater reliability (12). During anesthesia induction, the raters were placed closely to the anesthesia team and used TPS in real-time with direct observation.

The observation started with administering the first drug and ended with the handover to the surgical staff (25).

After the first anesthesia induction was finished, the participants used the Zurich Debriefing App for a videotaped debriefing. Afterwards participants performed another induction of general anesthesia and underwent the same procedure. Both anesthesia inductions have been rated by different raters to avoid any biases (Figures 1, 2).

Measurements

Participants completed a questionnaire after each debriefing. Psychological safety was measured using a validated German translation (26, 27) of the Team Psychological Safety scale.

Data analysis

The debriefings have been observed remotely by the study team (7). In particular, they applied four codes of the DE-CODE, a valid and reliable coding scheme for assessing debriefers' and learners' communication in debriefings (28, 29). The authors focused on learners reflective statements/marker including learners analyses why something happened (DE-CODE: *description*), mentioning mental models (DE-CODE: *mental models*), learners conclusions about lessons learned or other actions that s/he could have done (DE-CODE: *conclusion*) as well as future-oriented action plans (DE-CODE: *action plan*). The anesthesia teams have been observed from the beginning of the debriefing until the end of the debriefing and reflective statements/marker have been recorded.

Behavioral coding was conducted using a standard personal computer and Excel sheet. To ensure interrater reliability, two coders independently coded 20% (36 out of 180) of the videotaped debriefings.

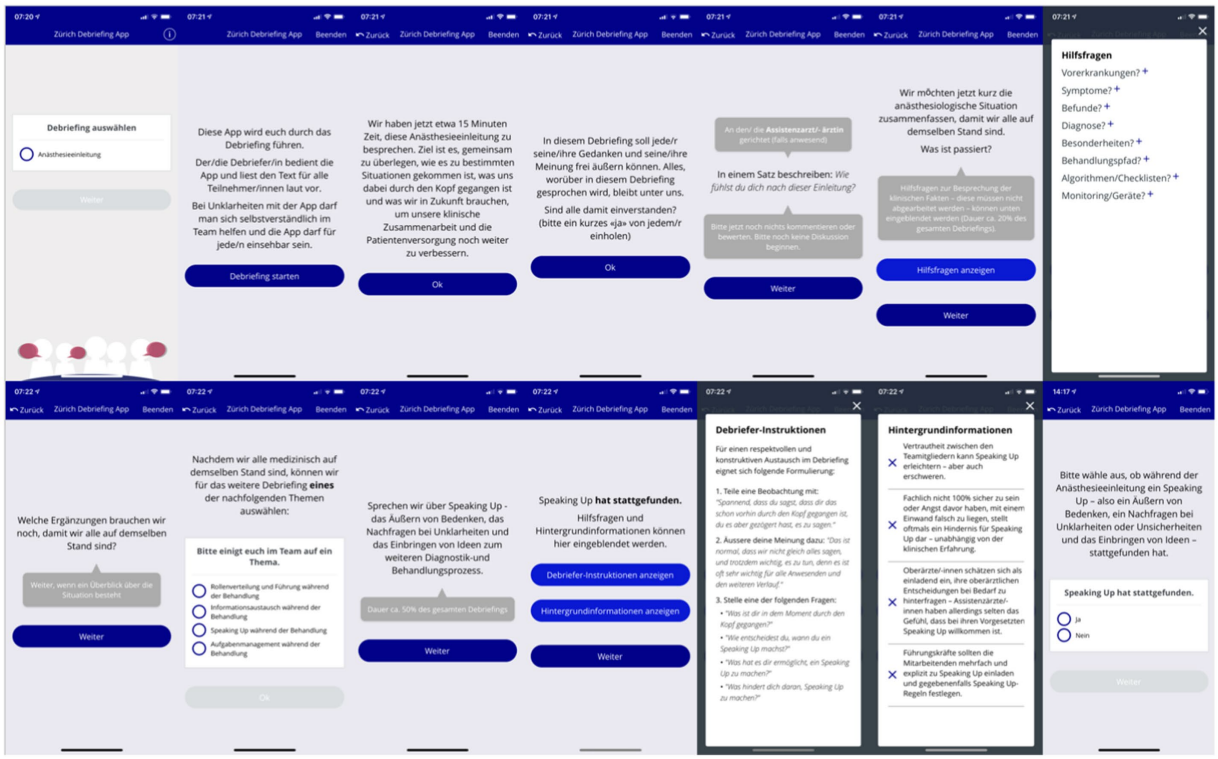

FIGURE 1
Screenshot of the application, showing the process of questioning.

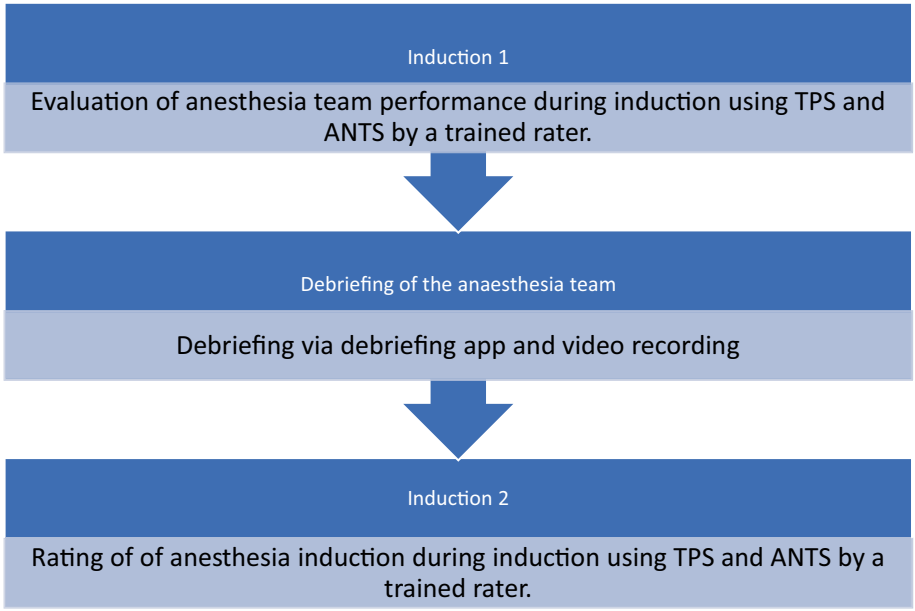

FIGURE 2
Study process.

Statistical analysis

Interrater reliability was assessed using the Intraclass Correlation Coefficient (ICC), suitable for ordinal, interval, and ratio scales. ICC values below 0.40 indicate poor reliability, between 0.40 and 0.59 are considered fair, 0.60–0.74 are good, and above 0.75 are excellent (30). Statistical analyses were performed using IBM SPSS V.26 software.

To evaluate the hypothesis that teams perform better during the second anesthesia induction, paired sample *t*-tests were conducted.

For the hypothesis concerning the relationship between the verbalization of reflective statements during debriefings and team performance during the second induction, linear regressions were performed. Additionally, a moderation analysis was conducted to examine whether this relationship is moderated by psychological safety.

Results

Interrater reliability

The ICC between two independent coders assessing 20% of the debriefings was 0.73, indicating good interrater reliability.

Participants and descriptive data

Debriefings involved a minimum of two and a maximum of three participants, including attending physicians, resident physicians, and nurses with varying levels of experience in anesthesia. The mean duration of debriefings was 12.5 min, with a range of reflective statements made by participants. The average anesthesia experience was 9.17 years, on average; the team size for induction was 2.5 people. One person had never had simulation training with debriefing until then; all other participants were familiar with debriefing through simulation training.

Descriptive data for inductions

Patients undergoing anesthesia inductions had an average ASA score of 3.05, with procedures primarily neurosurgical or thoracic in nature.

Hypothesis testing

Results from paired sample *t*-tests revealed a significant increase in team performance from the first to the second anesthesia induction ($p = 0.033$), confirming the first hypothesis.

Regarding the second hypothesis, linear regression analyses showed that senior consultants' reflective statements predicted post-assessment team performance scores ($R^2 = 0.732$, $p = 0.061$), while consultants' and registered anesthesia nurses' statements did not significantly predict team performance. Moderation analysis did not reveal significant interactions between reflective statements and psychological safety for any group of anesthesia care providers. Therefore, the first hypothesis was confirmed, while the second hypothesis was partially supported, and the moderation hypothesis was not confirmed (Table 1).

Discussion

Aim of this pilot study was to test the impact of evidence based, guided debriefing app on anesthesia care providers' team performance. Based on team science and debriefing literature, we hypothesized that

TABLE 1 ANTS and TPS score.

Performance	ANTS	TPS	Total
Induction 1	3.43	4.27	7.70
Induction 2	3.81	4.66	8.46
Increase (%)	9.46	7.83	8.56

using the debriefing app in between two complex induction of anesthesia will enable team members to reflect and thus improve the performance of the second induction. Specifically, we hypothesized that team performance will increase from first to second induction of anesthesia and that the more reflective statements are verbalized during debriefings, the better the team performance is during the second induction. In addition, we hypothesized that this relationship is moderated by psychological safety. We assessed reflective statements via behavior observation and team performance was assessed by using TPS. Results showed that our first hypothesis is confirmed.

Interpreting effect sizes is a critical aspect of research methodology. Cohen's benchmarks (1988) classify effect sizes as small ($d = 0.2$), medium ($d = 0.5$), and large ($d = 0.8$), but their application should not be overly rigid. Despite these benchmarks, small effect sizes can hold significant practical implications, as seen in instances like interventions leading to a substantial reduction in suicide rates with an effect size of $d = 0.1$. While Cohen's d for between-subject designs can be interpreted as a fraction of the standard deviation, offering a tangible measure, the most meaningful interpretation involves contextualizing the effect within existing literature and elucidating its practical implications. However, there is a lack of clear guidelines on how to undertake this process. Therefore, researchers must exercise discretion in interpreting effect sizes, considering both statistical benchmarks and the broader context of the research field (31).

Teamwork and thus patient safety can be improved by reflexivity, through reflexivity in debriefing, but also in a briefing or during action (32, 33). Based on this information, reflexivity in debriefing should be promoted.

In our study, the second hypothesis was that increased reflexivity in debriefing would lead to an improvement in TPS in the second induction, this was shown to be only partially significant. This was only shown in relation to the reflexivity of the senior doctors' statements. However, this was probably also due to the small sample in the pilot study. This would have to be analysed again in a larger study and especially the participants' share of conversation in the debriefing as well as the reflection markers would have to be considered further.

The second hypothesis is only confirmed for senior consultants, a main effect is shown in the reflective statements of the senior consultants and an increased performance post, otherwise no moderation effects were shown. The results show that our second hypothesis is not confirmed.

The strengths of the study are certainly demonstrated by the ease of conducting the debriefing using an app on a smartphone or pad, as this can be done in a resource-efficient and simple way. After all, the use of smartphones in everyday clinical practice is now well accepted by most doctors and nurses (34). Through the app, the team can be guided neutrally through the debriefing and the participants are tempted to reflect on their actions in the team. The limitations of this study are that it is a single center study and has only a small number of cases. Furthermore, organizing the same team for two consecutive complex anesthesia inductions proved to be a challenge.

It is noteworthy to highlight our adherence to recommendations put forth, as evidenced by the alignment of our approach with the findings elucidated in the systematic review on clinical debriefing tools: attributes and evidence for use. Additionally, our reference to authoritative documents such as Healthcare Simulation Standards of Best Practicetm, The Debriefing Process, Reflective debrief and the social space: offload, refuel, and stay on course, and Clinical debriefing: TALK© to learn and improve together in healthcare environments, underscores the robust methodology.

The incorporation of reflexivity during debriefing sessions has been shown in contemporary literature to be conducive to enhancing teamwork dynamics and bolstering patient safety measures (35). This is particularly pertinent given the complexities inherent in healthcare environments. Furthermore, our findings pertaining to the second hypothesis, while partially significant, warrant nuanced interpretation. The observed partial significance could be attributed, in part, to the relatively modest sample size utilized in our study. Moving forward, it may be prudent to delve deeper into the conversational dynamics within debriefings, potentially shedding light on the need to ensure equitable participation beyond senior consultants. It is plausible that other anesthesia providers may have contributed disproportionately to the overall discourse. Consequently, future analyses should prioritize assessing the balance of reflective markers rather than focusing solely on individual contributors.

The accessibility and dynamic nature of our debriefing application are notable, serving as an effective tool in guiding users through the debriefing process. By reducing barriers, such as complexity and time constraints, our application streamlines the debriefing experience, making it more accessible and resource-efficient in clinical settings.

Moreover, our findings underscore the versatility of our approach, as it is suitable for both hot and cold debriefings, as advocated by Sugarman (5). However, it is imperative to acknowledge the limitations inherent in our study design. As a single-center study with a modest sample size, our findings may not be generalizable to broader contexts. Furthermore, the pilot nature of our study posed challenges in ensuring stable team compositions for two sequential inductions, potentially impacting the robustness of our findings. Additionally, our study focused exclusively on a single discipline within healthcare, further limiting the generalizability of our findings.

Finally, despite concerns surrounding the integration of smartphone applications in clinical practice, our findings indicate a prevailing positive attitude among healthcare professionals toward their use. This trend is supported by the burgeoning adoption of smartphones among healthcare professionals over the past decade, with approximately 80% of doctors and 85% of medical trainees utilizing smartphones in their professional capacities (34).

For clinicians, these findings present significant advantages. They allow for systematic and structured debriefings to be conducted without a loss of time. Additionally, they document the learning effect. Furthermore, team members are trained to independently conduct effective debriefings. Based on the findings, the use of the application can be recommended; however, the effect of the subject of debriefing should not be overlooked (36). In this study, only

non-critical situations were discussed, aligning with the Safety II concept by Hollnagel et al. (37). Whether this structure yields similarly positive effects in situations involving incidents remains to be seen.

We hope that this pilot study will help to confirm our hypotheses in a larger study and create a tool through this app that can better integrate debriefing into everyday clinical practice and thus improve team performance and patient safety.

Data availability statement

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

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the patients/participants was not required to participate in this study in accordance with the national legislation and the institutional requirements.

Author contributions

CS: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft. JS: Data curation, Project administration, Visualization, Writing – original draft. MK: Conceptualization, Data curation, Formal analysis, Funding acquisition, Methodology, Project administration, Resources, Supervision, Writing – original draft. BG: Conceptualization, Funding acquisition, Methodology, Resources, Supervision, Validation, Writing – original draft, Writing – review & editing.

Funding

The author(s) declare that financial support was received for the research, authorship, and/or publication of this article. The research was supported by a grant from the Swiss National Science Foundation (Grant No. 100014_152822).

Acknowledgments

The authors thank Michael Ganter, Julio Moral, Reto Thomasin, Eva Streuli, Thomas Rieder and Roland Gsell for their great cooperation.

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.

The author(s) declared that they were an editorial board member of Frontiers, at the time of submission. This had no impact on the peer review process and the final decision.

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frontiers | Frontiers in Public Health

TYPE Original Research
PUBLISHED 09 August 2024
DOI 10.3389/fpubh.2024.1340953

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RECEIVED 26 January 2024
ACCEPTED 26 July 2024
PUBLISHED 09 August 2024

CITATION
Schlosser-Hupf S, Aichner E, Meier M, Albaladejo-Fuertes S, Mahnke A, Ruttmann K, Rusch S, Michels B, Mehrl A, Kunst C, Schmid S and Müller M (2024) Cost-effectiveness in an interprofessional training ward within a university department for internal medicine: a monocentric open-label controlled study of the A-STAR Regensburg.
Front. Public Health 12:1340953.
doi: 10.3389/fpubh.2024.1340953

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Cost-effectiveness in an interprofessional training ward within a university department for internal medicine: a monocentric open-label controlled study of the A-STAR Regensburg

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Introduction: Interprofessional collaboration in healthcare involves diverse professionals working together to address complex patient needs. Interprofessional training wards offer workplace-based interprofessional education in real healthcare settings, fostering collaborative learning among students. While their educational value is widely recognized, debates persist regarding their cost-effectiveness due to limited research. This study assesses the cost efficiency of the interprofessional training ward Regensburg (A-STAR) within the Department of Internal Medicine I at the University Hospital Regensburg, compared to conventional wards.

Methods: From October 2019 to December 2022, 7,244 patient cases were assigned to A-STAR or conventional wards by case managers, with a comprehensive analysis of all associated revenues and costs.

Results: A-STAR treated 1,482 patients, whereas conventional wards treated 5,752 patients, with more males and younger patients at A-STAR. A-STAR achieved higher profit per case (€1,508.74) attributed to increased revenues and reduced material costs. It generated an average of €1,366.54 more Diagnosis Related Groups (DRG) revenue per case annually than conventional wards, due to greater medical complexity reflected in a higher case-mix index (CMI: 2.4 vs. 2.2). The increased case complexity led to longer patient stays (9.0 vs. 8.1 days) and fewer cases treated annually at A-STAR (27.4 cases/year vs. 37.8 cases/year). The higher CMI did not result in a higher proportion of patients requiring isolation. A-STAR exhibited a higher capacity utilization rate (87.1% vs. 83.9%). Personnel costs per case at A-STAR were initially elevated due to enhanced observation by the senior physician but were gradually mitigated by expanding A-STAR's bed capacity. Material costs were consistently lower on a per-case basis at A-STAR (€1512.02 vs. €1577.12), particularly in terms of medication expenses, indicating more resource-efficient operations. From the A-STAR graduates, 18 individuals were recruited for permanent positions as doctors or nurses over 2 years.

Conclusion: A-STAR demonstrates economic efficiency and stability even during the COVID-19 pandemic. The substantial personnel acquisition is likely influenced by high levels of satisfaction with education and work and is economically relevant in medical staff shortages. These findings provide a compelling rationale for the broader implementation of interprofessional training wards, establishing them as vital platforms for nurturing future professionals.

KEYWORDS

interprofessional, training ward, cost-effectiveness, economic outcome, cost analysis, interprofessional education, interprofessional collaborative practice, internal medicine

1 Introduction

This study is grounded in the theoretical framework of interprofessional education, which emphasizes collaborative learning and practice among healthcare professionals to improve patient outcomes and healthcare efficiency. Interprofessional collaboration refers to a concerted and coordinated approach to healthcare delivery involving healthcare professionals from different disciplines working together to address patients' growing complex health needs (1, 2). This approach recognizes that no single healthcare professional can provide all the necessary care for a patient and that collaboration and communication among healthcare professionals are essential to optimize patient outcomes. Interprofessional healthcare aims to improve the quality of care, enhance patient safety, reduce healthcare costs, and improve patient satisfaction (3–15). Interprofessional collaboration also enhances shared decision-making with patients, ensuring their preferences and values are considered, which is crucial for effective and cost-efficient healthcare delivery (16). Most barriers and facilitators identified were at the inter-individual and organizational levels. The main obstacles included a shortage of time and training opportunities, unclear roles and responsibilities, concerns around professional identity, and inadequate communication practices (17).

Interprofessional training wards are specialized facilities within hospitals or medical centers where healthcare students and professionals from disciplines such as medicine, nursing, pharmacy, physical therapy, and social work come together to learn and practice interprofessional collaboration skills (18, 19). These wards offer real-life healthcare settings, where students work together as a team largely independent from but under the supervision of their trainers to provide care to patients (10, 20). This includes conducting patient assessments, developing treatment plans, implementing interventions, and evaluating patient outcomes. They are an ideal instrument for interprofessional teaching because they provide a controlled real-life environment for healthcare professionals from different disciplines to work together as a team and learn from and about each other. Interprofessional training wards promote a better understanding of the professional roles and responsibilities which may result in a more effective and efficient coopration (21–24). Interprofessional training wards typically involve a range of learning opportunities, including simulations, case studies, and debriefing sessions. They are facilitated by experienced educators and clinicians who help students and professionals to develop their interprofessional competencies, professional skills and provide feedback on their performance.

In 2016 the founding members of the Society for Cost and Value in Health Professions Education conceived the *Prato Statement, which* proposes "that the goal of economic analyses in professional and interprofessional education is to create an evidence base toward education that delivers maximum value for a given spend—and that drives education that is sustainable, accessible, and able to meet future healthcare requirements" (25). While there is no doubt that these training wards provide valuable learning experiences, the question of whether they are cost-effective remains. Few studies have examined the costs and benefits of interprofessional teaching, and even fewer interprofessional training wards in the medical context (26–29). There is one notable cost–benefit analysis of a Danish interprofessional orthopedic training ward. In 2009, Hansen et al. published data from the first Danish undergraduate interprofessional training ward at Regional Hospital Holstebro (30). The study compared costs, complications, and quality of life for 134 patients who underwent primary hip or knee replacement surgery on the interprofessional training ward versus a conventional ward. The results showed that the interprofessional training ward was more cost-effective than the conventional one for primary hip and knee replacement surgeries. Moreover, there was no difference in complications or patient-reported quality of life. In 2022, a study by one of the first German interprofessional training ward, HIPSTA, at Heidelberg University Hospital was published, which examined the clinical outcome of the ward's surgical patient collective (31). Compared to the 465 patients in the conventional wards, the 243 patients in the HIPSTA showed significantly shorter lengths of stay and fewer reoperations, with no difference in terms of postoperative complications, and in-hospital mortality.

Our study represents the first-ever analysis of an interprofessional training ward within the field of internal medicine, specifically focusing on a primarily gastroenterological patient population with complex medical needs. We investigated the hypothesis that the A-STAR operates with the same cost efficiency as the conventional wards of the Department of Internal Medicine I, Gastroenterology, Hepatology, Endocrinology, Rheumatology, and Infectious Diseases, at University Hospital Regensburg.

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2 Materials and methods

2.1 Patients

All patients who had been admitted to the A-STAR and conventional wards at the Department of Internal Medicine I, Gastroenterology, Hepatology, Endocrinology, Rheumatology, and Infectious Diseases, at the University Hospital Regensburg between October 1, 2019, and December 31, 2022, in this period were eligible for inclusion. Note that part of the conventional ward as well as the A-STAR were closed for Christmas holidays between 23rd December and 1st of January of each year. To mitigate potential selection bias, cases admitted and discharged during this holiday period were deliberately excluded between the 20th of December and the 6th of January annually.

2.2 Trial design

This study follows a monocentric, open-label, controlled design. No formal randomization procedure occurred, but case managers who were not otherwise involved in the study randomly allocated patients to either the A-STAR or conventional wards, depending on bed availability. Due to the high capacity utilization and frequent isolation requirements for patients with multi-resistant germs with the hepatology focus of the department, no consideration could be given to case severity or interprofessional educational value when allocating patients to the wards.

The trial protocol was approved by an independent ethics committee in Germany (Ethics Committee of the University of Regensburg: 20-1805_1–101). The trial was conducted by the latest version of the Declaration of Helsinki, with the Good Clinical Practice guidelines of the International Conference on Harmonization and relevant German laws and directives.

2.3 Treatment

A team of medical professionals and nurses was responsible for care within the conventional wards. Complementing this team, students in their final years and trainees in nursing actively participated in the daily ward operations of the ward. Patients of the A-STAR received care from a team of up to eight medical students in their final years and up to two nursing trainees per shift in their 2nd and 3rd years of training. They were supervised by experienced medical professionals and nurses. Unlike conventional wards, the A-STAR senior physician is present on the ward most of the day and is credited with 1 Full Time Equivalent (FTE). In addition to their work on the conventional wards, the three senior physicians on the conventional wards are also assigned to the outpatient clinic and the intensive care unit. And are credited with 3 FTEs. Selection for the A-STAR team was conducted via letter of motivation and a comprehensive CV by the head of the department and the head of the nursing team. Notably, medical students devoted 8–16 weeks of their last year to the ward, while nursing trainees allocated approximately 4 weeks to the A-STAR.

TABLE 1 Structure.

Characteristic	A-STAR	Conventional wards
Beds		
Mean no. 2019	8	49
Mean no. 2020	10	47
Mean no. 2021	11	46
Mean no. 2022	12	45
Senior physicians		
No.	1	3
Full-time equivalent	1	1,5
Residents (mean no.)	1.5	7.1
Mean no. 2019	1	7
Mean no. 2020	1.9	7.2
Mean no. 2021	1.6	7.3
Mean no. 2022	1	6.8
Medical students		
No.	04-Aug	03-Sep
Nurses		
Mean no.	2.2	12.5
Nursing trainees		
No.	4	02-Jun

The A-STAR bed area is seamlessly integrated within the conventional wards. Medical students and nursing trainees collaborate from a shared base, while doctors and nurses in the conventional wards maintain their distinct bases. Throughout the study period, the A-STAR unit encompassed a range of 8–12 beds, while the conventional wards accommodated between 45 and 49 beds. These wards provide care for patients diagnosed with diverse conditions, including gastroenterological, hepatological, infectious, endocrine, and rheumatological diseases (Table 1).

A structured routine characterized the A-STAR activities, encompassing daily planning sessions, patient visits, educational sessions, and feedback discussions, as illustrated in Figure 1; each day commenced with a unified daily plan after the nursing handover from the night shift and the initial mono-professional tasks performed by nursing trainees. Medical students and nursing trainees conducted the rounds together. On the conventional wards, doctors and nurses aimed to perform the rounds together when possible. Consultations with patients during rounds were primarily conducted by the physicians. Pharmacology students, pharmacists, and nutritionists participated weekly in the A-STAR rounds, evaluating medication for interactions and proper dosages. The conventional wards received advice from colleagues in the pharmacy once a week for selected cases. Weekly teaching visits were facilitated by a medical director or senior medical representative in all wards.

Daily, the A-STAR's medical students and nursing trainees engage in interprofessional educational training sessions, joined by a diverse spectrum of medical care professionals. Furthermore, the A-STAR provides a comprehensive training repertoire, including specialized

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Timeline	Monday	Thuesday	Wednesday	Thursday	Friday
08:00 – 08:30	Come together with Coffee and Tea (Flash day planning)				
08:30 – 10:15	Interprofessional Round with Nursing and Physiotherapy Trainees, Medical Students and their Supervisors	Interprofessional Teaching Round with Nursing and Physiotherapy Trainees, Medical and Pharmacology Students and their Supervisors	Interprofessional Round with Nursing and Physiotherapy Trainees, Medical Students and their Supervisors	Interprofessional Teaching Round with the Attending, Nursing and Physiotherapy Trainees, Medical Students and their Supervisors	Interprofessional Teaching Round with Nursing and Physiotherapy Trainees, Medical Students and their Supervisors and a Nutrionist
12:30 – 13.30		Interprofessional Training			Seminar on Endocrinology
14:00 – 14:30	Interdisciplinary Discussion with Demonstration of Recent Radiological Imaging				
14:30 – 15:00	Research Seminar		Journal Club	Standard Operation Procedures	Feedback Group Talks
15:50 – 16.00	Individual Feedback				
16:00 – 16:30	Case reports	Seminar on Key Symptoms	Monthly Seminar on Common Medications	Monthly Ultrasound Wokshop	
16:30 – 17:00		Interdisciplinary Tumour Board	Interdisciplinary Liver Transplantation Board	Interdisciplinary Tumour Board	

FIGURE 1
A-STAR schedule. A structured routine characterized the A-STAR activities, encompassing daily planning sessions, patient visits, educational sessions, and feedback discussions.

offerings such as resuscitation training, practical skills training using models, and in-depth sonography courses, thus ensuring a well-rounded educational experience for its trainees. This collective includes pharmacists, physiotherapists, nutritionists, clinic chaplains, technicians, psychologists, and more. Once a day, the entire medical department team convenes for an interdisciplinary discussion with an interdisciplinary X-ray presentation. Notably, both medical students and A-STAR nursing trainees actively participate in this forum. The day's activities culminate with feedback discussions and reflections.

2.4 End points and assessments

The German Diagnosis-Related Groups (DRG) system is a reimbursement system used in Germany to classify and reimburse hospitals for patient care based on the diagnosis and treatment provided. The system was introduced in 2004 and covers almost all inpatient cases. Under the DRG system, hospitals are paid a lump sum for each case, which is calculated based on the average resource use of selected hospitals. Each DRG is associated with a specific weight that represents the expected resource consumption and cost for treating patients in that group. The case-mix-index (CMI) is a numerical value that reflects the overall mix of patients treated by a hospital during a specific time period, such as a year. It is calculated by summing the individual weights of all patients treated in the hospital and dividing by the total number of patients.

The primary endpoint assessed profit per case, while the secondary endpoints encompassed DRG revenues per case, personnel costs per case, material costs per case, number of cases per bed, bed occupancy rates, and the average length of stay.

Our analysis was conducted on a per-case not per-bed basis to avoid bias by the following facts: 1. Private patients often used double rooms individual instead of shared occupancy. 2. During the COVID-19 pandemic, an area within the wards was temporarily reserved for COVID-19 patients. 3. Due to a shortage of nursing staff, some beds in the A-STAR and conventional wards were temporarily blocked.

Data were drawn from the hospital patient register regarding gender, age, Barthel Index, DRG revenues, number of cases, bed occupancy, and average length of stay. Surcharges, discounts, and revenues for elective medical services were not included in our analysis. The length of stay was calculated for the complete period with a stay in the department's intensive care unit, if necessary. Medical personnel costs were collected from the current collective agreement. Nursing personnel was not included in the analysis due to the shared nursing pool utilized by both A-STAR and conventional wards. Material costs were requested from the Accounting and Controlling department. Since the material costs of the A-STAR were recorded in total, not per case basis, within the account of one of the

conventional wards, these costs were allocated based on the number of beds.

2.5 Statistical analysis

Qualitative variables were compared between the A-STAR and the conventional wards by using the chi-square or Fisher's exact test, as quantitative variables were compared between the A-STAR and the conventional wards by using the Mann–Whitney U test. The Mann–Whitney U test was chosen over the independent t-test due to the non-normal distribution of the data, which was assessed using the Shapiro–Wilk test. All the tests were two-sided, and a p value of less than 0.05 was considered to indicate statistical significance. Data analysis was performed with IBM Corp. Released in 2021. IBM SPSS Statistics for Windows, version 28.0. Armonk, NY: IBM Corp.

3 Original results

3.1 The interprofessional training ward A-STAR: treating more men and younger patients

From October 2019 through December 2022, a total of 7,244 patient cases at the Department of Internal Medicine I, Gastroenterology, Hepatology, Endocrinology, Rheumatology, and Infectious Diseases, at the University Hospital Regensburg were randomly allocated to either the A-STAR or conventional wards by case managers. The demographic characteristics of the patient cases slightly differed in the two treatment groups (Table 2), except for the Barthel Index ($U = 4191840.000$; $Z = 1.678$, $p = 0.093$). Males were significantly more common in the A-STAR group than in the conventional wards [73.5% vs. 70.4%; $\chi^2(1) = 5.124$; $p = 0.025$]. Patients were significantly younger at the A-STAR (59 yr. vs. 61 yr.; $U = 4577905.000$; $Z = 3.987$; $p < 0.001$).

TABLE 2 Characteristics (2019–2022).

Characteristic	A-STAR (n = 1,482)	Conventional wards (n = 5,752)
Age		
Median (range)—yr	59 (18–101)	61 (16–98)
Sex		
Male—no. (%)	1,089 (73.5)	4,052 (70.4)
Female—no. (%)	393 (26.5)	1700 (29.5)
Barthel Index		
Median (range)—yr	100 (0–100)	100 (0–100)
Mean number of beds/year	11	46
Mean number of cases/year	300	1738
Mean number of cases/bed/year	27.4	37.8
Mean case mix index/year	2.4	2.2
Mean total DRG revenues	€2,115,448.05	€11,446,987.38
Mean DRG revenues/case	€9,372.83	€8,006.29

3.2 The interprofessional training ward A-STAR: superior to conventional wards in annual DRG income and resource-efficient material cost management

On average, A-STAR generated significantly higher revenues €9,372.83 per case [95% confidence interval (CI), €8,354.61–€10,391.04], as compared with the conventional wards ($U = 3726527.00$; $Z = -7.205$; $p < 0.001$) with €8,006.29 per case (95% CI, €7,526.87–€8,485.70) during the years 2019 until 2022 (Figures 2A, 3A).

The personnel costs per case of the A-STAR were initially higher than the conventional wards but were reduced over time by increasing the number of beds in the A-STAR (2019: 8 beds; 2022: 12 beds) (Figure 2B). Despite the increase in salaries according to collective agreements, the personnel costs for the A-STAR senior physician per case could be reduced due to the increase in the number of beds on the A-STAR from 322.12€ (2019) to 217.84€ (2022) and the personnel costs for the A-STAR residents per case from 208.62€ (2019) to 141.08€ (2022).

The total material costs per case of the A-STAR were initially higher than the conventional wards (2019: €2278.00 vs. €2100.97) but already fell below the costs of conventional wards from 2020 (2020: €2196.47 vs. €2384.12; 2021: €727.66€ vs.914.64; 2021: €845.95 vs. €908.74). The abrupt drop in material costs across all stations between 2020 and 2021 is attributed to the gradual discontinuation of internal activity allocation. Internal activity allocation is a cost center accounting allocation method that allocates costs for internal activities to the department that incurred them, e.g., laboratory and radiological diagnostics. On annual average, the total material costs on the A-STAR per case were €1512.02 and on the conventional wards €1577.12. The team can mainly influence medical (Figure 2C) internal activity allocation (IAA) costs. The mean total medical costs (A-STAR: €739.93 vs. CW: €815.20) per case in particular for medicines (A-STAR: €393.61 vs. CW: €475.63) but also medical and nursing consumables (A-STAR: €60.30 vs. CW: €67.91) lay beyond the costs of the conventional wards (Figure 3B). A-STAR spent more than conventional wards on pathology (A-STAR: €73.69 vs. CW: €58.43) and consultation of physicians with other specializations (€17.43 vs. €13.12) per case. IAA showed no relevant differences per case between A-STAR and conventional wards (€803.27 vs. €801.97).

3.3 The interprofessional training ward A-STAR: generating higher DRG revenues for complex cases

The higher DRG revenues of A-STAR were generated through the treatment of more complex cases than the conventional wards (Figures 3A,B). In the German Diagnosis Related Group (DRG) system, the higher revenue is the more economically severe the illness of the patient case. The economic severity of illness is represented by the relative weight multiplied by the base rate to obtain the DRG revenue. The Institute for Hospital Remuneration (InEK) sets the prime rate. The case-mix index (CMI) is a direct indicator of case severity. It is calculated by dividing the additive total of all relative

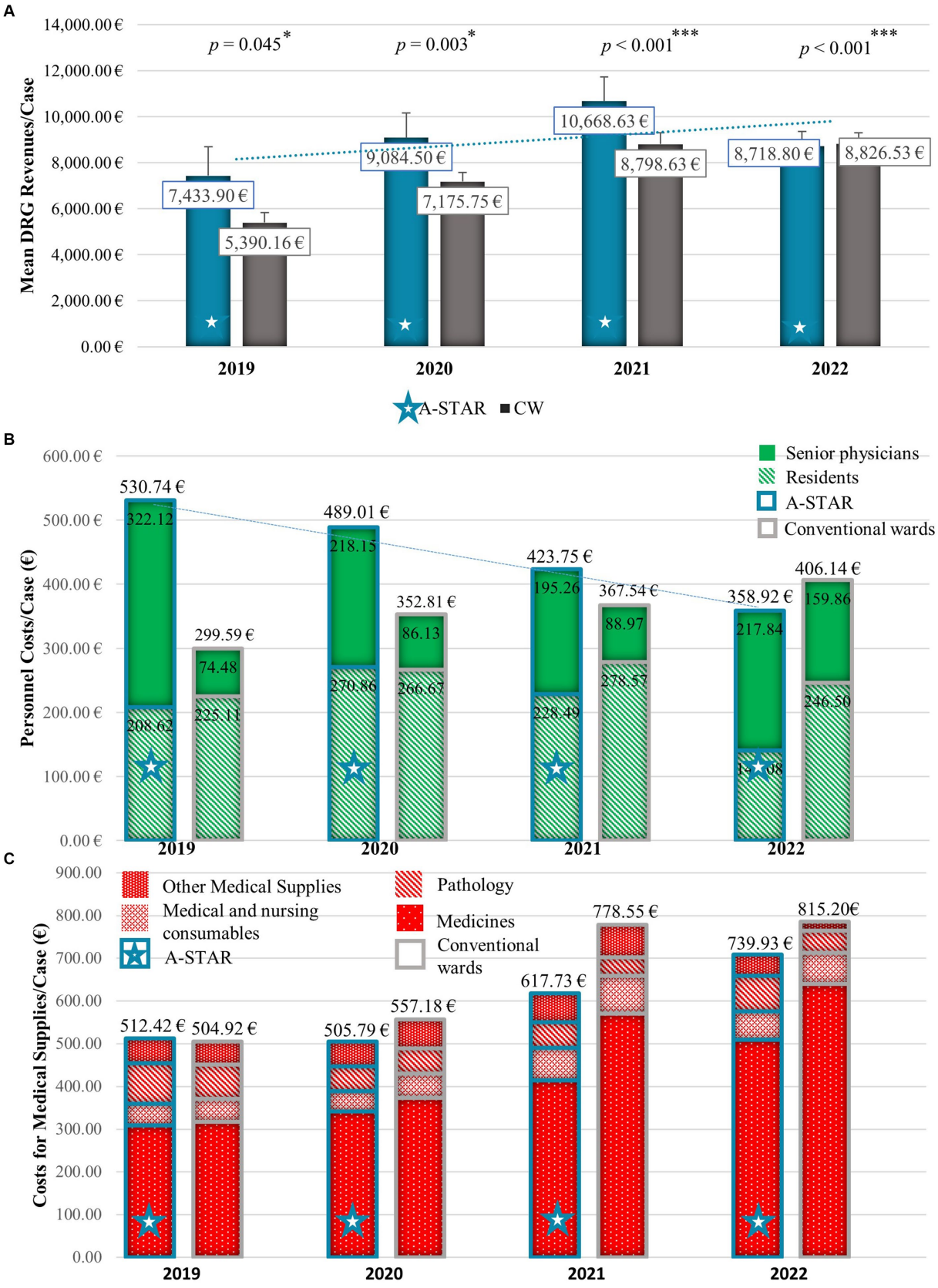

FIGURE 2
The interprofessional training ward A-STAR (blue star) performs superior over conventional wards concerning mean annual Diagnosis Related Groups (DRG) revenues per case and material costs per case and slightly higher personnel costs per case. **(A)** Mean annual DRG revenues/case with standard error of the mean of the A-STAR compared to conventional wards. On average, A-STAR (blue star) generated significantly higher revenues per case

(Continued)

FIGURE 2 (Continued)
compared to conventional wards (grey). 2019: €7,433.90 (n = 78) vs. €5,390.16 (n = 506); U = 16955.500; Z = −2.003; p = 0.045; 2020: €9,084.50 (n = 463) vs. €7,175.75 (n = 1759); U = 370964.000; Z = −2.951; p = 0.003;2021: €10,668.63 (n = 462) vs. €8,798.63 (n = 1737); U = 347221.500; Z = −4.454; p < 0.001;2022: €8,718.80 (n = 480) vs. €8,826.53 (n = 1717); U = 365450.000; Z = −3.795; p < 0.001. *p < 0.05% (significant), **p < 0.01% (very significant), ***p < 0.001% (highly significant). **(B)** Mean annual personnel costs per case for senior physicians (uniformly) and residents (hatched) of the interprofessional training ward (A-STAR) compared to conventional wards. The higher personnel costs per case of the interprofessional training station A-STAR (blue star) between 2019 and 2021 in comparison to conventional units were mitigated by a gradual increase in the number of beds allocated to A-STAR. **(C)** Mean annual materials costs per case (medicines, medical and nursing consumables, pathology, other medical supplies) of the interprofessional training ward (A-STAR) compared to conventional wards. With inflation, the material costs of the units increased between 2019 and 2022. After initially having slightly higher material costs in the case of A-STAR compared to conventional units, these costs, particularly medical expenses, were lower from 2020 to 2022.

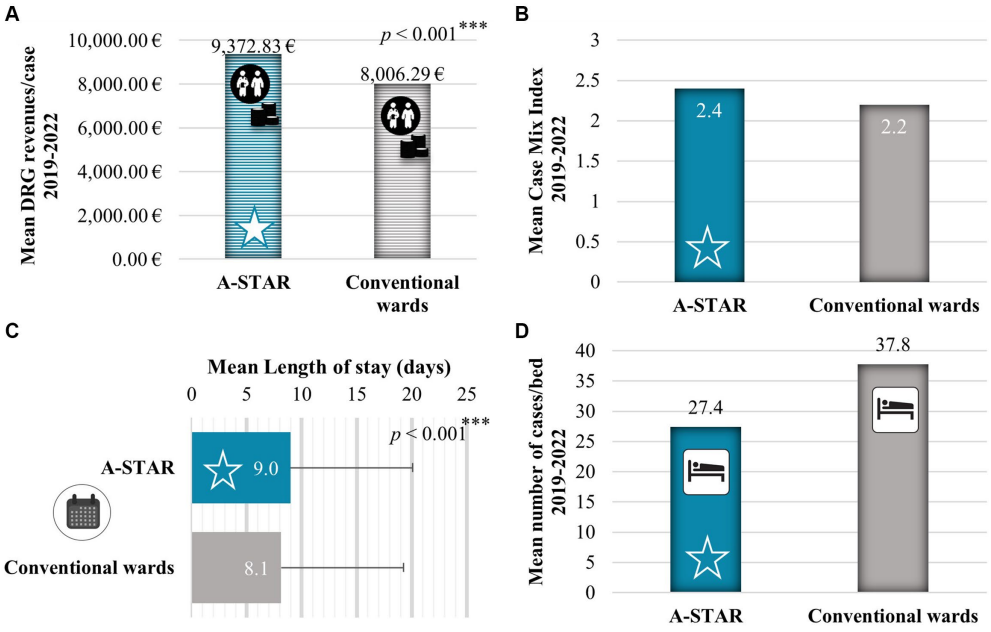

FIGURE 3
The interprofessional training ward A-STAR generated higher Diagnosis Related Groups (DRG) revenues through the treatment of patients with higher case complexity. **(A)** Between 2019 and 2022, A-STAR generated significantly higher revenues €9,372.83 per case on average (95% confidence interval [CI], €8,354.61 to €10,391.04.), as compared with the conventional wards with €8,006.29 per case (95% CI, €7,526.87 to €8,485.70); U = 3726527.000; Z = −7.205; p < 0.001. **(B)** In the period between 2019 and 2020, A-STAR (blue star) managed patients with greater case complexity and resource utilization, resulting in a higher Case-Mix Index (2.4 compared to 2.2) when compared to the conventional units (gray). **(C)** Mean length of stay in days of the interprofessional training ward A-STAR was very significantly longer compared to the conventional wards (9.0 vs. 8.1 days); U = 3925481.500; Z = −5.103; p < 0.001. **(D)** Between 2019 and 2022, A-STAR (blue star) handled fewer patient cases per bed compared to the conventional units (27.4 vs. 37.8). *p < 0.05% (significant), **p < 0.01% (very significant), ***p < 0.001% (highly significant).

weights by the additive total of treatment cases. The average CMI is higher in A-STAR (2.4) than in conventional wards (2.1) (Figure 3B). The increased case complexity results in longer lengths of stay (Figure 3C) and subsequently lower case numbers in a year at A-STAR (Figure 3D). The mean length of stay was longer at A-STAR compared to conventional wards (9.0 ± 11.1 vs. 8.1 ± 11.6 days, U = 3925481.500; Z = −5.103; p < 0.001). Per bed, A-STAR (27.4 cases/year) treats fewer patients than conventional wards (37.8 cases/year).

3.4 The interprofessional training ward A-STAR: balancing slightly higher personnel costs with increased DRG revenues and efficient material expenses

Between 2019 and 2022, A-STAR realized an average profit increase of €1,508.74 per case compared to traditional units (Figure 4). This boost in profit can be attributed to A-STAR's higher Diagnosis Related Group (DRG) revenues per case (€1,366.54 higher than DRG revenues in conventional wards) and lower material costs per case (€236.23 less than material costs in conventional wards), along with only slightly higher personnel costs per case (€94.03 more than personnel costs in conventional wards).

3.5 The interprofessional training ward A-STAR: surpassing the bed occupancy of conventional wards for patients requiring isolation

At 87.1%, the capacity utilization rate of A-STAR was higher than that of conventional wards (83.9%) (Figure 5A). The A-STAR consists of double-occupancy rooms, the conventional wards have, in addition to four single rooms, exclusively double-occupancy rooms as well.

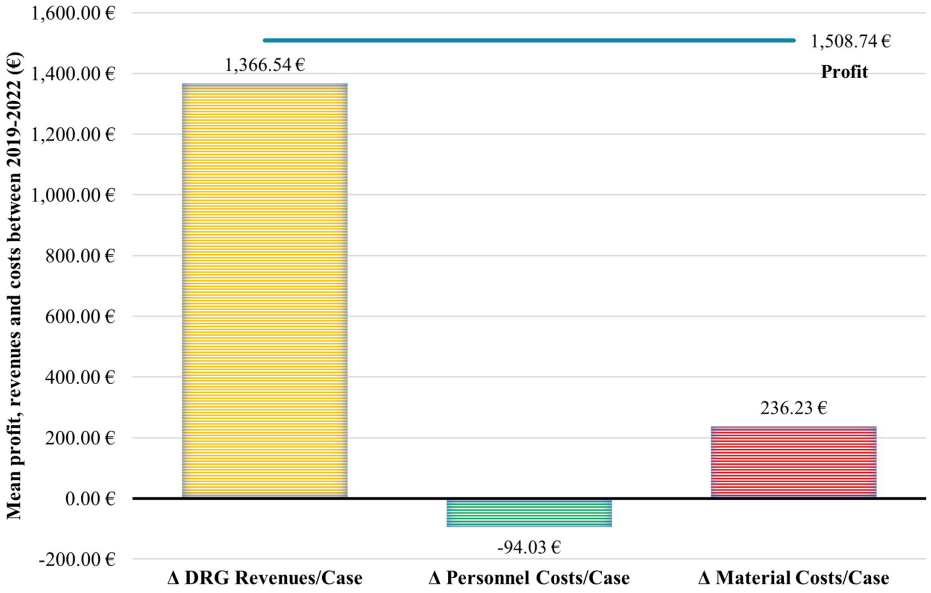

FIGURE 4
The slightly higher personnel costs of A-STAR are offset by the higher DRG revenues per case and the more resource-efficient material expenses. Between 2019 and 2022, A-STAR achieved on average €1,508.74 profit more per case compared to conventional units. This gain can be attributed to A-STAR having higher Diagnosis Related Group (DRG) revenues per case (€1366.54 difference to DRG of conventional wards) and lower material costs per case (€236.23 difference to material costs of conventional wards) and only slightly higher personnel costs per case (€94.03 difference to the personnel costs of conventional wards).

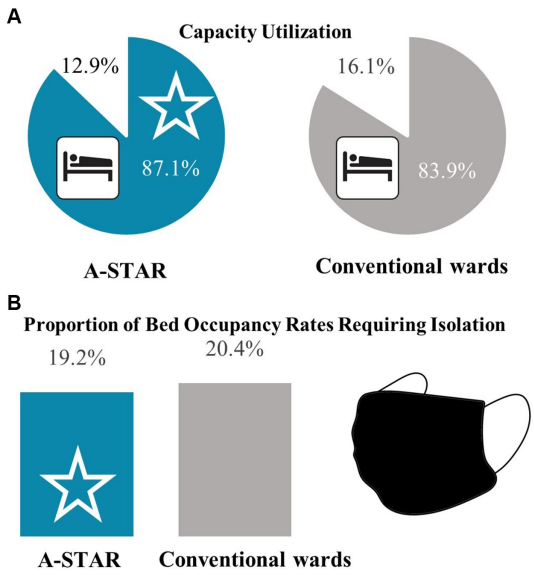

FIGURE 5
The bed occupancy rate of the interprofessional training ward A-STAR surpassed that of the conventional wards with a comparable proportion of patients requiring isolation. **(A)** Between 2019 and 2022, A-STAR (blue star) demonstrated a higher capacity utilization compared to the conventional units (87.1% vs. 83.9%). **(B)** The proportion of bed occupancy days requiring isolation was comparable between the interprofessional training ward A-STAR and conventional wards (CW); $\chi^2(1) = 0.985$; $p = 0.321$.

When patients cannot be cohort-isolated due to mandatory isolation of specific pathogens, it results in unoccupied beds. A-STAR showed a similar proportion of bed days with patients requiring isolation [19.2% vs. 20.4%; $\chi^2(1) = 0.985$; $p = 0.321$], who may lead to bed vacancies if they cannot be cohort-isolated in the double bedrooms (Figure 5B).

3.6 The interprofessional training ward A-STAR: demonstrating superiority in recruiting medical and nursing trainees for deployment

The earliest possible hiring start date after deployment on the A-STAR was January 1, 2020. Since then, notably, more new residents (9 vs. 3) and nurses (9 vs. 0) were recruited from the pool of medical students and nursing trainees who had worked in the A-STAR than the pool of medical students and nursing trainees from the conventional wards (Figure 6).

4 Discussion

Interprofessional training wards offer an exclusive opportunity for healthcare professionals to enhance their skills, collaborate, and learn in a real clinical setting. The scarcity of cost-efficiency data regarding these training wards hinders their adoption. We embarked on an investigation to explore the hypothesis that an interprofessional training ward, integrated within a university's internal medicine department, operates with comparable cost efficiency to conventional wards. The data presented in this comprehensive analysis shed light

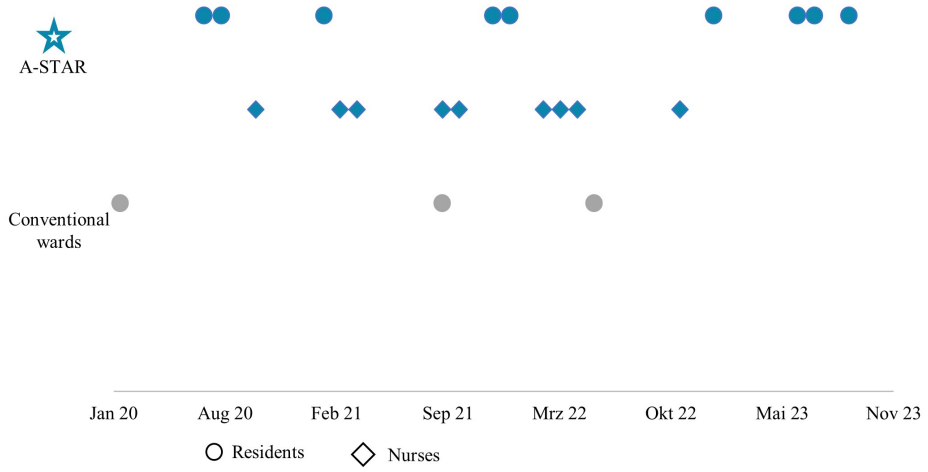

FIGURE 6
The interprofessional training ward A-STAR clearly excels in terms of recruiting medical (dot) and nursing (diamond) staff from the pool of trainees, who had been deployed on A-STAR and conventional wards. Between January 2020 and November 2023, a total of 9 doctors and 9 nurses who had been deployed at the A-STAR in advance started their first jobs in the Department for Internal I at the university hospital. In contrast, only 3 doctors from their trainee pool of the conventional wards were hired during this period.

on the outstanding performance of the interprofessional training ward, A-STAR, in several key aspects of healthcare management. This discussion delves into the various findings, highlighting their implications and significance in the context of healthcare delivery and resource management.

One of the standout achievements of A-STAR is its superior financial performance per case. Over the years from 2019 to 2022, A-STAR consistently generated substantially higher annual DRG revenues per case, outperforming conventional wards by €1,366.54 on average. A-STAR was able to generate higher DRG revenues by treating cases with greater complexity. The higher case complexity of the patients treated at A-STAR justifies the longer length of stay, which also resulted in a lower number of cases treated. The data indicates that A-STAR had a higher case-mix index (CMI), reflecting the complexity of the cases they handled. As a result, patients at A-STAR required a longer length of stay on average, which is a reasonable outcome given the need for more extensive care. In retrospective cohort studies conducted by Hansen et al. (30) and Kuner et al. (31), surgical and orthopaedic training wards exhibited shorter postoperative stays than conventional wards but showed no significant difference in baseline characteristics and probably case severity between their interprofessional training wards and their conventional wards. While randomization was not formally executed, one might have anticipated that the medical team would assign less complex cases to learners within A-STAR. This was probably unfeasible due to high occupancy. The higher CMI suggests that the medical performance of the A-STAR team allowed for severe cases to be assigned to the ward. A previous study about the A-STAR revealed that patient outcomes in the A-STAR ward were comparable to those in conventional wards, with similar rates of discharges against medical advice, complication-driven readmissions, ICU transfers, and mortality (32). Additionally, the high levels of patient satisfaction, particularly regarding team competence, ward atmosphere, and responsiveness to concerns, highlight the positive impact of interprofessional collaboration and education on patient care. These findings suggest that the structured interprofessional environment of A-STAR contributes significantly to its medical performance.

A-STAR also managed to reduce material costs per case over time. Certainly, particularly noteworthy is the significant reduction in medication expenses at the A-STAR. This could potentially be attributed to the regular oversight provided by pharmacy colleagues. Preliminary research indicates that collaborative efforts among pharmacists, nurses, and physicians can effectively curtail antibiotic expenses (33). The additional cost of A-STAR for pathology and consultation with physicians in other specialties aligns with the team's level of training. Collectively, these costs form a minor fraction of the overall material expenses and are justifiable considering the valuable learning outcomes they yield. Consistently, Hansen et al. found lower overall costs for treatment with a hip replacement in their interprofessional training ward than in their conventional wards (30) but did not explicitly break these down into material costs.

Despite the higher case complexity, A-STAR was not compromised by an increase in isolations and, in fact, demonstrated a higher bed occupancy rate compared to conventional wards. This observation is significant because treating more complex cases often involves a higher likelihood of isolation requirements, which can potentially lead to unoccupied beds due to infection control measures. However, the data suggests that A-STAR effectively managed patient isolations and maintained a higher bed occupancy rate, which is indicative of efficient resource utilization.

This increase in revenue per case over conventional wards contributed to a substantial boost in profit despite higher personnel costs per average. The A-STAR program incurred elevated personnel

costs per case, primarily due to the enhanced oversight offered by the senior physician dedicated to A-STAR, in contrast to their counterparts in the conventional wards. Similarly, Hansen et al. found increased staffing expenses in their orthopedic interprofessional training facility compared to conventional wards (30). It is imperative to underscore that patient safety remains paramount in training. As such, any compromise on the presence of senior physicians in the pursuit of cost reduction is unequivocally unacceptable. The assurance of patient well-being stands as a non-negotiable principle in this context. The personnel costs decreased as the number of beds in A-STAR increased. This suggests that scaling up the ward can be a viable strategy to optimize personnel costs.

An additional positive outcome observed during the study was the successful recruitment of medical staff, attributed to the engagement of trainees and students, although this was not the primary objective of the study. A-STAR demonstrated superior recruitment of medical and nursing trainees, a critical component of medical education and workforce development. According to the World Health Organization's State of the World's Nursing 2020 report, a significant global shortage of approximately 6 million nurses is by anticipated by 2030 (34). This shortage has already led to unoccupied hospital beds, and there is a growing scarcity of doctors. The trend of physicians choosing part-time schedules due to increasingly compressed work hours exacerbates this challenge, necessitating a larger workforce. In light of these challenges, the organization's remarkable success in personnel acquisition is encouraging. This achievement is likely influenced by a simultaneous sense of profound satisfaction stemming from both educational pursuits and professional endeavors. To gain a more comprehensive understanding of this phenomenon, it is essential that this relationship is subjected to further investigation in subsequent research endeavors.

The significant financial advantage of A-STAR and its success in recruiting healthcare workers is not only noteworthy but also plays a vital role in the sustainability of interprofessional training wards. The ability to achieve higher revenues while providing quality care reflects positively on the effectiveness of interprofessional training wards despite their educational mission. The study period coincided with the impact of the Covid-19 pandemic, officially declared on March 1, 2020. The pandemic-related restrictions persisted in Germany until April 7, 2023. Medical education largely shifted to digital platforms (24, 35–39), with negative impacts on students' psychological well-being (40–42). However, training of medical students and nursing trainees in the A-STAR remained uninterrupted during the pandemic without compromising revenue. In fact, the department's Diagnosis-Related Group (DRG) revenue increased during this challenging period. This underscores the resilience and economic viability of interprofessional training wards, even when facing exceptional circumstances.

Spanning more than 3 years and scrutinizing 7,234 patient cases, this study presents a comprehensive perspective on the cost-effectiveness of a training ward vis-à-vis conventional wards. A notable advantage of this research lies in including a control group comprising conventional wards. The study ensures real-world data analysis from a diverse internal medicine patient cohort, steering clear of artificial constraints associated with a single-case focus.

Nonetheless, certain limitations warrant consideration. Notably, the study's scope could be more expansive in its ability to delve into qualitative outcome parameters of internal medicine interventions. Additionally, it is essential to acknowledge that material costs were not individually tracked per case but instead were derived in total, not per case basis, within the account of one of the conventional wards and allocated based on the number of beds. Another limitation of this study is that it did not account for the costs associated with the organization and coordination of the interprofessional training ward. However, as it stands, this remains the sole instance of a comprehensive breakdown of revenue and expenditures for an interprofessional training station when contrasted with conventional wards.

Our findings suggest that in addition to their recognized advantages, interprofessional training wards offer cost-effectiveness. This discovery may serve as a compelling rationale for the wider implementation of such educational facilities. Establishing interprofessional training wards on a wide scale is advisable as breeding grounds for upcoming professionals. Future research should examine quantitative outcome parameters of heterogeneous patient cohorts from interprofessional training wards and the achievement of learning objectives by the trainees.

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 humans were approved by the Universität Regensburg Ethikkommission 93040 Regensburg. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required from the participants or the participants' legal guardians/next of kin in accordance with the national legislation and institutional requirements.

Author contributions

SS-H: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. EA: Data curation, Investigation, Writing – review & editing. MM: Data curation, Investigation, Writing – review & editing. SA-F: Writing – review & editing. AMa: Investigation, Writing – review & editing. KR: Writing – review & editing. SR: Writing – review & editing. BM: Writing – review & editing. AMe: Writing – review & editing. CK: Writing – review & editing. SS: Writing – review & editing. MM: Conceptualization, Funding acquisition, Project administration, Resources, Supervision, Validation, Writing – review & editing.

Funding

The author(s) declare that no financial support was received for the research, authorship, and/or publication of this article.

Acknowledgments

We extend our sincere gratitude to the dedicated interprofessional team of the A-STAR and conventional units, whose unwavering commitment and collaborative efforts were instrumental in the success of this study. We also express our heartfelt appreciation to the patients of the interprofessional training ward for their invaluable participation and contributions, without which this research would not have been possible.

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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frontiers | Frontiers in Medicine

TYPE Hypothesis and Theory
PUBLISHED 02 October 2024
DOI 10.3389/fmed.2024.1467362

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OPEN ACCESS

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RECEIVED 19 July 2024
ACCEPTED 28 August 2024
PUBLISHED 02 October 2024

CITATION
Reinders JJ, Başer Kolcu Mİ and Kolcu G (2024) Developing an interprofessional identity complementary to a professional identity - findings related to Extended Professional Identity Theory (EPIT). *Front. Med.* 11:1467362. doi: 10.3389/fmed.2024.1467362

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Developing an interprofessional identity complementary to a professional identity - findings related to Extended Professional Identity Theory (EPIT)

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Collaboration among various professions often faces barriers owing to divergent perspectives, priorities, and expertise shaped by distinct socialization processes. These differences can hinder effectiveness, efficiency, and workforce well-being. The Extended Professional Identity Theory (EPIT) addresses this issue by fostering an interprofessional identity without weakening professional identities. Drawing from psychological theories, EPIT explains the coexistence of interprofessional and professional identities, and predicts associated behaviors. It also emphasizes the importance of combining interprofessional identity formation with developing interprofessional competencies and adapting to environmental factors to achieve synergy in (temporary or permanent) mixed profession groups. Introduced in 2018, EPIT research initially relied on the measurement of congruent interprofessional behaviors as indirect indicators of interprofessional identity that could not yet be measured. An experiment demonstrated that enhancing social identification in mixed profession groups with interprofessional assignments reduced the social hierarchy within 6 h across three meetings. The 2020 development of the Extended Professional Identity Scale (EPIS) confirmed interprofessional identity as a three-dimensional social construct. So far, several scientific studies have supported many propositions of EPIT. These propositions are related to dimensionality and various psychometric properties, cross-cultural similarities, evidence and clues for interprofessional identity formation, and its predictive validity in interprofessional education and collaborative practice. Türkiye is among several countries (e.g., the Netherlands, Belgium, Germany, Lithuania, Finland, and Indonesia) where EPIT-based interprofessional identity is being investigated. To illustrate contextual differences and their potential cross-cultural implications, it is valuable to explore how interprofessional identity adds value in the Turkish context. This approach facilitates understanding the regional implications of interprofessional identity, including interprofessional education initiatives, increased university engagement, the development of measurement instruments, challenges and future directions, and national and international collaborations. This paper aims to explain and clarify EPIT propositions compared to other theories, describe

current evidence, and outline future research directions, with a focus on developments within the Turkish context as a showcase.

KEYWORDS

interprofessional identity, EPIT, EPIs, IPE, IPECP, theory, interprofessional collaboration, motivation

Introduction

Collaboration among members of various professions often encounters barriers due to differing perspectives, priorities, and expertise shaped by distinct socialization processes within their respective fields. However, interprofessional collaboration can overcome these challenges, leading to greater effectiveness (1, 2), increased efficiency (3, 4), and enhanced job satisfaction (5, 6).

Nurses and physicians, for instance, often have differing views on team communication (7), which can result in mutual criticism for perceived communication failures. Misunderstandings of roles and a lack of clear team leadership can negatively impact overall team performance. Similar role confusion exists among other professions, such as dentists and dental hygienists (8), occupational therapists, physical therapists, and physician assistants (9), as well as psychologists, exercise physiologists, and dietitians (10). Members of mixed profession groups may be reluctant to compromise their professional priorities or adapt solutions that significantly accommodate other professions, fearing it might diminish their professional distinctiveness (11). Moreover, a lack of shared expertise among various professions can hinder a more holistic approach to patient care (12).

The differing professional perspectives, priorities, and lack of shared expertise stem from separate socialization processes (13). Training within professional "social silos" leads to different frames of reference and social commitments (14). Yet, developing a profession-specific professional identity is essential as it is a source of motivation and, when the professional role is clear, guides behaviors and enhances performance (15). Distinct professional identities are also crucial for effective interprofessional collaboration (16). The diversity within mixed profession groups can be better utilized when members share a common team identity (17). However, this team identity is often linked to a specific team, and drastic changes in team composition can compromise shared identity and reduce group cohesion (18). In addition, such a shared identity would not have a transferable commitment to other teams, making this an inflexible social identity. This underscores the need for individuals to develop a shared identity related to interprofessional collaboration independent of a specific team identity.

Currently, three comprehensive theoretical frameworks have been developed to explain what interprofessional identity is and how it is formed. This paper describes one specific interprofessional identity theory: the Extended Professional Identity Theory (EPIT). EPIT is developed from a work and organizational psychological perspective and initially proposed for the Dutch oral healthcare (19). The purpose of this paper is to explain and clarify the propositions of EPIT in comparison with other theoretical approaches, describe current evidence, and outline future research directions, with a focus on development within the Turkish context as a showcase.

Formation and activation of social identity: implications for interprofessional collaboration

Identity, according to a psychological perspective, refers to one's sense of self shaped by individual personality, experiences and social interactions (20). This "self" is also known as "personal identity" which is distinct from a "social identity" (21–23). Social identity is linked to an individual's psychological association with a group or a social category. Tajfel (24) defines social identity as "part of an individual's self-concept which derives from his [or her] knowledge of his [or her] membership of a social group (or groups) together with the value and emotional significance attached to that membership." This definition was tested by Cameron which resulted in the Three-Factor Model of Social Identity (25). This model was also validated by Obst and White (26). Psychological research on social identity has revealed different implications at intrapersonal and interpersonal levels.

Identity theory explains the intrapersonal level of social identity. This identity theory is one of two separate but complementary fields of psychological study regarding social identity (27). The second field of study concerns the social identity theory. Identity theory explains how individuals cope with their multiple social identities (28) while social identity theory explains intergroup processes in which a distinction is made between ingroup and outgroup members (29). The risk of competition or conflict between different professional groups is enhanced by their separate socialization processes. Misunderstanding, social hierarchy, and stereotyping result from divergent perspectives, priorities, and lack of clarity about roles and expertise (7–9, 11, 27).

Isolated group socialization results in the formation of unique social identities. Inherent in social identity formation is the individual internalization of role clarity as associated with the group concept and commitment to the group or social category. When individuals become members or anticipate future membership (anticipatory socialization) of a certain profession, each profession will have its own group composition of members, frame of reference, jargon, and competencies. Each individual (future) professional learns to interpret his or her professional environment. The subjective interpretation of this environment represents the "context" that is unique to the individual (future) professional. This means that an environment contains contextual cues that we have learned to recognize as important to one of our particular social identities of which each individual has many (28). Such contextual cues function as "identity

triggers," which activate the related social identity. In turn, this activation will lead to the display of congruent behaviors (27, 30). Therefore, the formation of a social identity, such as a professional identity, is essential and simultaneously a challenge when activated among individuals with different profession-specific professional identities (Figure 1). Thus, a professional identity fosters professional behaviors but does not necessarily promote interprofessional behaviors.

Extended Professional Identity Theory and other interprofessional identity theories

Four significant differences between interprofessional identity theories, comparing EPIT (19) with other theories (31, 32), are dimensionality, the role of attitudes, theory integration, and behavior prediction (Figure 2). Since each theory is (partially) based on different theoretical propositions, this affects the measurement of interprofessional identity. Given that these measurement instruments and their theoretical foundations differ, they cannot be used interchangeably, except for one or two similar subscales.

First, EPIT (19) and Tong's theoretical approach (32) conceptualize interprofessional identity as a three-dimensional construct, while Khalili's dual identity (31) consists of four dimensions (29). Tong's (32) identity dimensions are derived from the work of Cameron (25), whereas EPIT's (19) dimensions are based on psychological studies on affective commitment and other social identity factors but also aligns with the work of Cameron (25, 33–35). Tong's theoretical approach applies Cameron's work to measure interprofessional identity using her Interprofessional Three-Factor Model of Social Identity Scale (36). One of its three subscales, cognitive centrality, assesses how much individuals consider their membership in a mixed professional group or social category. This subscale measures the amount of time spent thinking about being a group member (25). These thoughts might involve interprofessional concepts, but could also include multiprofessional ideas, as this distinction is not explicitly defined. The Extended Professional Identity Scale (EPIS) (37) is based on EPIT (19) and is also three-dimensional but measures specific interprofessional beliefs (Table 1). It includes items such as "I like meeting and getting to know people from other health professions" (interprofessional belonging), "I would be very happy to spend the rest of my career with an interprofessional team" (interprofessional commitment), and "Joint clinical decision-making should be an important part of interprofessional collaboration" (interprofessional beliefs).

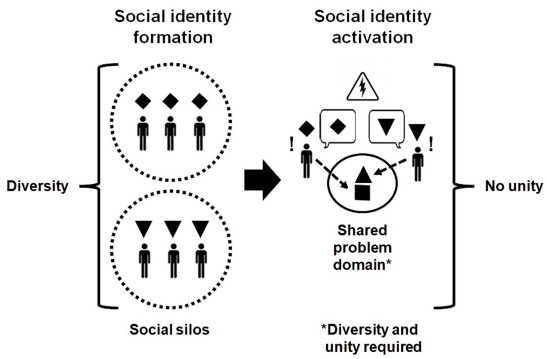

FIGURE 1
Isolated social identity formation versus activation in a mixed profession group.

Second, the roles of attitudes differ. Khalili (31) measures attitudes as an identity dimension, whereas EPIT (19) views attitudes as crucial antecedents to interprofessional identity formation (36), Attitudes, defined as positive or negative evaluations of objects, people, or events (37, 38), influence (affective) commitment and, thus, have motivational effects on the importance of a group to an individual (39).

Third, the integration of theories varies between interprofessional identity theories. Khalili's dual identity (31) combines interprofessional belonging and professional belonging as identity dimensions of the same construct, while EPIT (19) and Tong (32) treat these two dimensions as dimensions of separate social identities, professional identity and interprofessional identity. EPIT (19), drawing from Turner's Social Categorization Theory (40), posits that interprofessional identity is superordinate to professional identity. This framework acknowledges multiple social identities and the broader social categories individuals belong to (28). Unlike the dual identity approach (31), EPIT (19) states that attitude is an antecedent rather than an identity dimension, aligning with Allport's Intergroup Contact Theory (41) which emphasizes the social process of reducing prejudice through active collaborative intergroup interactions creating positive attitudes towards members of different groups. Furthermore, EPIT (19) is the only theory that explicitly integrates identity theory and social identity theory as two separate but complementary psychological theories about social identity. This is in line with the work of Stets and Burke (27), who described how each individual has many social identities (identity theory) that can sometimes conflict with the social identities of other individuals (social identity theory). As a social identity is a source of motivation, each social identity serves an important purpose for groups and group memberships. When two social identities of one individual are simultaneously activated by their identity triggers, individuals do not have to choose between these identities if they are complementary. Identity mobility between professional identity and interprofessional identity can be triggered based on relevance of the perceived necessity of congruent actions in a certain context (42–44). This is also the reason why "extended" has been added to the name of the Extended Professional Identity Theory. This refers to extending the professional identity of an individual with an additional social identity. Other words for "extended" is "broadened" or "widened" which is in line with superordinate social identities as identification with "widening circles of group membership" (40). According to EPIT (19), interprofessional identity can be developed without altering professional identity, because both are separate and distinct social constructs. This assumption was tested by Bostedt et al. (45). If professional identity and interprofessional identity are distinct social identities, interprofessional socialization could be enhanced without changing professional identification. After interprofessional training, interprofessional socialization increased significantly with strong effect sizes while professional identity, measured with the Macleod Clark professional identity scale, indeed remained unchanged. This professional identity scale is not three-dimensional but does contain items related to professional belonging and professional commitment (46).

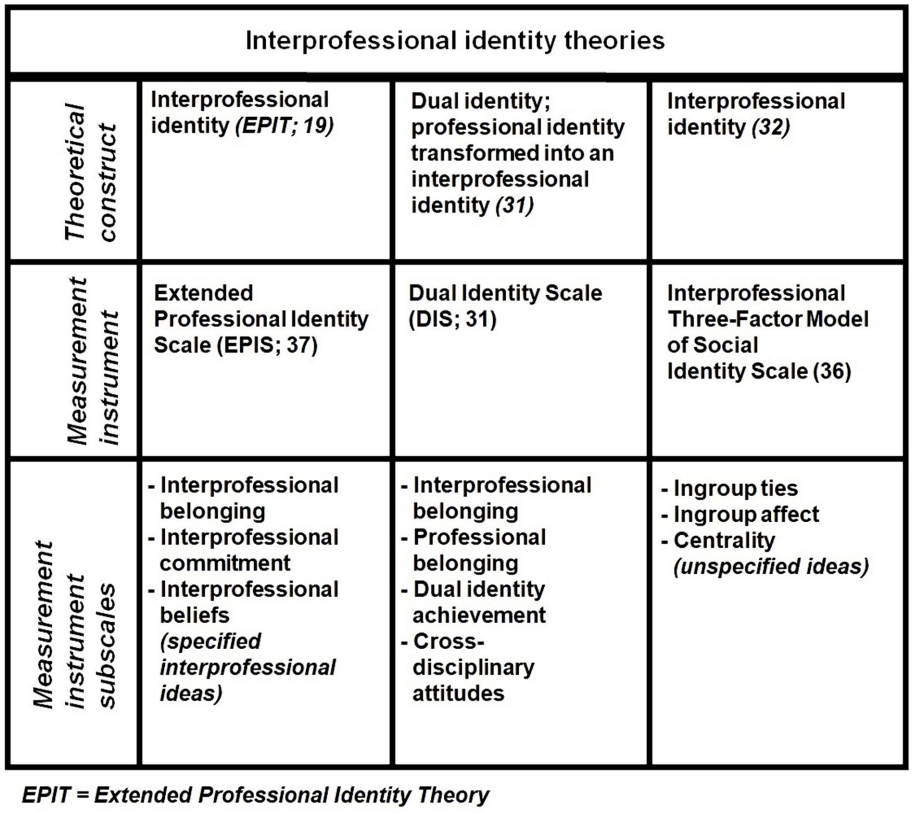

FIGURE 2
Comparison of interprofessional identity theories and their measurement instruments.

Fourth, behavior prediction differs among these theories. Effective measurement instruments should be able to predict relevant behaviors. The Interprofessional Three-Factor Model of Social Identity Scale (36) and EPIS (47) differ in that the former measures centrality, which reflects the amount of time spent thinking about group membership without necessarily involving normative interprofessional thoughts. Centrality is sufficient for demonstrating whether various social identities share the same dimensions, regardless of group composition and purpose. However, it does not clarify behavioral orientation. EPIT argues that these thoughts must be specifically interprofessional for an interprofessional identity to predict congruent behaviors. This principle is based on the identity-behavior congruence mechanism (30). The beliefs outlined by EPIT (19) and measured with EPIS (47) represent normative views on interprofessional collaboration, with individuals either agreeing or disagreeing with these perspectives. It is important to note that the EPIS subscale on interprofessional beliefs does not address perceptions of how specific clinical practitioners' actions align with their specific professions. Instead, it focuses on a mindset that reflects how the individual believes professionals should behave. Consequently, to avoid cognitive dissonance, the individual is expected to act in accordance with these beliefs (48). In psychology, cognitive dissonance refers to the mental discomfort experienced when one's beliefs and actions are inconsistent or contradictory. This discomfort often motivates a change in either beliefs or actions to achieve greater alignment and reduce the dissonance.

EPIS's construct validity has been confirmed through Confirmatory Factor Analysis and this instrument demonstrates good to excellent internal consistency in the Netherlands (47), Lithuania (49), Germany (50), and Indonesia (51). However, the construct validity of Khalili's Dual Identity Scale (31) and of Tong's Interprofessional Three-Factor Model of Social Identity Scale (36) has yet to be confirmed by a confirmatory factor analysis.

Interprofessional identity formation and activation according to EPIT

The formation of interprofessional identity is grounded in the principles of social identification with a specific group or social category. Traditionally, social identification in psychology is mostly measured by assessing one dimension, affective commitment (33, 34). This focus aligns with the primary purpose of most studies, which often centers on staff retention or career changes. Developing a three-dimensional instrument to measure a specific social identity poses a challenge. Beliefs or self-concepts related to a particular group, profession, or organization require custom-made measurement instruments, necessitating multiple psychometric studies to reliably assess the cognitions responsible for predicting unique congruent behaviors. This process is time-consuming, complex, and lacks feasibility because professions can change. However, interprofessional identity encompasses a definable set of beliefs related to interprofessional collaboration and is not confined to a single

TABLE 1 Extended Professional Identity Scale (EPIS)—an interprofessional identity measure.

Subscale	Items
Interprofessional belonging	
	1. I like meeting and getting to know people from other health professions. 2. I feel a strong attachment toward interprofessional teams comprising cross-disciplinary health professionals. 3. I enjoy learning and collaborating with people from other health professions. 4. I like learning about other health professions.
Interprofessional commitment	
	5. I would be very happy to spend the rest of my career with an interprofessional team. 6. I identify myself with other members of an interprofessional team. 7. I am proud to be a part of an interprofessional team. 8. I prefer working with others in an interprofessional team.
Interprofessional beliefs	
	9. All members of an interprofessional team should be involved in goal setting for each patient. 10. When care decisions are made, the interprofessional team members should strive for consensus on planned processes. 11. Interprofessional team members should jointly agree to communicate plans for patient care. 12. Joint clinical decision-making should be an important part of interprofessional collaboration.

1 = strongly disagree; 2 = disagree; 3 = neutral/no opinion; 4 = agree; 5 = strongly agree.

profession, which can be more dynamic, as demonstrated in Macdonald's Sociology of Professions (52). Based on EPIT's propositions, an interprofessional identity can be formed through a combination of three factors (Figure 3).

First, a group must be identifiable so that individuals can associate with it. If individuals do not seem connected, the collection will not be perceived as a social entity. This concept aligns with Campbell's (53) theory of entitativity, which describes the degree of perceived "groupness." This psychological perception is crucial for social identification, as individuals can only commit to an entity they recognize as existing. Thus, mere group composition is insufficient to create a social entity with which individuals can commit. For example, people waiting at a bus stop are usually a collection of unrelated individuals and are rarely perceived as a specific group. They form only a temporary queue that will disperse once each person has reached their destination. Entitativity is influenced by three factors: (1) similarity, (2) proximity, and (3) common fate. Enhancing entitativity can be achieved in several ways like intergroup comparison, emphasizing mixed profession group membership, or creating competition between such groups.

Second, contact frequency fosters a sense of belonging and commitment to a group or social category, provided these interactions are positive, leading to favorable attitudes (37, 38). Consequently, positive attitudes towards members of a mixed profession group should enhance interprofessional commitment (39). Interprofessional belonging as a member of a specific profession is likely to depend on professional beliefs related to the positioning of this profession in a larger community of various professions (54, 55). This positioning might be profession-centered but can also be more holistic. A more holistic positioning will make it more likely that interprofessional identity formation can be enhanced in a shorter time. Professional beliefs related to holistic professional positioning are likely to foster a stronger sense of interprofessional belonging, which is an aspect of interprofessional identity. Consequently, the formation of professional identity can partially influence the development of interprofessional identity. This is unrelated to the assumption that these two social identities are distinct social constructs.

A "ceiling effect" of interprofessional identification is necessary to cultivate a more robust interprofessional identity, which in turn fosters sustained motivation for interprofessional collaboration. This relies on a steady increase in interprofessional commitment, which is a form of affective commitment influenced by the frequency of positive social interactions (56). This also implies that interprofessional identification depends on the social proximity and interactions between members of various professions. Thus, the strength of an interprofessional identity is closely tied to the local social environment during a specific period. This suggests that relatively stronger (EPIT-based) interprofessional identities are likely to be more prevalent in secondary care compared to primary care, where various professions have less social interaction. A study on EPIT-based interprofessional identity among Dutch dietitians and physiotherapists working in primary care versus secondary care seems to support this assumption (57). When an intentional long-term strategy on interprofessional identity formation is applied, even individuals in primary care would probably be more prone to actively seek social contact with other professions and create interprofessional networks in primary care settings or beyond. This is based on the idea that interprofessional identity is a source of motivation towards interprofessional collaboration (58). Thus, a stronger interprofessional identity represents a stronger intention to initiate interprofessional collaboration (independent of competence and environmental factors). The degree of social cohesion within mixed profession groups should be enhanced by the affective commitment of individual mixed profession group members (18, 59). When this interprofessional commitment influences social cohesion, it will also improve psychological functioning by enhancing individual resilience (60). Resilience is the individual's ability to withstand negative and hopeless situations when facing a problem (61). Resilient individuals are also more capable of making effective decisions under pressure compared to less resilient individuals (62).

Third, group concept is required to develop a self-concept as a group member. The relationship between group concept and group membership will shape the nature of social identity and, consequently, influence the behaviors exhibited when this identity is activated. In this case, an interprofessional identity. The self-concept related to an interprofessional identity is related to something that is accepted,

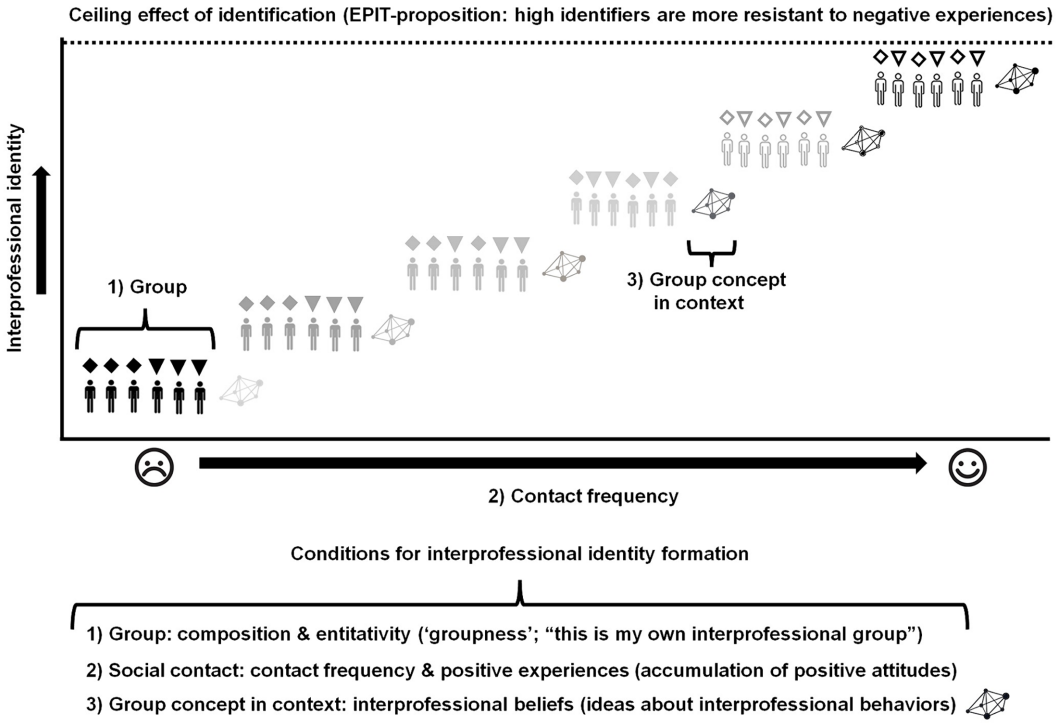

FIGURE 3
Interprofessional identity formation based on Extended Professional Identity Theory.

considered to be true, or held as an opinion by the individual identifier (63). In other words, interprofessional beliefs as an identity dimension. These interprofessional beliefs will guide behavioral orientation linking interprofessional identity with congruent interprofessional behaviors (30).

Based on Tajfel (24) definition of social identity, supported by findings from Cameron (25) and Obst and White (26) and the confirmation of the three-dimensionality of EPIT-based interprofessional identity across four countries (47, 49–51), it is plausible to expect a degree of interprofessional identification even before actual interprofessional socialization. This phenomenon is referred to as "anticipatory socialization" (64). In other words, individuals can feel a sense of connectedness and hold certain beliefs prior to becoming group members. Thus, everyone can already possess an interprofessional identity, although it may be weak. This also depends on the degree of social contact with (future) members of other professions in (future) work-related situations. Therefore, it also depends on the social proximity of (future) members of other professions.

Students who infrequently encounter peers from other professions in contexts relevant to their future careers are likely to have a weaker interprofessional identity compared to those who regularly interact with students from other professions, even if these interactions are not directly interprofessional. However, it is unlikely that an interprofessional identity will be very strong before interprofessional socialization begins, as social identification is primarily strengthened through social contact. A pre-socialization interprofessional identification has been confirmed by a study conducted among dental and dental hygiene students in the Netherlands (58). Halfway through their studies but prior to their interprofessional education (IPE), Dutch dental and dental hygiene students in the city of Groningen exhibit a certain degree of interprofessional identification. However, the circumstances of these particular student groups differ from most curricula in other Dutch cities because they share the same facilities, such as a skills lab and student clinics. Since these students were accustomed to almost daily social proximity, they may have developed a stronger interprofessional commitment. However, since they did not participate in any IPE, they did not develop stronger interprofessional beliefs beforehand. Since interprofessional beliefs guide congruent interprofessional behaviors, interprofessional hierarchy was still present among dental and dental hygiene students without prior IPE experience but with close proximity (65).

As all three identity dimensions take time to develop, interprofessional identity formation during IPE requires a long-term strategy (33, 34). This approach ensures a more sustainable interprofessional identification by fostering higher interprofessional commitment, which, in turn, leads to increased motivation towards interprofessional collaboration (3, 58), combined with interprofessional belonging and beliefs when triggered by certain contextual cues ("identity triggers"). Without frequent interprofessional socialization, graduates may lose their motivation for interprofessional collaboration when faced with discouragement in their new workplaces, particularly if they feel excluded, have minimal interprofessional contact, or are not convinced that interprofessional collaboration can achieve desired results.

Drenth et al. (3) demonstrated the principles of EPIT-based interprofessional identity formation and its relation to team dynamics and outcomes in a rehabilitation setting. Within a rehabilitation center, they formed six mixed profession groups. These groups met regularly for 15 months during in-person and online sessions. During

these sessions, work-related issues were discussed within the same mixed profession group, ensuring active and frequent engagement in a work-related context. Throughout these sessions, participants developed interprofessional beliefs by discussing shared values, organizational context and structure, group dynamics and interactions, as well as entrepreneurship and business management (66). The mixed profession groups could develop interprofessional belonging by their designated mixed profession group membership and interprofessional commitment by contact frequency. Interprofessional beliefs were cultivated by promoting a mindset that is psychologically linked to belonging to a mixed profession group. After this period, participants' interprofessional identities significantly increased, group dynamics improved, and efficiency rose by 10–15%, related to an average decrease of almost 12 in-patient days while maintaining the same quality of care. Based on this study, interprofessional identity was associated with improved team dynamics and outcomes; however, the causal relationship between interprofessional identity and congruent behaviors was not established. Additional research is needed to investigate this causal relationship and explore the activation of interprofessional identity.

The activation of an interprofessional identity only happens when the individual perceives a context with cues relevant for this social identity. Thus, when no contextual cues are recognized as interprofessional identity triggers, no congruent interprofessional behaviors will be displayed (Figure 4). This also implies that interprofessional identity triggers are learned and rely on knowledge as part of interprofessional competencies. Such competencies are acquired during IPE and workplace learning in practice.

Interprofessional identity should predict behaviors related to interprofessional collaboration. Which the WHO defines as "interprofessional collaboration occurs when health workers from various professional backgrounds collaborate with patients, families, carers, and communities to deliver the highest quality of care across settings" (67). Of course interprofessional collaboration is also required for shared problem domains outside and beyond the healthcare setting and can apply to other issues than health.

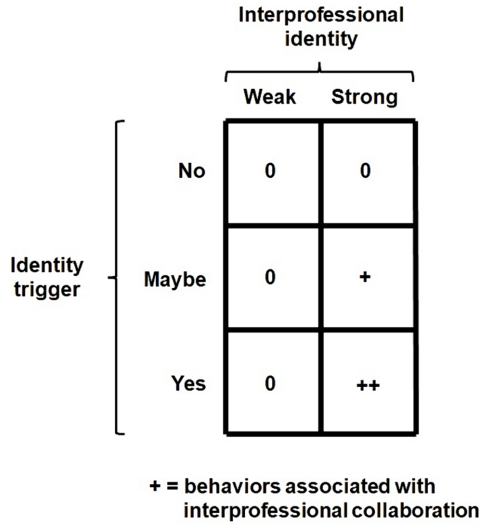

FIGURE 4
Interprofessional identity triggers.

According to Tajfel (24), social identity acts as a source of motivation when activated by an identity trigger. Like motivation, social identity influences the intensity, direction, and persistence of an individual's effort toward achieving a desired goal (68). The primary difference between social identity and motivation is the sense of belonging, which involves an internalization or psychological social association within the individual. Since interprofessional identity is a source of motivation for interprofessional collaboration, forming part of an individual's self-concept and being triggered by contextual cues or identity triggers, the interprofessional identities of unrelated individuals should collectively predict outcomes related to shared problem domains. This also implies that individuals with a strong interprofessional identity would consistently function this way, regardless of their (new) teammates or network. Just like interprofessional competence, individuals carry their interprofessional identity with them wherever they work. To test this assumption, we measured EPIT-based interprofessional identity in a student population of dental and dental hygiene students before they participated in IPE and before they were a member of a mixed profession group (Figure 5).

After identifying individuals with strong interprofessional identities (high identifiers) and weak interprofessional identities (low identifiers) within each profession, they were randomly assigned to mixed profession groups under either strong or weak interprofessional identity conditions (58). The Extended Professional Identity Scale (EPIS) was used to measure interprofessional identity (47). Despite the relatively small difference in the degree of interprofessional identification between the two conditions, the difference was significant. Eight weeks after measuring their individual interprofessional identities, we presented the same problems to be solved by mixed profession groups in both conditions. We found that groups with relatively strong interprofessional identities performed better than those in the other condition. Students with strong interprofessional identities were more socially interactive within their own mixed profession group. These groups also generated more solutions to shared problems. A replication by an ongoing and unpublished study yields similar promising findings, showing the same patterns and indicating that greater differences in interprofessional identification between conditions also result in greater differences in joint outcomes.

Showcasing EPIT-based interprofessional identity research and developments in Türkiye

In Türkiye, there are review studies on interprofessional education, cross-sectional descriptive, and experimental studies covering various professions, scale adaptation and scale development studies, program development studies, training activities independent of education programs such as interprofessional education academy and examples of trainer development programs (69–86). The inclusion of an article on interprofessional education in the accreditation standards for medical faculties, along with the emphasis on interprofessional communication and teamwork, is a significant step, even though these standards are not explicitly part of the accreditation for nursing, health sciences, and dentistry education. Nonetheless, many health professionals faculties have made it a goal to address these

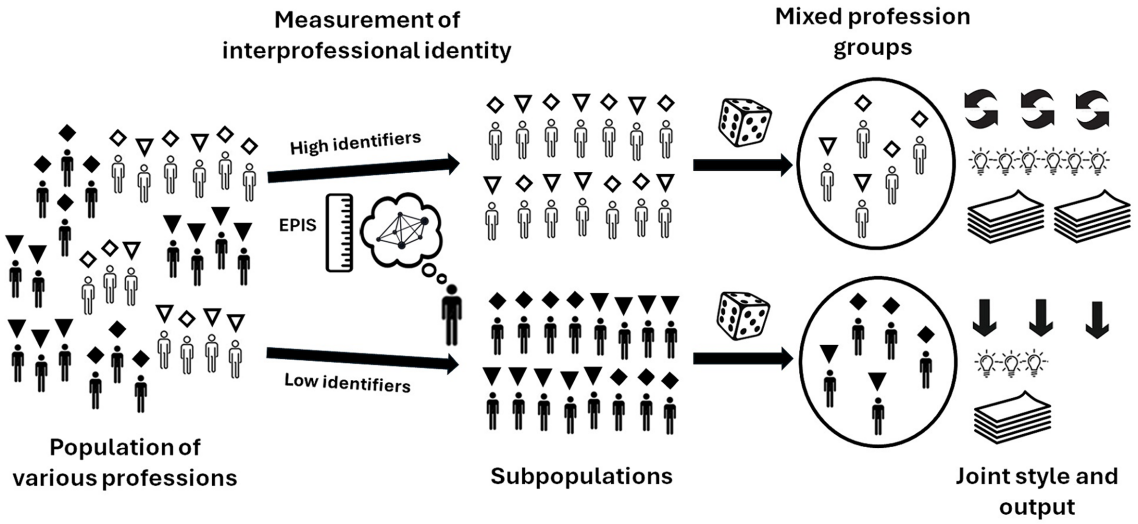

FIGURE 5
Interprofessional identity as an individual predictor of joint outcomes.

competencies in their curricula. As a result, courses focusing on interprofessional education have been incorporated into their curricula. These efforts are seen as crucial steps toward establishing the foundation required to enhance interprofessional collaboration in practice. The number of Turkish universities that are engaged in interprofessional education has increased considerably in the past 10 years (Figure 6). Google Scholar can provide some indication of interprofessional education developments in Türkiye based on national and international research output between 2014 and 2024. However, the number of Turkish universities conducting preparatory research on interprofessional education or evaluating their interprofessional education activities is currently relatively small. Out of 207 Turkish universities (87), only 15.5% (32 universities) appear to be engaged in interprofessional education. This percentage is only an estimation. Despite the relatively small number of Turkish institutions with IPE, the number of Turkish institutions involved in IPE research increased after 2019. The latter indicates a greater increase of Turkish IPE development and implementation compared to earlier years.

In addition to the growing emphasis on interprofessional education, collaborative practice is also on the rise. A study evaluating interprofessional collaboration within a real work environment in palliative care services at Tekirdağ Dr. İsmail Fehmi Cumalıoğlu City Hospital exemplifies this trend. Presented as an oral presentation at the 1st International Eastern Black Sea Family Medicine Congress, held from May 25–27, 2023, the research highlights the significance of collaborative efforts among healthcare professionals in improving the quality of palliative care (88). This study showcases practical applications and outcomes in a clinical setting, underlining the crucial role of teamwork in enhancing patient care.

An indication that interprofessional collaboration is gaining importance in Türkiye is the increasing development and adaptation of related measurement instruments. Numerous tools have been created to assess interprofessional education and collaboration. Many of these instruments, such as a Turkish interprofessional identity scale (EPIS-TR, the Turkish translation of EPIS), attitude scales (e.g., RIPLS and IPAS), and teamwork scales (e.g., SITAT), have already been completed, while many others are still in progress of development or publication (89, 90).

Future directions for interprofessional identity research in the Turkish context

Numerous discussions at both international and national levels have centered on the challenges of evaluating the impact of interprofessional education and collaboration on health service delivery and outcomes. To address this issue, interprofessional research is being planned to offer diverse and comprehensive assessment opportunities. Many areas within this field remain scientifically unexplored and await investigation. This also includes interprofessional identity as a new research domain within interprofessional education and collaborative practice research.

Organizing training programs to enhance interprofessional collaboration at the local level presents significant challenges. In Türkiye, health-related professions typically follow discipline-based and integrated training programs. Integrating an additional program for a common educational purpose within these existing frameworks is highly complex. Therefore, establishing a university-wide unit called the "Interprofessional Education Coordinatorship," which includes representatives from all health-related educational units, may be an appropriate solution. This organization would enable each representative to better align their individual programs with the joint interprofessional program, actively contributing to the development, implementation, and maintenance of the collaborative curriculum. Additionally, representatives from local "Interprofessional Education Coordinatorships" could form a national non-governmental organization dedicated to interprofessional education and collaboration. This organization would provide a platform for local coordinators to share best practices, find alternative solutions to common problems, and design new collaborations and scientific

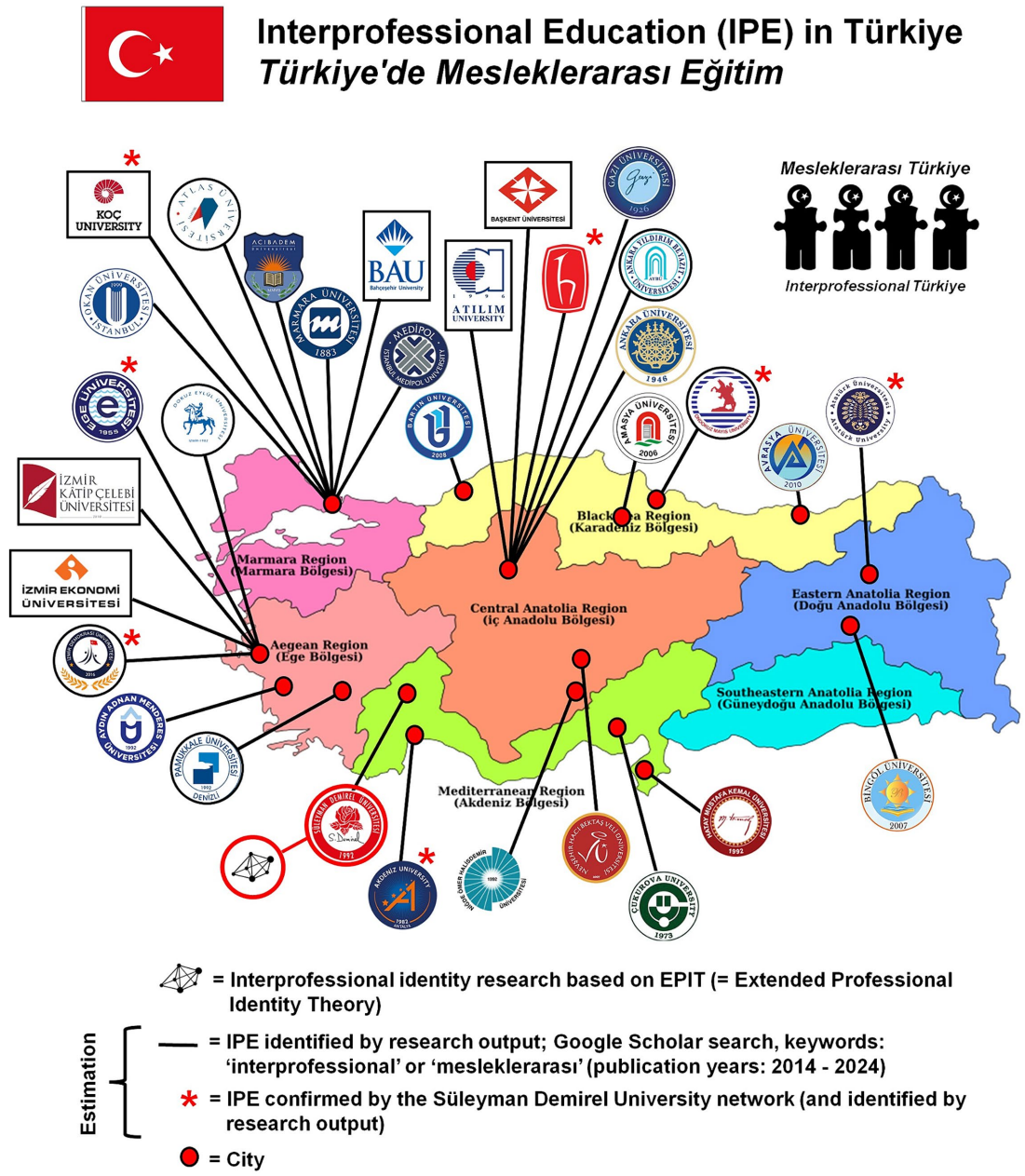

FIGURE 6
Turkish universities with interprofessional education or plans for its implementation.

research initiatives. Such national structuring would facilitate the effective resolution of local issues through benchmarking, while also providing opportunities for publishing in scientific journals and organizing conferences and symposiums dedicated to interprofessional education, collaboration, and research. At Süleyman Demirel University, the working principles of the "Interprofessional Education Coordinatorship" have already been established, and efforts to further develop this unit are ongoing.

For interprofessional collaboration to effectively enhance the quality of national health services, it is crucial to ensure representation at the ministerial level. Having ministry-level representation focusing on interprofessional identity and competencies that directly improve health service delivery is invaluable for ensuring the smooth operation of this process. Collaborative efforts developed jointly with the Ministry of Health, universities, and non-governmental organizations will play a pivotal role in quality enhancement processes by fostering a culture of interprofessional collaboration nationwide. To advance this initiative, Süleyman Demirel University is spearheading the "1st Interprofessional Education Academy," supported by TÜBİTAK for the first time in 2024. This national-level interprofessional training event will involve trainers from five Turkish universities (91).

While the context and necessity for interprofessional education and interprofessional identity and collaboration research are internationally recognized (92), addressing issues and devising

solutions must be tailored to each nation's specific circumstances. Therefore, despite national-level barriers and limitations, every country has the potential to contribute scientifically to this field. By fostering international collaboration among researchers and practitioners, countries can enrich the global knowledge base on interprofessional identity, education, and collaboration, leading to the identification of effective approaches to local challenges. For example, even though the measurement of EPIT-based interprofessional identity has similar psychometric properties in different countries (47, 49–51), the formation of interprofessional identity might depend on cultural differences. In addition, it is likely that the style of congruent behaviors predicted by interprofessional identity are different depending on culture due to different customs, habits and values. Also, it is likely that the overall degree of interprofessional identification will depend on social circumstances and norms in a country apart from the local social environment (57). Numerous organizations play pivotal leadership roles in advancing interprofessional education, collaboration, and research globally, actively striving to develop and expand this field (93, 94).

Global organizations for interprofessional education and collaborative practice share a common goal: to advance the theoretical foundations of interprofessional education and collaborative practice, address practical challenges, and propose solutions through international scientific and cultural exchanges in the domain of interprofessional education, collaboration, and research. Turkish scholars participate at various levels in these organizations. Although advancing interprofessional collaboration research in Türkiye may seem challenging, progress is promising through scientific inquiry and international engagement grounded in solid theoretical foundations. By consolidating these efforts into national-level organizations through local collaborations, Türkiye has the potential to assert itself more effectively on the global stage. This can be achieved by comparison and learning from local solutions such as measuring interprofessional identity, cultivating it, and enhancing interprofessional collaboration by systematically enhancing stronger interprofessional identities within the Turkish context.

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

JR: Conceptualization, Formal analysis, Investigation, Methodology, Software, Supervision, Visualization, Writing – original draft, Writing – review & editing. MB: Conceptualization, Investigation, Writing – original draft, Writing – review & editing. GK: Conceptualization, Formal analysis, Investigation, Writing – original draft, Writing – review & editing.

Funding

The author(s) declare that no financial support was received for the research, authorship, and/or publication of this article.

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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frontiers | Frontiers in Medicine

TYPE Systematic Review
PUBLISHED 02 October 2024
DOI 10.3389/fmed.2024.1449715

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OPEN ACCESS

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RECEIVED 15 June 2024
ACCEPTED 05 September 2024
PUBLISHED 02 October 2024

CITATION
Brownie S, Yap JR, Blanchard D, Amankwaa I, Pearce A, Sampath KK, Yan A-R, Andersen P and Broman P (2024) Tools for self- or peer-assessment of interprofessional competencies of healthcare students: a scoping review.
Front. Med. 11:1449715.
doi: 10.3389/fmed.2024.1449715

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Tools for self- or peer-assessment of interprofessional competencies of healthcare students: a scoping review

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Introduction: Healthcare professionals are expected to demonstrate competence in the effective management of chronic disease and long-term health and rehabilitation needs. Care provided by groups of collaborating professionals is currently well recognized as a more effective way to support people living with these conditions than routine, single-profession clinical encounters. Clinical learning contexts provide hands-on opportunities to develop the interprofessional competencies essential for health professional students in training; however, suitable assessment tools are needed to support student attainment of interprofessional competencies with self-assessment espoused as an important component of learning.

Method: A structured approach was taken to locate and review existing tools used for the self-assessment and peer assessment of students' competencies relevant to interprofessional practice.

Results: A range of self- and/or peer assessment approaches are available, including formally structured tools and less structured processes inclusive of focus groups and reflection.

Discussion: The identified tools will usefully inform discussion regarding interprofessional competency self- and peer assessment options by healthcare students participating in a broad range of clinical learning contexts.

Conclusion: Self- and/or peer assessment is a useful approach for those seeking to effectively enhance interprofessional learning and measure the attainment of related competencies.

KEYWORDS

interdisciplinary education, interdisciplinary communication, interprofessional collaboration, self-assessment, peer assessment, healthcare student

1 Introduction

An increasing focus on interprofessional education is needed as student health professionals prepare for a context of increasing health complexity, non-communicable disease, co-morbid conditions, and aging populations (1, 2). Programs of care provided by professionals working together are currently well recognized as a more effective way to support people living with these conditions than routine, single-profession clinical encounters. Patients increasingly expect a broader and more coordinated approach to their care (2, 3). Recognition of the need for team-based collaborative care and interprofessional education is not new as shown by documents such as the *World Health Organization (2010) Framework for Action on Interprofessional Education and Collaborative Practice* (4). Subsequently, curriculum content focused on the development of interprofessional competencies is an increasingly expected component of health professional education (5, 6). Interprofessional competencies form the basis of safety, quality, and patient-centeredness in team collaboration contexts (7, 8). These competencies include team participation, leadership, and communication (9). Interprofessional competence also includes soft skills such as attitudes, values, ethics, and teamwork, facilitating difficult conversations, multi-party communication, and trust building (8, 10, 11). Interprofessional competence is required for effective modern healthcare practice but all too often, various barriers get in the way of teaching interprofessional (IP) competencies, given that training usually involves professionals working in isolation using their own discipline knowledge base (1, 12).

Clinical learning environments, or contexts in which health professional programs are taught and practice placements occur, provide hands-on opportunities to support student attainment of IP competencies. Best practices in clinical education involve continuous feedback as a critical link between teaching and assessment and essential in supporting the educational process (13, 14) with self- and peer assessment espoused and regularly used as an important component of the learning sequence (15, 16). Twenty years ago, Ward et al. (2002) reported that reflection on practice using self- and peer assessment is not without difficulties, raising concerns such as issues in objectivity and reliability of students assessing their own performance (17), and debates have persisted since that time (18). Despite these concerns, self-assessment is widely implemented as an educational learning process (16). In the face of concerns, suitably validated self- and peer assessment tools are needed to guide best practices, complement faculty assessment processes, and effectively maximize learning (19).

Previous reviews identifying interprofessional assessment tools for use with prelicensure students have focused on post-placement or post-intervention assessment of IP competency (20) or the identification of tools for use by faculty in the assessment of student IP development (21). This inquiry aimed to locate assessment tools and assessment processes used by prelicensure healthcare students for the self- and peer assessment of IP competency attainment in clinical learning contexts, including the potential for use within an interprofessional student-led clinic. Student-led clinics (SLCs) are a unique option for the provision of practice placements in health professional programs (22). They are used with increasing frequency to enhance the opportunity and experience for prelicensure students in hands-on practice, especially in primary healthcare settings, while also providing benefits to service users and communities (22–24). SLCs May involve students from single professions (22) or May be interprofessional in nature (25, 26). Within both general clinical learning contexts and SLCs, tools May be used to assess either individuals or whole teams in interprofessional competencies.

This study sought to understand what assessment tools and self/peer assessment processes have been used by prelicensure healthcare students during interprofessional self-assessment and peer assessment processes in clinical learning environments with two or more health professionals working together. In developing this search, we noted that "tools," "techniques," instruments," and "scales" are frequent terms used interchangeably in the literature (27–29). Definitions are closely aligned and often contradictory (30, 31). For this review, the term 'tool' is reported for consistency. Consistent with our research question, we also report processes that did not include the utilization of formally developed 'tools' but also other means such as self- or peer reflection and focus group discussions to measure, assess, or reflect on interprofessional competency development.

The inquiry focused on student self- and peer assessment versus assessment undertaken by teaching faculty and on the self-assessment of interprofessional competencies versus profession-specific competencies. The review aimed to answer the following questions:

- What tools and self—/peer assessment processes have been used by prelicensure healthcare students to undertake self- and/or peer assessment of interprofessional competencies in an interprofessional clinical learning context (contexts in which health professional programs are taught and practice placements occur) with two or more health professions working together?

2 Method

2.1 Reporting guideline

A scoping review was considered most appropriate for investigating the research question as this topic has not yet been comprehensively reviewed. In such instances, scoping reviews are suitable to provide a general overview of available evidence (assessment tools) as a precursor to more detailed inquiry (32). A scholarly approach was undertaken in conducting the review using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) statement (33).

2.2 Eligibility criteria

This review sought primary studies using qualitative, quantitative, or mixed methods for assessing interprofessional competencies. Specifically, we searched for studies involving healthcare students (from two or more professions working together) at any level of study, participating in interprofessional education activities, and utilizing tools to self-assess interprofessional competence or peer assess other students. The search focused on prelicensure students. Publications in which participants included registered health professionals and those with initiatives to maintain registration or undertake continuing professional development were excluded. Studies that assessed IPE programs more broadly and in which tools were used for the primary purpose of program evaluation, as opposed to specifically assessing student IPE competencies as a result of such programs, were excluded. The selection criteria are summarized in Table 1.

TABLE 1 Inclusion and exclusion criteria.

Inclusion criteria	Exclusion criteria
• Self-assessment • Peer assessment • Healthcare students at any level of study • Interprofessional education involving two or more professions working together • Assessment of interprofessional competence	• Registered health professionals • Initiatives to maintain registration • Continuing professional development • Assessment of IPE programs • Studies involving one profession only • Studies using self or peer assessment for program evaluation only

2.3 Information sources

The literature search was completed in May 2023 and updated in November 2023 followed by analysis and write-up. Four electronic databases, ProQuest, ERIC, Medline, and Embase, were searched for literature published in the 25 years preceding the search date. By focusing on the last 25 years, the review aligns with the transfer in various nations of hospital-based education to university-based education and captures the most relevant and impactful developments in the field of Interprofessional Education and Collaborative Practice (IPECP). This approach allowed us to concentrate on the period during which these concepts gained significant traction, thereby providing a more focused and pertinent analysis.

2.4 Search process

The search strategy was guided by the research question and the inclusion/exclusion criteria, focusing on three broad concepts: healthcare student, peer- and self-assessment, and interprofessional competence, with refinement through MeSH headings in Medline. The initial search in ERIC used the following keywords: [(Pre-registration OR Pre-licensure) AND (Healthcare student OR Healthcare student) AND (postgraduate OR undergraduate) AND (Evaluate OR Assessment OR assessing OR assess OR outcome OR outcomes OR examin* OR evaluate) OR (measurement OR measure OR measuring) AND (Competenc* OR Competent) AND (interprofession*) AND tools]. The search strategy was then tailored to each database accordingly. Google Scholar was specifically used to search for gray and narrative literature that might have been missed in the focused search as well as to explore reference lists of relevant primary papers in the database search.

2.5 Study selection

Search results were imported into Covidence® (34), an online software for review data management and screening, which automatically removed duplicates. Initial screening of the titles and abstracts was conducted by two sets of independent reviewers. Disagreements regarding paper inclusion were resolved by discussion between a third and fourth reviewer.

Full texts of included studies were then reviewed by two sets of independent reviewers. Discrepancies and conflicts were resolved by a third reviewer.

2.6 Data extraction

Two reviewers independently extracted relevant data from the included studies via Covidence for review and discussion by all authors. This information encompassed the following parts: the characteristics of studies (publication year, country, study design, sample population, and size), participant features (student professional field and level of study), and characteristics relating to the intervention, control, and outcome measures (IPE, interprofessional competency, and self/peer assessment tools). Any conflicts that arose between the reviewers were resolved by consensus.

Focused effort with significant rereading and team discussion was needed to locate studies directly relevant to the research questions. This was because significant literature was identified where students undertook self-assessment activities using published scales; however, on close examination, the student self-assessment data were used to inform tutor evaluation of the effectiveness of the IPE program or intervention rather than for the students' personal assessment, discussion, and reflection. Examples include (35–37). Articles that used student self-assessment data purely to inform program evaluations were excluded in the review process because this review directly related to the question 'what tools and self/peer assessment processes have been used by prelicensure healthcare students to undertake self- and/or peer assessment of interprofessional competencies in an interprofessional clinical learning context with two or more health professions working together?' Some studies had a dual-purpose use of the student self-evaluation data—to inform both student self-evaluation and program evaluation. If data were available for student self-assessment and/or reflection, the study was identified as relevant to this review.

3 Results

Twenty studies were identified of direct relevance to the review question (see Figure 1).

3.1 Characteristics of included studies

Table 2 provides a summary of the characteristics of each study selected for inclusion in this review. Studies were identified across a 25-year timeframe from 2009 and involved quantitative, qualitative, and mixed-methods approaches. A wide range of health professions were reported in the selected studies with nursing and pharmacy the most frequently noted. Studies originated from the United States, Canada, Australia, and the United Kingdom, with the highest number (14 or 70%) having been published in the United States.

3.2 Analysis of included studies

For the purposes of this review, assessment tools identified May have been used for either self- or peer assessment, with results having been provided to students for the purposes of learning assessment, rather than being used by educators or researchers for program or course evaluation. Table 3 lists each study and provides information about the number of participants, the intervention (IPE learning activity), the participating student population, and the specific

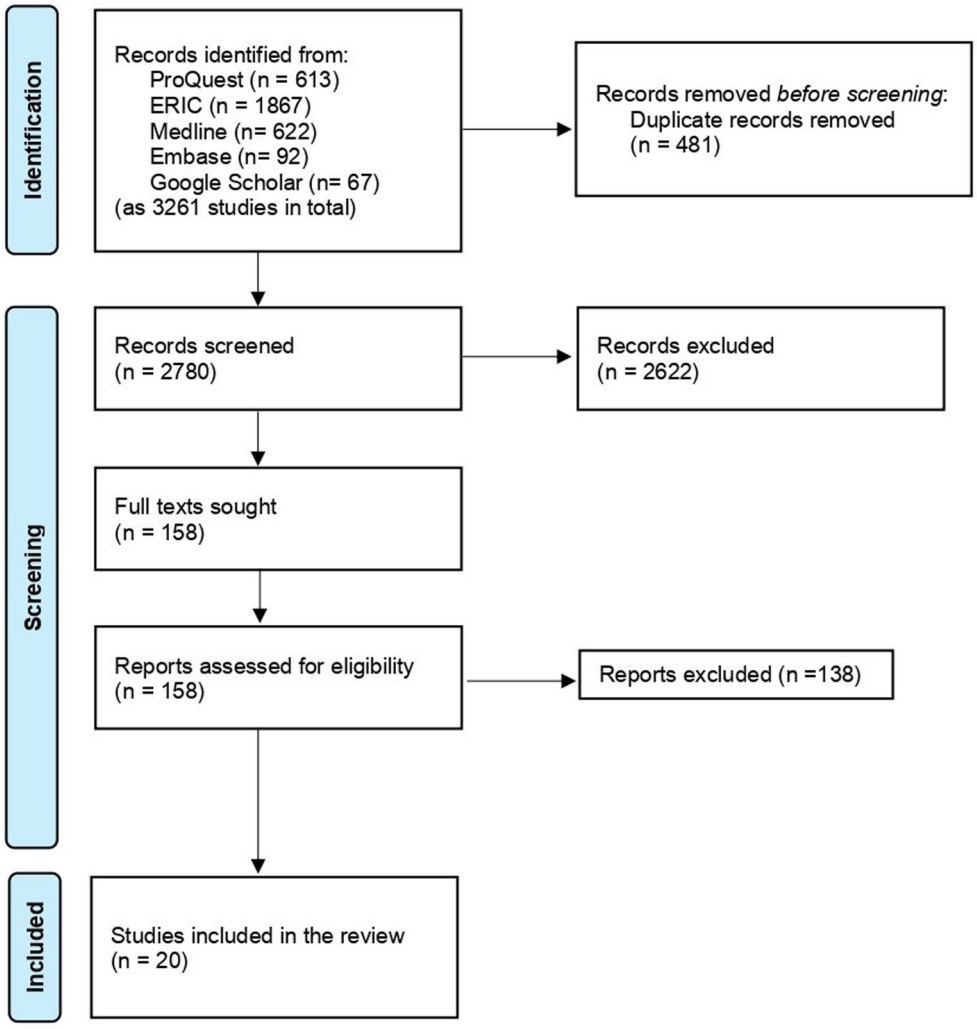

FIGURE 1
Literature search and PRISMA diagram.

assessment tools used. Note that where assessment was undertaken by *instructors* or *faculty* in conjunction with self-assessment or peer assessment in a given study, these tools are not listed. For example, Begley et al. (2019) also used the Creighton Interprofessional Collaborative Evaluation (C-ICE) instrument, a "25-point dichotomous tool in which the evaluator awards one point if the interprofessional team demonstrates competency in a 2 specific area, or no point for failure to do so" (p. 477). Because this tool involves evaluator 3 (not self- or peer-) assessment, this tool is not listed or considered further here (38).

The 12 specific tools in Table 3 have been used for self-and/or peer assessment of interprofessional competencies across the twenty included studies are shown in Table 4.

The origins of the frequently used tool can be found in USA which has a strong history of formally established interprofessional learning collaboratives. For example, the ISVS Scale was developed by the Minnesota-based National Centre for Interprofessional Education and Practice (39), the IPEC scale was developed by the Washington-DC-based Interprofessional Education Collaborative. It appears that US educators have the autonomy to choose and utilize various tools or to construct their own approaches. The UK hosts CAIPE—the Centre for the Advancement of Interprofessional Practice and Education established in 1987 to drive interprofessional practice in health (40). However, UK educational providers appear to have less autonomy as UK-based regulators mandate the actual competencies, which must be addressed by each profession. We can only speculate that this May be why only one UK-based manuscript appeared in this search.

The 12 assessment tools vary in different ways, although 11 of the 12 tools are quantitative, Likert-scale measures, with the exception being the Description of a Meaningful Interprofessional Learning Situation Tool developed by Dubouloz et al. (2010) to capture students' perspectives qualitatively, via open-ended questions. This is the only specific qualitative tool used (41); however, other studies also adopted less structured approaches to self and peer assessment, such as the use of focus groups or written reflection tasks. Table 4 only includes the 14 studies in which formal tools were utilized. Utilization of tools was most frequently reported in mixed-methods studies, in conjunction with a more structured, quantitative approach utilizing a scaled tool (38, 42–44). Two studies adopted a solely qualitative approach, with students undertaking self-assessment via reflective written questionnaire/open-ended survey (post-test-only and pre-and-post, respectively) (45, 46).

TABLE 2 Characteristics of included studies.

Category	Number of papers	Percentage[1]
Assessment design		
Qualitative	2	10%
Quantitative	9	45%
Mixed	9	45%
Self or peer assessment		
Self-assessment	16	80%
Both peer and self-assessment	4	20%
Student professions included		
Nursing (registered or nurse practitioner)	14	70%
Medicine	8	40%
Pharmacy	11	55%
Social Work	6	30%
Physical Therapy/Physiotherapy	9	45%
Dental	2	10%
Occupational Therapy	6	30%
Physician Assistant	4	20%
Speech and Language Therapy/Pathology	5	25%
Public Health	3	15%
Audiology	2	10%
Other professions (1 study each)[2]	11	55%
Year published		
2000–2009	2	10%
2010–2019	10	50%
2020+	8	40%
Country of publication		
USA	14	70%
Canada	3	15%
Australia	2	10%
UK	1	5%

[1]Percentage of student professions sums to greater than 100 as studies included students from two or more professions. [2]Clinical Psychology, Radiography, Cardiac Physiology, Dietetics, Nutrition, Anaesthesiologist Assistant, Human Services, Recreational Administration, Graduate Counseling, Exercise Science, Human Kinesthetics.

Among quantitative approaches, the most frequently used tool was the IPEC (43, 44, 47, 48). This is a 5-point Likert scale tool based on the well-known core competency statements developed by the Interprofessional Education Collaborative (IPEC, 2011), a U.S. collaboration involving peak bodies from six health disciplines. An early 42-item scale includes 8 to 11 items for each of the four key domains in the statement (values and ethics, roles, and responsibilities, interprofessional communication, and teams and teamwork), although Nieuwoudt et al. (2021) used a shortened 16-item scale and Porter et al. (2020) modified the scale to use 'the team', instead of 'I' for each of the competencies (43, 49). Note that an updated version 3 of the IPEC competency standards was released in late 2023 shortly after the conclusion of the search process associated with this manuscript (50). The updated version is available as a resource to inform future studies.

Three of the included studies used ISVS for students to self-assess attitudes, values, and beliefs about the value of interprofessional socialization (44, 51, 52). The second most used tool was the Readiness for Interprofessional Learning Scale (RIPLS), used by Ref. (41, 53–55). However, it is important to note that in each of these cases, this tool was used alongside one or more other tools for assessing competencies. In each study including RIPLS the decision to include it is not explained. While a valid and reliable tool, RIPLS (56), was not designed to be an outcome or impact measure. It is designed to measure attitudes toward IPE *before* starting an IPE intervention. However, it is appropriate to include studies, which have utilized the RIPLS scale on the basis that this scale measures attitudes and values as regards interprofessional educational activities. Collaborative attitudes and values, including the attitude and openness to follow leaders within a team, are important interprofessional competencies (10, 11, 57), and students' awareness of their own situation is an important part of interprofessional learning. In considering the decision to include studies using the RPILS scale in the findings of this search, it is important to reflect on the variance among the 12 tools highlighted in Table 4. Assessment is a multivariate process. One size does not fit all. Thus, a selection of different types of tools and processes for differing settings is both valid and useful.

Considering differences is also important to differentiate between the most common type of tool, which measures individual competencies (whether for oneself or one's peers), and those which measure competencies overall, for a team. Most located studies used individual and personal scales, but there were some examples of scales or tools which measured overall team functioning, skills, or approaches. These include the CATME used in Ref. (58) originated in engineering, and which involves individuals assessing self- and team-member contributions to a team, and the Teamwork Assessment Scale used in Ref. (53), which assesses team functioning in a given situation (items include 'the team roles were distinct without ambiguity', for example). The CASCD scale used by Ref. (59) measures perceptions of team interaction and satisfaction with decision-making and is thus also more situational and team functioning focused than a scale of individual skills, knowledge, or experience.

Other studies used (either solely or alongside named tools) in-house constructed Likert-scale instruments not listed in Table 3 (51, 57, 60). Validation for these tools, particularly a detailed description of their psychometric properties, was typically lacking (61). Likert-scale ranked approaches were typically used in a pre- and post-design before and after the intervention, but there are also examples of retrospective, post-then-predesign where participants recalled prior knowledge after the fact (48) and ICCAS used by Vyas et al. (2021) is designed to be completed only once, rating abilities after training and also as recalled previously (62). Overall, there was significant variability in the approaches to self- and peer- assessment undertaken by students in these contexts and in the tools and processes used.

4 Discussion

Effective assessment should be designed in a multifaceted manner and include a variety of formative and summative assessment activities and continuous learner feedback with each assessment activity designed to build, test, and affirm learner capability and expand

TABLE 3 Interprofessional education self/peer assessment tools.

Study	Participants	IPE activity and population description	Assessment design	Outcome/s assessed	Self-assessment IPE tool/s	Peer assessment IPE tool/s
Anderson, 2006	126	Interprofessional clinical teaching workshop of patient during an acute hospital episode Pre-registration (above first-year) clinical psychology, occupational therapy; medical; nursing; physiotherapy; pharmacy, radiography, cardiac physiology; dietetics; and speech and language students	Mixed	Interprofessional competencies in knowledge, skills and attitudes of team working	• (Pre) 5-point Likert scale questions recording student hopes, concerns, and expectations on the learning event • (Post) 19 5-point Likert scale questions, on the structure, organization of the session, and the teaching methodology + open-ended comments on the best and worst aspects	N/A
Dobson, 2009	134	Interprofessional quality improvement (QI) activity Undergraduate University of Saskatchewan nursing (years 2 and 4), nutrition (year 2); pharmacy (year 3), and physical therapy (year 3) students	Quantitative	Interprofessional team knowledge, attitudes, and beliefs	• 16 7-point Likert scale questions on interprofessional self-reflection	(Post) Group evaluation score, including 9 7-point Likert scale questions anchored by diametrically opposing statements about the functioning of their team + Open-ended comments
Dubouloz, 2010	1	Interprofessional Rehabilitation University Clinic in Primary Health Care	Mixed	Attitudes toward interprofessional learning and collaboration	• RIPLS: readiness for interprofessional practice • DMILTS: description of a meaningful Interprofessional learning situation tool	N/A
Guitard, 2010	15	Interprofessional Rehabilitation University Clinic in Primary Health Care Prelicensure audiology; occupational therapy; physiotherapy and speech-language pathology students	Qualitative	Level of knowledge and perceptions about the importance of interactional determinants of collaboration	• Written, semi-structured questionnaire (post-)	N/A
Seif, 2014	332	Interprofessional service-learning course and student-run free clinic (SRFC) Pre-clinical physical therapy; occupational therapy; physician assistant; medical; pharmacy students	Quantitative	Interprofessional perceptions and attitudes and perceptions of clinical reasoning skill	• IEPS: interdisciplinary education practice learning scale RIPLS: readiness for interprofessional practice	N/A
Sevin, 2016	15	Collaborative Competencies in Service Learning Course Undergraduate nursing and social work and graduate professional pharmacy students	Quantitative	Interprofessional education collaborative competencies	• IPEC (42-item) Interprofessional education collaborative competency self assessment tool • NB: an updated version 3 of the IPEC competencies was released on November 2023	N/A

(Continued)

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TABLE 3 (Continued)

Study	Participants	IPE activity and population description	Assessment design	Outcome/s assessed	Self-assessment IPE tool/s	Peer assessment IPE tool/s
Simko, 2017	60	Interprofessional Pain Education Course Senior nursing and year 5 pharmacy students who attended an elective course	Quantitative	Perspectives on interprofessional teamwork and collaboration	• IEPS: interdisciplinary education perception scale • CSACD: collaboration and satisfaction about care decisions	N/A
Nash, 2018	191	A multifaceted educational program consisting of technology-enhanced delivery as well as interactive exercises in a joint health assessment course University of Louisville nurse practitioner (year 2 of a 2-year program) and dental (year 1) students	Quantitative	Knowledge of Interprofessional education core competencies; attitudes toward interprofessional education; attitudes toward teamwork; self-efficacy in functioning as a member of an interdisciplinary team	• A 17-item measure of student understanding of IPE core competencies (based on Interprofessional Education Core Competencies); • RIPLS: Readiness for Interprofessional Practice • T-TAQ (24 of 30 items only) Team STEPPS Teamwork Attitudes Questionnaire • SEF-MIT: Self-Efficacy in Functioning as a Member of an Interdisciplinary Team Scale	N/A
Seaman, 2018	62	Interprofessional clinical placement in ambulatory care Final year students enrolled in Master of Nursing Science or MBBS (medicine)	Mixed	Interprofessional socialization	• ISVS: Interprofessional Socialization and Valuing Scale • Open-ended questionnaires: (Pre) anticipated learning • (Post) student perspectives on the impact of experience	N/A
Begley, 2019	162	PE telehealth cases Creighton University pharmacy (years 1–3) and physician assistant (year 2) students	Mixed	Interprofessional student team performance	• TSS: Team Skills Scale • Written reflections (pharmacy students)	N/A
Leithead, 2019	152	High-fidelity simulation (HFS) operating room (OR) interprofessional team training Senior medical, undergraduate nursing, and nurse anesthesia students	Quantitative	Attitudes toward interprofessional learning and collaboration	• RIPLS: Readiness for Interprofessional Practice • 15 6-point Likert scale questions on interprofessional teamwork	TAS
Roberts, 2019	45 students and 51 health professionals	Study 1: IPE workshop on pediatric head injury; Study 2: IPE workshop on error disclosure Recreational admin; nursing; social work; speech pathology; pharmacy and public health graduate and undergraduate students; and health professionals	Quantitative	Interprofessional competencies	• IPEC (42-item) interprofessional education collaborative competency self-assessment tool	N/A

(Continued)

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TABLE 3 (Continued)

Study	Participants	IPE activity and population description	Assessment design	Outcome/s assessed	Self-assessment IPE tool/s	Peer assessment IPE tool/s
August, 2020	39	Community Homeless Interprofessional Program (CHIP) or Diabetes Education Wellness (DEW) Wayne State University health students of pharmacy (years 1–3), medical (years 1–2), social work (various years), physical therapy (years 1–3)	Quantitative	Interprofessional socialization	• ISVS: Interprofessional Socialization and Valuing Scale	N/A
Johnson, 2020	68	An experiential interprofessional education program based on the ICF model	Qualitative	Interprofessional education collaborative competencies	• Open-ended pre- and post-survey	N/A
		Graduate professional physical therapy; physician assistant; pharmacy students				
Pawlowska , 2020	111	Baby Day: a pediatric IPE activity Graduate physical therapy, occupational therapy and speech language therapy; and undergraduate nursing students	Mixed	Interprofessional collaborative competencies	• 5-point Likert scale questions on the extent activity allowed students to meet interprofessional learning goals of activity • Guided reflective writing assignment	N/A
Porter, 2020	11	Effects of Experiential Competency-Based Interprofessional undergraduate course Pre-professional human services; public health and nursing students	Mixed	Interprofessional competencies	• Modified IPEC ('I' replaced with 'the team') + • Open-ended prompts describing reflections pertaining to team experiences	N/A
Nieuwoudt, 2021	77	Interprofessional simulation sessions, representing a GEM ward Pre-registration (year 1) nursing and occupational therapy students	Mixed	Interprofessional practice competencies	• IPEC (16-item); interprofessional education collaborative competency self assessment tool • Focus groups	N/A
Timm, 2021	26	An interprofessional faculty + student-led clinic Undergraduate and graduate nursing; social work; exercise science; graduate counselor education students	Mixed	Interprofessional practice competencies	• IPEC (42-item); interprofessional education collaborative competency self assessment tool • ISVS: interprofessional socialization and valuing scale • Focus group interviews	N/A
Vyas, 2021	1,099	A telehealth-based interprofessional education (IPE) experience Teams of one doctor of osteopathic medicine and one or two doctor of pharmacy students	Mixed	Interprofessional collaborative competencies	• ICCAS: Interprofessional Collaborative Competencies Attainment Scale	A peer evaluation on the TEAMMATES app V7.8.0, providing feedback to their team member(s)
Earnest, 2022	1,357	Classroom-based IPE course Anaesthesiologist assistant, dental medicine, medical, nursing, pharmacy, physical therapy, physician assistant; public health and social work students	Quantitative	Team member effectiveness and collaborative competency	• CATME: Comprehensive Assessment of Team Member Effectiveness	CATME

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TABLE 4 Tools used for self or peer assessment of interprofessional competencies.

Scale	Full name	Description	Studies used	Validated?
ISVS	Interprofessional socialization and valuing scale	A 24-item, 6-point Likert scale measuring beliefs, behaviors, and attitudes underlying interprofessional socialization (assumptions and worldviews, knowledge and skills concerning collaborative teamwork, values, and identities)	Seaman, 2018 August 2020 Timm, 2021	Yes
IEPS	Interdisciplinary education perception scale	A 12−/18-item, 6-point Likert scale measuring perceptions and attitudes about competency and autonomy, the need for cooperation, and the perception of actual cooperation	Seif, 2014 Simko, 2017	Yes
RIPLS	Readiness for interprofessional learning scale	A 19-item, 5-point Likert scale measuring perceptions of knowledge, skills, and attitudes regarding readiness to learn with other healthcare professionals	Dubouloz, 2010 Seif, 2014 Nash, 2018 Leithead, 2019	Yes
IPEC	Interprofessional education collaborative competency self-assessment tool	A 32- or 16-item (revised), 5-point Likert scale measuring competencies related to collaborative practice based on core competency statements developed by the Interprofessional Education Collaborative (IPEC, 2011)	Sevin, 2016 Roberts, 2019 Timm, 2021 Nieuwoudt, 2021	Yes
ICCAS	Interprofessional collaborative competencies attainment survey	A 20-item, 5-point Likert scale measuring perceived skills in communication, collaboration, roles and responsibilities, collaborative patient-family-centered approach, conflict management/ resolution, and team functioning. Completed once after IPE training, rating abilities two times: once as recalled prior to training, and again now that training is done	Vyas, 2021	Yes
TSS	Team skills scale	A 17-item, 5-point Likert scale measuring self-assessment of skills required to work effectively on an interprofessional care team (interpersonal skills, discipline-specific skills, and geriatric care skills)	Begley, 2019	Unclear
CATME	The comprehensive assessment of team member effectiveness	A 5-item, 5-point Likert scale measuring team member contributions in five areas based on team effectiveness literature (contributing to teamwork, interacting with teammates, keeping the team on track, expecting quality, having relevant knowledge/skills/abilities)	Earnest, 2022	Yes
CSACD	Collaboration and satisfaction about care decisions	A 9-item, 7-point Likert scale was used to assess the quality of interaction in making care decisions and satisfaction with the decision-making process in the health setting (7 related to collaboration)	Simko, 2017	?
DMILST	Description of a meaningful interprofessional learning situation tool	Short-answer, open-ended questions to identify: (1) knowledge of other professions gained, (2) learning experiences about four key determinants of collaboration, and (3) students' perceived impact of the interprofessional application on client care, their learning, and educator–clinicians' supervision	Dubouloz, 2010	No
T-TAQ	Team STEPPS teamwork attitudes questionnaire	A 30-item, 5-point Likert scale measuring five core components of teamwork: team structure, leadership, situation monitoring, mutual support, and communication	Nash, 2018	Yes
SEF-MIT	Self-Efficacy in functioning as a member of an interdisciplinary team scale	A 17-item, 4-point Likert scale measuring self-efficacy in two core competency statements developed by the Interprofessional Education Collaborative (IPEC, 2011)—roles/responsibilities and interprofessional communication	Nash, 2018	No
TAS	Teamwork assessment scale	A 14-item, 5-point Likert scale observational tool measuring overall team functioning, based on a theoretical model of teamwork	Leithead, 2019	Yes

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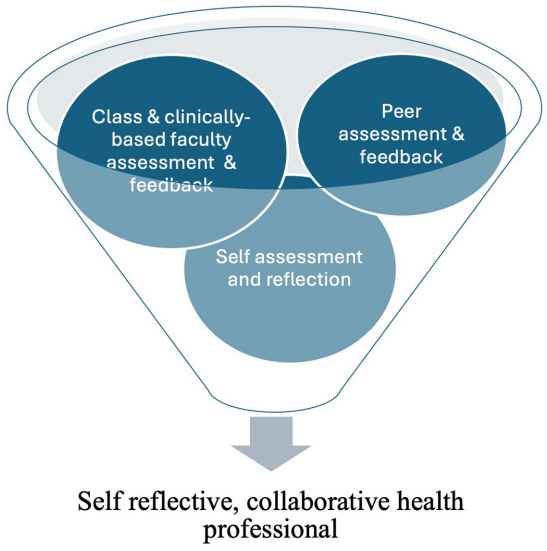

FIGURE 2
A comprehensive approach to assessment.

understanding. Using more than one assessment type helps give students a range of ways to demonstrate what they have learned and what still needs to be learned (63). Among the wide milieu to be learned by student health professionals, interprofessional insight and practice capabilities are increasingly important as populations age and levels of chronic and complex care priorities increase (2).

A recent review reported results of a search designed as a resource of interprofessional assessment tools used by faculty (21). This search was designed to complement this study by locating and providing a pointer to tools and processes available for student self-assessment and peer assessment of interprofessional understanding and capability. As highlighted, the search identified studies utilizing and reporting formally developed IP self- and peer assessment tools along with other studies reporting processes such as focus groups and reflection—the benefit being an identification of a broad range of resources that can used to engage with students and their peers and enhance IP related learning among health professional students during their learning experiences. A significant benefit of self- and peer assessment is the extent to which these processes increase student understanding of their current capabilities and learning needs (58, 64).

4.1 Self- and peer assessment tools

Despite concerns in the literature about the objectivity and reliability of students assessing their own performance and/or that of their classmates (17, 18), peer and self-assessments have been shown to significantly contribute to the expansion of student capability and positive learning outcomes (64–66). The argument that self-assessment May be unreliable, inflated, and/or biased can be mitigated by including others (for example, peers, colleagues, and clients) in the assessment of self (67). Thus, the review has searched for examples using both self- and peer assessment tools and processes with both noted as being complementary to each other (65).

Documented benefits of self-assessment include the growth that occurs when students learn how to assess their own competencies and/or those of their peers. This includes increased 'deep-level' learning, critical thinking, and problem-solving skills (66). Reported benefits also include growth in self-awareness and the transition from tutor-directed learning, to self-directed learning, and ultimately, autonomous, reflective practice (66).

Timing of assessment and the benefits of repeating assessments are important considerations. Students May rate themselves inappropriately high before their learning experience and score lower in terms of comfort or ability after the placement, once they have greater insight into their capabilities and have been provided with an opportunity to reflect (51, 68). Self-assessment has also been reported as more likely to be inflated among first-year students with further instruction and reflection recommended to moderate over-confidence and self-bias among novice learners (69).

Aside from the use of formalized tools to facilitate self and/or peer assessment, verbal or written reflection and engagement in focus groups provide the opportunity for students to safely contemplate and recognize their own strengths and weaknesses and, as such, is a valuable aid to learning. Benefits also include reported increases in empathy, comfort in dealing with complexity, and engagement in the learning process (45, 46, 70, 71).

4.2 Assessment as a comprehensive concept

> *"Effective assessment is more like a scrapbook of mementos and pictures rather than a single snapshot."*
>
> Wiggins and McTighe, 2005, p 152

Multiple methods are needed to best capture the major aspects of knowledge and competency acquisition among student health professionals (72, 73). While the search has successfully identified self and/or peer assessment options for educators and their learners, it is important to position these within a broader suite of assessment options to maximize the development of a self-reflective health professional. Figure 2 illustrates the comprehensive nature of student assessment and the multivariate approach outlined by Wiggins and McTighe (2005), which is needed to support the development of critically thinking, self-reflective practitioners (63).

Blue et al. (2015) have noted that the lack of progress relating to the assessment of interprofessional competencies continues to create challenges for educators. Various studies conducting assessments have focused on learner attitudes toward IPE as opposed to learner IP knowledge or skill (61, 74, 75). Moreover, existing tools lack sufficient theoretical and psychometric development (61, 75). The Readiness for Interprofessional Learning Scale (56) and the Interdisciplinary Education Perception Scale (IEPS) (76) have been widely used, for both faculty (21) and student self and/or peer assessment (55), and other tools or scales have been locally developed to meet specific institutional goals and objectives (43, 49, 74). Blue et al. (2015) and Nieuwoudt et al. (2021) found that few programs reported systematic processes for evaluating individual student's skills and behaviors related to interprofessional collaboration. It is clear that rigorous assessment and evaluation methods, standardized and widely used tools, and longitudinal assessment from diverse contexts are needed if the field of IPE is to advance and align with the demands of changing clinical care systems.

4.3 Need for further research

More study is needed to investigate the strengths and merits of qualitative scales versus more qualitative approaches in the assessment of interprofessional competency and within the suite of currently available self and/or peer assessment options. Reflective, deep dive approaches—both have been used in the literature, but little seems to have been done to reconcile them, test the value or otherwise of one over another or within mixed approaches (74) What is clear is that for the field to progress, there needs to be some consensus agreement on which measures to use to most effectively support learning.

5 Limitations

This study focuses on studies reporting self-assessment and peer assessment processes. Findings identify considerable variance among the identified tools and processes and the ways in which they were utilized. Several studies undertook a case study approach or included small cohorts only, so results May not be comprehensive or generalizable. As a detailed description of learning outcomes and psychometric properties of the results was typically lacking, it is not possible to make evidence-based comparative comments about which of the individual tools and/or processes as the most effective aids for learning. Thus, readers are encouraged to consider the recommendations in conjunction with the combination of assessment and feedback processes available to assess interprofessional readiness, capability, and competence and aid student learning.

6 Conclusion/recommendations

This review has identified a range of self- and peer assessment tools and processes to usefully contribute to the assessment of interprofessional competencies. Findings highlight the option of using a range of self and/or peer assessment approaches including formally structured tools and less structured processes, inclusive of focus groups and reflection. Discussion recommends that results identified within this search be used to complement tools, which can be used by faculty and others within a broader mosaic of assessments designed to support learning and the development of competent, self-reflective beginner practitioners. As such, the research provides a useful resource for seeking to effectively enhance interprofessional learning and competencies attainment. Of note is the conclusion that there is still more study to be undertaken in this area including the need for greater clarity and consensus agreement about definitions, tools, and the most appropriate measurement approach.

Data availability statement

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

Author contributions

SB: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. JY: Data curation, Formal analysis, Investigation, Writing – review & editing. DB: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing – review & editing. IA: Data curation, Formal analysis, Investigation, Writing – review & editing. AP: Data curation, Formal analysis, Investigation, Writing – review & editing. KS: Data curation, Formal analysis, Investigation, Writing – review & editing. A-RY: Data curation, Formal analysis, Investigation, Methodology, Writing – review & editing. PA: Formal analysis, Investigation, Methodology, Writing – review & editing. PB: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Project administration, Supervision, Writing – review & editing.

Funding

The author(s) declare that financial support was received for the research, authorship, and/or publication of this article. This research is supported by a Trust Waikato Community Impact Grant, Hamilton, New Zealand.

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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frontiers | Frontiers in Medicine

TYPE Original Research
PUBLISHED 16 October 2024
DOI 10.3389/fmed.2024.1428941

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OPEN ACCESS

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RECEIVED 07 May 2024
ACCEPTED 25 September 2024
PUBLISHED 16 October 2024

CITATION
Rietdijk WJR, Maljaars-Hendrikse M, van Dijk M, Malik RF, Tan N and van der Kuy PHM (2024) Constructing a measure for self-perceived open organizational culture in a university hospital pharmacy.
Front. Med. 11:1428941.
doi: 10.3389/fmed.2024.1428941

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Constructing a measure for self-perceived open organizational culture in a university hospital pharmacy

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Background: An open organizational culture in the workplace represents an environment where information, ideas, and feedback are freely exchanged among all members, regardless of position or rank. Currently, there are no valid survey instruments to measure this culture within a healthcare context. To address this gap, we developed a survey instrument to measure self-perceived open organizational culture at a university pharmacy using a test re-test study design.

Methods: Data were collected during classroom training on basic mediation skills study. Participants completed the same questionnaire before (test phase) and after the training (validation phase). The questionnaire included statements assessing open organizational culture. The data were analyzed using standardized psychometric methods, including correlations, Exploratory Factor Analysis (structural validity), and construct validity by correlating the open organizational culture scores with the Interpersonal Communication Inventory.

Results: In the test phase, 191 participants (161 females, 84%; response rate = 39.7%) contributed to the initial construction of the self-perceived open organizational culture survey instrument. In the validation phase, 81 of the original respondents completed the questionnaire again. Three latent factors were identified, retaining 22 of the 37 items: "enabling systems" (7 items), "open behavior" (8 items), and "trusting and supporting coworkers" (7 items). High correlations were found among the three factors ($r > 0.6$), and between these factors and the Interpersonal Communication Inventory ($r > 0.35$). Cronbach's alphas were all above 0.85, indicating good internal consistency. During the validation phase, the factors demonstrated high internal consistency, test/re-test correlations, and agreement.

Conclusion: This study presents a 22-item survey instrument for measuring individual differences in self-perceived open organizational culture within a university hospital pharmacy. The instrument demonstrates internal consistency and construct validity. Further validation of its psychometric properties and testing in other healthcare departments are recommended.

KEYWORDS

open organizational culture, healthcare, validation, survey, reliability, construct validation

Introduction

Organizational culture is crucial in understanding and addressing workplace challenges (1, 2). It encompasses shared beliefs, norms, and values that shape employee behavior, attitudes, and well-being. Additionally, organizational culture reflects an organization's processes, practices, and activities, influencing employee performance (3–5). In healthcare, recent studies on organizational processes indicate a growing emphasis on fostering an "open" culture (4, 5).

An open organizational culture (OOC) in healthcare involves an environment where information, ideas, and feedback are freely exchanged among all members, regardless of rank and position (4–8). High-performing healthcare teams consistently exhibit an OOC, where open communication fosters creativity and drives significant breakthroughs (8). This culture promotes trust and mutual respect, empowering individuals to voice their thoughts and contribute to shared goals (9, 10). In healthcare, OOC elements overlap with general organizational psychology but also include specific aspects such as patient orientation and psychological safety (5).

The relevance of an OOC in healthcare is heightened by current challenges, such as workplace safety concerns and the increasing demand for transparent professional communication (5, 11). This is especially critical given the current of personnel shortages and mounting pressure on healthcare systems due to aging populations (4–6, 12), which can increase the likelihood of workplace conflicts among colleagues increases. Implementing and monitoring an OOC can help address these issues effectively.

From both research and management perspectives, it is essential to objectively measure and monitor the perceived OOC of employees within healthcare departments. However, to our knowledge, no valid and reliable survey instrument currently exists in the literature that can measures this. An earlier Delphi study identified key aspects of an OOC specific to healthcare departments (5). Building on these findings, we used them as a basis for developing a survey instrument to measure self-perceived OOC. This procedure aligns with the Checklist for Reporting of Survey Studies (CROSS) guidelines for survey measurement research (13).

To achieve this, we used data from a study on the effect of a classroom training on mediation skills to assess the test–retest reliability, structural and construct validity, and internal consistency of a newly developed questionnaire on self-perceived OOC at a university hospital pharmacy. We hypothesize that the items derived from the study by Malik et al. (5) can be effectively used to construct a reliable survey instrument. Additionally, we anticipate that the underlying factors will align with the qualitative findings of Malik et al. (5). Furthermore, we expect to find positive ($r > 0.40$) between the factors of OOC and the score on the Interpersonal Communication Inventory (ICI) (7).

Abbreviations: EFA, Exploratory Factor Analysis; ICI, Interpersonal Communication Inventory; KMO, Kaiser-Meyer-Olkin measure of sampling adequacy; OOC, Open Organizational Culture.

Method and analyses

Study context and participants

At pharmacy departments of the university hospital, we aimed to train all healthcare personnel in basic mediation and professional communication skills. To evaluate the effectiveness of the training, participants completed the same questionnaire before and after the training sessions. The data or this study were derived from these trainings. All healthcare personnel from the two pharmacy departments at Erasmus MC – the in-patient and out-patient pharmacies – were invited to participate. The two pharmacies had comparable team compositions, backgrounds, education levels and job roles. There were no exclusion criteria; all employees were eligible to join. The effectiveness of the intervention was assessed using a before-and-after study design.

Intervention

We designed a concise training program to equip participants with basic mediation skills, aimed at de-escalating tension in professional communication at an early stage (14). These classroom sessions also focused on fostering an open atmosphere to discuss differences among colleagues before conflicts escalate. The training included techniques derived from professional mediator training to maintain constructive dialogue during escalation or disagreement. Each team was asked to have 3 to 4 colleagues participate in three additional in-depth training sessions. All training sessions were conducted in a classroom setting and lasted 90 min each. This intervention took place between June 2022 and January 2023.

Data collection

The questionnaires were distributed to the healthcare professionals' hospital e-mails addresses using pre-programmed surveys in Castor EDC (version 2023.4.5.0), a web-based system designed for secure and valid data collection through electronic Case Report Forms (eCRFs). The system tracks completion rates and prevents duplicate or repeated entries. Participants received the questionnaires before and after the intervention period, referred to as the test phase and validation phase, respectively. The questionnaire measured various dimensions, including baseline characteristics (e.g., sex, years of work experience), the ICI, and 37 items assessing the self-perceived OOC within a healthcare department. The inclusion of OOC in both pre- and post-training questionnaires aimed to develop a reliable OOC survey instrument from these data.

After the intervention period, the same questionnaire was sent again, including the OOC items, regardless of intervention completion, to assess test/re-test reliability. The study was approved by the Medical Ethics Review Board of Erasmus MC (MEC-2022-0159), and written informed consent was obtained from all participants prior to participation. This study is part of a larger pre-registered project available on the Open Science Framework (available at: DOI 10.17605/OSF.IO/N8GE7). The COnsensus-based Standards for the selection of health status Measurement INstruments (COSMIN) checklist for patient-reported outcome measurement instruments is provided in the Supplementary material (15).

Item development

The original English and Dutch statements were developed using the Delphi method (5). Two authors verified the content (i.e., MMH, MvD) in consultation with an English language editor at Erasmus MC. Subsequently, two authors (i.e., MMH and WJRR) reviewed the items to ensure they were understandable, clear, and unambiguous. Both the Dutch and English versions are available in Supplementary material A. These statements reflect healthcare workers' perceptions of important aspects of an OOC, making them suitable for use as a survey instrument. In the original study, leadership, employee attributes, organizational processes, and, to some extent, patient orientation were identified as the main themes. Our approach allows us to confirm whether these themes also emerge when quantitatively measuring OOC in a department. While the original study identified the important dimensions and statements of OOC, it did not provide response categories for use as a survey instrument. For each statement, respondents rated their agreement on a 7-point Likert scale, ranging from [1] "completely agree" to [7] "completely disagree." This scale was chosen to assess self-perceived OOC because it is well-suited measuring perceptions on a continuous scale ad avoids strong ceiling or floor effects (16, 17).

As the questionnaire was similar before and after the training, we expected the factor structure (i.e., which items load on which factors) to remain consistent before and after the training. However, we did expect that the levels of self-perceived OOC and associations may have changed due to the training. In other words, if a factor reflects a specific phenomenon before the training and the measure is internally consistent, it should continue to measure the same phenomenon. The factor structure should remain stable, though the levels of the measures may vary.

Construct validity

The ICI, developed by Bienvenu (7), was included to assess its correlations with the OOC factors identified in the initial analysis. The ICI measures an individual's ability to communicate effectively and listen well. We expected positive correlations ($r > 0.40$) between OOC factors and the ICI in the test phase.

Statistical analysis

We analyze the data in three steps. First, we described the characteristics of the study respondents using descriptive statistics. Categorical variables are reported as number and frequencies. Second, during the test phase, we conducted an Exploratory Factor Analysis (EFA) to identify emerging factors, following established guidelines (18). A factor was retained if it had at least three statements loading onto it, with factor loadings of 0.50 or higher. Statements we retained and assigned to the corresponding factor also if they loaded high on one factor and relatively low on others (19). If these conditions were no met, the statement was removed and the EFA repeated. We also inspected statements for meaningful content in relation to the identified factors to ensure content validity and coherence. The Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) and Bartlett's test statistic (20, 21) were reported to assess the suitability of the data for factor analysis. A KMO value above 0.8 was considered adequate, and a Bartlett's test p-value below 0.05 was sufficient to proceed with EFA. This process allowed us to present the final statement set with adequate factor loadings and qualitative label the factors. We also reported Cronbach's alpha to reflect internal consistency. Second, we calculated Pearson correlation coefficients between the latent factors identified and examined correlations between the OOC dimensions and the ICI. Third, during the validation phase, we repeated the EFA, calculated correlations, created Bland–Altman plots, and assessed Cronbach's alpha. Data management was performed using Castor EDC (version 2023.4.5.0) and R studio (version 4.2.1), while statistical analyses were conducted using SPSS 28.0.1.0. A p-value below 0.05 was considered statistically significant.

Results

Background characteristics

The background characteristics of the respondents in the test phase sample are presented in Table 1. The sample included 191 pharmacy employees, with a response rate of 39.7%. The majority were female ($n = 161$, 84%), most were between 20 and 40 years old ($n = 114$, 60%), and most worked day shifts only ($n = 170$, 89%).

Test phase

We conducted three EFAs to align the underlying data structure with content-meaningful factors. In the first EFA, we included all 37 items derived from the previous study (5). The analysis showed a KMO value pf 0.956 and a statistically significant Barlett's test (Bartlett's statistics = 6160.01, $p < 0.001$). Four factors were identified

TABLE 1 Respondent's background characteristics ($n = 191$).

Total sample		191 (100)
Sex	Male	30 (16)
	Female	161 (84)
Age	20–40 years	114 (60)
	41–60 years	67 (35)
	>61 years	10 (5)
Department	Inpatient pharmacy	123 (64)
	Outpatient pharmacy	68 (36)
Shift work	Day shifts	170 (89)
	Switch day/night shifts	21 (11)
Tenure at department	<10 years	160 (84)
	11 to 20 years	16 (8)
	21 to 30 years	12 (6)
	31 to 40 years	3 (2)
Employment contract	Full-time	99 (52)
	Part-time	84 (44)
	Flexible-contract/Freelance	8 (4)

All variables are categorical and presented as number (with percentage in parentheses).

(eigenvalue>1.0), but 12 items that did not load significantly onto any factor (factor loadings <0.5), resulting in an explained variance of 62.6%. These 12 items were excluded in the second EFA.

In the second EFA, the KMO value remained at 0.956, and Barlett's test was again statistically significant (Bartlett's statistics = 3853.07, $p < 0.001$). This analysis revealed three factors (eigenvalue >1.0) with an explained variance of 64.2%. One item did not load significantly on any factor, and another loaded relatively well onto all three factors. Both items were deleted for the third EFA. Content validation showed that the remaining items were well-clustered around their respective factors.

The third and final EFA had a KMO value of 0.954 and significant Bartlett's test (Bartlett's statistics = 3453.30, $p < 0.001$). All retained items loaded strongly onto one factor and weakly on the others. We also confirmed that the items aligned with their respective factors based on content validity, which was the case. As a result, we included 22 items in the final set of questions, retaining three factors that explained 64.9% of the variance. Table 2 presents the original 37 items (in order presented to the respondents) and indicated which items were included in the final item set. The three factors were labelled: enabling systems, open behavior, and trusting and supporting coworkers. These factors and their associated items make sense from both content validity and theoretical perspectives, with items clustering logically under their respective factors. Supplementary material B provides the rotation matrices for all three EFAs and the results of each step.

Table 3 presents the Cronbach's alpha values and the correlations among the three factors. All three factors demonstrated a Cronbach's alpha higher than 0.9. Additionally, the Pearson correlation coefficients showed strong correlations among the three factors ($r > 0.7$, $p < 0.001$). Significant positive correlations were also observed between the ICI and the three OOC factors: enabling systems ($r = 0.37$, $p < 0.001$), open behavior ($r = 0.43$, $p < 0.001$), and trusting and supporting coworkers ($r = 0.47$, $p < 0.001$). Supplementary material C provides the distributions of the scores, along with skewness and kurtosis of the three factors.

Validation phase

Approximately eight months after the intervention and initial survey, respondents were asked to complete the same questionnaire again. Of the 191 original respondents, 81 participated in the follow-up. We repeated the EFA using the 22 items identified in the test phase, constraining the solution to three factors (see Supplementary material D). The KMO statistic was 0.894, and Barlett's test of sphericity was statistically significant (Bartlett's statistics = 1358.07, $p < 0.001$). The results showed some inconsistencies regarding which items loaded strongly or poorly onto the originally defined factors. However, as shown in Table 4, when we considered the factors as identified in the test phase, we observed high Cronbach's alphas for the three subscales in the validation phase ($\alpha > 0.88$). Additionally, test/re-test correlations were strong for the factors: enabling processes ($r = 0.65$, $p < 0.001$), open behavior ($r = 0.70$, $p < 0.001$), and trusting and supporting coworkers ($r = 0.56$, $p < 0.001$). Figure 1 displays Bland–Altman plots showing high agreement between the test phase and validation phase outcomes for the three factors. Supplementary material E provide a comparison between the total sample in the test phase ($n = 191$) and the 81 respondents in the validation phase. No significant differences were found in the distributions of these variables, indicating no bias in loss to follow up.

Discussion

This study aimed to construct a survey instrument to measure self-perceived OOC within university hospital pharmacies. An OOC is characterized by an environment where information, ideas, and feedback are freely exchanged among all members, regardless of their position and rank (4–6). From the original 37 statements, 22 items were selected to reflect three interrelated factors of an OOC in a university hospital pharmacy: enabling systems, open behavior, and trusting and supporting coworkers. The results indicated that these three factors were sufficient to explain a significant portion of the variance.

Of the original 37 items, 15 were excluded for various reasons. For example, the specific context of the pharmacy in this study may have led to the exclusion of certain patient-related items, such as item 9 ("the patient gives us feedback on the experienced care"), as pharmacists typically do not have direct contact with patients, despite their role in the care process. This item, however, may be more relevant in inpatient and outpatient clinical departments. Another excluded item, item 34 ("We are open to views from a wide network, such as those of other departments, professions and institutions"), might reflect an important aspect of an OOC but may be less perceptible within the pharmacy context.

Our study identified three factors associated with measuring self-perceived OOC in a healthcare department. These factors showed some overlap with those identified in the Delphi study by Malik et al. (5) (p. 8). The *first factor*, "enabling systems," was measured by seven items, including: "Our procedures and systems ensure transparency with regard to successes and points of improvements" (item 2). Transparency about processes and improvements is crucial for fostering an OOC. Another item, "Management should lead by example and demonstrate behavior consistent with an OOC (item 28), emphasizes the importance of leadership in promoting openness. The items in this factor relate to how systems should facilitate an OOC within the department, which is why we labelled it "enabling systems."

Organizations use both formal and informal methods to organize processes. By structuring processes to promote an OOC, they can facilitate professional communication among colleagues across hierarchies (5, 12) and foster fair, transparent decision-making (4). Additionally, an OOC may enhance work engagement and job satisfaction (22). Therefore, the factor "enabling systems" should focus on designing of a coherent set of processes that support and sustain an OOC.

The *second factor*, "open behavior," was measured by 8 items. In an OOC, individual behavior significantly impacts the department as a whole. Each coworker should be mindful about their behavior within the department. This includes avoiding the abuse of power (item 21) and feeling comfortable expressing differing opinions, as reflected in item 24: "We feel comfortable in discussions to speak our minds when our thoughts deviate from the norm." It also involves the ability to voice constructive criticism without fear of negative consequences, as captured in item 26: "we can express constructive criticism without

TABLE 2 Original and retained items.

Item	English statement	Factor	Factor	Factor	Included?
		Enabling systems	Open behavior	Trusting and supporting coworkers	
1	We show interest in each other's competences				Excluded
2	Our procedures and systems ensure transparency with regard to successes and points of improvement	0.621	0.273	0.262	Included
3	There is informal contact that strengthens cohesion within the team				Excluded
4	Our management or supervisor is well informed about the daily working routine and can take the right decisions	0.761	0.229	0.194	Included
5	We have faith in each other's competencies	0.463	0.200	0.635	Included
6	We continuously improve based on what we have learnt from the feedback systems of our department	0.605	0.305	0.394	Included
7	Our management or supervisor helps us to solve problems	0.749	0.344	0.239	Included
8	We listen to each other's opinions regardless of the hierarchy and take decisions on substantive grounds				Excluded
9	The patient structurally gives us feedback on the experienced care				Excluded
10	We do not blame each other for incidents	0.117	0.196	0.643	Included
11	Respect for colleagues and patients is one of our most important values	0.187	0.231	0.804	Included
12	We trust each other's intentions	0.297	0.293	0.741	Included
13	We support each other emotionally in our department	0.223	0.242	0.651	Included
14	We sincerely approach each other positively, give each other compliments and express appreciation	0.484	0.338	0.606	Included
15	Colleagues with prestige also dare to be vulnerable				Excluded
16	Joint reflection on our actions and processes is structurally embedded in our work	0.581	0.317	0.349	Included
17	We invest in a learning environment in which people in training are allowed to challenge their supervisors				Excluded
18	We can indicate that we cannot cope with the high workload and if so, serious attention is being paid	0.659	0.413	0.253	Included
19	The views of the patients influences our policy				Excluded
20	We discuss in our department how we can prevent incidents from reoccurring				Excluded
21	We do not abuse power	0.283	0.594	0.400	Included
22	We feel free to question the decisions or actions of colleagues with authority	0.467	0.540	0.382	Included
23	We feel safe to be ourselves within the organization	0.321	0.651	0.438	Included
24	We feel comfortable in discussions to speak our minds when our thoughts deviate from the norm	0.318	0.800	0.292	Included
25	We are informed and involved with regard to changes in our department				Excluded
26	We can express constructive criticism without fear of negative consequences	0.361	0.785	0.233	Included
27	The culture in our department makes it easy to acknowledge mistakes and to learn from each other's mistakes				Excluded
28	Our management or supervisor show exemplary behavior that fits into an open culture	0.674	0.487	0.300	Included
29	We dare to be open about our individual points of improvement and how they can be further developed	0.323	0.597	0.339	Included
30	Possible dysfunction is addressed in time and is constructively resolved				Excluded
31	We are aware of each other's qualities and make sufficient use of them				Excluded
32	We are outspoken to each other and not about one another; should this be otherwise, we will call each other to account				Excluded

(Continued)

TABLE 2 (Continued)

Item	English statement	Factor	Factor	Factor	Included?
		Enabling systems	Open behavior	Trusting and supporting coworkers	
33	Difficult topics that stand in the way of openness, such as shame, fear, power, distrust and dysfunction, can be discussed openly				Excluded
34	We are open to views from a wide network, such as those of other departments, professions and institutions				Excluded
35	We recognize, value and stimulate diversity	0.307	0.512	0.395	Included
36	We experience low barriers to discuss ideas and issues with our management or supervisor	0.493	0.581	0.125	Included
37	We can listen to and watch others without judging immediately	0.415	0.382	0.536	Included

The rotated factor matrix of the final EFA is presented in the table. Numbers are factor loadings to the respective factor.

TABLE 3 Correlation matrix and Cronbach's alpha.

			Factor		
		Mean (SD)	Enabling systems	Open behavior	Trusting and supporting coworkers
Factor	Enabling systems ($n = 7$ items)	3.51 (1.35)	1.00		
	Open behavior ($n = 8$ items)	3.00 (1.26)	0.81	1.00	
	trusting and supporting coworkers ($n = 7$ items)	2.79 (1.14)	0.72	0.74	1.00
	Interpersonal communication inventory	2.39 (0.30)	0.37	0.43	0.47
	Cronbach's alpha		0.921	0.931	0.912

All Pearson's correlations are significant with a $p < 0.001$. Sample size is 191 participants.

fear of negative consequences." Therefore, we labelled this factor "open behavior."

In a department comprising diverse colleagues with varying personalities, individual open behavior is essential. Collectively, employees shape the department's culture. As noted in previous research, on an individual level, showing interest and respect (5), and the ability to give and receive feedback (5) are key components in shaping an OOC. A critical element in this process is *professional socialization* (23), which refers to an individual's journey to become familiar with the organization, department, processes, and culture. This is essential for existing and new employees to understand and actively participate in an OOC.

The *third factor*, "trusting and supporting coworkers," was measured by 7 items. In an OOC, trust and support are crucial for effective collaboration among coworkers. The items associated with this factor emphasize these aspects. For example, "We have faith in each other's competencies" (item 5), reflects the *trust* respondents have in their coworkers. Additionally, item 37 stated: "we can listen to and watch others without judging immediately." This highlights the importance of trust and the ability to listen to each other without immediate judgement in fostering an OOC. Successful collaboration within a department requires trust and psychological safety (4, 5). Higher scores on these items indicate greater trust and support among coworkers, which, in turn, contributes to cultivating an OOC. Therefore, we labelled this third factor "trusting and supporting coworkers."

To our knowledge, this is the first study to operationalize a measure of self-perceived OOC. Creating safe work environments is crucial, particularly in light of movements like "#me-too" movement, which have underscored the need for safety and openness in all workplaces, including healthcare (11). A safe environment allows individuals to express themselves freely about work-related aspects. Our survey instrument may help measure and monitor an OOC in a broader range of healthcare departments beyond just a pharmacy department.

The present study demonstrates that the self-perceived OOC measure has good test–retest reliability. The test–retest correlations, Cronbach's alpha values, and Bland–Altman plots indicate that the 22 items and three factors are relatively stable over time. However, it remains possible that the intervention impacted the responses regarding self-perceived OOC, which future research should further explore.

Previous research has measured other aspects related to working in healthcare, such as safety attitudes towards patients, using the Safety Attitude Questionnaire (24), which assesses six domains related to a safety culture (e.g., teamwork and climate). This questionnaire originated in the Intensive Care Unit, focusing specifically on patient safety (24). While the concepts of patient safety and OOC are related, OOC takes a broader view of working in a healthcare setting. In addition to patient safety, healthcare workers should also focus on factors such as enabling systems fostering trust and support among colleagues. For example, this includes perceptions of how individuals function within the department and manage work load. We argue that fostering an OOC, where team members feel free to speak out and collaborate effectively, can also help safeguard patient safety.

TABLE 4 Validation-phase.

		Factor		
		Enabling systems	Open behavior	Trusting and supporting coworkers
Factor	Enabling systems	1.00		
	Open behavior	0.78	1.00	
	Trusting and supporting coworkers	0.63	0.73	1.00
	Cronbach's alpha	0.882	0.915	0.891

All correlations are significant with a $p < 0.001$. Sample size is 81 participants.

Limitations of the study and recommendations for future research

Some limitations discussed here should be considered for future studies. First, the response rate of 39.7% may be regarded as low for studies one of this nature. A possible reason for the low response rate could be that the research group is part of the same department, which may cause colleagues hesitant about participating in the training and survey.

Further, the training may have affected the level of self-perceived OOC and its associations with ICI. However, when the items are reflecting the same underlying factor and are internally consistent, we would expect a similar factor structure. Additionally, we did not correlate the emerging factors of self-perceived OOC and ICI during the validation phase. At this stage, following the classroom mediation skills intervention, perceptions of OOC in relation to ICI may have shifted. This could have influenced the strength of the correlations, which is why these analyses were not conducted in this study.

Also, because this study was conducted within the context of conflict resolution training, the findings may not be generalizable to broader context, and further validation is required. The fact that the researchers of the study were from the same department as the respondents may have also affected the responses due to potential relationships between them. Moreover, there was a significant loss to follow-up; of the original 191 respondents, only 81 respondents completed the survey after the training (Supplementary material E). This attrition may affect the results presented in the validation phase, and these findings should be interpreted with caution.

Future research should aim to confirm our findings using a confirmatory factor analysis, such as structural equation modeling. This approach would help further validate this instrument for research and management purposes. Our study provides an initial 22-item survey instrument to measure self-perceived OOC at large university hospital pharmacy. Further validation could be achieved by correlating scores on this scale with other personality and work-related factors. Consistent with our hypothesis, we found a significant positive correlation between the ICI and the dimensions of an OOC. Intuitively, an OOC is associated with high levels of ICI (7). Establishing construct validity is the next essential step in understanding self-perceived OOC (19).

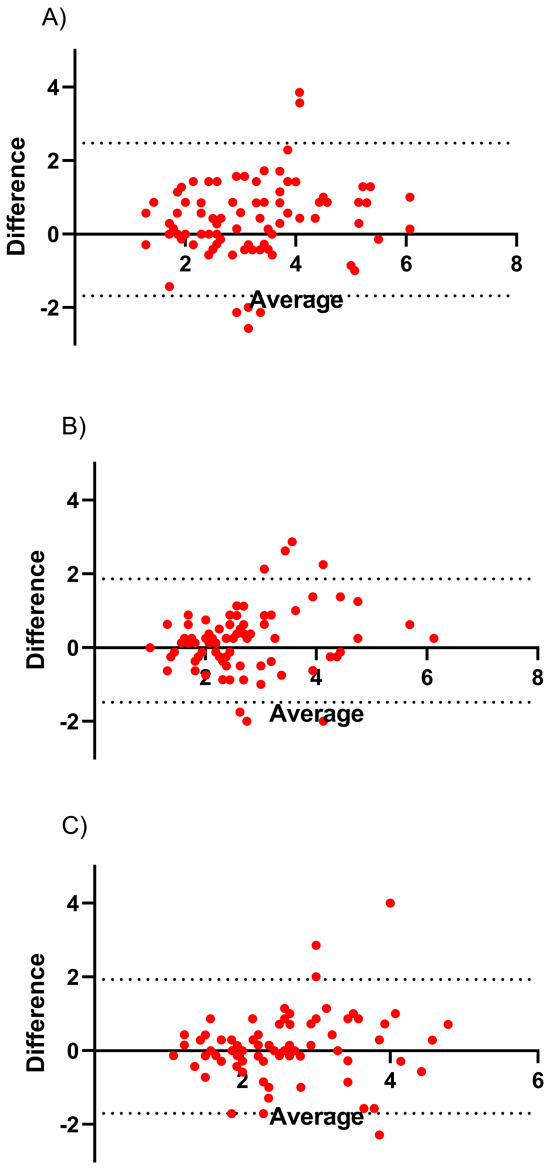

FIGURE 1
Bland–Altman plots. The Bland–Altman plots present the agreement between the identified factors in the test and validation-phase for **(A)** enabling systems, **(B)** open behavior, and **(C)** trusting and supporting coworkers. All factors show that there is a high degree of agreement. Taken together the Bland–Altman and high test–retest correlation this indicates that these factors are relatively reliable measures.

To this end, the factors identified in our study should be correlated with other individual differences associated with an OOC and psychological safety at work. This approach may also be applied in other professional settings where an open OOC is considered beneficial for job performance. Future research may also correlate the OOC factors with established models, such as the Job-Demands Resources model (25), which explains factors influencing job performance. An OOC may reduce the "costs" associated with maintaining high job performance (i.e., job demands) while positively influencing employee "health" (i.e., resources). However, the specific effects of an OOC on the Job-Demand resources model require investigation in future studies.

Conclusion

An OOC environment is characterized by free exchange of information, ideas, and feedback among all members, regardless of position or rank. To the best of our knowledge, no existing survey instrument specifically measures this type of culture within a healthcare department. This study aimed to develop a 22-item survey instrument to assess self-perceived OOC at a university hospital pharmacy. Our findings indicate that the survey instrument demonstrates internal consistency and shows evidence of construct validity. However, further validation and examination of its psychometric properties is recommended.

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 humans were approved by Erasmus Medical Center, Medische Ethische Toetsingscommissie (METC). The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

WR: Investigation, Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization. MM-H: Writing – review & editing, Writing – original draft, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Conceptualization. MD: Writing – review & editing, Writing – original draft, Validation, Methodology, Formal analysis, Data curation, Conceptualization. RM: Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Investigation, Data curation, Conceptualization. NT: Writing – review & editing, Writing – original draft, Validation, Resources, Methodology, Investigation, Formal analysis, Data curation. PK: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Conceptualization.

Funding

The author(s) declare that financial support was received for the research, authorship, and/or publication of this article. The study is funded by the Netherlands Organization for Health Research and Development (ZonMw, grant number: 10430132220026).

Acknowledgments

We thank all participants at both pharmacies for their contribution to this study. We also thank the language editor Ko Hagoort (Erasmus MC) for his proofreading of the final draft of this 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.

The author(s) declared that they were an editorial board member of Frontiers, at the time of submission. This had no impact on the peer review process and the final decision.

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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.2024.1428941/full#supplementary-material

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frontiers | Frontiers in Medicine

TYPE Perspective
PUBLISHED 07 January 2025
DOI 10.3389/fmed.2024.1490282

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RECEIVED 02 September 2024
ACCEPTED 19 November 2024
PUBLISHED 07 January 2025

CITATION
Williams KN, Lazzara EH, Hernandez J, Klocko D, Chandran N, Paquette SL, Preble R, Sadighi M, Tran B, Kilcullen M, Rege R, Reed G, Salas E, Tannenbaum SI and Greilich PE (2025) Integrating competency-based, interprofessional teamwork education for students: guiding principles to support current needs and future directions.
Front. Med. 11:1490282.
doi: 10.3389/fmed.2024.1490282

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Integrating competency-based, interprofessional teamwork education for students: guiding principles to support current needs and future directions

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Interprofessional teamwork is vital to effective patient care, and targeting healthcare learners earlier in their education can lead to greater improvement in confidence and competence in teamwork skills. Despite this, institutions have continued struggling to integrate competency-based interprofessional teamwork curriculum in undergraduate health care professions' education. The current article provides guidance related to design, implementation, and assessment for institutions seeking to implement competency-based teamwork education and training strategies for healthcare students. Guiding principles and strategies for curricular design focus on conducting thorough interprofessional needs analyses and building transportable, evidence-based competencies that apply across professions. For implementation, key principles center on strategies to ensure adequate professional representation and faculty development. Assessment considerations focus on building infrastructure for evaluation that spans professional schools. These strategies aim to create a robust, effective, and sustainable IPE curriculum that enhances collaboration and teamwork among future healthcare professionals. By addressing the key areas of design, implementation, and assessment, this article offers comprehensive guidelines for advancing interprofessional education. We believe incorporating the key guiding principles and strategies from this paper will enable institutions to integrate teamwork education and training more effectively into undergraduate healthcare training, which will facilitate institutions' ability to ensure learners are "team ready" as they transition into the workforce after graduation.

KEYWORDS

teamwork training, interprofessional, competency-based medical education, healthcare education, curriculum design, implementation, longitudinal assessment

Introduction

It is well established that teamwork is vital for providing safe and effective patient care. Healthcare students have the capacity to impact patient care through their interactions on teams and with patients even while in training. Residents may be particularly vulnerable to committing preventable errors if teamwork skills are lacking, which can negatively impact patient care (1). Given their direct role in patient care, there has been a recent shift in viewing residents more as providers than as trainees (2). This requires healthcare students to be "team ready" upon graduation from their pre-licensure programs. This shift is supported by the American Association of Medical Colleges (AAMC) specifying teamwork competencies needed for the transition to residency through its Entrustable Professional Activities (EPAs) (3). Similarly, the Canadian Interprofessional Health Collaborative's (CIHC) competency framework for advancing collaboration (4) and the Interprofessional Education Collaborative (IPEC) competencies (5) target teamwork and maintain relevance across healthcare professions in the career space. Evidence shows earlier introduction of such competencies confer greater confidence and competence in first year post-graduate residents upon entering residency (6). Further, evidence suggests that biases between healthcare professions are formed early, prior to interprofessional education (IPE) in students (7), which is echoed by current stereotypes held by both students and the public (8, 9). Thus, introducing education in teamwork competencies as early as possible may reduce the need for unlearning of bad habits upon entry into the workforce – in this case about teamwork and interprofessional collaboration. Incorporating longitudinal education and assessment opportunities additionally permits learners to receive extended feedback, see their own progress and its impact on their teams over time (10).

The Center for the Advancement of Interprofessional Education (CAIPE) defines interprofessional education as "occasions when two or more professions learn with, from and about each other to improve collaboration and the quality of care" (11). Although exposure to people from other professions may be beneficial, without some degree of structure, there is the risk of learning incorrect lessons/insights. Therefore, it is relevant to intentionally target these learners for teamwork and interprofessional learning experiences as early as possible to minimize negative repercussions of poor teamwork competencies and/or stereotype biases. Despite this, institutions have struggled to incorporate such curricular events in the undergraduate medical education space (12). The current article provides guidance related to design, implementation, and assessment for institutions seeking to implement competency-based teamwork education and training strategies for healthcare students, which are informed by the literature and our collective experience as healthcare professionals, educators, administrators, and assessment experts collaborating through the TeamFIRST program at University of Texas Southwestern Medical Center. Guiding principles and strategies for curricular design focus on conducting thorough interprofessional needs analyses and building transportable, evidence-based competencies that apply across professions. For implementation, key principles center on strategies to ensure adequate professional representation and faculty development. Assessment considerations focus on building infrastructure for documentation that spans professional schools. We believe incorporating the key guiding principles and strategies from this paper will enable institutions to integrate teamwork education and training more effectively into undergraduate healthcare curriculum, which will facilitate institutions' ability to ensure learners are "team ready" as they transition into the workforce after graduation.

Design recommendations: needs analysis and faculty selection

The first step in the process of generating an effective IPE program is to conduct a thorough needs analysis that identifies competencies for longitudinal instruction and assessment which effectively incorporate nuances between professional groups. Although there are existing needs analyses for healthcare [e.g., the Hennessy-Hicks Training Needs Analysis questionnaire; (13)], these often rely on self-report mechanisms to identify training needs. For example, the Hennessy-Hicks questionnaire assesses series of clinical tasks and requests providers to rate (1) how critical the task is for their job and (2) how well they are performing the task. Not only is this method targeted to healthcare providers (rather than trainees), but this method also makes the needs analysis vulnerable to the potential role of survey biases and the Dunning-Kruger effect altering the results of the needs analysis. The Dunning-Kruger effect refers to a cognitive bias where individuals with limited competence in a particular domain tend to overestimate their abilities, while those with higher competence may underestimate theirs (14). To avoid these issues, it would be beneficial for future research to focus on the development of a standardized teamwork training needs analysis targeted to the undergraduate professional education space. Strategies for effective integration of team-oriented needs analyses include card sorting tasks to objectively evaluate shared mental models (15), surveys to evaluate teamwork contexts (16), and simulation to evaluate team performance (17). To maximize generalizability, such needs analyses should be aligned with existing competency frameworks. For example, the Canadian Interprofessional Health collaborative's (CIHC) competency framework for advancing collaboration (4) specifies six domains of competency that relate to communication and teamwork. These include relationship-focused care services, team communication, role clarification and negotiation, team functioning, team differences/disagreements processing, and collaborative leadership. Similarly, the Interprofessional Education Collaborative (IPEC) competencies include four domains that span values and ethics, roles and responsibilities, communication, and teams and teamwork.

Competency frameworks such as IPEC and CIHC often overlap, and it can be challenging to identify which should take priority when beginning an interprofessional needs assessment. Institutions may find utility in reviewing existing research-based consensus methods that have been used to evaluate IPE competency frameworks thus far and using these as a starting point to begin an institutional consensus

evaluation when planning the needs analysis. Rogers et al. (18) conducted two international workshops to come up with international consensus on aspects that are vital to assessment of interprofessional learning in the context of interprofessional education. They identified five domains as key themes relevant across competency frameworks that should be incorporated in assessment: role understanding, interprofessional communication, coordination/collaborative decision-making, interprofessional values, reflexivity, and teamwork. These can be utilized as a baseline for identifying competency frameworks most relevant to an institution's goals. Initial needs assessments should rely heavily on input from key stakeholders to ensure all aspects of the assessment align with the interests and logistical realities across levels of the organization (19). Thus, it can be helpful to conduct consensus exercises with key stakeholders within the organization to solidify the competency framework and subsequent competencies to focus on during the needs analysis phase. For example, to produce design guidelines for assessment using their competency framework, Smeets et al. (20) compiled separate expert groups consisting of interprofessional experts, patients, educational scientists, students, and teachers. They had each of these groups meet to come to consensus regarding key guidelines for IP assessment plans at their institution regarding three key features: (1) the assessment tasks, (2) the pool of assessors, and (3) procedures that should be used to assess IP competencies in students. They then had meetings with representatives from each of these groups to come to consensus across the different types of stakeholders. This strategy enabled them to reach consensus across stakeholder groups in most of their guidelines for assessment (20). Thus, these methods may be an effective way for organizations to identify the competency framework and individual competencies that should be targeted, and subsequently identify the specific assessment methods that can be used to inform a targeted educational improvement plan at their institution. Benefits and disadvantages of varying data collection methods for needs assessments can be found in Goldstein and Ford (21).

Although it is common practice to begin instructional design improvements through needs analyses (22), without core faculty to guide the program and assessment, educational interventions are vulnerable to overlapping with one another and achieving insufficient depth to enable the learner to progress through mastery across the learning objectives in longitudinal curriculums (23, 24). Therefore, establishing a core faculty of educators or champions that take responsibility for maintaining clear and deep learning objectives across the full curriculum is beneficial to ensure appropriate sequencing of performance opportunities, learning events, and content (25). Maximum success for progressive educational interventions and behavioral assessments requires significant involvement from faculty scholars to oversee longitudinal goals of the program (24, 26). It is beneficial to target faculty involved in consensus processes in the needs analysis phase as primary individuals for these roles, as participating in the consensus process enables them to have a greater understanding of the program's scope than individuals who were not involved in such processes. Key skills, knowledge, and functions of the ideal individual(s) to represent core faculty are outlined in Figure 1. Failure to meet these requirements can ultimately cause substantive conflict between the stakeholders' needs and the students and faculty at the front line of the program, which lead to wasted effort and threaten program utility and sustainability (27).

Implementation recommendations: piloting and faculty development

Once the training needs analysis has been completed and core faculty have designed the curriculum, designers should ensure all

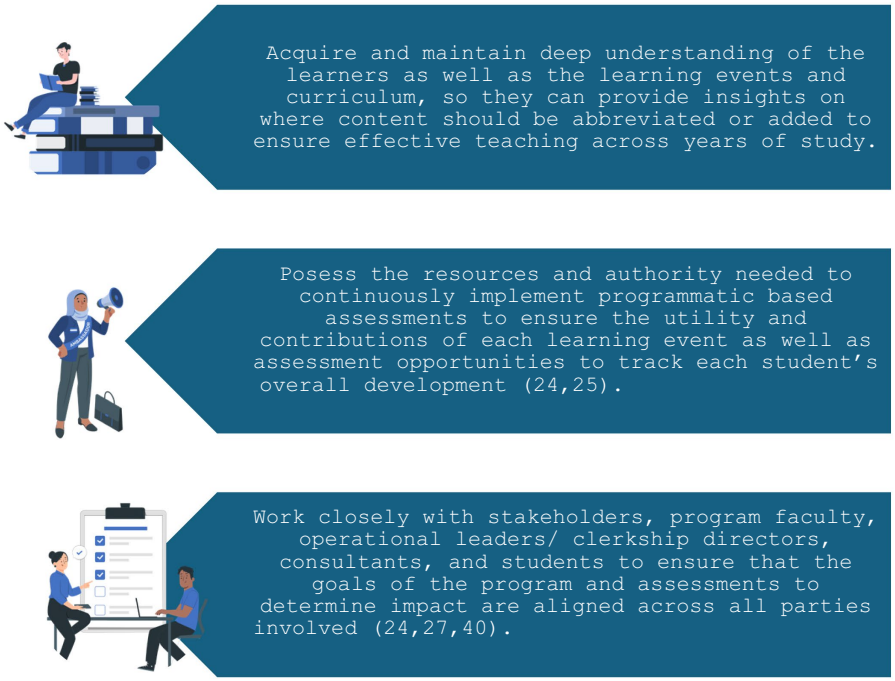

FIGURE 1
Key abilities of the program's core faculty. Illustrations provided by StorySet (https://storyset.com/).

module plans are appropriately built on each other throughout each iteration and according to the potential for co-education across health professionals. Piloting is vital to the success of this process (28). Pilot sessions create an early opportunity for iteration on developed curriculum, activities, and rubrics, and allow further improvement opportunities when they continue to be implemented in each cohort (28). To get the most out of piloting sessions, they should ideally incorporate a selection of the faculty who will lead the learning activity, as well as students who will participate and/or have participated in a previous event (if the activity has previously proceeded to the implementation stage). Both sets of students add utility to piloting sessions. While former students can use their culminated experience to advise changes that enhance its usefulness to prepare students for subsequent courses or clinical practice, students who are naïve to the intervention can provide a fresh perspective that serves as a more realistic test of how the event will be perceived by the incoming student cohort. As evidence of the benefits of incorporating diverse student opinions in curriculum development, the University of Illinois College of Medicine – Chicago generated the Student Curricular Board (SCB) to leverage students' expertise for curriculum improvements, and discovered this program was effective in using student knowledge to lead to improvements in program evaluation and longitudinal curriculum design (29). They found participation in the SCB additionally benefited student awareness of program initiatives and increased their inclination to pursue careers in academic medicine (29). Such programs also offer opportunities to further develop faculty representatives who deliver content to students.

When implementing a curriculum at a large academic medical center, it is rarely practical to have few faculty implement all program-related content. Additionally, institutions often face significant barriers in coordinating professional school schedules and balancing student ratios to create an adequate IPE experience (30). The impact of these barriers on IPE can be mitigated by integrating faculty representatives from varying disciplines into IPE to ensure adequate professional representation (8). For example, a UK university implemented their IPE program by having two faculty members (one from each program) deliver content in tandem to model appropriate behaviors to groups of students (8). To meet the need for diverse faculty, early efforts to establish a core faculty should further extend to a representative set of faculty members who deliver series of related learning activities to the students. Development of extended faculty is vital for identifying informal norms within the organization and combating areas where it contradicts the learning objectives (e.g., if in practice some clinicians at the institution do not adhere to the standardized handover protocols being taught or adequately engage in interprofessional collaboration (25)). Through this process, institutions can make developing faculty a priority (25), which further promotes these individuals to become education leaders, champions, and role models. There are a variety of methods to develop faculty. Examples of successful methods include provision of multiple forms of resources to aid teaching sessions (e.g., written and video-based content, Q&A sessions, and technical support), incorporating opportunities to participate in pilot sessions and co-create the curriculum, as well as post-activity debriefing sessions to provide feedback, and attend curriculum-specific educational sessions and workshops to improve their teaching and understanding of teamwork competencies. For example, McMillan et al. (31) describes key strategies to establish faculty commitment and ownership through conducting faculty-led workshops and disseminating data-driven findings to faculty. One of the leading causes of faculty resistance to change in medical education contexts is lack of common vision and consensus (32). Thus, the methods recommended in the previous section to reach consensus on the selected competency framework and needs analysis procedures may be a powerful mechanism to reduce faculty resistance to change during the implementation phase. Consensus meetings may also help to develop groups of faculty members and students representing each discipline and enhance interprofessional experience within these groups, which may further facilitate transfer of training to the clinical environment by contributing to the development of communities of practice that help students and faculty learn within the workplace (33, 34). Further, capitalizing on the experience of faculty involved in the needs analysis stage enables their insights from the needs analysis to transfer into implementation of the curriculum. Such efforts can be instrumental in ensuring that faculty have the knowledge and skills to convey curriculum content to students in ways that are more likely to be reflected in assessments.

Assessment recommendations: infrastructure and logistics

For assessment, IPE can be greatly aided by developing a capacity for academic evaluation that spans professional schools and facilitates collaboration. Assessing progression to mastery requires longitudinal assessment and linking many sources of data across the learners' duration in the program (23). Although it is often easier in the short term to allow individuals to fill in names using free-text fields or handwriting, this system is vulnerable to error and highly inefficient in the long term. It is nearly inevitable to have several students within a given course have similar or even identical names, which renders them insufficient for the purpose of longitudinal identification, and nicknames can both help and hinder this process. Linking longitudinal data can be much more successful by establishing a database that links student full names, nicknames, and student ID numbers, and provides these linked pieces of information to raters in a drop-down format across surveys. Tools with survey functionality such as REDCap (35) can be completed using smart phones, tablets, or laptops, making them a reasonably adequate replacement for paper form. For institutions that do not have access to REDCap, Qualtrics™ also has capabilities for longitudinal assessment and data linkages. Each of these systems can be programmed to utilize or download study ID numbers in place of identifiable information if there are substantive privacy concerns (though this is not typically the case, given these systems are secure and may only be accessed by those specified to have access rights). A system that includes multiple sources of identifying information enables raters to easily select the correct student based on a variety of information, rather than any single piece, and standardizes the identification process across assessment methods can greatly improve data linkages. During live events, this process can be further streamlined by having participants wear name tags, so that independent raters can identify students with no knowledge of their names and minimal introductions during the event. Coloured lanyards or scrubs can be used as a powerful mechanism to identify participants within teams. For example, nurse roles may wear red lanyards/scrubs, while physician roles where blue, etc. This can further be used to link survey data within groups even when it is anonymized (e.g., blue is associated with an individual study ID of 1, red 2, etc.).

Even with such tools, it is often challenging to capture sufficient nuances in complex performance episodes and/or reliability suitable for assessment in dynamic, live environments (36). Use of video recording technology can facilitate this process and enable the development and implementation of more refined grading criteria. For virtual events, Microsoft Teams can be useful for identifying participants; though, it requires participants to log into their accounts. We advise use of the transcript function embedded in these systems, as they are invaluable in helping raters identify speakers to grade more accurately and efficiently. Further, video recording provides a mechanism that enables the use of multiple raters, without the scheduling challenges typically associated with this decision. Use of recordings can enable more thorough assessment of accuracy as well as inter-rater reliability, thus, enhancing rating confidence and quality (36). Video recordings of performance episodes themselves can be used as source material in assessment. For example, it permits videos to be distributed to students so they can review their performance in conjunction with expert feedback, which is superior for student learning compared to traditional feedback methods (37). Further, it can support separate grading for different purposes (e.g., if grading criteria are different for summative relative to formative feedback purposes). Video recording enables greater professional collaboration across schools, as the occurrences can be referred to by each professional identity to evaluate their learners and areas for improvement. For example, two Dutch universities of Applied Sciences used this strategy to assess students' interprofessional collaboration skills using five interdisciplinary raters spanning expertise in psychology, nursing, educational sciences, physiotherapy and education sciences, and pedagogy (38). Use of this diverse set of raters (made possible by video recording) enabled the study to produce high quality and comprehensive insights into students' performance as well as the adequacy of the assessment tools and tasks (38). Where available, videos of previously evaluated sessions may be utilized to facilitate rubric development and rater training to reduce the time these take to implement. Use of previous sessions as learning opportunities is crucial when attempting to utilize real time ratings of the event, as preliminary pilot or training sessions utilizing video recordings without rewind/pause functions allow weaknesses of the assessment for live ratings to be identified and resolved prior to implementation (e.g., if the assessment items are too numerous or complex to be reliably assessed in real time). Continuously evaluating findings of these assessments relative to organizational goals is vital to ensure that the program continues to meet institutional needs. This can be accomplished through continued participation of consensus groups through data analysis phases, and the insights of these groups can be leveraged to lead to further improvement in the curriculum, implementation, and assessment practices. Additional tips for selecting appropriate raters and developing grading rubrics for assessment, as well as supporting continuous improvement of programs are discussed in Williams et al. (39).

Discussion

Interprofessional education is vital to ensuring that future healthcare professional graduates are "team ready" upon graduation. It is necessary to minimize potential negative impacts of stereotypes in the workplace as well as prepare learners to be more equipped to participate in teamwork immediately upon graduation, as their role increasingly transitions to that of a provider rather than learner. Despite significant progress over the last decade, many challenges remain to adequately integrate teamwork and IPE education into the undergraduate space. Scheduling and time constraints remain a significant burden across curriculums to integrate interprofessional learning opportunities and competencies. Further, it has remained a challenge to ensure adequate and accurate representation from various health professionals and retain key faculty throughout implementation of curriculums.

Effective teamwork and IPE should negate or minimize the potential negative impacts of stereotype development, facilitate personal bonding, effective teamwork and collaboration skills across educational boundaries leading to consistent demonstration of positive outcomes across learners. This article has presented several strategies to improve integration of interprofessional education into the undergraduate healthcare education space. These span curriculum design, implementation, and assessment, and have been guided by the collective expertise and experience of our Team FIRST working group that includes administrators, healthcare professionals, educators, and assessment experts.

Pertaining to design, we highlight strategies for developing standardized teamwork training needs analyses for undergraduate professional education. These assessments should utilize objective evaluation methods, such as card sorting tasks (e.g., to assess the how shared mental models are based on how similarly team members group relevant patient- or role-based information), teamwork context surveys (e.g., to assess features of the environment team members perform within, such as hierarchy, information transfer, department interdependence, and task prioritization structures), and team performance simulations (e.g., execution of a code situation which can be assessed by trained observers), to mitigate biases and improve accuracy. Using consensus methods to identify and align these assessments with established competency frameworks, such as those provided by the CIHC, IPEC, and AAMC EPAs ensures a comprehensive approach to evaluating and meeting educational needs.

Regarding implementation, integrating faculty representatives from different disciplines into IPE is essential. This strategy ensures adequate professional representation, appropriateness of the curriculum, and helps mitigate barriers related to coordinating professional school schedules and balancing student ratios. We further expand on strategies to develop faculty with piloting processes, resources, opportunities for curriculum co-creation, and post-activity debriefing sessions. Despite the use of these methods, it is plausible institutions may still encounter barriers due to either resistance to change or lack of interprofessional experience among faculty. Maintenance of the groups formed during consensus meetings associated with the needs analysis and curriculum development are a key source to prevent these barriers from occurring and ameliorate their negative impact during implementation.

Related to assessment, we outline several mechanisms to more effectively develop longitudinal assessment systems. Establishing a comprehensive database that links student names, nicknames, and ID numbers is recommended to improve data linkages and facilitate longitudinal assessment, while we suggest tools like REDCap for efficient and accurate data collection and management, enabling better tracking of student progress and outcomes. We further advocate using video recordings to capture complex performance episodes, which enables the use of multiple raters and more refined grading

criteria. These recordings can be used to enhance inter-rater reliability (i.e., consistency between raters) and provide a mechanism to deliver valuable feedback to learners. Videos support separate grading purposes, such as summative and formative assessments, and facilitate professional collaboration across schools.

Notably, we recommend using consensus methods with varied groups of stakeholders across each of these phases of curriculum development, implementation, and assessment. Reaching consensus across stakeholders will be useful to help organizations overcome common barriers to change in healthcare education. We recognize that the resources required for these initiatives may seem daunting; these organizations may find it helpful to engage in digital tools to foster more informal or asynchronous collaboration between these groups to reduce the time commitment required and the likelihood of scheduling conflicts negatively impacting participation. In summary, these strategies aim to create a robust, effective, and sustainable IPE curriculum that enhances collaboration and teamwork among future healthcare professionals. By addressing the key areas of design, implementation, and assessment, this article offers comprehensive guidelines for advancing interprofessional teamwork education. We believe institutions incorporating guidance from this article may offer some relief from existing challenges to IPE and generate an effective teamwork curriculum earlier in undergraduate healthcare education.

Limitations and future directions

As healthcare systems grow more complex, the coordination of interprofessional education across diverse professions and competencies presents increasing challenges. Due to the variation in existing competency frameworks and the distinct objectives of different organizations, recommending a single, universally acceptable competency framework is currently unfeasible. While institutions are working toward internal consensus on competency standards, curriculum, and assessment practices, further interorganizational, national, and international collaboration is essential to refine frameworks that can be broadly adopted. Such efforts will significantly support the development of competencies and assessments that are rigorously aligned with best practices and demonstrate positive effects on long term outcomes.

Data availability statement

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

Author contributions

KW: Conceptualization, Investigation, Visualization, Writing – original draft, Writing – review & editing. EL: Conceptualization, Investigation, Writing – original draft, Writing – review & editing. JH: Writing – review & editing. DK: Writing – review & editing. NC: Writing – review & editing. SP: Writing – review & editing. RP: Writing – review & editing. MS: Writing – review & editing. BT: Writing – review & editing. MK: Writing – review & editing. RR: Writing – review & editing. GR: Writing – review & editing. ES: Conceptualization, Writing – review & editing. ST: Conceptualization, Writing – review & editing. PG: Conceptualization, Writing – review & editing.

Funding

The author(s) declare that no financial support was received for the research, authorship, and/or publication of this article.

Acknowledgments

We would like to thank the faculty and leadership of the Quality Enhancement Plan-TeamFIRST at the University of Texas Southwestern Medical Center who have contributed substantively to many of the insights addressed in this perspective article. Additionally, we would like to thank our standardized patient raters, Jonathan Griffin and Qui Alexander, for their engagement with our program and diligence in assessing our undergraduate medical students.

Conflict of interest

ST was employed by the Group for Organizational Effectiveness, Inc.

The remaining 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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frontiers | Frontiers in Medicine

TYPE Original Research
PUBLISHED 28 January 2025
DOI 10.3389/fmed.2024.1497799

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RECEIVED 17 September 2024
ACCEPTED 16 December 2024
PUBLISHED 28 January 2025

CITATION
Hirsch C, Audet E, Dawood E, Beardmore F, Hussain N, Wong WC, Barry RJ and Buckley S (2025) Participation in a pre-registration student interprofessional education (IPE) society: influence on subsequent professional practice. *Front. Med.* 11:1497799. doi: 10.3389/fmed.2024.1497799

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Participation in a pre-registration student interprofessional education (IPE) society: influence on subsequent professional practice

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Background: Student interprofessional education (IPE) societies or organizations are popular ways to support pre-registration health professions students to develop the understanding and skills needed for collaborative working. Our experience with the University of Birmingham Knowledge and Skills Exchange (KASE) is that, whilst such societies can be excellent vehicles for IPE, sustaining them can be challenging; and that consistent faculty support, adequate resource and a focus for society activities are needed for them to flourish. Whilst the longer term impact of pre-registration IPE has been demonstrated, less is known about the influence of student IPE society membership on participants' subsequent professional practice. To inform institutional decisions about establishing and maintaining a student IPE society, we have investigated the perceptions of early career health professionals who were KASE members during their pre-registration training.

Methods: KASE alumni working as early career health professionals were invited to participate in the study. Their perceptions of the influence of KASE on their transition to practice and experience as early career health professionals were explored through online semi-structured interviews and interview transcripts analyzed thematically. Resulting themes were reviewed for relevance to the University of Birmingham (UK) IPE Framework, which uses the competency domains of the Canadian Interprofessional Health Collaborative Competency Framework as the required learning outcomes for IPE at Birmingham.

Results: Eight interviews with former KASE members were conducted between November 2022 and March 2023. Interviewees had between 2 and 5 years of experience in their professional role. Six themes relating to the influence of KASE on their subsequent professional practice were identified: interprofessional communication, teamworking, patient-centered care, leadership and organizational skills, confidence and resilience. Three of these themes related to required IPE learning outcomes. Two further themes: time to build relationships; and informality and autonomy, suggested possible reasons for such influence.

Conclusion: Early career health professionals considered that participation in the KASE student IPE society helped their transition into the healthcare work environment and encouraged them to adopt a more collaborative and patient-centered approach. Benefits reported suggest that faculty support for institutional student IPE societies is worthy of consideration.

KEYWORDS

interprofessional education (IPE), pre-registration, student societies, influence on practice, professional practice, health professions, student organizations

Introduction

Student interprofessional education (IPE) societies, known in some contexts as student IPE organizations, are popular ways to support pre-registration health professions students to develop the understanding and skills that they need to work as members of multi-disciplinary teams [(1), Supplementary Appendix 1]. Such societies may have a single focus of activity (2–4), or, like our University of Birmingham Knowledge and Skills Exchange (KASE), engage in a range of activities as the interests of members and resources of the society allow.

Our experience with the University of Birmingham Knowledge and Skills Exchange (KASE) (5) is that, whilst such societies can be excellent vehicles for IPE when working well, sustaining them in a context of rapid student 'turnover' can be a challenge; and that consistent faculty support, adequate resource and a focus for activities are needed if they are to grow and develop over time. As such, student IPE societies are not 'cost neutral' either for students or staff; and it is important to know whether the commitment that both groups make to their society has the desired effects on subsequent clinical practice. In short, is establishing a student IPE society in a university a good use of time and resources?

Investigations of the long-term impact of pre-registration IPE provide evidence for its positive impact on clinical practice and patient care (6–9). However, whilst some authors (10) have studied the initial impact of participation in an interprofessional student society, few have considered longer term influence on transition to practice and experience as an early career health professional.

The University of Birmingham pre-registration IPE Framework provides for core and optional IPE activities at three levels: raising awareness, knowledge and skills building, and application to practice (11). Required IPE learning outcomes at Birmingham are those of the Canadian Interprofessional Health Collaborative IPE Framework (12). All pre-registration health professions students may participate in the Birmingham Knowledge and Skills Exchange (KASE) as an optional IPE activity. KASE members have participated in team building activities, including healthcare team challenges, student-led workshops and case discussions, a weekend at an outdoor pursuits center and volunteering with local charities and elderly care environments. KASE members also contribute to development of formal IPE through membership of the Birmingham IPE Steering Group; and some have had the opportunity to share their KASE experience through conferences and publications.

Established in 2015, The Birmingham Knowledge and Skills Exchange has existed for almost 10 years and the founding members are now early career health professionals. To identify any long-term effect of participation in a student-led IPE society, we have investigated their perceptions of how KASE has influenced their subsequent experience in clinical practice, focusing particularly on how KASE has influenced their transition to the healthcare work environment, preparedness for their role(s) in the healthcare team and approach to teamworking and patient care. The outcomes of our study will help to inform institutional decisions about whether to set up a student IPE society.

Materials and methods

KASE alumni who were working as early career health professionals were invited to participate via email, social media or through personal contact. Full information, including a participant information sheet and consent form were emailed to those who expressed an interest in taking part. All participants gave informed consent in advance of the interviews.

Semi-structured interviews were conducted over Zoom at a time convenient to the interviewee. Each lasted approximately 40 minutes and was conducted by two student members of the research team (ED and GW or FB and NF), who were the successors and "near-peers" of the interviewees. Open questions explored interviewee's perceptions of the impact of KASE on their professional development, their teamwork and approach to patient care (for interview schedule, see Supplementary Appendix 2). All interviewers were trained in interview techniques in advance of data collection and were debriefed by faculty members of the research team after each interview. Interviews were recorded and transcribed in Zoom and the transcription checked for accuracy against the audio recording. Pseudo-anonymized transcripts were stored on a secure server.

Data were analyzed thematically using the Framework Method (13) and Microsoft Excel 2016. The Framework Method is a well-known "Codebook" approach to thematic analysis (14) that is suitable for analysis of semi-structured interview data in projects with multiple researchers who have varying levels of analytical expertise (13). Following transcription (Stage 1) and familiarization (Stage 2), student researchers (ED, FB, NH, WW) undertook initial coding of all transcripts (Stage 3). They then worked with CH and EA to develop and apply an analytical framework in order to ensure consistency of coding (Stages 4 and 5). CH and EA identified and summarized groups of related codes (categories) and prepared a

tree diagram of potential themes (Stage 6). All members of the team discussed and agreed the final themes (Stage 7).

Agreed themes were compared to the learning outcomes for each domain of the Birmingham IPE framework and relevance of themes to each domain noted.

Results

Eight KASE alumni were interviewed between November 2022 and March 2023. Participants were from medicine (1), dentistry (1), nursing (1), pharmacy (3), physiotherapy (1) and clinical psychology (1). All had been KASE members during their pre-registration training and in addition had been KASE committee members for between 6 months and 3 years. At the time of interview, all had worked in interprofessional teams for between 2 and 5 years after leaving university and all had continued to work interprofessionally within their scope of clinical professional specialization.

Influence of KASE on subsequent professional practice

Through Framework analysis, six themes relating to the effect of participation in KASE on subsequent professional practice were identified. These were: interprofessional communication, team working, patient-centered care, leadership and organizational skills, confidence and resilience. Interviewees reported that these aspects of professional practice were fostered by KASE activities such as team building weekends, educational and social events, volunteering (in both homeless and elderly residential living contexts), and committee work.

Interprofessional communication

Interviewees reported that their participation in KASE had helped them to develop their ability to communicate well with other professionals, to the benefit of their subsequent clinical work. This included their ability to listen actively and adapt their language as needed, to understand different perspectives and to explain their own role to others:

> *"knowing how to communicate with professionals that aren't my own."* 04 Nursing

> *" in the team, I'm also more likely to listen [and to ask], "what do you think?" It's important to listen to other people and KASE taught me that. "* 01 Medicine

> *"more confidence to present my role and understand it and explain things that people maybe don't know about it."* 03 Pharmacy

These benefits translated into improved ability to undertake handovers with a range of professions and to improved communication with patients:

> "*We would have handovers in the morning with the nursing team. So the language used was appropriate for nurses.. . . Then we do a handover specifically with the medical team. . . and it's the same with the physiotherapists as well. If there's anything to hand over to them, it would be in their language*" 04 Nursing

> *"because I've seen the holistic way that MDT were done through the KASE challenge. . . explaining decisions to patients. . . making sure they understood it properly when we're making a decision on medicine for example."* 03 Pharmacy

Teamworking

Interviewees reported that involvement with KASE assisted their ability to work in a multi-disciplinary team by making them more aware, respectful and appreciative of the roles of others:

> "*I'm a better person because of KASE. . . I'm more likely to do the easy stuff. [To] say thank you. Say sorry. Say please. . . And just (be) appreciative of what they do"* 01 Medicine

> "[KASE] *made me more appreciative of struggles that the professions go through. I think you tend to think that your profession has it [the] worst. . . But. . . everyone has their own difficulties in their profession"* 04 Nursing

> "*the biggest takeaway from my experience with KASE is [the importance of] collaboration and communication within the team and mutual respect."* 08 Physiotherapy

They were also more aware of the importance of team dynamics, the challenges of team hierarchies and the importance of a holistic, team approach to patient care:

> "*having the experience [with KASE] has shifted my perspective of it [the team] being at least a significant hierarchy . . . there is nothing better than having the team dynamic be such that people can speak without feeling judged or they are not afraid. . . of feeling spoken down to"* 08 Physiotherapy

> "*[KASE] helps you understand that everyone's role is contributing something. . . So to take a holistic view of patient care and to try and step back. . . see the bigger picture*" 03 Pharmacy

Patient-centered care

These insights into teamworking helped interviewees to be more patient-centered in their approach and to see the patient as an integral member of the team:

> *"I remember there's this one lady... [who was] struggling mentally, and I thought, where can I go to help this lady?... Because of my knowledge of chaplaincy, through... KASE... I ended up doing that referral, and it was really helpful."* 04 Nursing

> "*And I think KASE did a lot of that for me... I don't even think about it [the team] as a multidisciplinary team, I just think this person knows the most about that,... I'm going to go and speak to them... I'm going to go and discuss with them what they think would be best*" 07 Pharmacy

> "[the] value of collaboration, and you included patients and family members in that ... they are a part of the multidisciplinary team and maybe working with KASE helped me see that earlier than some of my colleagues who are transitioning in" 08 Physiotherapy

Leadership and organizational skills

All interviewees reported that participation in KASE had helped to develop their leadership and organizational skills, including time management, delegation and management of meetings:

> *"being a (KASE) committee member... allowed me to get to know the different professions even more, and also [to] improve my own organizational skills."* 05 Pharmacy

> *"being involved in a society... helps with leadership, becoming more assertive and working as a team with healthcare professionals that I did end up working with 2 years later."* 02 Dentistry

Some interviewees also reported that their positive experience with KASE encouraged them to pursue career development opportunities that required interdisciplinary working and to become an advocate for IPE societies:

> *"When that [multidisciplinary project] opportunity came up, I jumped on it.... And being able to [say]'it needed to be interdisciplinary' right? You're not going to manage that with one perspective."* 06 Clinical Psychology

> "*It's hard sometimes to encourage people to do so [join KASE] because people like to stick with their own group. That's just natural. But I would definitely recommend it. It will help you clinically. You think that you know about people's professions, but you just don't."* 04 Nursing

Confidence

KASE enhanced interviewees' confidence to make the transition to clinical practice, particularly the confidence to speak up, to admit that they did not always have a solution, to approach others and to ask for help.

> *"I think it [KASE] improved my confidence*2. 02 Dentistry

> *" So I'll go up to a physiotherapist and a pharmacist and just say 'hello', you know, 'how are you all', ask my question and not be too scared doing it."* 01 Medicine

> "*KASE... gave me confidence... not (that) I don't have any fear. But I'm happy to go and ask anyone the questions I have and I'm happy to walk up to someone and say, 'I've just been looking at this. I'm not sure whether it's a silly question. But could you talk me through?'"* 07 Pharmacy

> "[*KASE] gave me the confidence to tell patients that I don't have a solution, but I know so and so, or I can speak to so and so colleague."* 02 Dentistry

Several interviewees explained that greater confidence stemmed from building relationships with other professions during KASE activities and coming to see the "person behind the profession."

> *"But the other side of things also is seeing other professionals as not just their profession, but as humans as well."* 04 Nursing

> *"Because of KASE, I go on to the ward, and... I see the person, and then the profession second." 05 Pharmacy*

Resilience

Interviewees recognized that KASE had helped them to develop their resilience; and identified several ways in which this had happened: they appreciated more the importance of asking for help and of having an adaptable approach to changing circumstances; and through their improved understanding of others' roles, they appreciated that they could help others in their turn:

> *"I think as part of (being in) KASE I'm more likely to ask for help... So if I had... a drug question, I'd approach the pharmacist first... I am more likely to ask for help in places that I didn't know existed, or I knew they existed, but I probably wouldn't have approached them."* 01 Medicine

> "*So I think KASE it, it's hard to quantify but it's more the kind of... adaptability... I used to work in [Trust X] as [a junior doctor,... the MDT team working there was really useful but really easy as well... then coming to [Trust Y, it] is very busy... but also very understaffed. you kind of need to know who to*

> *ask for what. . . the understanding and the ability to change*" 01 Medicine

> "*As I left Uni, I was asked to shadow her [the Physician Associate] for a little bit. . . she was just like "Oh, I bet you don't even know what I do." I said, "actually, I do. You do this, this, this and this.". . . And it opened up that dialogue which wouldn't have been there before.*" 05 Pharmacy

Enabling features of KASE

Analysis identified two further themes that suggested why KASE fostered the development of more collaborative professional practice: time to build relationships with individuals from other professions and informality and autonomy.

Time to build relationships

Interviewees considered that the nature of KASE, in which members worked with each other to plan and carry out activities over weeks, months and (in some cases) years, enabled them to build relationships that led to greater understanding of, and ability to communicate with, other professions:

> *"With KASE, it was a couple of years. . . You're working with everyone in the team for each of the goals that you set. . . creating those connections was more beneficial compared to having say two weeks where there's no continuity. Just doing that for a couple of weeks doesn't give you the insight."* 02 Dentistry

> *"And then, we all became friends, you spend a lot of time together. You chat with people and. . . you'll see the same people every 3 weeks. You get to know them as people."* 06 Clinical Psychology

> *"[On placement] You don't really spend enough time with them [other healthcare students] to have any kind of real relationship, whereas [in KASE] we were creating relationships with each other." 07 Pharmacy*

Informality and autonomy

Learning informally and socializing in KASE enabled interviewees to ask questions and share their experiences; and being able to decide what activities to pursue and how, allowed them to address the interests and concerns of members:

> "*KASE allowed conversation between professionals. It allowed just more organic learning, nothing so structured and just spending time with the professionals."* 04 Nursing

> *"We chose all the topics, we worked together to choose things that we wanted to talk about. Asked the people in KASE what they wanted to learn about. but [with the] emphasis on getting to know them as people*" 07 Pharmacy

> "*[With KASE] you are taken out of the academic environment, and you get to know people socially, which benefits professional relationships. The kind of challenges that we did as well, [it] wasn't just, you know, clinically focused. . . but just general problem solving.*" 03 Pharmacy

Relevance of themes to interprofessional competencies

The content of three of the themes identified relate to five of the six domains of the Birmingham IPE Framework, which uses the competencies of the Canadian Interprofessional Health Collaborative (CIHC) Framework as its required learning outcomes. These are Interprofessional Communication, Team Working and Patient-Centered Care (Table 1).

Discussion

We investigated former members' perceptions of the impact of their participation in the Birmingham Knowledge and Skills Exchange (KASE) on their subsequent experience in clinical practice, including their transition to the healthcare work environment, preparedness for their role(s) and their approach to teamworking and patient care.

Our findings suggest that participation in KASE can lead to a range of perceived benefits to subsequent practice, including enhanced interprofessional communication, teamworking, patient-centered care, leadership and organizational skills, confidence and resilience. The content of the first three themes relate to required learning outcomes for Birmingham IPE. Given that outcomes for Birmingham IPE are the competencies of the Canadian Interprofessional Health Collaborative Framework, our findings may be of interest to others who use the Canadian framework or others with similar competencies.

Our findings align with those of the Inter Health Professionals Alliance at Virginia Commonwealth University (10) which found that an interprofessional healthcare student-led initiative, involving participation in monthly community outreach projects and hosting student-led campus sessions supported students' knowledge and skills development, interprofessional networking and professional competence; and with the findings of Fleming and colleagues, who reported benefits to attitudes toward collaborative practice and team working from interprofessional healthcare team challenges (15).

Skills development through participation in uni-professional student societies has also been reported. Zeeman and colleagues (16) mapped skills acquired through participation in three pharmacy student societies to required core competencies and

TABLE 1 Relevance of themes to interprofessional competencies.

IPE framework competency domain	Overview of domain learning outcomes	Relevant study theme (example quote)
Patient-centered care	To seek out, integrate and value, as a partner, the input, and the engagement of the patient/client family/community in designing and implementing care/services.	Patient-centered care "[*the*]*value of collaboration, and you included patients and family members in that. . .they are part of the multi-disciplinary team and maybe working with KASE helped me to see that earlier than some of my colleagues who were transitioning in.*" 08 Physiotherapy
Interprofessional communication	To communicate with different professions in a collaborative, responsive and responsible manner.	Interprofessional Communication *"in the team I'm more likely to listen and [ask] 'What do you think?' it's important to listen to other people and KASE taught me that."* 01 Medicine
Role clarification	To understand their own role and the roles of those in other professions, and use this knowledge to establish and achieve patient/client/family and community goals.	Interprofessional Communication *"more confidence to present my role and understand it and explain things that people maybe don't know about."* 03 Pharmacy
Collaborative working	To understand and apply principles of collaborative practice. This domain supports shared decision-making and leadership but also implies continued individual accountability as defined within one's professional scope of practice.	Teamworking *"the biggest takeaway from my experience with KASE is [the importance of] collaboration and communication within the team and mutual respect."* 08 Physiotherapy
Team functioning	To understand the principles of teamwork dynamics and group/team processes to enable effective interprofessional collaboration.	Teamworking *"having the experience [with KASE] has shifted my perspective of it [the team] being at least a significant hierarchy . . . there is nothing better than having the team dynamic be such that people can speak without feeling judged or they are not afraid. . . of feeling spoken down to" 08 Physiotherapy*

The required learning outcomes of the Birmingham IPE Framework are those of the Canadian Interprofessional Health Collaborative (CIHC). Domains and descriptions of CIHC competencies are shown, together with related themes and illustrative quotes from this study. Our themes did not relate to the CIHC Domain of Interprofessional Conflict Resolution.

found that such societies offered opportunities to develop up to two thirds of those required for pharmacy, including skills of collaboration. Student IPE societies such as KASE, however, provide added value compared to uni-professional student societies, in that they foster interaction between the different professions who will form multi-disciplinary teams of the future and, as noted by one of our KASE respondents, help students to see the importance of collaboration earlier than their colleagues who had not had the same experience.

The benefits of KASE participation seem to accrue in part from the fact that students were members of KASE over extended periods of time and so had the opportunity to build relationships, indeed friendships, with students from other professions. This intuitive finding aligns with those of Meffe et al. (17), who noted that time is needed for the development of relationships of trust and respect between nursing, midwifery and medical students. Similarly, though of shorter duration than KASE, students taking part in the recent All-Ireland interprofessional healthcare team challenge valued the opportunity over 6–8 weeks to develop relationships with students from other healthcare professions (15).

The informality of KASE activities, whether educational or social, also seems to enable benefits to subsequent practice by encouraging students to share their questions and concerns, characteristics which may relate to theories of active and social learning (18) and the applicability of the contact hypothesis to interprofessional contexts (19). Furthermore Mink et al. (6) reported that students on an interprofessional training ward considered that informal interactions during shared breaks improved interprofessional collaboration and socialization; whilst Meffe et al. (17) discuss the value of informal time during their interprofessional education pilot program in maternity care suggest that these contacts within social groups reduce intergroup prejudice.

The opportunity to direct their own society was valued by interviewees and may have contributed to realization of the reported benefits to clinical practice. The fact that IPE societies such as KASE are student-led, with members undertaking much of the work of event organization and delivery, can be seen as an advantage for overstretched faculty. However, our study suggests that some of the activities that were most valuable, such as the healthcare team challenges and volunteering in local elderly care facilities, were often those that required faculty support to be successful. In this context, it is worth noting that other extra-curricular healthcare team challenges that have reported benefits (15, 20, 21) also involved extensive faculty support.

Undertaking this study has led us to reflect on the term 'student-led' and to a greater appreciation that, as Nagel and colleagues noted (22), this is often used as an umbrella term that can encompass a range of contexts: from initiatives that are informed by student needs and preferences but organized by faculty, to those that are student-led, both in terms of content and organization. As a multi-activity society, the position of KASE on this continuum varies, depending on how much faculty support is required for a particular event. In establishing a society, institutions may wish to consider where on this continuum their society will lie, bearing in mind that the ability of a student-led society to be self-sustaining will depend on the focus of its activity or activities. Our view is that some provision for faculty oversight and support should be part of any plans to establish a society.

Benefits accruing from the greater approachability of near-peer tutors have been widely reported in health professions education, including in interprofessional settings (23). In our study, we employed current KASE committee members as near-peer interviewers to help encourage open responses from interviewees. This approach had the added advantage that the student members of the research team were able to gain valuable skills of qualitative research and to learn first-hand about the potential benefits of their commitment to KASE. Again however, faculty support is needed for the benefits of this approach to be realized.

Whilst our interviewees were well placed to comment on the influence of KASE on their subsequent professional practice, our study has several limitations. Some professions may find participation in a student IPE society more beneficial than others and our interviewees may have been more favorably disposed toward KASE than a different professional mix. As volunteers and former KASE committee members, their experience may not fully reflect that of students who took a less active role; and whilst interview questions related to the influence of KASE *per se*, their perceptions may have been influenced by participation in other IPE activities or student societies. Despite our best efforts otherwise, our analysis may have been influenced by our position as health professions educators with an interest in interprofessional education; and whilst our study has identified benefits for subsequent professional practice, we can only infer relevance to rather than achievement of required IPE learning outcomes.

Within the context of these limitations, our study suggests that participation in a student IPE society can benefit subsequent professional practice and signals enabling features of these societies that may be difficult to replicate in other curricular settings. Our findings resonate with our anecdotal experience over the years and suggest that working with students to establish and sustain a student IPE society is a beneficial use of faculty time and resource.

Conclusion

Early career health professionals considered that participation in the KASE student IPE society helped their transition into the healthcare work environment and encouraged them to adopt a more collaborative and patient-centered approach. Benefits reported suggest that faculty support for institutional student IPE societies is worthy of consideration.

Data availability statement

The datasets presented in this article are not readily available because no permission was gained from participants to share raw anonymized interview data. Requests to access the datasets should be directed to CH, c.a.hirsch@bham.ac.uk.

Ethics statement

This study involving humans was approved by the University of Birmingham Ethics Approval Committee (ERN_2022-0369). It was conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

CH: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Writing – original draft, Writing – review and editing. EA: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review and editing, Project administration, Resources, Supervision, Validation, Visualization. ED: Data curation, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review and editing. FB: Data curation, Formal analysis, Investigation, Writing – original draft, Writing – review and editing. NH: Data curation, Formal analysis, Investigation, Writing – original draft, Writing – review and editing. WW: Data curation, Formal analysis, Investigation, Writing – original draft, Writing – review and editing. RB: Conceptualization, Funding acquisition, Supervision, Writing – original draft, Writing – review and editing, Formal analysis. SB: Formal analysis, Methodology, Supervision, Validation, Writing – original draft, Writing – review and editing.

Funding

The author(s) declare that financial support was received for the research, authorship, and/or publication of this article. This research was supported by an Internal Seedcorn Educational grant from the University of Birmingham.

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.2024.1497799/full#supplementary-material

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frontiers | Frontiers in Medicine

TYPE Original Research
PUBLISHED 29 January 2025
DOI 10.3389/fmed.2025.1446695

Check for updates

OPEN ACCESS

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RECEIVED 10 June 2024
ACCEPTED 15 January 2025
PUBLISHED 29 January 2025

CITATION
Fleischmann D, Binder B, Huss M, Elger T, Wolf C, Loibl J, Tews HC, Kandulski A, Schmid S, Müller M and Kratzer A (2025) Interprofessional approach to personalized medication management and therapy optimization in IBD care.
Front. Med. 12:1446695.
doi: 10.3389/fmed.2025.1446695

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Interprofessional approach to personalized medication management and therapy optimization in IBD care

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A considerable number of patients with chronic inflammatory bowel diseases (IBD) are required to manage extensive polypharmaceutical regimes, which significantly elevates the risk of drug–drug interactions. Also, the disease's impact often leads to the consumption of additional self-medication by the patients such as naturopathic remedies to alleviate disease-induced suffering and nutritional supplements to compensate for malabsorption syndromes inherent to the condition. There is a well-established consensus that polymedication coupled with unregulated supplementary intake can jeopardize the safety of drug therapy. Despite this, pharmaceutical co-supervision—proven to mitigate adverse drug events and enhance patient adherence to treatment—is generally lacking in routine clinical settings. Furthermore, the assessment of individual therapy adherence, a crucial predictive factor for therapeutic outcomes, is frequently suboptimal. In response to these issues, this study implemented an interdisciplinary approach wherein a team comprising medical and pharmaceutical professionals conducted a comprehensive survey coupled with a medication review for patients attending an IBD outpatient clinic. Employing an IBD-specific questionnaire alongside the patients' documented medication regimens enabled the identification and subsequent discussion of current therapeutic concerns and potential medication-related risks during follow-up consultations. This intervention aimed to bolster individual patient satisfaction and enhance medication safety, ultimately fostering sustained success in IBD management.

KEYWORDS

inflammatory bowel disease, patient safety, clinical pharmaceutical care, interprofessional collaboration, medication management

1 Introduction

Inflammatory bowel diseases (IBD), comprising Crohn's Disease (CD) and Ulcerative Colitis (UC), represent a complex array of pathologies characterized by both acute and chronic inflammation within the gastrointestinal tract. Current estimates suggest a prevalence rate of 0.3%, with a global uptrend in incidence attributable to various factors, underscoring the growing relevance of IBD in contemporary and future internal medicine (1–4). Recent pharmacological advancements have expanded the therapeutic arsenal, notably with the inclusion of target-specific antibodies, which are playing an

increasingly pivotal role in IBD treatment (5, 6). Nonetheless, the management of IBD, whether newly diagnosed or pre-existing, poses substantial challenges due to numerous obstacles faced by patients and healthcare providers throughout the therapeutic process.

A significant aspect of IBD is its considerable psychological impact, as it is a chronic condition requiring long-term management. Psychosocial stressors can critically influence disease progression (7–9). Although psychological co-supervision is recognized as a beneficial component of comprehensive IBD care, many patients seek additional self-directed interventions with non-prescription drugs. In that regard, Bauer et al. found in a recent nationwide German survey, that 50% of IBD patients were using complementary or alternative medicines (CAM) in self-medication alongside their actual IBD medication (10). Additionally, Lakatos et al. found that the use of CAM was more common in patients undergoing supportive psychiatric/psychological therapy. CAM also encompass naturopathic remedies, such as plant-derived products, which carry a notable risk of hepatotoxicity, as well as specialized nutritional supplements, including multivitamin preparations that frequently contain potentially hazardous concentrations of certain components (11). While it is understandable for IBD patients to look for such supplementary approaches which could be potentially advantageous, they also introduce risks, such as undermining treatment efficacy or precipitating additional health issues due to adverse drug interactions. This is especially problematic given the high incidence of polypharmacy among IBD sufferers and its associated risks. In this context, a recent retrospective study by Mesonero et al. found, that 18.4% of all surveyed patients were simultaneously using 5 or more drugs, a threshold that is commonly used to define polypharmacy. The authors also concluded that polypharmacy was mainly found in older adults and those with comorbidities and that it was the only factor associated with IBD treatment nonadherence in the study (12).

In this context, enhanced pharmaceutical co-supervision could play a critical role in improving medication safety and efficacy while also bolstering compliance with established treatment regimens (13–16). Adequate adherence to therapy is a key determinant of successful long-term management of IBD (17, 18). Despite widespread recognition of its importance, patient adherence is rarely evaluated through systematic assessments (19).

To address these gaps, our study deployed an interdisciplinary team of physicians, nurses, and specialized clinical pharmacists at an IBD outpatient clinic. This team leveraged an existing interprofessional network within the Department of Internal Medicine to conduct a multi-faceted evaluation and optimization of patient-specific medication strategies (20, 21). The primary objective was to integrate assessments of individual treatment adherence (i.e., the reliable intake of prescribed IBD medication as well as regular appearance to scheduled appointments in our clinic) with comprehensive pharmaceutical reviews to identify and mitigate drug-related issues and optimize therapeutic outcomes. Moreover, the study aimed to offer a more personalized, multidisciplinary approach to treatment, thereby promoting more consistent adherence to therapy. Additionally, it sought to uncover individual and systemic barriers to effective IBD management within the outpatient setting, facilitating improvements in patient care and treatment success.

2 Methods

2.1 Study design

This prospective, transversal, unicentric, open-label study was conducted at the Department of Internal Medicine I (specializing in Gastroenterology, Hepatology, Endocrinology, Rheumatology, and Infectious Diseases) of the University Hospital Regensburg, Germany, from April 1 to December 31, 2023.

2.2 Study population

Participants included both male and female patients aged 18 years or older who either had a confirmed diagnosis of IBD per the European Crohn's and Colitis Organization (ECCO) criteria or presented symptoms indicative of inflammatory gastrointestinal disorders pending an IBD diagnosis (22, 23). Exclusion criteria encompassed individuals with an insufficient understanding of the questionnaires as well as incomplete medical records and/or questionnaires.

2.3 Procedure

Three weeks prior to their scheduled visit at the IBD outpatient clinic, eligible patients received an invitation by mail or e-mail to partake in the study through completion of a preliminary questionnaire detailing their current therapy regimen and medication plan (Supplementary Figures S1, S2). This questionnaire was mainly based on previously existing questionnaires that had been used in our clinic to assess patients´ medication and therapeutic adherence and was subsequently modified for this IBD study using various pre-existing, standardized tests assessing therapy adherence and IBD patient experience (24–26). The questionnaire featured sections on diagnosis history, adherence levels, personal understanding of their therapy, and open-ended items querying additional counseling needs. Responses were gauged on a 5-point Likert scale (27). Subsequently, a clinical pharmacist evaluated the provided medication plan and initial questionnaire to identify areas for therapeutic enhancement or potential adherence obstacles. The review process emphasized drug dosage, interaction risks, and possible adverse effects of the medications. Non-indicated medications were flagged for discontinuation, and adjustments to therapy based on international IBD guidelines were recommended where applicable (22, 23).

If participants reported using nutritional or plant-based supplements, these substances were critically assessed for efficacy and safety through comprehensive literature reviews. Outcomes of these pharmaceutical reviews were systematically documented and categorized (28). Findings were then collaboratively discussed with the attending physicians before patient consultations, allowing for informed adjustments to therapeutic approaches based on the insights gathered.

2.4 Post-consultation follow-up

Following their clinic visits, patients completed a second questionnaire focusing on their personal experiences and the potential impact of the initiative on pre-existing concerns over their therapy and on the individual knowledge about their IBD medication (Supplementary Figure S3).

2.5 Statistical analysis

Demographic and disease-specific data were summarized in terms of absolute (n) and relative (%) frequencies (Table 1). The pharmaceutical intervention outcomes were likewise quantified (Table 2). Questionnaire responses and medication review data were analyzed, presenting averages and standard deviations (Figures 1–3).

2.6 Ethical considerations

The study adhered to the ethical standards of the University Hospital Regensburg's human research guidelines. Ethical approval was secured prior to the commencement of the study. Participants provided informed consent, ensuring the anonymity and confidentiality of their data. All participant information derived from questionnaires and medication reviews was anonymized to prevent any identification of individual patients.

3 Results

During the study, 97 patients were invited to partake in the study and data was fully collected from 42 patients at the IBD outpatient clinic. The median age of the cohort was 48 years, with a predominance of female participants, who constituted 69% of the sample (Table 1). The distribution of diagnoses within the group showed a near balance between CD and UC, with 38 and 36%, respectively. Additionally, 11 patients were categorized under a preliminary diagnosis of inclassificable colitis, indicating a potential form of inflammatory bowel syndrome pending a definitive diagnosis.

The historical data on diagnosis and therapy revealed that a significant portion of the patients had a longstanding relationship with the clinic. Specifically, 43% of the patients reported having received their initial diagnosis over 10 years ago, and 29% had started their IBD treatment at this outpatient clinic during the same time frame. This long-term engagement highlights the chronic nature of IBD and the extended duration of care that is often required. According to the medical documentation after the appointment in the outpatient clinic, 43% of surveyed patients were in clinical remission at the date of their appearance in the outpatient clinic while 57% of all participants reported mild to moderate symptoms. There was no patient with severe symptoms. Disease activity was thereby assessed according to the ECCO guidelines (22, 23).

Regarding the therapeutic regimens reported, a significant number of patients were on complex medication plans involving advanced pharmacological treatments. These included immunomodulators such as azathioprine, cyclosporine A, and tacrolimus, as well as biologic therapies. Biologics used by the patients included anti-TNF-α agents

TABLE 1 Demographic and disease characteristics of patients (N = 42).

Median age (range) - years	48 (18–74)
Male	52
Female	46
Sex	
Male	13 (31%)
Female	29 (69%)
Diagnosis	
Crohn's Disease (CD)	16 (38%)
Ulcerative Colitis (UC)	15 (36%)
Inclassificable Colitis	11 (26%)
Initial diagnosis	
<1 yr	6 (14%)
1–5 yrs	12 (29%)
5–10 yrs	6 (14%)
>10 yrs	18 (43%)
Treatment in outpatient clinic	
<1 yr	12 (29%)
1–5 yrs	16 (38%)
5–10 yrs	2 (4%)
>10 yrs	12 (29%)
Disease activity	
In remission	18 (43%)
Mild to moderate symptoms	24 (57%)
Severe symptoms	0
Medication	
No IBD Medication/5-ASA/Corticosteroids	7 (15%)
Immunomodulators	15 (36%)
Azathioprin	7 (16%)
Cyclosporin A	4 (10%)
Tacrolimus	4 (10%)
Biologics	20 (48%)
Infliximab	7 (17%)
Adalimumab	6 (14%)
Vedolizumab	3 (7%)
Ustekinumab	4 (10%)

TABLE 2 Overview of pharmaceutical interventions after medication check (N = 42).

First medication check	36 (86%)
Degree of pharm. intervention	33 (79%)
Polymedication (>5 drugs)	30 (71%)
Pharm. interventions per patient	1.6 (±0.4)
Degree of implementation	92% (61 of 66 pharm. interventions)
Discontinuation of medication	9 (21%)
New medication started	6 (14%)

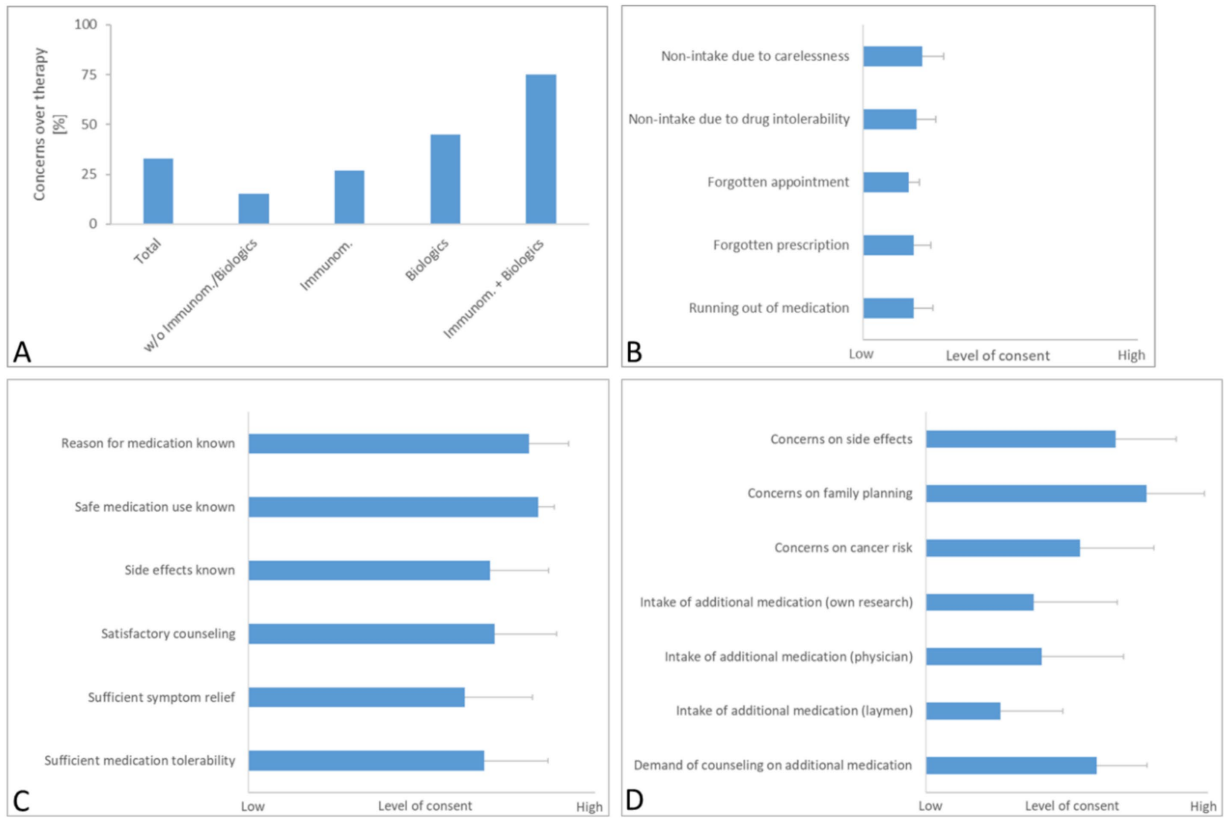

FIGURE 1
Results of questionnaire 1. Interviewees were asked to answer questions on general concerns over their therapy **(A)**, the pre-existing therapy adherence **(B)** and their current medication knowledge and satisfaction **(C)**. Also, respondents could indicate, whether they had specific concerns over their medication and if they were taking additional drugs or supplements for their IBD therapy **(D)**. Results are depicted as mean with SD (*N* = 42). For results depicted in panels **(B–D)**, a Likert scale from 1 (no consent) to 5 (high consent) was used. For the question on concerns over implications for their family planning **(D)**, merely answers from patients younger than 45 years were analyzed (*N* = 27).

(infliximab, adalimumab), integrin blockers (vedolizumab), and interleukin blockers (ustekinumab). These treatments reflect the current standards in IBD management, targeting various pathways to reduce inflammation and manage symptoms in severe cases. Only 15% of all surveyed patients did not take any specific IBD medication or merely aminosalicylates (5-ASA) or corticosteroids at the time of the survey.

3.1 Therapy adherence and individual concerns

3.1.1 Concerns about current therapy

The initial segment of the questionnaire revealed that 33% (14/42) of all respondents harbored general concerns about their ongoing IBD therapy (Figure 1A). Notably, the expression of concern was disproportionately higher among patients prescribed with immunomodulatory substances (27%, 4/15) and biologics (45%, 9/20). Specifically, only 15% of patients (1/7) not on such medications (i.e., patients currently taking no specific IBD medication or merely aminosalicylates or corticosteroids) expressed doubts about their therapy, whereas a significant 75% (3/4) of those on a combination of immunomodulators and biologics reported concerns, reflecting apprehensions possibly tied to the complex side effects and long-term implications of these potent drugs.

3.1.2 Adherence based on reliable intake of prescribed medication and appearance at medical appointments

In the second part of the questionnaire (Figure 1B), the majority of patients reported to consistently take their medication as prescribed and to diligently arrange for prescription refills and medical appointments.

3.1.3 Knowledge and information satisfaction

Responses regarding knowledge of medication and its impact on symptom control (Figure 1C) showed that most patients were well-informed about the indications and dosing of their medications. Additionally, a substantial number reported satisfaction with the information provided about potential side effects, although the level of satisfaction regarding symptom relief and medication tolerability was slightly lower but still substantial, scoring 3.4 and 3.7 out of 5 on the Likert scale, respectively.

3.1.4 Additional concerns and consultation needs

In alignment with earlier findings, a significant number of participants expressed heightened concerns about side effects like increased cancer risk and the implications of treatment on family planning (the latter assessed only among patients under 45 years of age) (Figure 1D). Regarding the use of non-prescription medications,

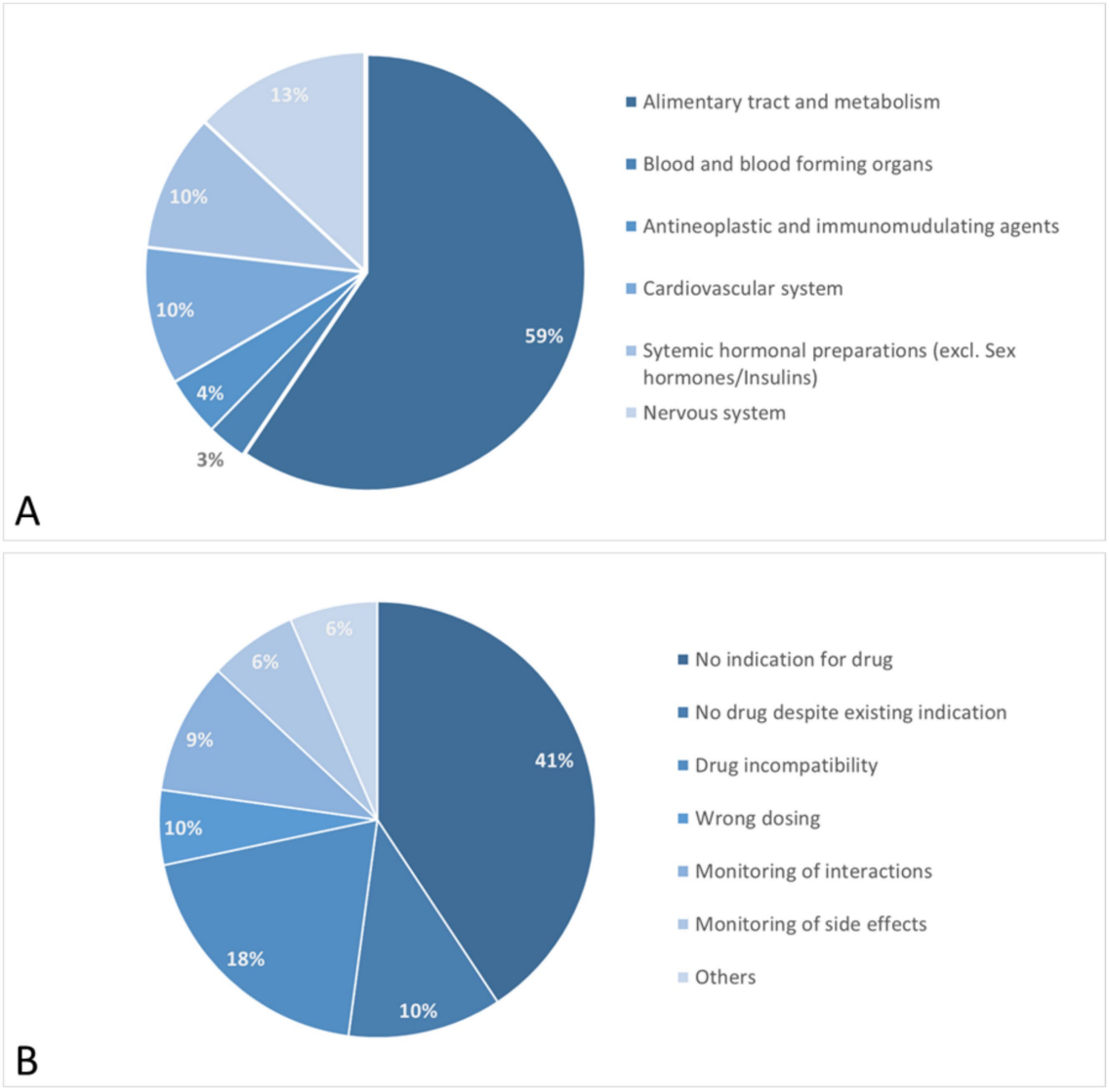

FIGURE 2
Results of pharmaceutical medication check. ATC classification of affected drugs **(A)** and documented pharmaceutical interventions **(B)**.

such as plant-derived drugs and dietary supplements, about 50% of the respondents indicated that they were using these products, based on their own research or the advice of a healthcare provider. Interestingly, reliance on recommendations from non-medical sources was less common.

Moreover, a notable portion of the cohort voiced a desire for further guidance on additional medications or supplements during upcoming visits, highlighting an ongoing need for comprehensive patient education and support in managing their IBD therapy effectively.

3.1.5 Pharmaceutical medication check

As part of the study, patients were required to submit their current medication regimen, which could either be in the form of a nationally harmonized medication plan or a personal list that included all medications and supplements being used. Surprisingly, 86% of participants reported that they had never undergone a medication check of the kind performed in this study (Table 2).

The data also revealed that a substantial 71% of patients were taking more than five different drugs, surpassing the threshold commonly associated with polymedication, which is frequently correlated with an elevated risk of medication errors and adverse drug interactions (29–31).

Following the review of the submitted medication lists, a potential pharmaceutical intervention was identified for 79% of all medications analyzed. On average, 1.6 interventions were documented per patient. Notably, 61 of the 66 recommended pharmaceutical changes (92%) were implemented by the attending physicians, indicating a high level of collaboration between the pharmaceutical and medical staff.

Furthermore, for 35% of the patients, the pharmaceutical review led to either the initiation of a new medication or the discontinuation of an existing one.

During the study, a comprehensive medication review highlighted various drug classes impacted by pharmaceutical interventions. Notably, the majority of interventions involved medications for the alimentary tract and metabolism, which represented 59% of all drugs

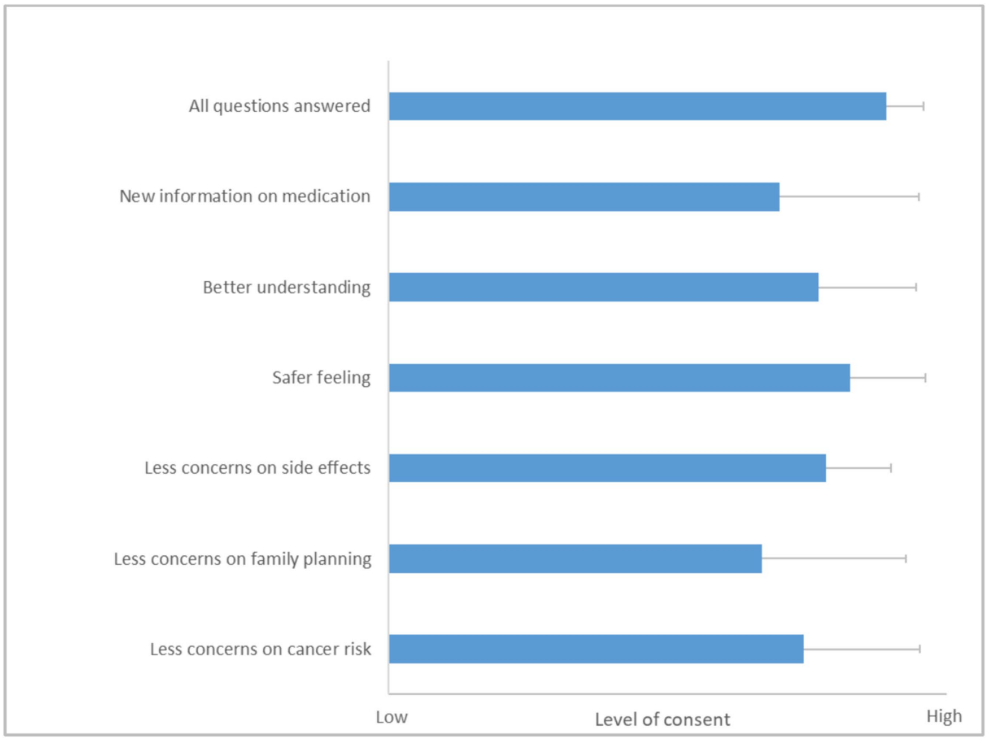

FIGURE 3
Results from questionnaire 2 on client experience and implications on future therapy adherence. A Likert scale from 1 (no consent) to 5 (high consent) was used. Results are depicted as mean with SD (N = 42). For the question on concerns over implications for their family planning, merely answers from patients younger than 45 years were analyzed (N = 27).

reviewed. This category includes treatments for acid-related issues, functional gastrointestinal disorders, bile and liver therapies, antidiarrheals, medications for constipation, supplements, vitamins, and antidiabetic drugs.

Furthermore, 13% of the interventions targeted drugs affecting the nervous system, such as analgesics, antiepileptics, antiparkinsonian drugs, and psycholeptics.

Cardiovascular medications also accounted for 10% of the interventions, encompassing antihypertensives, diuretics, vasodilators, vasoprotectives, beta and calcium channel blockers, drugs affecting the renin-angiotensin system, and lipid-modifying agents.

Additionally, systemic hormonal preparations, including systemic corticosteroids, thyroid hormones, and pancreatic hormones, were also adjusted in 10% of the cases.

The specific pharmaceutical interventions revealed several key insights into the management of medication plans among IBD patients. A significant 41% of the cases involved medications for which no clear indication was found either in the medication plan or the patient record. This lack of indication highlights a substantial area of concern where drugs may be prescribed without sufficient documentation or justification, emphasizing the need for rigorous review and justification of each medication's use.

In 23% of these cases, these interventions focused on naturopathic remedies and nutritional supplements mainly comprising herbal products containing curcuma or artichoke extracts and various combinations of b vitamins. For these products used in self-medication, no clear medical indication could be established in most instances. Additionally, these products often carry a risk of severe adverse effects, such as acute liver injury. In 10% of the cases, the introduction of an additional drug was advised to manage a pre-existing condition, suggesting that some patients' current treatment regimens were insufficient to fully address their medical needs.

Furthermore, 18% of the intervention instances pertained to drug incompatibilities where the concomitant use of multiple drugs led to significant physico-chemical interactions. These interactions could drastically reduce the bioavailability of the involved medications, potentially compromising treatment effectiveness.

Optimization of the dosing regimen, including adjustments to the total dose and dosing intervals, was required in another 10% of the cases.

Finally, monitoring for potential pharmacological drug interactions (involving CYP450 enzyme system and others) and possible side effects was recommended in 9 and 6% of cases, respectively.

In the follow-up questionnaire, patients shared their experiences of the appointment at the outpatient clinic, reflecting on how it influenced their therapy adherence and overall satisfaction. The results from this feedback were overwhelmingly positive (Figure 3). Most patients felt that the discussion during their appointment was comprehensive, with a majority rating the coverage of all relevant topics at an impressive 4.9 out of 5.0.

Further insights from the questionnaire showed that the patients gained valuable knowledge about their medication during these

sessions. They reported a better understanding of their therapy, scoring an average of 4.2 out of 5.0, which highlights the informative nature of the consultation. Additionally, the clarity and depth of the information provided seemed to enhance their sense of security regarding their treatment, as evidenced by a safety feeling score of 4.6 out of 5.0.

A significant aspect of the consultation was its impact on the patients' perceptions and possible concerns about their medication. The majority thereby noted a decrease in concerns about potential side effects, with a score of 4.3 out of 5.0. This improvement is crucial as it likely contributes to higher adherence and better overall management of their condition. The patients also indicated that discussions during the appointment alleviated worries about the effects of their therapy on family planning and the risk of developing cancer.

4 Discussion

The outcomes of the questionnaires and comprehensive medication checks conducted during the study offer significant insights into how patients perceive their current IBD therapy and how they adhere to prescribed treatments.

A significant proportion (33%) of study participants reported substantial concerns about their current IBD therapy. This observation is consistent with findings from a recent study, wherein participants expressed notable concerns, particularly regarding their treatment and its potential side effects. In that study, a visual analog scale (VAS) ranging from 0 to 100 was employed to assess these concerns. Among $n = 113$ patients aged 35–59, concerns about medication effects were rated at a mean value of 65 on the VAS (32). In our study, individual concerns were markedly more pronounced among patients prescribed immunomodulatory substances and biologics, with such individuals exhibiting two to three times more concern than those not receiving these treatments. The heightened apprehension reached a peak in patients receiving combination therapy of both drug classes, with 75% expressing concerns, although it's important to note that the number of patients in this specific subgroup was relatively small ($N = 4$).

The study's findings emphasize the intricate interplay between advanced therapeutic strategies for IBD—which frequently necessitate the use of potent pharmacological agents associated with considerable adverse effects—and the consequential psychological burden experienced by affected patients (33, 34). This underscores the critical need for healthcare providers to consider both the physical and emotional well-being of patients when planning and administering treatment. These findings have been incorporated into national and international clinical guidelines, which emphasize the importance of considering both clinical efficacy data and the potential psychological burden on patients when selecting and implementing potent therapies for IBD (35, 36). In our outpatient clinic, we therefore closely collaborate with the Department of Psychosomatics of our university hospital to ensure optimal patient care.

The study revealed a high degree of consistency by the patients in taking their medications and staying engaged with their healthcare providers, with data mirroring findings from a previous survey by Bager et al., which reported an overall therapy adherence rate of 93% among IBD outpatients (37). The respondents also showed a commendable level of knowledge concerning why and how to take their medications, and the potential side effects involved. However, despite their good understanding, many patients still harbored significant concerns about the long-term implications of their medications, particularly in relation to adverse drug reactions, the potential risk of cancer, and effects on family planning. These fears seem to stem from a comprehensive awareness of the chronic nature of their condition and the lifelong dependency on medication it entails.

A considerable portion of the patients also expressed a need for more in-depth counseling about potential additional medication options for treating IBD, as well as a notable number of patients taking additional medication or nutritional supplements based on their own research. This proactive approach to self-management highlights a gap in the patient-provider communication that could be bridged with more thorough and frequent pharmaceutical counseling sessions.

In terms of the medication checks performed during the study we could find three main areas of interest:

Firstly, a significant majority of the interventions involved medications for the digestive tract and metabolism, reflecting the intricate medication regimens that IBD patients often must navigate. This finding emphasizes the challenge of managing a disease that not only affects the gastrointestinal system directly but also requires careful balancing of nutritional needs and medication effects.

Secondly, more than half of the interventions resulted from either inappropriate medication use without a clear indication or a missing medication that was indicated. In 35% of these cases, this led to either the introduction of new medications or the discontinuation of existing ones. This high rate of medication modification underscores the complexity of IBD symptoms and the involvement of multiple healthcare providers, which can sometimes lead to fragmented care without adequate coordination.

Lastly, the significant desire for more detailed counseling on additional medication options reveals the deep psychological impact of chronic diseases like IBD. This need for more information also showcases the potential of pharmaceutical counseling to enhance patient treatment satisfaction and outcomes.

Overall, the integration of pharmaceutical counseling into routine IBD care was highly valued by patients, as evidenced by improved understanding and satisfaction with their treatment following these sessions. This proactive approach not only meets the immediate clinical needs but also significantly enhances the treatment experience, fostering better health outcomes and adherence to therapies. Such findings advocate for a more integrated, patient-centered approach in managing IBD, emphasizing the importance of addressing both the medical and emotional needs of patients.

5 Conclusion

In the management of IBD, the complexity inherent in polymedication and escalated therapy regimens can significantly hinder patient adherence. To address these challenges and enhance patient satisfaction and safety in outpatient settings, our interdisciplinary team undertook a comprehensive evaluation of current treatment practices. This involved the implementation of a

dual-part approach: administering a detailed questionnaire to assess patient perceptions and concerns regarding their therapy, and conducting a thorough pharmaceutical medication check to evaluate and optimize their current treatment regimens.

The data collected from these initiatives revealed telling insights. A notable percentage of patients expressed substantial concerns about their ongoing treatments, highlighting a pervasive sense of unease and uncertainty about the long-term effects and efficacy of their medication regimes. Many patients indicated a desire for more in-depth discussions about potential additional treatment options, suggesting a need for broader information dissemination and more personalized treatment planning.

Furthermore, the medication checks performed revealed ample opportunities for optimization of current treatment regimens. In many instances, adjustments made to the medications not only aligned better with best practice standards but also addressed individual patient needs more effectively, reducing the risk of adverse drug reactions and enhancing the overall treatment efficacy. In this context, we strongly advocate for the implementation of a routine medication review during every visit for IBD patients. Such an initiative holds the potential to enhance patient safety substantially and optimize therapeutic outcomes, thereby addressing critical aspects of patient care in this population. Furthermore, this approach could be highly beneficial in more effectively integrating the patient perspective into clinical practice (38).

The outcomes of this interdisciplinary approach have been highly positive, resulting in significant improvements in patient satisfaction and medication safety. It is important to acknowledge, however, that the overall number of interviewees was not particularly high and only from one outpatient clinic, and it is likely that primarily patients with an already elevated level of adherence agreed to participate in the study. Also, long term effects on patients´ therapeutic adherence could not be adequately measured with our study design, as the time span of the survey and intervention would have been too short. Finally, the IBD-specific questionnaire that was used in this study, needs to be further validated with a greater number of participants to guarantee reproducibility and consistency among larger numbers of interviewees. Despite these limitations, the positive feedback from patients clearly highlighted the value of personalized and attentive care. This tailored approach not only enhanced patient satisfaction but also considerably increased trust in the treatment process, emphasizing its importance in clinical practice. As a result of these successes, our team plans to intensify these efforts moving forward, continuing to refine and expand our methods to ensure that every patient receives the most effective and safe treatment possible. This initiative not only supports better health outcomes but also encourages a more engaged and informed patient community, essential for long-term disease management in IBD.

Data availability statement

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

Ethics statement

The studies involving humans were approved by the Ethics Committee of the University of Regensburg. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

DF: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Validation, Visualization, Writing – original draft, Writing – review & editing. BB: Investigation, Writing – review & editing. MH: Investigation, Writing – review & editing. TE: Writing – review & editing. CW: Writing – review & editing. JL: Investigation, Writing – review & editing. HT: Formal analysis, Investigation, Project administration, Resources, Supervision, Writing – review & editing. AKa: Investigation, Writing – review & editing. SS: Investigation, Writing – review & editing. MM: Supervision, Writing – review & editing. AKr: Investigation, Project administration, Supervision, Writing – review & editing.

Funding

The author(s) declare that no financial support was received for the research, authorship, and/or publication of this article.

Acknowledgments

We thank our patients for participating in the study and Lisa Pfeiffer for organizational support.

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.2025.1446695/full#supplementary-material

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frontiers | Frontiers in Medicine

TYPE Original Research
PUBLISHED 05 February 2025
DOI 10.3389/fmed.2025.1483551

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OPEN ACCESS

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RECEIVED 20 August 2024
ACCEPTED 24 January 2025
PUBLISHED 05 February 2025

CITATION
Schwarz HL, Straub C, Bode SFN, Ferschl N, Brickmann C, Berberat PO and Krüger M (2025) Learning and working on an interprofessional training ward in neonatology improves interprofessional competencies. *Front. Med.* 12:1483551. doi: 10.3389/fmed.2025.1483551

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Learning and working on an interprofessional training ward in neonatology improves interprofessional competencies

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Introduction: Interprofessional education (IPE) is essential for healthcare professionals to prepare them for future interprofessional collaboration (IPC). Interprofessional training wards (ITWs) have been set up for IPE and results have been published. There are no published studies on ITWs in neonatology. We have designed and established the Interprofessional Training Ward in Neonatology (IPANEO) for nursing trainees (NT) and medical students (MS) in a neonatological intermediate care (IMC) ward. We report on the concept and the results with regard to the interprofessional competencies of the participants, including parent satisfaction.

Methods: Supervision by medical and nursing learning facilitators, 2week blocks each with 2 NT (n = 30) and 2 MS (n = 23) in their final year, ward-in-ward concept, 3 patients cared for. Evaluation of the participants (pre/post) with the Interprofessional Socialisation and Valuing Scale (ISVS), the Interprofessional Collaboration Scale (ICS) with questions on IP communication, accommodation and isolation as well as with an IPANEO-specific evaluation (IPQ), an external evaluation with the "Observational Questionnaire for Learning Facilitators" (OQLF) and a "Questionnaire on Parent Satisfaction" (PSQ) (n = 33).

Results: IPANEO participants showed significant increases in competencies in IP communication, accomodation and isolation (ICS), a better IP-collaboration and a higher role definition (IPANEO specific questionnaire). The ISVS 9A/B global scores increased. According to the self-assessment there were significant improvements in the external evaluation in all IP-categories (OQLF). The feedback from the parents was significantly positive (PSQ).

Conclusion: Interprofessional learning and working on IPANEO had a positive impact on interprofessional competencies with high parent satisfaction.

KEYWORDS

interprofessional training ward, interprofessional learning, interprofessional practice, interprofessional competencies, interprofessionality in neonatology

1 Introduction

Interprofessional collaboration (IPC) is essential for a good patient-centered care in today's healthcare system (1–3). In Germany, as in many other countries (4), an interprofessional (IP) training structure has not yet been established [(5), p. 26, (6), p. 17, (7)], although this has long been called for (inter)nationally [(8), p. 7, (9), (10), p. 3, (11), p. 17].

Work-based learning as interprofessional education (IPE) in the clinical setting has been shown to be particularly effective for subsequent IPC (12–18). One example of IP-based learning environments are interprofessional training wards (ITWs) (19). On ITWs, students from different healthcare professions learn from, with and about each other and are simultaneously responsible for the care of patients (19, 20). ITWs have mainly been established in adult medicine (11, 19, 21). Positive developments of participants of a rotation on an ITW with regard to professional role development, communication skills and IP competencies such as socialization and teamwork skills have been demonstrated (13–18). Long-term effects have been confirmed (22, 23). In addition, patient satisfaction is high and the cost-effectiveness of ITWs has been demonstrated (13–18, 24). To date, there are no accessible comparable studies that include self-assessment, external assessment of IP skills by qualified learning facilitators and patient or parent satisfaction in pediatrics (7, 17) and no publications on ITWs in neonatology (25). The special, sensitive patient cohort of premature and newborn infants entails a high degree of complexity in interaction and social structures and therefore places high demands on interprofessionality (25, 26). This requires precise coordination of interprofessional cooperation between medical staff, e.g., in the form of the concept of "minimal or optimal handling," the reduction of unnecessary, stressful contact in order to minimize stress in premature or newborn babies (61). In addition, individualized communication with the parents that is appropriate to the particular life situation is necessary (27–29). The influence of individual experience and emotions on IP learning has been investigated (30). To date, this is a medical professional field that is not covered in great detail in medical degree programs in Germany (62), as in many other countries (31). As a result, it can be observed that medical doctors in the field of neonatology are increasingly dependent on the expertise of experienced nurses and interprofessional collaboration (26, 31). Informal learning by medical doctors from nurses has been reported (32) and the appreciation for integration into a kind of community of practice that nursing teams form has been demonstrated (33).

As a transfer project of the first Pediatric Interprofessional Training Ward in Germany (IPAPAED, Freiburg with funding from the Robert Bosch Stiftung), the Interprofessional Training Ward in Neonatology (IPANEO) was established at the "Muenchen Klinik Schwabing" on a neonatological IMC (intermediate care) ward, a neonatology unit of the highest level of care, in 2019. The IPANEO at the pediatric clinic of "Muenchen Klinik gGmbH" is therefore a learning unit based on the concept of the IPAPAED Freiburg (34).

The aim of the study was to evaluate whether participation in IPANEO leads to measurable improvements in participants' IP competencies and to understand whether IPANEO participants benefit from their experience. We report on the results in terms of interprofessional competencies after a rotation on an ITW.

2 Methods

2.1 Interprofessional training ward in neonatology (IPANEO)

The interprofessional team on the IPANEO consists of two NT and two MS. The trainees work alternately in the early and late shift and, with the support of the team at the ward (ward-in-ward concept), also cares for the IPANEO patients before and after the daily IPANEO time. The interprofessional working time on the IPANEO starts at 08:00 a.m. with the arrival of the MS and the nursing and medical learning facilitators (LF) and ends at 04:00 p.m. At night and at weekends, the patients are cared for by the regular ward team. Interprofessional simulation (IPSI) on CPR/resuscitation is included in the two-week course (35) (Figure 1). A group reflection (36) is held daily at 01:00 p.m., followed by a "SPRINT- Speed InterProfessional PeeR TeachIng NeonaTology," a short interprofessional peer-teaching unit [see "SIESTA," (37)], which is integrated into the daily routine twice a week (from 01:30 p.m.; Figure 1). Learning facilitation and guidance follows an internal curriculum (6, 38, 39), which includes reflection on roles and responsibilities, team communication and professional identity (40). Structured concepts for the ward on pocket cards and a selection of patients with clearly defined clinical pictures also provide a framework (35).

2.2 Study design and cohort

Prospective, non-randomized, quasi-experimental study with pre- and post-questionnaires (T1, T2) before and after IPANEO, including assessment questionnaires on self-perception and external assessment as well as parent satisfaction (T2). The study population comprises 23 final-year MS of a six-year medical school program and 30 NT in their 2nd or 3rd year of training of a three-year nursing degree (a non-university degree in Germany) (total $n = 53$).

2.3 Data collection

All IPANEO participants from November 2019 to March 2022 (20 rotations) were included. The parent questionnaires were collected between October 2019 and December 2020 ($n = 33$). Participation was voluntary and participants provided written consent.

2.4 Quantitative methodology

The outcome measures were recorded using the ISVS - Interprofessional Socialisation and Valuing Scale [(41), p. 171ff], the ICS - Interprofessional Collaboration Scale (42) and, in addition, the IPANEO-specific questionnaire (IPQ) - a questionnaire created individually for Neonatology Schwabing [see (35)]. In addition, the data from the "Observational Questionnaire for Learning Facilitators" (OQLF) and the "Parent Satisfaction Questionnaire" (PSQ) were analysed (IPANEO specific questionnaires). The paper-based pre (T1) and post (T2) questionnaires were completed on the introductory day and on the last day. Only the PSQ and the second part of the IPQ (11–30) were only collected at T2.

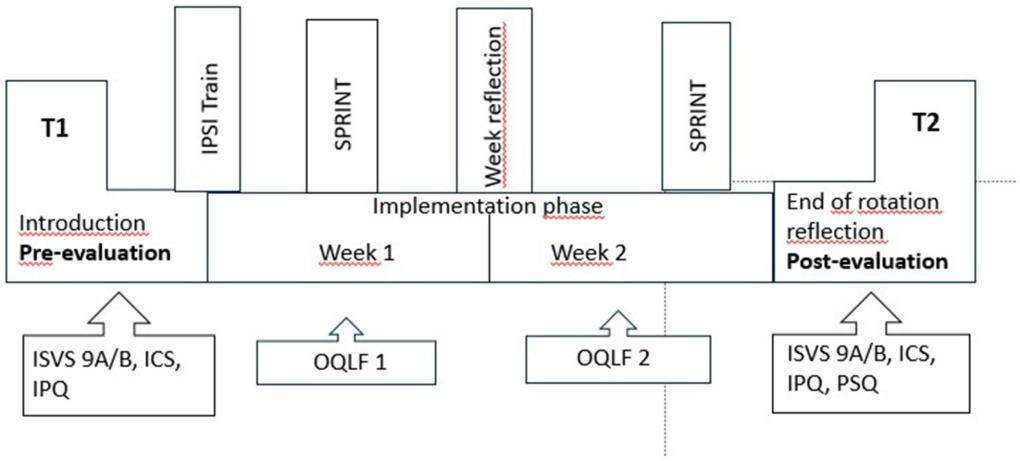

FIGURE 1
IPANEO- the concept (35). The two-week rotation is flanked by an introduction session and an end-of-rotation reflection. Pre- and post-evaluations include the ICS, the ISVS 9A/B, the OQLF, the IPQ and the PSQ. T1: ICS, Interprofessional collaboration scale, ISVS, Interprofessional collaboration and valuing scale. Week 1/2: OQLF, Observational questionnaire for learning facilitators. T2: IPQ, IPANEO specific questionnaire, PSQ, Parent specific questionnaire.

2.4.1 ISVS 9 set A and set B (*n* = 51)

The two short, 9-item equivalent forms of the ISVS have been applied, each subscale reflects key concepts of IP practice (41). The ISVS versions for IPANEO were adopted with the transfer of the IPAPAED, translated from English, and scientifically reviewed and validated (35). The ISVS was adopted with the transfer of the IPAPAED, translated from English, and scientifically reviewed and validated (35). 18 items measuring beliefs, attitudes and behaviors in relation to interprofessional relationships, collaboration and socialization were rated on a 7-point Likert scale from 6 (fully agree) to 0 (fully disagree) (Set A/B: 9 items each). The evaluation was based on the global scores and complemented by the assessment of the individual questions.

2.4.2 ICS medicine (*n* = 22) and ICS nursing (*n* = 29)

Perceptions of communication, isolation and accomodation were measured in a 13-point survey. A rating from "1 = strongly disagree" to "4 = strongly agree" could be given. The three categories as well as the individual questions were evaluated in order to identify the most significant increases (communication, accommodation) or decreases (isolation).

2.4.3 IPANEO specific questionnaire (*n* = 51)

The IPANEO specific questionnaire was adopted from the specially developed IPAPAED questionnaire (35) during the transfer from Freiburg and adapted for neonatology. Participants were able to select within a categorization from 1 (best possible) to 5 (7 items). This questionnaire includes demographic data, a project-specific evaluation as well as elements of communication, role definition and collaboration.

2.4.4 IPANEO observational questionnaire for learning facilitators (*n* = 62)

An "observational questionnaire for learning facilitators" (transfer from Freiburg (39)) developed to assess the participating learners was evaluated interprofessionally by the nursing and medical learning facilitators during the 2 weeks (*n* = 117 observational questionnaires, Likert scale 1 to 3). For the calculations, values from the first week of implementation (initial assessment) were compared with the values from the second week (final assessment) [subdivided into IP communication (4 items), IP collaboration (5 items), IP role definition (3 items)].

2.4.5 Parent satisfaction questionnaire (*n* = 29)

This questionnaire was transferred from IPAPAED Freiburg including general aspects of care and rating of the IPANEO (17). Parents used a Likert scale (1 to 4/ 1 to 5) to rate the care of their premature or newborn baby by the respective professional group and the interprofessional cooperation of the team. The length of stay on the ward and the gestational age (28–42 weeks' gestation) of the premature/newborn baby were also documented.

2.5 Data analysis and statistics

Statistical calculation and data analysis in GraphPad (version 10) with the Wilcoxon-signed-rank-test (T1, T2) and the Mann–Whitney-U-test for the post-data (T2) of the IPQ (11–30). The median (m) and the *p*-value [(p), two-sided] are visualized as dominant values. Descriptive measures [median (m) in the confidence interval (CI), mean (me), standard deviation (SD)] were also used.

2.6 Ethics

The concept and implementation of IPANEO as well as the evaluation were approved by "München Klinik gGmbH." All participants gave their written consent to complete the questionnaires and to be contacted by email and agreed to the publication of the anonymised data.

3 Results

All 53 IPANEO participants from November 2019 to March 2022 were included in the study. NT and MS were comparably represented in both groups. 86% of participants were female, all male participants were MS. The participants were on average 23 years old (18–33 years). Due to missing questionnaires all but 2 participants were included in the analysis resulting in a response rate of 96%. The age of the premature/newborn babies was at an average of 35–38 weeks during the period of care on the IPANEO (me = 5.2, SD = 1.0; PSQ 11) and the average length of stay on the ward was 8 days (me = 7.8, SD = 5.3; PSQ 9).

3.1 Quantitative evaluation

3.1.1 Self-assessment

3.1.1.1 High development of interprofessional socialization and valuing (ISVS)

The global scores of the ISVS 9A/B increased in both professional groups (PGs) (Figure 2). After the two-week IPANEO rotation the participants rated their competencies significantly higher in all IP categories, e.g., they stated an increase in the assumption of responsibility ($m = 4$ "agree," pre; $m = 6$ "fully agree," post; $p < 0.0001$, ISVS 9B-All, 7) and independence ($m = 3$ "partially agree," pre; $m = 6$ "fully agree," post, $p < 0.0001$, ISVS 9B-All, 2). According to their self-assessment all participants developed a significantly greater awareness of one's own role in the team ($m = 4$ "agree," pre; $m = 6$ "fully agree," post; $p < 0.0001$, ISVS 9B-All, 1).

Both PGs showed a significant increase in the appreciation of how important it is to integrate families as members of the team ($m = 5$ "strongly agree," pre; $m = 6$ "fully agree," post; $p < 0.0001$, ISVS 9A-All, 7). In particular the NT developed a significantly higher understanding of involving patients in participatory decision-making in the context of their healthcare ($m = 4$ "agree," pre; $m = 6$ "fully agree," post; $p < 0.0001$; ISVS 9A-NT, 8). Likewise all participants favored working in an interprofessional team at T2 ($m = 5$ "strongly agree," post; $p < 0.0001$; ISVS 9B-All, 3). Again, the highest significant increase in the commitment with interprofessional practice was found in the group of the NT ($m = 4$ "agree," pre; $m = 6$ "fully agree," post; $p < 0.0001$; ISVS 9A-NT, 2). MS reported to have acquired a significantly higher awareness of the role of nursing in a team through participation in and practical performance of nursing activities ($m = 4$ "agree," pre, $m = 6$ "fully agree," post, $p < 0.0001$; ISVS 9A-MS, Figure 3).

3.1.1.2 Improvement of interprofessional cooperation (ICS)

The ICS is categorized in the dimensions communication, accommodation and isolation. In all three ICS categories the medians remained at a constant level. Significant increases were found in the following questions: Prior to participation the PGs had different treatment conceptions ($m = 2$ "disagree," pre; $p < 0.0001$, ICS-NT, 4) and differences of opinion often remained unresolved ($m = 3$ "agree," pre; $p < 0.0001$, ICS-MS, 11). These perceptions changed significantly to positive assessments after the IPANEO ($m = 3$ "agree," post, ICS-NT, 4, $m = 2$ "disagree," post, ICS-MS, 11).

3.1.1.3 Increasing importance of interprofessional collaboration (IPQ)

After the IPANEO the importance of IP communication for patient care was rated very highly by the participants ($m = 1$ "very high importance," pre, post, no significant difference between the PGs, post; IPQ-All, 8) and satisfaction with the feedback culture increased significantly ($m = 3$ "partly/partly," pre; $m = 2$ "satisfied," post; $p < 0.0001$, no significant difference between the PGs, post; IPQ-All,

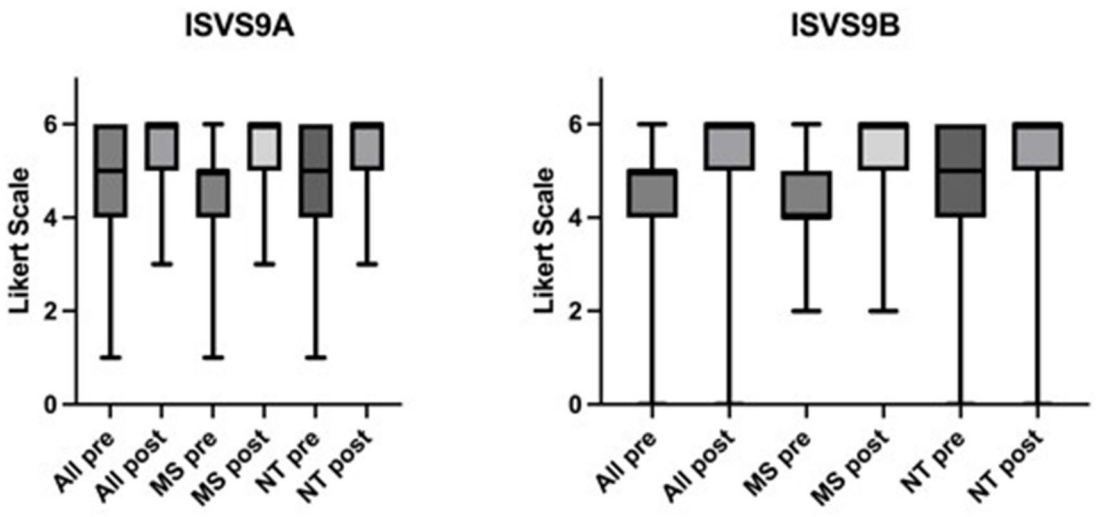

FIGURE 2
Significant changes in the ISVS 9A/B global scores. Scale from 0 to 6 on a Likert scale. Higher numbers indicate an increase in competencies. Pre =T1, post = T2. ISVS 9A/B-All, MS, NT, $p < 0.001$, n=459. ISVS 9A/B: Interprofessional Socialisation and Valuing Scale, 9- Item Equivalent versions. MS: edited by MS, NT: edited by NT.

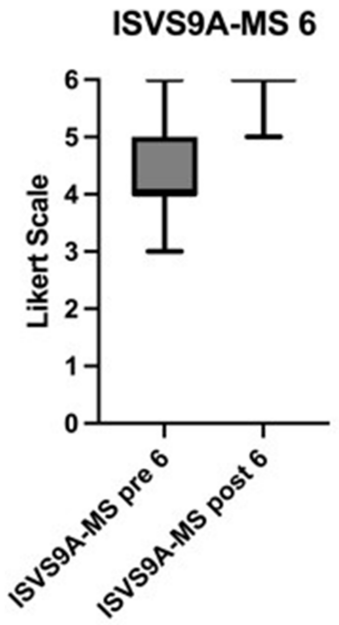

FIGURE 3
Awareness of nursing in a team. Significant changes in the ISVS 9A-MS 6 score in medical students. Scale from 0 to 6 on a Likert scale. Higher numbers indicate a significantly higher awareness of nursing in a team. Pre = T1, post = T2, $p < 0.0001$, $n = 198$. ISVS 9A: Interprofessional Socialisation and Valuing Scale, 9-Item Equivalent version. MS: edited by MS.

10). Concerning the IP-collaboration the motivation to utilize the support of the other PG increased ($m = 2$, "high," pre; $m = 1$ "very high," post; p-value <0.0001; significant difference between the PGs, post; $p = 0.015$, IPQ-All, 8).

3.1.2 External assessment

3.1.2.1 High assessment by the learning facilitators (OQLF)

In the external evaluation by the learning facilitators there were significant increases in the ability to communicate with other PGs and parents ($m = 2$, "with help," pre; $m = 1$, "confident," post; $p < 0.0001$, OQLF, 10–13). In addition a significant increase in the definition of one's own role as well as the role of the other PG was found ($m = 2$, "with help," pre; $m = 1$, "confident" post; $p < 0.0001$, OQLF, 14–16). Concerning IP-collaboration the participants improved the "interdisciplinary cooperation with members of other professional groups" significantly and reached an evaluation result of a "safe interprofessional cooperation" ($m = 1$ "safe," post; $p < 0.0001$; OQLF, 1–5).

3.1.2.2 Parents' satisfaction with the treatment (PSQ)

The results of the parents questioning confirm good care from the IPANEO team, which had a positive effect on the child's treatment ($m = 1$, "very good," CI = 0.96; PSQ, 2, 3). The parents stated that they had received all important information about the clinical course ($m = 1$, "definitely," CI = 0.96; PSQ, 5). The treatment team of students and trainees was perceived by the parents as an interprofessional team ($m = 1$, "very good," CI = 0.96; PSQ, 4). If necessary, 98% of the parents surveyed would agree to repeat treatment on IPANEO ($m = 1$, "definitely," CI = 0.98, PSQ, 6).

Based on these results a rotation on a neonatological ITW appears to have a positive effect on IP competencies and interprofessional training on an IMC at a neonatological (university) hospital appears to be feasible in terms of learning success.

4 Discussion

This study is the first to report on the outcomes of a voluntary rotation on an ITW in neonatology, including parent satisfaction and supervision by board-certified professionals. The importance of a clear structure (see Figure 1) in the changing context of professional IP training was highlighted (43). In order to initiate the lifelong learning process of competence development, the participants were actively encouraged to form an interprofessional team and take responsibility through the teaching concept (44, 45). As a result, they recognized that treatment success for patients can be achieved in an IP team (35). After ITWs in internal medicine and surgery improved interprofessional collaboration and teamwork as well as typical dynamic group development processes were reported: A significant increase in the assumption of responsibility and independence, information sharing as well as conflict resolution was found (13, 19–21, 46). As defined in the CanMEDs concept, one of the main tasks of physicians is to be a "member of a team" (47). Our results support the development of participants into team players: We show a significant increase in well-being in participatory decision-making within the team and with patients (48, 49). Extensive group reflection was conducted in line with the discussion of social constructive theory and interprofessional learning (36). The learning facilitators encouraged a culture of speaking up and listening, creating a "safe place with space for learning" (36).

Profession-specific differences in the acquisition of interprofessional competencies have been reported (11, 20). In the pre-evaluation the participants rated physicians' activities and decisions more important ($m = 3$ "agree," pre; $p < 0.0001$, ICS-NT, 12, Figure 4), due to a reluctance to discuss new treatment methods ($m = 3$ "agree," pre, post; $p < 0.0001$, ICS-NT, 7) and to ask for the opinion of the other PG ($m = 2$ "disagree" pre, post; $p < 0.0001$, ICS-NT, 8). After participation, the answers shifted significantly in the direction of a role image of both professions that was perceived as equal ($m = 2$ "disagree," post, ICS-NT, 12, Figure 4). Likewise NT rate their own profession as less equal than that of their medical colleagues (50, 51). Possible solutions to this imbalance appear to be a reduction in hierarchies, as well as a change in task division and areas of responsibility (50, 51). However, this requires the cooperation and collaboration of all professions involved [(52), p. 19ff]. The historically shaped hierarchy in the healthcare system ascribes a key role to the physician's profession, even in times of change [(5), p. 182]. A significant increase in the appreciation of the nursing profession has been shown (53, 54, 63). It is therefore understandable that NTs in particular are emerging as future multipliers for IP collaboration (51, 55). This indicates that different professional groups benefit in different ways from a rotation on an ITW (34).

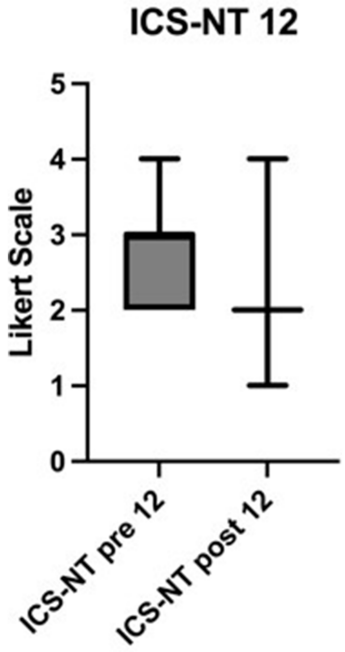

FIGURE 4
Shift in the role image of nursing care. Significant change in the ICS-NT 12 score in nursing trainees. Scale from 1 to 4 on a Likert Scale. Lower numbers indicate a higher role image (compared to physicians). Pre = T1, post = T2, $p < 0.0001$, $n = 150$. ICS-NT: Interprofessional collaboration scale, NT: edited by NT.

As with many IPE concepts, assessing the impact remains a challenge (23, 56). A strength of this study is encountering this challenge with a comprehensive evaluation (57). Limitations are the conduction of the study in a neonatological context only, the rather small sample size and the lack of a qualitative data analysis with regard to interprofessional competencies and a control group. In addition, the timing of the data collection immediately before and after the intervention means that only short-term effects can be assumed with the results presented.

5 Conclusion

Future research on IPE should include qualitative analyses in order to investigate the background and motives for the aforementioned changes in behavior as well as the increase in competence and examine the long-term effects more closely. Repeated formal, objective evaluations of IPE participants and a control group without interprofessional intervention is desirable. In addition, the effects on IPC should be recorded by evaluating the staff of the wards or clinics where IPE takes place. The aim should be to include other professional groups as trainees in healthcare and pediatric nursing, physiotherapy and occupational therapy, students of medicine, pharmacy, midwifery and other PGs ("Scandinavian model") to participate in interprofessional training (58) and to implement IPE as an integral part of the curricula at all training levels in the long term (3, 59, 60).

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 study was conducted in accordance with the ethical regulation of the Munich hospital gGmbH. The participants provided their written informed consent to participate in this study.

Author contributions

HS: Investigation, Writing – original draft, Methodology. CS: Conceptualization, Writing – review & editing, Investigation, Methodology, Supervision. SB: Conceptualization, Writing – review & editing, Supervision. NF: Writing – review & editing, Investigation, Project administration, Resources. CB: Writing – review & editing, Data curation, Methodology, Validation. PB: Funding acquisition, Writing – review & editing, Conceptualization, Project administration, Supervision. MK: Supervision, Writing – review & editing, Conceptualization, Funding acquisition, Resources.

Funding

The author(s) declare that financial support was received for the research, authorship, and/or publication of this article. The implementation of the IPANEO was financially supported by the Robert Bosch Foundation (Project Operation Team, grant number 01000039-003). The funders had no role in study design, data collection, data analysis, the decision to publish, or the writing of the manuscript.

Acknowledgments

We thank all participants of the IPANEO as well as the team on the ward and the participating parents.

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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frontiers | Frontiers in Medicine

TYPE Original Research
PUBLISHED 06 February 2025
DOI 10.3389/fmed.2025.1491177

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OPEN ACCESS

EDITED BY
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RECEIVED 04 September 2024
ACCEPTED 24 January 2025
PUBLISHED 06 February 2025

CITATION
Müller PA, Straub C, Heinzmann A, Langer T, Bode SFN, Griewatz J, Kimmig C and Friedrich S (2025) Residents as learning facilitators inside and outside of interprofessional education: a faculty development program in postgraduate pediatric training.
Front. Med. 12:1491177.
doi: 10.3389/fmed.2025.1491177

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Residents as learning facilitators inside and outside of interprofessional education: a faculty development program in postgraduate pediatric training

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Introduction: Changing learning environments in health professions are an important challenge of interprofessional education (IPE). When students experience IPE activities during their undergraduate training, they are often guided by trained learning facilitators. Students still spend more time in non-IPE settings, often guided by residents. Residents rarely undergo specific training for core teaching competencies that are crucial in both IPE and non-IPE contexts. At our pediatric hospital, some residents were trained as learning facilitators on an interprofessional training ward. To bridge the gap between IPE and non-IPE learning facilitation for the other residents, we developed the resident-as-teachers course "How to teach pediatrics."

Methods: "How to teach pediatrics" was implemented as a 4-week blended learning program based on the framework of Core Competencies for Medical Teachers (KLM). The intended learning outcomes were to reflect on residents' role modelling and professionalism as well as personal teaching practice, emphasize learner centeredness and foster social and communicative competencies. Participants self-assessed their teaching competencies pre/post-course using a validated questionnaire (FKM_L). Oral feedback was gathered by group reflection and qualitative feedback by open-ended survey questions.

Results: 26 residents participated in the course, of which $N = 22$ qualified for the pre/post-course self-assessment via the FKM_L (return rate: $n = 9$; 40.9%). Participants reported an increase in the competency fields of "didactical activities in medicine," "social and communicative competence," "role model and professional behavior" as well as "reflection and further development of own teaching practice." Participants evaluated the course overall as "very good," stated a high learning gain and estimated the course to be a good preparation for teaching students.

Discussion: "How to teach pediatrics" shows the feasibility of integrating faculty development as part of resident training. We observed a self-assessed increase in core competencies for medical teachers after participating in the course. Although more participants need to be included and long-lasting effects still

10.3389/fmed.2025.1491177

need to be proven, such faculty development programs for learning facilitators might be an opportunity to ensure a more consistent and high-quality learning experience for students in both IPE and non-IPE teaching and learning activities.

KEYWORDS

Interprofessional education, resident-as-teachers, train the trainer, faculty development, core competencies for medical teachers

1 Introduction

Changing learning environments for students in health professions represent one of the most significant challenges in interprofessional education (IPE) (1, 2). Over the past decades, an increasing number of IPE teaching and learning activities have been developed. During these undergraduate training sessions, students are often supported by learning facilitators (3). Given the complex dynamics inherent in IPE courses, there is broad consensus that effective faculty training is essential for IPE. Consequently, learning facilitators must be equipped with teaching competencies that include reflecting on roles and responsibilities, facilitating learning, fostering discussion and team communication and developing a professional identity (4–6). Those competent learning facilitators are crucial as they promote a culture of open communication and active listening, as well as creating a "safe place with space for learning" (7). As a result and necessity, faculty development and the provision of teaching competencies have become areas of growing interest in interprofessional education (3, 8).

While IPE-related training is crucial for IPE-learning facilitators, it may not be sufficient. Structured IPE activities still constitute only a small portion of the overall curriculum for medical students, although students constantly find themselves in non-structured IPE and non-IPE activities during their courses or day-to-day clinical practice. Students still spend more time in non-IPE activities, where they interact with various learning facilitators, many of whom are residents. Those medical experts play a central role in the education of students. Medical students reported that they acquire approximately one-third of their knowledge from residents (9). Thereby residents have always been deeply involved in clinical teaching, dedicating a significant part of their daily work to teaching medical students. Their critical role in teaching both medical students and fellow residents became increasingly clear over the past few decades (10–13). Residents in non-IPE settings are also highly motivated and there is substantial evidence highlighting their importance as learning facilitators (14). However they rarely participate in formal faculty development programs or residents-as-teachers workshops. The majority of residents don't receive any standardized teaching training before starting their residency or during residency (15, 16).

While there is a lack of faculty development for residents, several competency frameworks for medical professionals have been established. One model was proposed by the Royal College of Physicians and Surgeons in Canada (CanMEDS) (17). In this framework the role of the "Scholar" emphasizes the responsibility in teaching as a lifelong learner who improves and maintains professional action and behavior through continuous learning. Based on the CanMEDS framework and the "Competencies for Medical Educators" by Srinivasan et al., Görlitz proposed the Core Competencies for Medical Teachers (Kernkompetenzen für Lehrende in der Medizin, KLM) (18, 19). The KLM serves as a guide for the qualification of teaching faculty and supports further advancement of the content, training formats and evaluation of faculty development initiatives and therefore, establishes uniform quality criteria. The KLM outlines a profile of requirements for all teachers in medical education as it defines six competencies for medical teachers, which are equally relevant: educational action in medicine, learner centeredness, social and communicative competencies, role modelling and professionalism, reflection and advancement of personal teaching practice and systems related teaching and learning (18). These competences overlap with the competencies in the IPE context mentioned above, especially regarding learner centeredness, social and communicative competencies, role modelling and professionalism, reflection and advancement of personal teaching practice. The development in those competencies cannot be taken for granted in the increasing complexity of daily healthcare delivery. This underscores the importance of longitudinal faculty development programs, both within IPE and non-IPE, to offer residents the opportunity to further develop their competencies. Residents-as-teachers workshops and faculty development enable residents to acquire essential teaching competencies and core competencies for learning facilitation in both IPE and non-IPE context (20). In our tertiary pediatric hospital, residents have been taken on the role of learning facilitators for medical and nursing students on an interprofessional training ward since 2017 (21–24). In advance they received a train-the-trainer workshop where they participated in sessions providing competencies on communication, feedback, learner centeredness, role modelling and self-reflection (25). These train-the-trainer workshops could only be offered to residents who participated in our interprofessional training ward as learning facilitators. However, the majority of the residents in our tertiary pediatric hospital still have not received any training in teaching competencies or core competencies for learning facilitation. Hence there is still a gap in the training for learning facilitation between IPE and non-IPE in our hospital. To bridge this gap through faculty development, we conceptualized and implemented a residents-as-teachers course named "How to teach pediatrics." This led to the following research questions:

- How does the "How to teach pediatrics" course influence IPE and non-IPE-related core medical teaching competencies in our tertiary pediatric hospital?
- In which way does our course influence self-perceived core medical teaching competencies in pediatric residents?
- Which aspects of the course influence self-perceived competencies in particular?

2 Methods

2.1 The residents-as-teachers workshop: "how to teach pediatrics"

To overcome the gap between IPE and non-IPE learning facilitation through faculty development, we conceptualized and

implemented a residents-as-teachers course named "How to teach pediatrics." The course program was developed based on the framework of Core Competencies for Medical Teachers (german: *Kernkompetenzen für Lehrende in der Medizin* = KLM) (18). For the purpose of the workshop "How to teach pediatrics," we focused on four of the six KLM competencies that overlap with the competency frameworks for learning facilitators on interprofessional training wards. Therefore we focused on learner centeredness, social and communicative competencies, role modelling and professionalism and reflection and advancement of personal teaching practice as we saw the greatest overlaps within these competency fields.

We developed "How to teach pediatrics" according to the principles of constructive alignment (26). Following these principles, intended learning outcomes (ILOs) should be in line with teaching and learning activities and assessment tasks. The main intended learning outcomes for "How to teach pediatrics" were derived from the four KLM competencies mentioned above. Specifically, the intended learning outcomes were:

(1) Residents analyze their role as learning facilitators and their role modeling for undergraduate medical students in an individual or small group setting.
(2) Residents apply principles of student-centered learning, such as considering students' prior knowledge and fostering a safe learning environment.
(3) Residents implement theory-based approaches in providing structured feedback to undergraduate medical students
(4) Residents reflect their personal teaching practice and advance teaching competency development.

Based on the intended learning outcomes, we developed teaching and learning activities and selected assessment tasks (Figure 1).

"How to teach pediatrics" was developed as a training course that lasts 4 weeks. The course was led by experienced teachers from the medical context. All of them have taken on the role of learning facilitators for medical and nursing students in our interprofessional training ward.

At the start of the course, participants were asked to complete an online preparatory e-learning, which was then used as a flipped classroom activity in the first on-site workshop. In the e-learning, we mainly covered different areas of providing and receiving feedback, including specific techniques. Additionally, participants were given a reflection task about their own past learning experiences from both undergraduate and postgraduate medical training. The reflection task consisted of two parts:

1 "Thinking back to your undergraduate and postgraduate medical training, which teacher stands out for you and why?"
2 "How exactly did this teacher facilitate your learning?"

This reflection task served to relate concepts of role modeling and learning facilitation to participants' own lived experience. It was designed to facilitate participants' discussion on the role and importance of being a role model during the first on-site workshop. This workshop also included practical exercises on feedback techniques in role-play activities [e.g., Ask-Tell-Ask method; (27)]. Furthermore, the importance of creating a safe learning environment as a prerequisite for successful social learning was emphasized, based on the participants' shared reflections. Elements of learner centeredness were discussed, with a particular emphasis on promoting

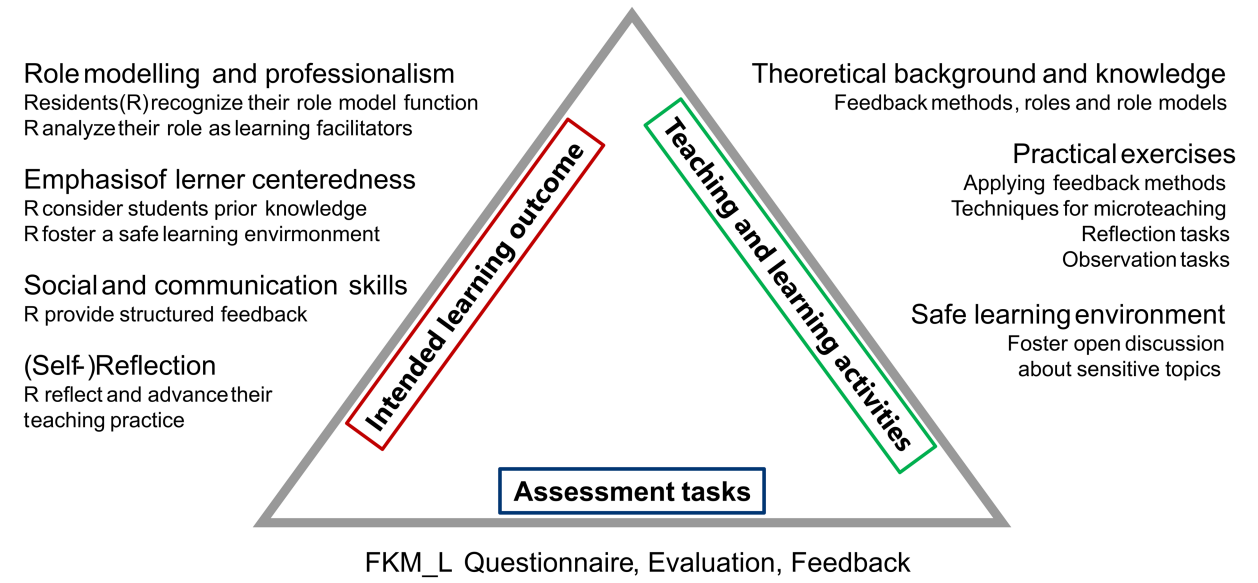

FIGURE 1
How to teach pediatrics—constructive alignment. Intended Learning Outcome (=ILO, framed in red): Reflection on residents' role in the domain of role modelling and professionalism, (self-)reflection and development of personal teaching practice, emphasis of learner centeredness and advancement of social and communicative competencies. Teaching and learning activities (framed in green): Mediation of theoretical background and knowledge, practical exercises and creation of a safe learning environment. Assessment (framed in blue): Rating of the participants own teaching competencies pre/post using a validated questionnaire [FKM_L = Freiburg questionnaire for assessing competencies in medicine, teachers (German: Freiburger Fragebogen zur Erfassung von Kompetenzen in der Medizin, Lehrende)], evaluation of the course and direct feedback during the course.

a culture that embraces mistakes. After the course, participants received an observation task:

> "In the next 2 weeks, you should be observed by a final year medical student in a situation involving patients and/or parents and receive feedback from them. This situation could involve taking a brief medical history, conducting an examination, or having a conversation."

The aim of the observation task was to practice accepting feedback correctly and to model this behavior for students. Medical students in their final year of a six-year course spending rotations on different wards of the hospital were given a structured observation form and then asked to give feedback to residents. Residents approached medical students that were available in their current work environment prior to the second on-site workshop. Medical students were then asked to observe residents in a short day-to-day activity, e.g., taking a history from a patient and parents, or conducting a physical examination. In the workshop, participants shared their experiences with the observation task. This led to a lively discussion around giving and receiving feedback. Additionally, there were sessions on how to deal with group dynamics and small group teaching techniques [e.g., Think-Pair-Share method; (28)]. We also discussed the teaching materials available at our clinic and how to use them to achieve students' learning goals (Figure 2).

2.2 Participants

The course was initially offered to residents of a tertiary pediatric hospital in the first 2 years of training only. Group size was limited to 8 participants, to allow for a close facilitation by the one person teaching the course. For the first two rounds of the course, participants were recruited according to availability during course hours in the afternoon (e.g., not on holiday, available to be absent from the ward for 3 h, no shift work). Participants were informed about their participation via email. 8 and 7 residents took part in the first two rounds of the course. For the third round of the course, some adaptations were made. Firstly, two teaching faculty were available for the course, so the number of participants was raised to a maximum of 15. Secondly, the course was opened to all residents and fellows of the pediatric hospital, as well as pediatricians from outpatient primary

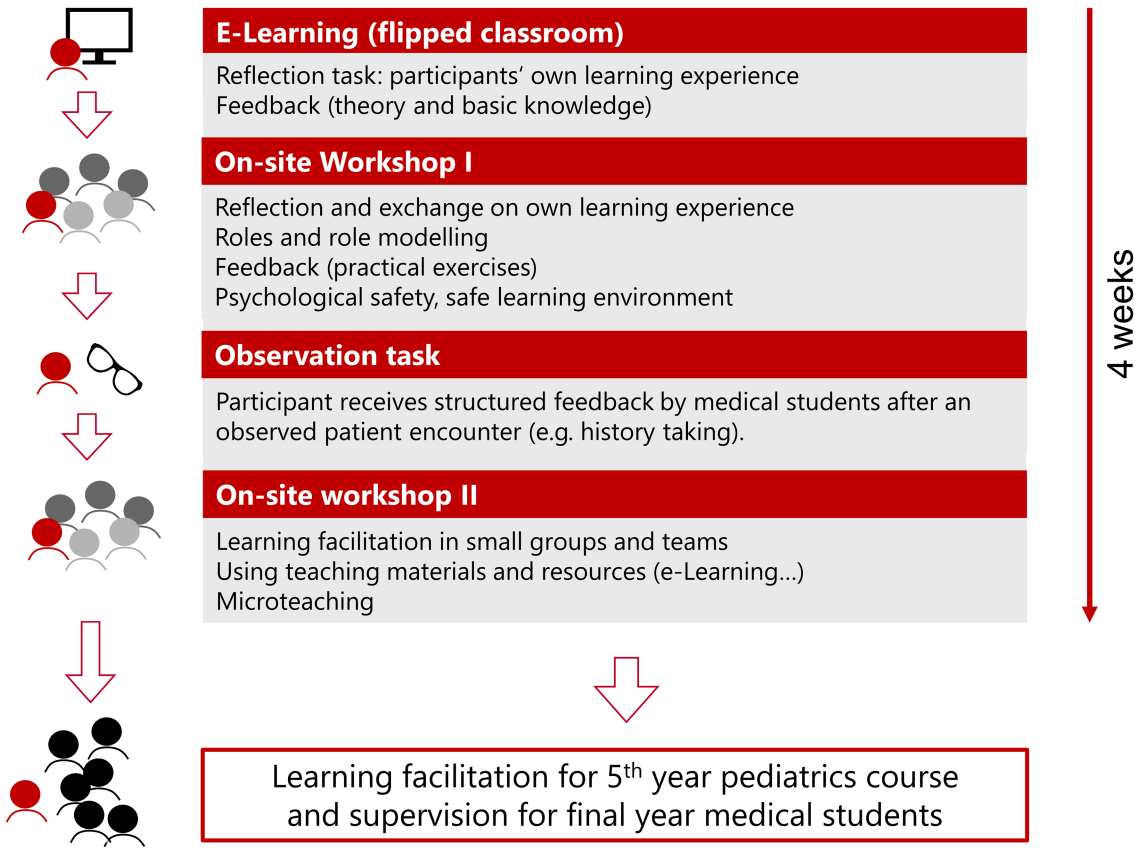

FIGURE 2
How to teach pediatrics—concept. The red mannequin represents a resident participating in the four-week residents-as-teachers workshop. The dark and light grey mannequins are other participants and the black mannequins are medical students. In the beginning participants go through an e-Learning. The first on-site workshop includes exchange on the reflection exercise, practical exercises and input on creating a safe learning environment. Subsequently participants are observed by medical students and receive structured feedback afterwards. During the second on-site workshop participants share their experiences and discuss aspects of group dynamics, microteaching, group teaching techniques and the teaching materials available at our clinic. After the four-week training, course participants will teach medical students during the 5th year pediatric course and supervise medical students on the wards.

care pediatric offices. Primary care pediatricians participated in the course to prepare for a new program, where final year medical students spend 4 weeks of their pediatrics rotation in outpatient primary care pediatric offices. Participation in the course was offered to all residents and fellows via email (around 70 people), with 10 places available. Likewise, primary care pediatricians were invited to the course via email (around 30 people), with 5 places available. Finally, 6 residents, 1 fellow and 4 primary care pediatricians participated in the third round. All participants were asked to give oral feedback at the end of the course and fill in both the course evaluation and the FKM_L questionnaire in both the pre and the post self-assessment.

2.3 The FKM-L questionnaire

To measure the achievement of the defined Intended Learning Outcomes (ILOs), we used the FKM_L Questionnaire, which was "developed to capture individual and group-based competency profiles of medical educators" (29). The FKM-L concept is based on the Core Competencies for Medical Teachers [KLM; (18)]. The questionnaire assesses six core competencies of the KLM model through global questions and subareas, enabling medical teachers to understand and reflect on their teaching competencies.

For each competency field of the FKM_L the items of the subareas were summarized with good internal consistency. Across the six core competencies, there are 22 subareas and further subscales, comprising a total of 69 items. All scales were subjected to item analysis. For each item (e.g., "I use different teaching/learning methods in my classes), respondents were asked to rate their approval on a five-item Likert type scale ("Totally agree" to "Do not agree at all") (29).

For our faculty development program, "How to Teach Pediatrics," we examined the competency fields of "Learner Centeredness," "Social and Communication Skills," "Role Modelling and Professionalism," and "Reflection and Development of One's Own Teaching Practice." Additionally, we were interested in the self-assessment of the competency field "Medical Didactic Skills." We excluded the subareas "Examination" and "Coherence with Examination Goals" as they were not relevant to our course. We also left out the core competency of "System-Based Learning" since our course aimed to improve individual teaching competencies of the residents (Figure 3).

2.4 Course evaluation form

Course evaluation consisted of an online questionnaire with 19 5-point Likert-type items and two open ended questions ("What did you like the most?," "What could be improved?"). It was based on a modified version of the Maastricht Clinical Teaching Questionnaire, which is used at the local university to evaluate small-group teaching and seminars in medicine (30).

2.5 Data collection

Data were collected between 2021 and 2024 during the "How to Teach Pediatrics" courses. During that time, 21 residents, 1 fellow and 4 primary care pediatricians participated in the course. Participants were asked to complete both the course evaluation and the FKM-L questionnaire. The FKM-L was completed both as a pre-assessment and a post-assessment upon the end of the course. Data collection was conducted online via the Unipark platform by Tivian (www.unipark.de, Tivian GmbH, Hürth, Germany) on mobile devices.

2.6 Data analysis

Data were analysed in Microsoft Excel. Means and standard deviations for subscales and global items were calculated as described

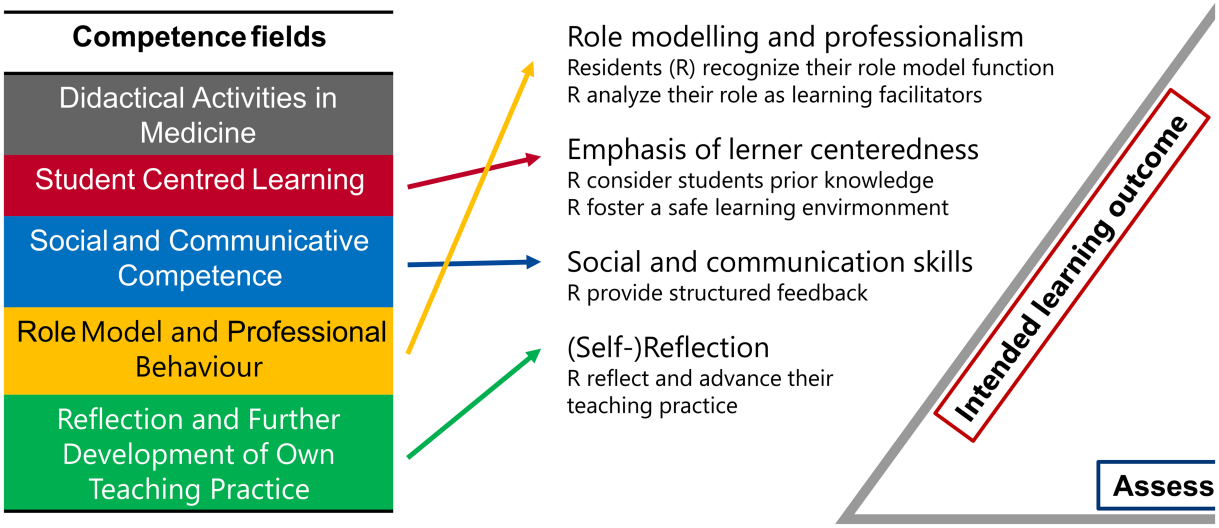

FIGURE 3
FKM_L Competence fields and intended learning outcome. The five competence fields assessed through the FKM_L questionnaire are presented. The colored arrows indicate the corresponding content of our intended learning outcomes and the core competencies we aim to convey.

previously (29). Due to small sample size for the FKM_L, only descriptive statistical analysis was conducted. Free-text comments from evaluation forms were extracted and analysed by two authors independently (PAM and SF) and grouped according to positive and negative aspects about the course.

2.7 Ethics

All participants gave written informed consent before completing the questionnaire. Completing the FKM_L was not mandatory for participating in "How to teach pediatrics." The study was approved by the Institutional Review Board of the University of Freiburg (No 21–1300).

3 Results

3.1 Sample characteristics

26 residents participated in a total of three implementations between November 2021 and April 2024. The course evaluation was completed by 20 of 26 participants (return rate 76.9%). For the pre/post self-assessment via FKM_L questionnaire, analysis was limited to hospital-based doctors (i.e., residents and fellows), lowering the number of possible respondents to $N = 22$. The response rate was n = 9, return rate 40.9%. 44.4% of these nine participants were female, 77.8% were between 25 and 30 years old and the mean of years working in hospital was 2 years. Full sample characteristics can be found in Supplementary data.

3.2 Self-assessment: core competencies for medical teachers

Due to small sample size for the FKM_L, we describe trends and conduct descriptive statistical analysis in the following. We saw an increase in all five core competencies which we recorded with the FKM_L questionnaire. Participants reported an increase in their self-perceived competencies in "didactical activities in medicine" (mean: pre: 3.48; SD: 0.91 versus post: 4.02; SD: 0.68), "student centered learning" (mean: pre: 3.92; SD: 0.99 versus post: 4.15; SD: 0.80), "social and communicative competence" (mean: pre: 3.11; SD: 0.95 versus post: 3.97; SD: 0.89), "role model and professional behavior" (mean: pre: 3.58; SD: 0.94 versus post: 4.06; SD: 0.76) and "reflection and further development of own teaching practice (mean: pre: 2.41; SD: 1.07 versus post: 3.37; SD: 0.94). In the latter we saw the highest difference between the pre and post survey (difference pre vs. post: 0.96), whereas regarding "student centered learning," the smallest increase was mentioned after the course (difference pre vs. post: 0.3.32) (Figure 4).

3.2.1 Global items within the core competencies

The FKM_L questionnaire divides the core competencies into further global items to query subareas of the competency fields. Thus, in both sub-competencies of "didactical activities in medicine," we saw a slight increase after the course, both in the "conception of learning goal oriented lessons" (MH01: mean: pre: 3.44; SD: 0.86 versus post: 4.11; SD: 0.57) and in "design of teaching situation(s) conducive to learning" (MH02: mean: pre: 3.52; SD: 0.96 versus post: 3.89; SD: 0.79) (Figure 5).

Regarding the subareas of "student centered learning," there was almost no trend regarding the "design/use of an atmosphere conducive to learning" (LO01: mean: pre: 4.50; SD: 0.69 versus post: 4.65; SD: 0.62). However, a trend towards a slight increase could be observed in "consideration of prior knowledge" (LO02: mean: pre: 3.3.37; SD: 0.91 versus post: 3.85; SD: 0.76) (Figure 6).

In the core competency of "social and communicative competence," participants rated their competency higher in "comprehensible, structured communication" (KK01: mean: pre: 3.74; SD: 0.80 versus post: 4.33; SD: 0.47) and stated a slight improvement of "constructive handling of dynamic group processes" (KK02: mean: pre: 3.11; SD: 0.87 versus post: 3.58; SD: 1.11). Participants reported an improvement in their self-assessed competency in "specification of unambiguous (learning) objectives" (KK03: mean: pre: 3.15; SD: 0.97 versus post: 4.19; SD: 0.72). Additionally, participants rated their competence in giving "constructive feedback" higher after the course (KK04: mean: pre: 2.74; SD: 0.89 versus post: 3.78; SD: 0.79) (Figure 7).

In the competency field of "role model and professional behaviour," participants reported an increase in the subareas of "reflection on professional actions" (PH01: mean: pre: 3.19; SD: 1.02 versus post: 3.78; SD: 0.74) and "perception of the function as a role model" (PH02: mean: pre: 3.93; SD: 0.86 versus post: 4.33; SD: 0.61). There was a slight increase in "stimulation to engage with professional action" (PH03: mean: pre: 3.63; SD: 0.78 versus post: 4.07; SD: 0.81) (Figure 8).

The course led to a higher self-assessed competence among participants regarding "critical review and documentation of teaching behavior and development" (RW01: mean: pre: 2.86; SD: 1.18 versus post: 3.78; SD: 0.67) and the "targeted development of [their] teaching competencies" (RW02: mean: pre: 2.11; SD: 0.83 versus post: 3.30; SD: 0.71). Additionally, participants reported to expand their role spectrum after the course (RW03: mean: pre: 2.11; SD: 0.92 versus post: 2.89; SD: 0.78) (Figure 9).

3.3 Course evaluation and feedback

Participants evaluated the course after the second on-site workshop (return rate: n = 20; 76.9%). They stated a high learning gain after participating in the course (Figure 10A-1, Mean: 4.10, standard deviation: 0.51) and estimated the course to be a good preparation for teaching students (Figure 10A-2, Mean: 4.65, standard deviation: 0.57). Furthermore the participants stated that the course encouraged them to further extend their knowledge in learning facilitation for medical students (Figure 10A-3, Mean: 4.65, standard deviation: 0.62). The participants actively took part in the course and the discussion (Figure 10A-4, Mean: 4.85, standard deviation: 0.3.36) and rated the course overall as "very good" (Figure 10A-5, Mean: 4.70, standard deviation: 0.46).

Asked about positive aspects of the course in the free-text comments and in a feedback round at the end of the on-site workshops, participants repeatedly mentioned the "open discussion" and found the "exchange between participants extremely valuable." They appreciated the "open, trusting atmosphere" and felt that the course was conducted in a "friendly, positive and structured way." One

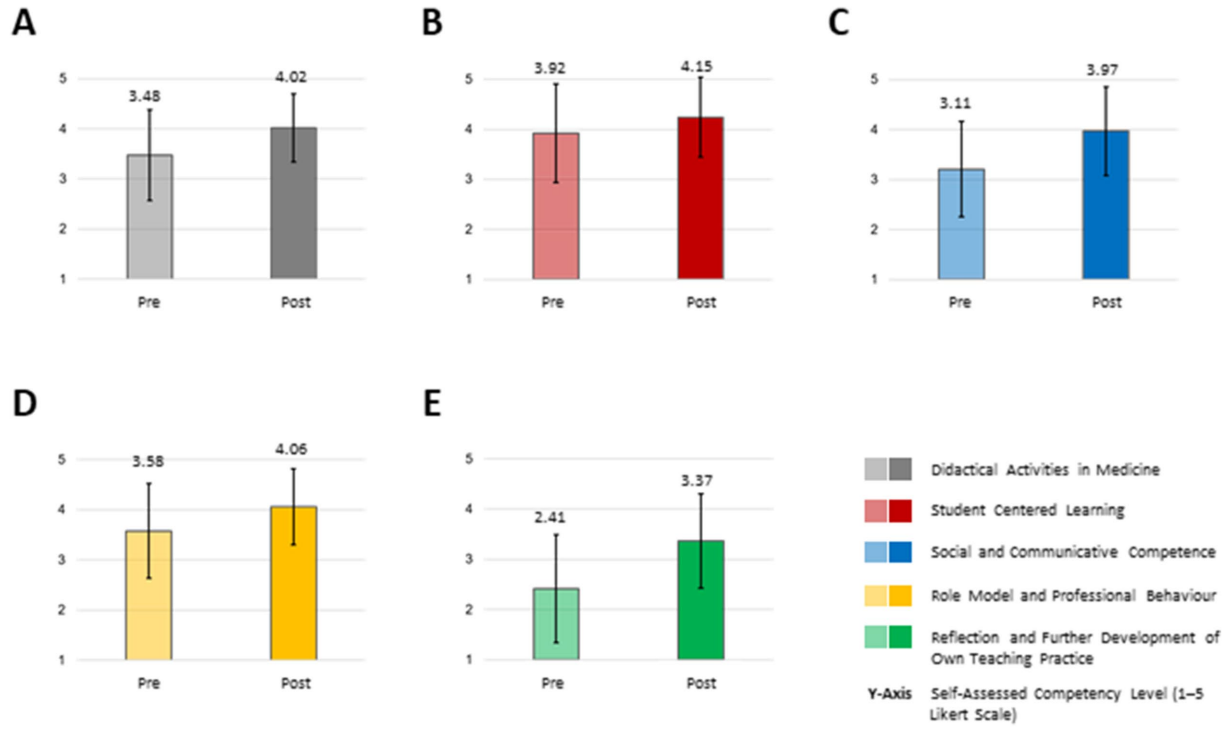

FIGURE 4
Competence fields pre/post "How to teach pediatrics." The results show the self-perceived teaching competencies pre/post our teaching course using the FKM_L questionnaire (**A**: "Didactical Activities in Medicine"; **B**: Student Centered Learning"; **C**: "Social and Communicative Competence"; **D**: "Role model and Professional Behavior" and **E**: "Reflection and Further Development of Own Teaching Practice"). The colored bars (pre = transparent colored, post = strong colored) show the mean values based on a five-point Likert scale with 1 indicating low level of approval, meaning low competency level and 5 indicating a high level of approval, therefore high level of competency. Narrow lines represent the standard deviation. *n* = 9.

participant appreciated the "safe learning environment in the course." Additionally, "helpful ideas for the implementation of teaching techniques and feedback" were positively mentioned, as well as the "opportunity for practical exercises in the course" and introduction to "microteaching techniques" and "teaching with limited time resources." Moreover, several participants mentioned the areas of "culture of error" and "feedback" as "helpful."

Asked which aspects of the course could be improved or even be removed from the course the participants found the "e-Learning too extensive." Moreover, some participants expressed the desire for even "more time dedicated to practical exercises."

4 Discussion

In this study we report on our findings from a faculty development program in postgraduate pediatric training which was attended by 26 participants. The program was designed to bridge the gap in training the learning facilitators for medical students between IPE and non-IPE learning activities in our tertiary pediatric hospital. Based on the framework of core competencies for medical teachers [KLM; (18)], we developed a short course specifically for pediatric residents, which was later expanded to fellows and primary care pediatricians. We measured self-reported teaching competencies, using the validated FKM_L questionnaire (29). We found an increase in self-reported competencies in all areas measured, with some differences that warrant discussion.

Concerning our methodology, we decided to use the FKM_L questionnaire since it was developed based on the same competency framework that we used to define the intended learning outcomes for our course. We hypothesized that this would enable us to assess the effects of our teaching and learning activities in line with the principles of cognitive alignment (26). Secondly, the original questionnaire was developed and validated in German and within the German medical education system. Our study was conducted in Germany, with all participants being German native speakers. Therefore, we omitted possible hindrances that may be caused by non-validated translations, without cross-cultural adaptation (31). However, we made some adaptations to the original version of the FKM_L, removing one core competency and two subareas. These were related to systems-based learning/teaching and taking student exams. The reason for these adaptions was that the target audience for our course were medical doctors involved in day-to-day clinical teaching at the bedside, both individually and in small groups. To increase meaningfulness and reduce cognitive load for participants, we decided to focus on core competencies that are necessary for this particular area of learning facilitation (32). The second focus was on aligning interprofessional and non-interprofessional hands-on learning facilitation, rather than revising curricula or student exams. We therefore selected the five core competencies of the KLM framework the overlap with proposed frameworks for learning facilitators in IPE and adapted the questionnaire accordingly. We decided to apply a retrospective pretest (RPT) methodology for collecting data. This means we made participants complete the questionnaire retrospectively at the end of

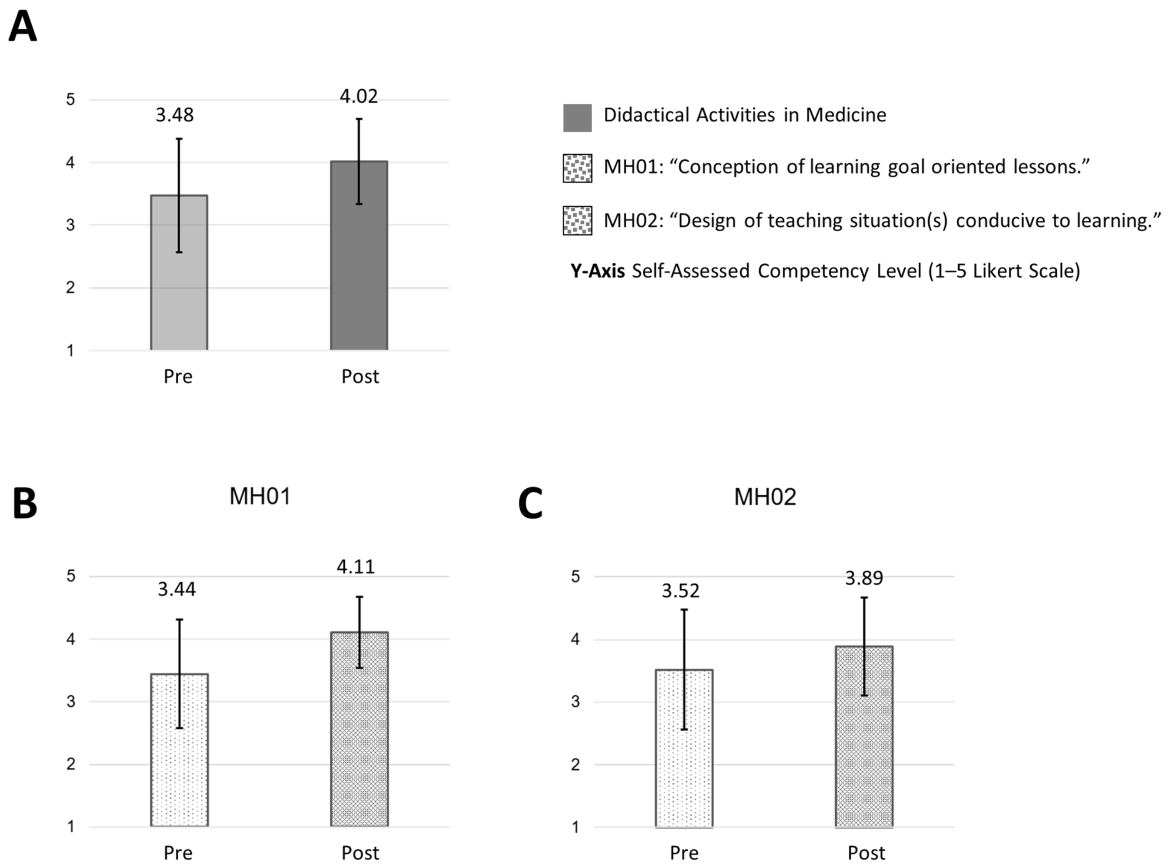

FIGURE 5
Didactical activities in medicine and subareas pre/post "How to teach pediatrics." The results show the self-perceived teaching competencies in "didactical activities in medicine" **(A)** and subareas **(B,C)** pre/post our teaching course using the FKM_L questionnaire. The colored bars (pre = transparent/light colored/dotted, post = strong colored/dotted) show the mean values based on a five-point Likert scale with 1 indicating low level of approval, meaning low competency level and 5 indicating a high level of approval, therefore high level of competency. Narrow lines represent the standard deviation. *n* = 9.

the course, for both the pre and post assessment. This decision was based on exisiting evidence, that traditional pre/post assessments in interventions like ours are prone to response-shift-bias (33). Moreover, data from the Stanford Faculty Development Program indicate that for training clinical teachers, RPT showed better correlation with housestaff and student evaluation and traditional pre/post comparisons (34, 35). Since the context of our program was similar to the Stanford program, we argue that our choice is supported by existing evidence in the literature.

As for course evaluations results, we observed a high level of motivation and participants positively mentioned open discussions. These factors likely contributed to a positive learning environment. A positive learning environment refers to Level 1 "Reaction" in Kirkpatrick's Four-Level Model and states the importance of enjoyment of a learning activity (36). Participants were directed towards their own prior experiences as learners, which helped them relate to the course content.

Concerning the results we saw an increase in self-reported competencies in all domains, referring to the Level 2 "Learning" in Kirkpatrick's model. Generally this does not come as a surprise, since self-reported competencies after a teaching and learning activity tend to increase (37). Still, these findings underline that we were able to address the intended learning outcomes on a global level and point towards a positive influence concerning core medical teaching competencies in our tertiary pediatric hospital.

Taking a closer look at ways how our course influences self-perceived core medical teaching competencies in pediatric residents, we found the biggest increase in self-perceived competency in "Reflection and further development of own teaching practice." This increase comprised items as "development of own teaching competencies" and "critical reflection of own teaching." The specific role of a teachers is summarized in the "Scholar" domain of the widely accepted CanMEDs framework (38). However, reflecting on this particular role and its continuous development has not been widely implemented into postgraduate medical training. Therefore our findings are in line with results from other faculty development programs for junior health professionals (20).

We found the smallest difference in pre/post-assessment for the area of "Student centered learning." One possible explanation is the fact that participants rated this competency higher than in all other core competencies in pre-assessment. Participants were rather young and learner-centered approaches have become more widespread in the last 20 years, so participants are likely to have experienced some learner-centered education themselves (39). Considering the literature, Tipton et al. faced a comparable effect after their residents-as-teachers course with no significant effect in the "ability to create a

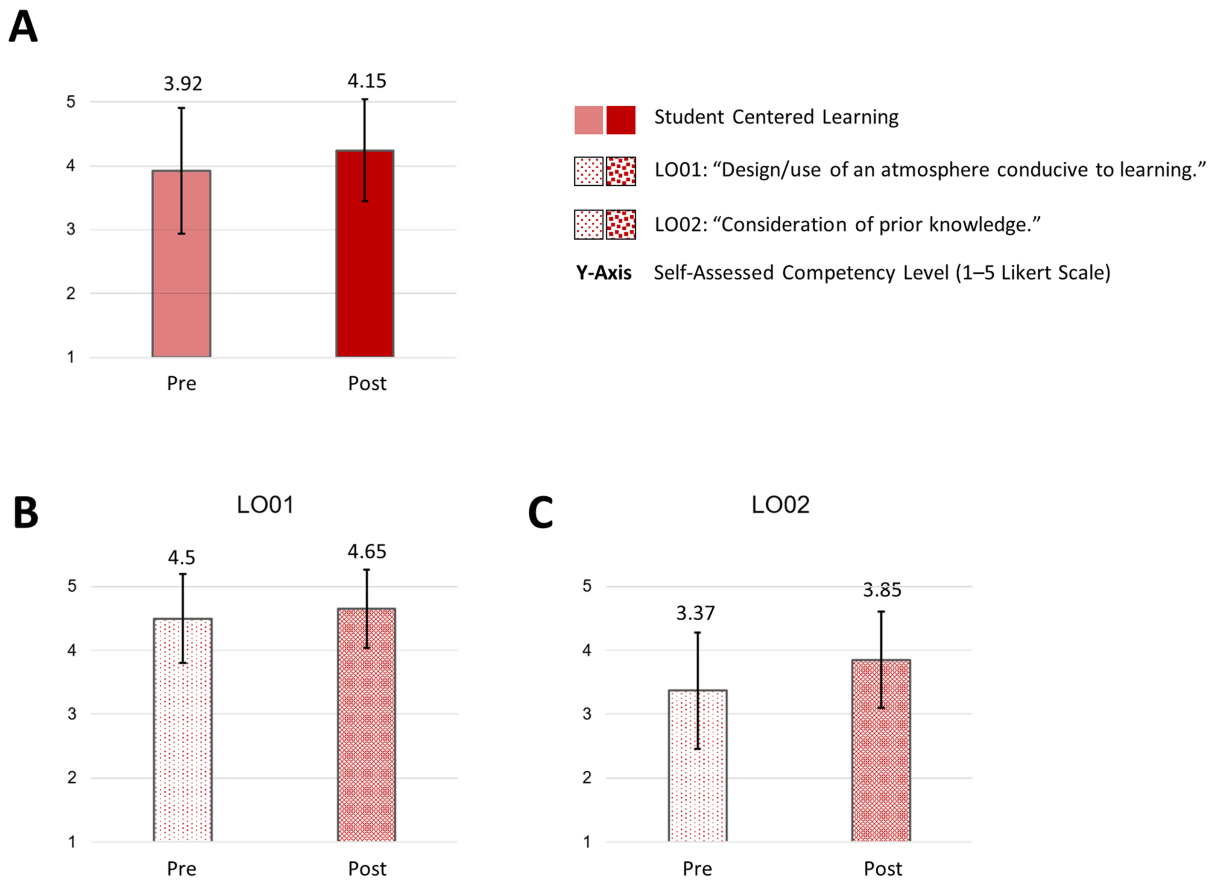

FIGURE 6
Student centered learning and subareas pre/post "How to teach pediatrics." The results show the self-perceived teaching competencies in "student centered learning" **(A)** and subareas **(B,C)** pre/post our teaching course using the FKM_L questionnaire. The colored bars (pre = transparent/light colored/dotted, post = strong colored/dotted) show the mean values based on a five-point Likert scale with 1 indicating low level of approval, meaning low competency level and 5 indicating a high level of approval, therefore high level of competency. Narrow lines represent the standard deviation. *n* = 9.

positive learning environment" with participants starting from a high level (3.73 on a 5-point Likert scale) (40).

In addition to the broader trends, it is important to consider the implications of the changes observed in specific competency areas. For example, competencies related to medical didactics, such as defining learning objectives and ensuring constructive alignment, showed substantial improvement. These concepts, though fundamental to teaching, are often new to residents transitioning from learners to educators. This emphasizes the need for faculty development programs to introduce and reinforce these essential teaching principles.

The increased competency in social and communication skills, particularly in feedback techniques, also merits attention. Practicing feedback techniques were one of the aspects of the course influencing self-perceived competencies in particular. Effective feedback is a critical component of medical education, and the course's focus on practical feedback strategies likely contributed to the observed gains. These findings are consistent with other studies highlighting the importance of feedback training in improving teaching outcomes (37). The trends of our course we see in the post-course measurement is comparable to other residents-as-teachers programs regarding "giving feedback," "I am skilled giving feedback" or "providing effective feedback" (40–43).

Despite the immediate positive outcomes in level 1 "reaction" and 2 "learning," the sustainability and impact (Kirkpatrick levels 3 and 4) of these effects remains uncertain. Participants cited time constraints as a barrier to implementing teaching practices learned in the course. This challenge is well-documented in the literature, with time pressures often limiting the ability of healthcare professionals to engage fully in teaching activities in a long-term view and learned teaching techniques get lost over time (40, 41). While our course provided a solid foundation, its long-term impact on teaching practices will depend on ongoing support and reinforcement.

Strengths of this study include a clear theoretical framework that the course was based on, with a validated questionnaire available for measuring outcomes (18, 29). The theoretical framework was used to inform constructive alignment to ensure that intended learning outcomes, teaching and learning activities and assessment tasks were in line (26). The study addresses a highly relevant topic, adding some new aspects to the existing body of evidence for residents as teachers and how to improve their readiness for teaching.

There are several limitations to this study which need to be taken into careful consideration: The FKM_L questionnaire relies on self-reported outcomes only, which may constitute a significant bias (44). It would be desirable to achieve a more objective way of measuring residents' teaching competencies. Furthermore, as a result of consistent process evaluation and adaptation, the nature of the course and its participants changed slightly over the time of data collection. This was a natural effect of ongoing quality improvement efforts and changes in staff but

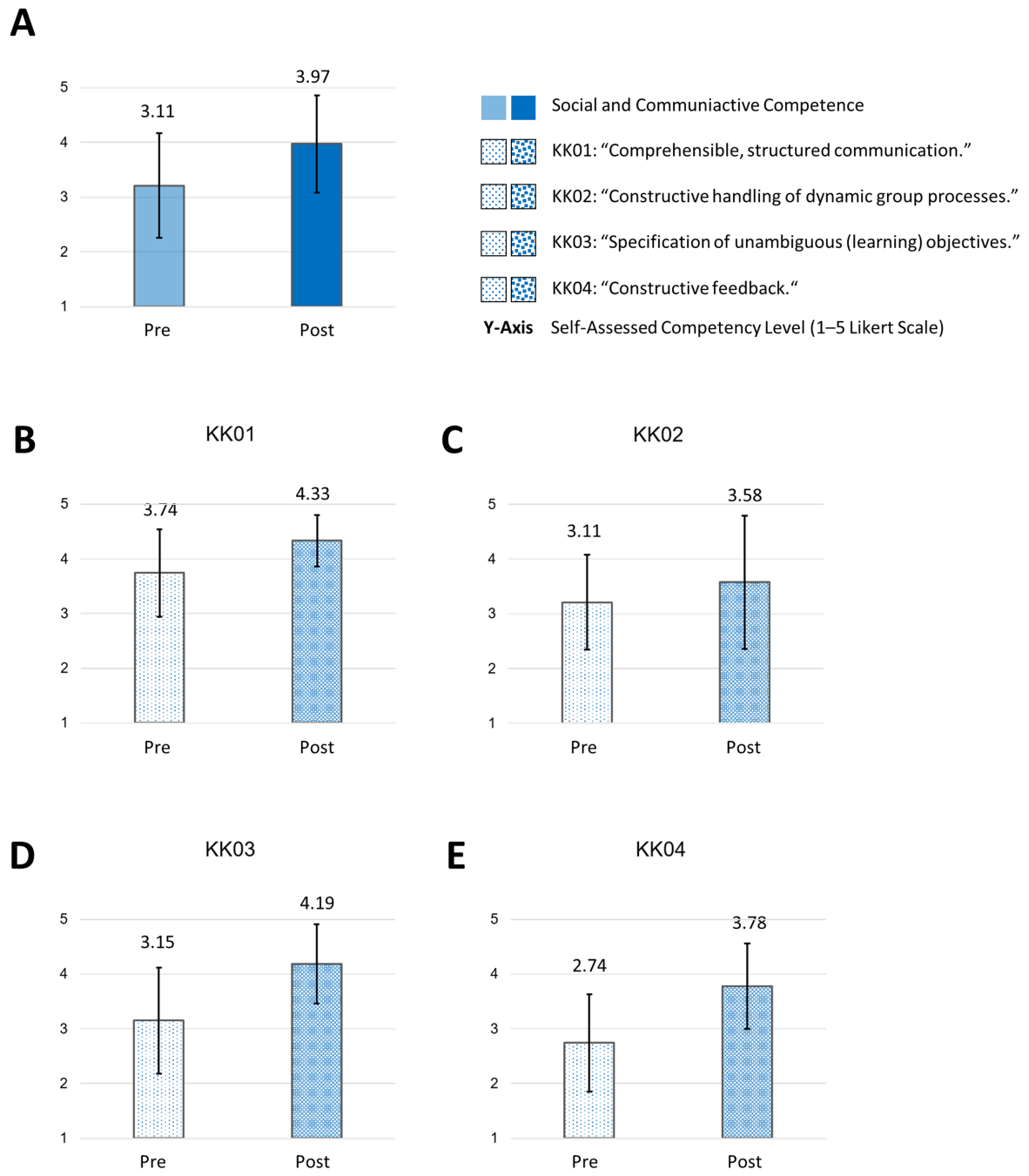

FIGURE 7
Social and communicative competence and subareas pre/post "How to teach pediatrics." The results show the self-perceived teaching competencies in "social and communicative competence" **(A)** and subareas **(B–E)** pre/post our teaching course using the FKM_L questionnaire. The colored bars (pre = transparent/light colored/dotted, post = strong colored/dotted) dotted show the mean values based on a five-point Likert scale with 1 indicating low level of approval, meaning low competency level and 5 indicating a high level of approval, therefore high level of competency. Narrow lines represent the standard deviation. *n* = 9.

should be taken into account when interpreting the data. Sample size is small ($n = 9$) and does not allow for any meaningful statistical analysis, other than of descriptive nature. One reason for this was given by participants as they felt they did not have sufficient time to complete both course evaluation and FKM_L during the course itself. Qualitative data are limited to short answers to open-ended questions and do not allow for extensive exploration of motives for learning success (or the lack thereof). Data interpretation is finally limited by the single-center nature of this study. Some of the effects observed might be due to local circumstances and not be generalizable to other contexts.

To overcome some of these limitations and improve quality of data, some measures have been put into place and will yield in new results in the future: To allow for more time for answering questionnaires during the course, adaptations have been made to the course program. Due to changes in staff policy, it will be possible to run the course twice a year with up to 15 participants each, allowing for more data to be collected in a shorter time. Most importantly, participants will re-assess their teaching

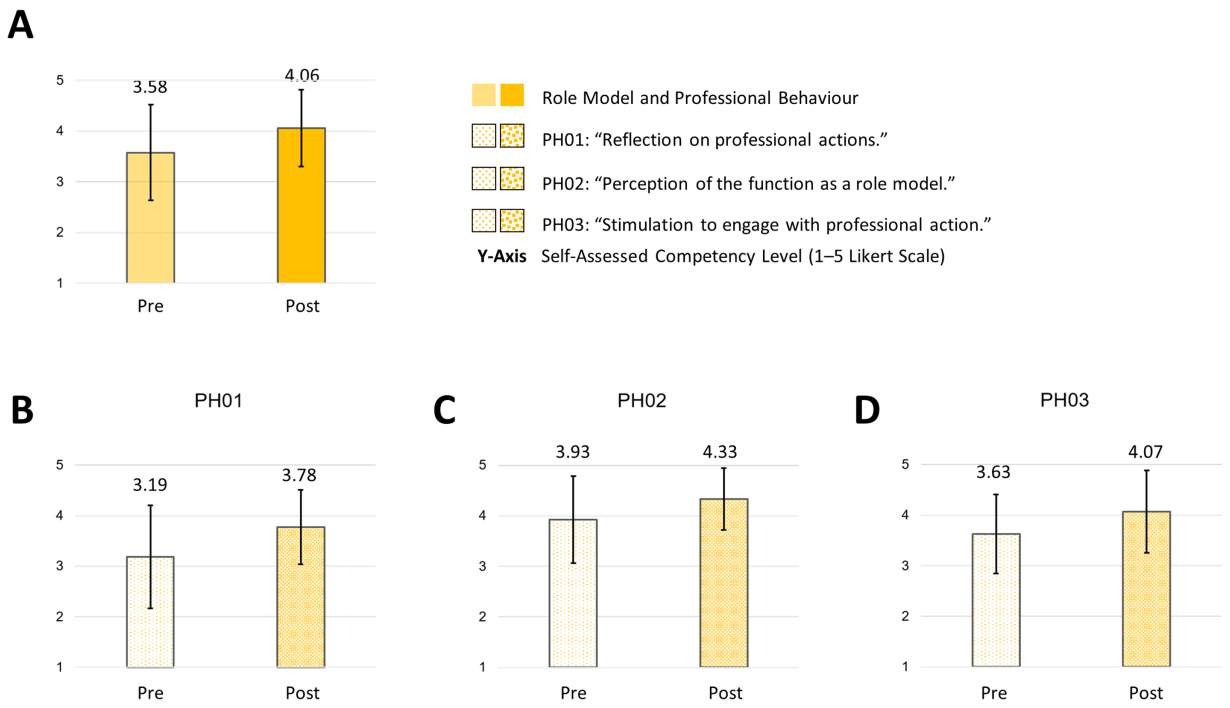

FIGURE 8
Role model and professional behavior and subareas pre/post "How to teach pediatrics." The results show the self-perceived competencies in "role model and professional behavior" **(A)** and subareas **(B–D)** pre/post our teaching course using the FKM_L questionnaire. The colored bars (pre = transparent/light colored/dotted, post = strong colored/dotted) dotted show the mean values based on a five-point Likert scale with 1 indicating low level of approval, meaning low competency level and 5 indicating a high level of approval, therefore high level of competency. Narrow lines represent the standard deviation. *n* = 9.

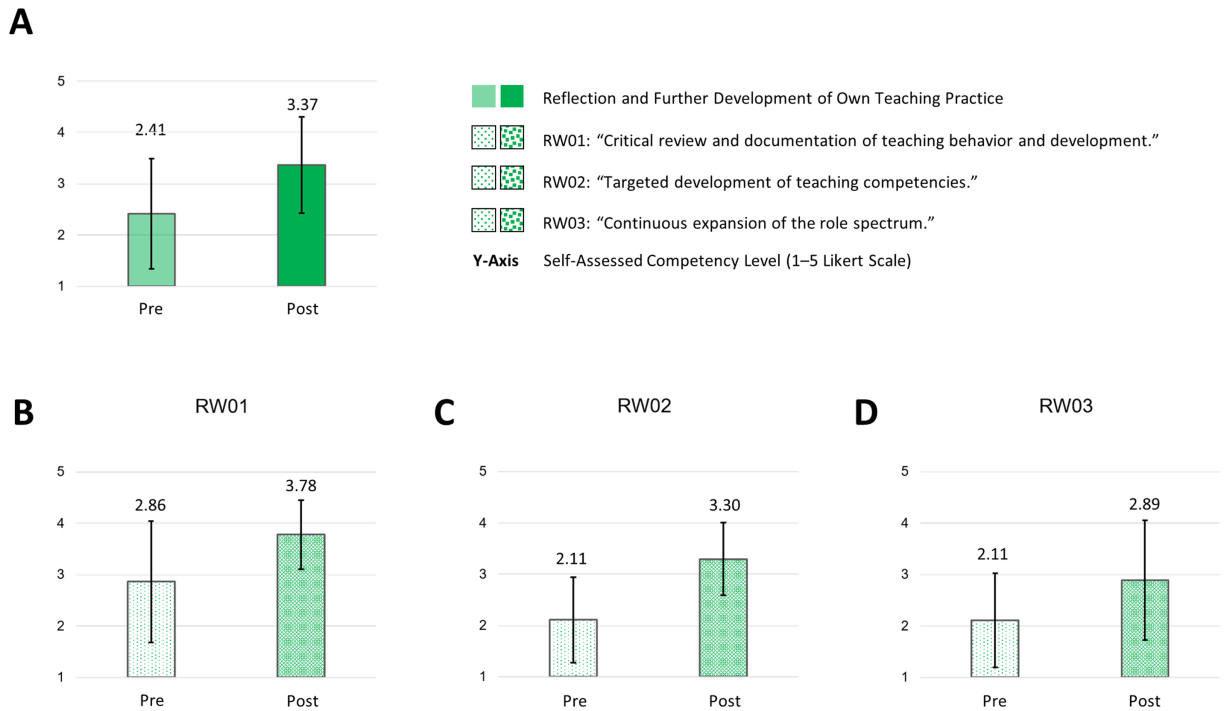

FIGURE 9
Reflection and further development of own teaching practice and subareas pre/post "How to teach pediatrics." The results show the self-perceived teaching competencies in "reflection and further development of own teaching practice" **(A)** and subareas **(B–D)** pre/post our teaching course using the FKM_L questionnaire. The colored bars (pre = transparent/light colored/dotted, post = strong colored/dotted) dotted show the mean values based on a five-point Likert scale with 1 indicating low level of approval, meaning low competency level and 5 indicating a high level of approval, therefore high level of competency. Narrow lines represent the standard deviation. n = 9.

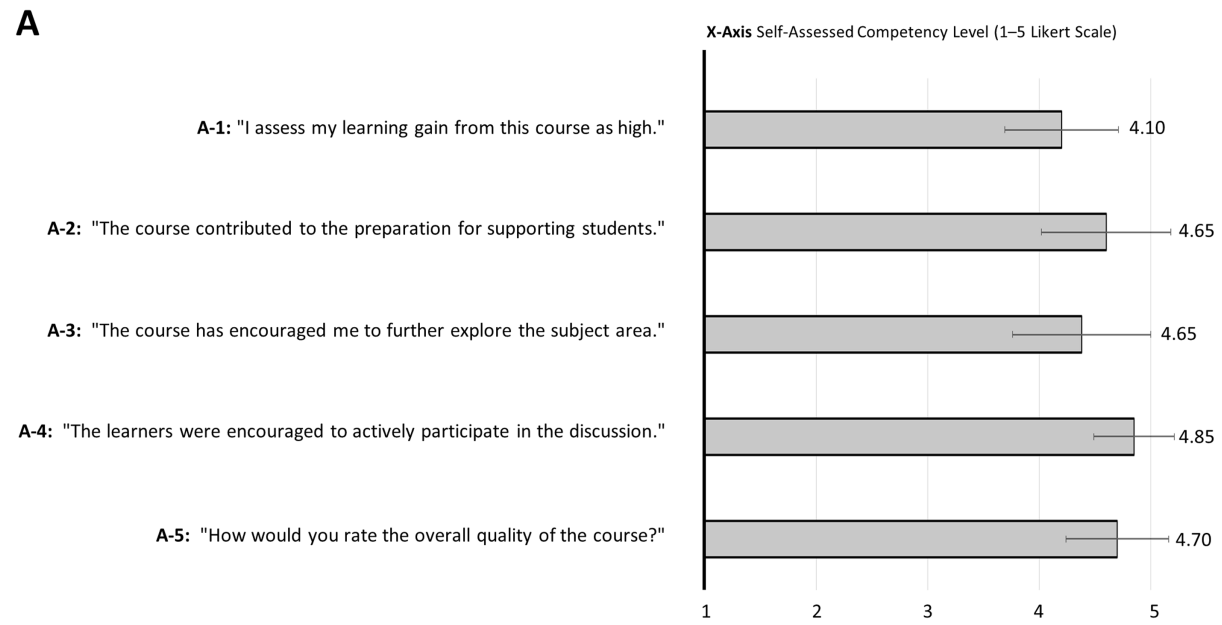

FIGURE 10
Evaluation. The evaluation of "How to teach pediatrics" by participants is presented. The grey bars show the mean on a five-point Likert scale where 1 = do not agree and 5 = completely agree (A-1 to A-4), and 1 = very poor and 5 = very good (A-5). The standard deviation is represented by narrow lines. n = 20 (A-1, 2, 4, and 5), n = 13 (A-3).

competency again when teaching a group of 8 medical students in the two-week 5th pediatrics course. At the same time, data will be collected from student evaluation which is also based on a validated questionnaire. This will allow for a comparison of self-reported teaching competency and assessment by students and might lead to a more objective way of measuring teaching competency and progress.

In conclusion, our study demonstrates that a well-structured faculty development program, grounded in a theoretical framework and aligned with core teaching competencies, can provide an opportunity to enhance the teaching abilities of pediatric residents at a tertiary pediatric center. While the immediate effects are promising, ongoing efforts are needed to ensure the sustainability of these improvements and to explore more objective measures of teaching competency in our context. The small sample size allows only for a descriptive analysis and limits generalizability of our data. Nonetheless those kind of faculty development programs for learning facilitators might allow for students to experience a well-founded level of learning facilitation outside of IPE teaching and learning activities. By continuing to refine and expand our program, we hope to contribute to more effective and impactful faculty development in mono- and interprofessional education.

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 humans were approved by Institutional Review Board of the University of Freiburg (No 21-1300). The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

PM: Conceptualization, Data curation, Investigation, Project administration, Resources, Visualization, Writing – original draft, Writing – review & editing. CS: Conceptualization, Investigation, Methodology, Project administration, Supervision, Validation, Writing – review & editing. AH: Conceptualization, Funding acquisition, Methodology, Project administration, Resources, Supervision, Writing – original draft, Writing – review & editing. SB: Funding acquisition, Methodology, Project administration, Resources, Supervision, Writing – review & editing. JG: Formal analysis, Investigation, Methodology, Writing – review & editing. CK: Conceptualization, Data curation, Investigation, Methodology, Project administration, Resources, Writing – original draft, Writing – review & editing. SF: Conceptualization, Data curation, Investigation, Methodology, Project administration, Resources, Writing – original draft, Writing – review & editing. TL: Funding acquisition, Methodology, Project administration, Resources, Supervision, Writing – review & editing.

Funding

The author(s) declare that financial support was received for the research, authorship, and/or publication of this article. The implementation of "How to teach pediatrics" was financially supported by a non-restricted grant for teaching from the University of Freiburg, Germany.

Acknowledgments

We thank all participants of the course "How to teach pediatrics." Special thanks to Marianne Giesler, Maria Lammerding-Köppel who provided the FKM_L questionnaire for this study. We acknowledge support by the Open Access Publication Fund of the University of Freiburg.

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.2025.1491177/full#supplementary-material

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frontiers | Frontiers in Medicine

TYPE Original Research
PUBLISHED 10 March 2025
DOI 10.3389/fmed.2025.1516156

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OPEN ACCESS

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RECEIVED 23 October 2024
ACCEPTED 19 February 2025
PUBLISHED 10 March 2025

CITATION
Nawagi F, Vyas R, Kiguli Malwadde E, Yuan S, Bedoll D, Adejumo PO, Phimister R, Drendall J, Seeling J and Suleman F (2025) Advancing Interprofessional Education and Collaborative Practice: outcomes of the AFREhealth-FAIMER Student Elective Exchange Program in Health Professions Education in Africa.
Front. Med. 12:1516156.
doi: 10.3389/fmed.2025.1516156

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Advancing Interprofessional Education and Collaborative Practice: outcomes of the AFREhealth-FAIMER Student Elective Exchange Program in Health Professions Education in Africa

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Background: While some African health professions institutions have advanced in integrating Interprofessional Education and Collaborative Practice (IPECP) into their curricula, many still struggle with traditional, siloed training. To address this gap, the African Forum for Research and Education in Health (AFREhealth), partnering with FAIMER, a division of Intealth, developed the AFREhealth-FAIMER IPECP Student Elective Exchange Program (IPECP Program). This study assessed the IPECP competencies of participating students and gathered stakeholder perspectives on the IPECP Program.

Methods: The 2018 revised Interprofessional Collaborative Competency Attainment Scale (ICCAS), containing 21 items, was used to assess student participants' IPECP competencies before and after participating in the IPECP Program. Paired sample T-tests were run to examine if there was a significant improvement in IPECP competencies after students participated in the program, on both the total and item score levels. The study also administered online surveys to collect feedback from faculty and managers of the IPECP Program on its design, implementation, benefits, and challenges.

Results: Students reported a significant improvement in IPECP competencies after participating in the program, with the mean ICCAS total score rising from 79.27 ($\pm$12.24) pre-training to 85.63 ($\pm$8.75) post-training ($t(179) = 7.48$, $p < 0.005$). All faculty participants (100%, $n = 18$) indicated that country-specific case studies facilitated teaching IPECP skills through virtual delivery. Additionally, 6 out of 18 program managers noted that this program marked their institution's first engagement in virtual IPECP electives. All faculty ($n = 18$) and managers ($n = 10$) who responded to the survey thought the IPECP program enhanced regional collaborations and global exposure and equipped the students with cross-country IPECP skills. Internet connectivity was a cross-cutting challenge among faculty and managers given the virtual nature of the program.

Discussion and conclusions: The student participants of the IPECP Program self-reported enhanced IPECP competencies, fostering an understanding of the various population health issues in multiple African countries. The findings suggest that faculty-guided, country-specific case studies may offer a viable strategy for implementing IPECP during international electives using a virtual mode of delivery.

KEYWORDS

Interprofessional Education and Collaborative Practice, Africa, virtual student elective exchange, country specific case studies, international elective

1 Introduction

Interprofessional Education (IPE) in the health professions involves students from two or more health and social care professions, learning with, from, and about each other (1). Interprofessional Collaborative Practice (ICP), on the other hand, occurs when health and non-health professionals work together with patients, their families, carers, and communities to deliver high-quality care (1). Interprofessional Education and Collaborative Practice (IPECP) combines the educational aspects of IPE with the practical application of ICP to prepare professionals to work in teams to deliver patient-centered, safe, and equitable care, addressing both individual and population health needs (2).

Despite the benefits of IPECP, many healthcare professionals worldwide, including in Africa, continue to train in silos with each health profession running its activities independently without interaction with other health professions. While a few African institutions have integrated IPECP into their curricula (3, 4), the global burden of emerging, re-emerging, and new diseases highlights the need for interprofessional collaboration across country borders (5). A vivid example is the West African Ebola outbreak in 2014, which required multinational health teams to contain the epidemic (6). Nevertheless, opportunities for interprofessional learning in diverse healthcare settings remain limited in Africa.

To address this gap, the African Forum for Research and Education in Health (AFREhealth), partnering with FAIMER, a division of Intealth, developed the AFREhealth-FAIMER IPECP Student Elective Exchange Program in Health Professions Education (IPECP Program) in Africa (7). AFREhealth is an interdisciplinary group that collaborates with Ministries of Health, training institutions, and other stakeholders to enhance health care in Africa through research, education, and capacity-strengthening (8). Intealth, a Philadelphia, US-based private nonprofit, advances global healthcare education through its ECFMG and FAIMER divisions (9). FAIMER promotes excellence in International Health Professions Education through programmatic and research activities (10).

The IPECP Program aimed to prepare health professions students to work effectively in interprofessional teams and apply their knowledge, skills, and values in their future practice. This study assessed the IPECP competencies of students and gathered stakeholder insights on the IPECP Program's design, implementation, challenges, and benefits.

2 Materials and methods

2.1 AFREhealth-FAIMER IPECP Student Elective Exchange Program (IPECP Program) - overview and description

2.1.1 IPECP Program overview and student selection

A total of 13 institutions from 10 African countries participated in the IPECP Program as shown in Table 1. Twelve participating institutions were from English-speaking countries. Mozambique, although a Portuguese-speaking country, had English-proficient staff and students at its participating host institution, Lúrio University. An agreement between the host institutions, FAIMER, and AFREhealth ensured clear, reciprocal resource allocation and opportunities. AFREhealth received a grant from the National Institutes of Health (NIH), through which it contracted FAIMER to design and implement the IPECP Program. FAIMER allocated $2,800 to each host institution for internet, faculty time, and administrative costs. FAIMER's web-based application system enabled students to view elective opportunities and submit applications, allowing institutions to manage and track applications in real-time.

Host institutions managed the selection of students for the IPECP Program, inviting applicants through advertisements. Selection criteria included student interest, availability for a six-week commitment, academic standing, and representation from various health professions such as medicine, pharmacy, nursing, and dentistry among others as shown in Table 2. Undergraduate clinical-year students were eligible, given their familiarity with a clinical learning environment and the ethical considerations in clinical rotations. Students applied for electives at a host institution outside their home country in groups of five, ensuring interdisciplinary representation. Faculty members teaching the students at the host institution represented at least two health professions from the students' group. Each host institution independently accommodated one cohort from another institution, with placements scheduled according to the availability of electives and academic calendars. The interprofessional composition of each student group varied annually based on selection criteria, with a minimum requirement of students from at least two different health professions. The six-week placements involved virtual engagement in all IPECP activities.

2.1.2 IPECP Program curriculum

A total of 13 electives were available at the undergraduate level. The study team developed the curriculum in conjunction with IPECP

TABLE 1 Participating institutions and country-specific case studies used to guide learning (N = 13) in AFREhealth-FAIMER Interprofessional Education and Collaborative Practice Student Elective Exchange Program in Health Professions Education in Africa (IPECP Program).

Country	Name of institution	Case study
Ethiopia	Debre Tabor University	Protein-energy malnutrition in Ethiopia.
Ghana	Kwame Nkrumah University of Science and Technology	The emergence of multi-drug-resistant bacteria "superbugs:" Implications on contemporary practice in Ghana.
Kenya	Jomo Kenyatta University of Agriculture and Technology	Care of a sick newborn in a developing country: A case study for Kenya.
Kenya	Kenyatta University Medicine	COVID-19 pandemic challenges and hopes: A case study in Kenya.
Malawi	Kamuzu University of Health Sciences	Accessibility to health-related services among children who are living with cerebral palsy in Malawi.
Mozambique	Lurio University	Community health and well-being with a view to good practices and behavior change in low-income communities in Nampula-Mozambique.
Nigeria	University of Ibadan	Cancer diagnosis in women and their quality of life in Nigeria.
Rwanda	University of Rwanda	Interprofessional approach to dog bite in Rwanda.
Uganda	Busitema University	Infection prevention and control.
Uganda	Makerere University	Targeted maternal health initiatives for reducing maternal mortality and morbidity in Uganda.
Uganda	Mbarara University of Science and Technology	COVID-19-related service delivery in Uganda.
Zambia	Lusaka School of Nursing	Adherence to COVID-19 preventive measures in Zambia's high-density populated communities: A case of Lusaka.
Zimbabwe	University of Zimbabwe	Optimizing antiretroviral therapy adherence (O-ART) in Zimbabwe.

Each case study had a description of the case and guiding questions for the students to enable them to study the case while appreciating the various IPECP competencies described in the ICCAS. The case studies also had reference sections for the students about the case and IPECP, activities to do, and a description of the overall aim in line with IPECP.

experts from Yale University in the US, Makerere University in Uganda, University of Global Health Equity in Rwanda, and Stellenbosch University in South Africa. International and local expertise provided a global perspective and contextualized the curriculum to local needs. Guided by social constructivism (11) and activity learning theories (12), the curriculum for students, including the faculty training workshop, emphasized learning as a social process, fostering knowledge-building through collaboration and integration of real-world scenarios.

The student curriculum included a virtual pre-orientation course on IPECP followed by virtual introductions to chosen host institutions. Due to COVID-19 travel limitations, virtual electives featuring country-specific case studies on population health were provided (see Table 1). The case studies were developed based on the common occurrences in the various countries in the fields of maternal and child health, public health, and epidemic disease outbreaks among others. The elective program structuring did not vary much based on the number of students at each institution or the health care system in each country. This is because each institution followed the same guidelines in terms of the number of students and how to conduct the program but only varied on what case study to use to enable learning. The activities included weekly online sessions, literature reviews, weekly progress assignments, live online interactive lectures, pre- and post-program IPECP competency self-assessments, collaborative innovation, and report writing. Figure 1 shows the flow of students' participation and self-assessment in the IPECP Program.

Two faculty members from different professions guided the learning process at each host institution. All host institution faculty participated in a two-hour online training workshop covering IPECP competencies, program scope, teaching strategies, and assessment of IPECP in an international elective setting in Africa. FAIMER, a division of Intealth and AFREhealth, co-owned this training. It was developed and delivered with IPECP and Health Professions Education (HPE) experts from FAIMER, Makerere University, Uganda, University of Global Health Equity, Rwanda, Stellenbosch University, South Africa, and Yale University, USA. This training occurred before the IPECP Program, with annual synchronous refreshers for ongoing skill reinforcement. The virtual component was regional within Africa, and each cohort rotated through a host institution outside their home country.

2.2 Study design and measures

This analytic cross-sectional study examined students' self-assessed IPECP competencies before and after their participation in the IPECP Program from 2021 to 2023. The 2018 revised Interprofessional Collaborative Competency Attainment Scale (ICCAS) (13) was used to self-assess students' IPECP competencies. The ICCAS, is a validated tool and includes 21 statements intended to measure the self-reported competencies of interprofessional care in interprofessional education programs (14, 15). Twenty statements measured IPECP domains, such as teamwork, interprofessional communication, shared values, and ethics of interprofessional collaboration on a 5-point Likert scale (1 = "Poor" to 5 = "Excellent"), with the total scores ranging from 20 to 100. The 21st statement measured the students' general ability to collaborate interprofessionally as compared to their ability before the IPECP Program, on a reverse 5-point Likert scale where 1 = "Much better now" and 5 = "Much worse now."

The study team developed two surveys: one for faculty (Faculty Survey) and another for managers (Manager Survey). These surveys

TABLE 2 Sociodemographic characteristics of the students (N = 180) in the AFREhealth-FAIMER Interprofessional Education and Collaborative Practice Student Elective Exchange Program in Health Professions Education in Africa (IPECP Program).

Characteristic	Frequency (*n*)	Percentage (%)
Gender		
Female	94	52.2
Male	86	47.8
Course of study		
Anesthesia	5	2.8
Biomedical engineering	1	0.6
Biomedical sciences	1	0.6
Dentistry	7	3.9
Laboratory medicine	11	6.1
Medicine	56	31.1
Midwifery	5	2.8
Nursing	42	23.3
Nutrition	1	0.6
Occupational therapy	1	0.6
Pharmacy	30	16.7
Physiotherapy	13	7.2
Public health	2	1.1
Radiography	2	1.1
Speech and language therapy	1	0.6
Veterinary medicine	2	1.1
	Mean	SD
Age	24.54	3.85
Year of study	4.27	1.20
Duration of the undergraduate program of study	4.75	1.05

were designed due to the lack of existing tools and literature for assessing the implementation of Interprofessional Education and Collaborative Practice (IPECP) during international electives among faculty and managers on a global scale. Drawing on prior experience in conducting evaluation studies in international elective programs across various institutions and countries in Africa (16, 17), the team ensured the surveys were contextually relevant. The surveys were piloted among FAIMER Africa staff, who worked closely with both faculty and managers and had a deep understanding of their respective roles. This phase aimed to establish the surveys' rigor and usability, ensuring clarity and alignment with the intended objectives. Revisions were made post-pilot to enable alignment with the intended research objectives. The questions to the managers were mainly operational and one addressed IPECP skills development. This was added because the managers were provided with an orientation on the IPECP definition, competencies, and how to aid the operational implementation of the various IPECP electives, as part of their training. Thus, their views on IPECP are key yet often missed in Health Professions Education program evaluation.

The Faculty Survey gathered the insights of the faculty, using a 5-point Likert scale under the following sections: (1) overall program functionality and virtual implementation, (2) teaching resources and tools, (3) communication methods, (4) student learning experience, (5) faculty skills and commitment to IPECP continuation, and (6) program benefits. An open-ended question in the Faculty Survey was used to elicit the challenges of the IPECP Program design and delivery.

The Manager Survey gathered the insights of the managers under the following sections using either a 5-point Likert scale or a Yes/No scale: (1) students' skill development, (2) reciprocity and partnerships, (3) virtual participation and preferred delivery, (4) program benefits, (5) getting academic credit for participation in the IPECP Program, and (6) challenges of the IPECP Program design and delivery.

2.3 Ethics considerations

Ethics clearance was granted by the Mulago Hospital Research and Ethics Committee (MHREC-2024-156) and the Uganda National Council for Science and Technology (HS4461ES). Administrative approval was secured through Memoranda of Understanding (MOU) between FAIMER, AFREhealth, and the 13 participating institutions. Informed consent was sought from every participant and password protection of the database using the Intealth data privacy policy was done to observe confidentiality.

2.4 Study participants

The participants of this study included all the faculty, students, and managers of the IPECP Program. The managers were the administrative staff with administrative education background at each university. The managers usually handle the operational, instructional design, technical, and administrative implementation of international elective programs at each participating university institution. Study participants were all invited to participate online via their email addresses. Online consent was sought from the participants by reading the consent statement, and if they agreed to participate, they would click, "Yes." This would enable them to proceed to the survey section. The email to all participants was sent by the FAIMER Africa administrator with the link to the survey.

2.5 Data collection and analysis

The ICCAS scale was administered online via Microsoft Forms to each student cohort from 2021 to 2023 at the beginning and the end of the IPECP Program as a mandatory part of the curriculum. Student participation in the program and assessment is shown in Figure 1. In each administration, the ICCAS scale was open for 1 month, and two reminders were sent. Faculty and Manager Surveys were administered online via Microsoft Forms to the faculty and managers in May 2024 voluntarily. The surveys were available for 2 months, with weekly email reminders sent.

For univariate analysis of participant characteristics, frequencies, proportions, and measures of central tendency, i.e., the mean, were

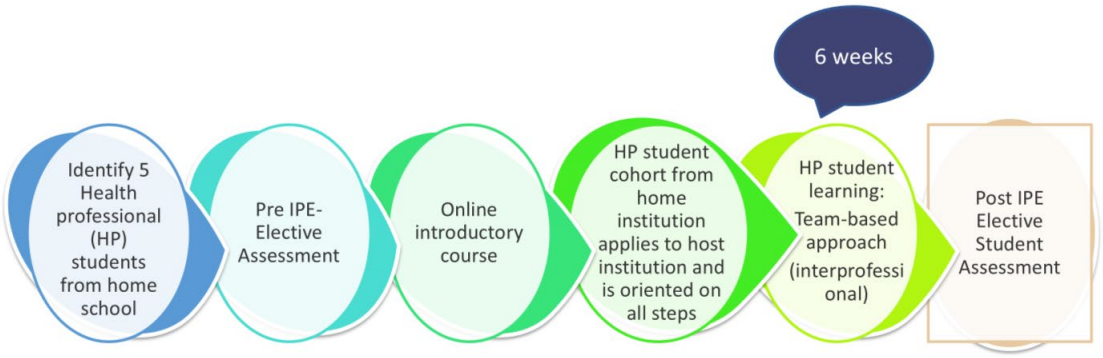

FIGURE 1
Student participation and assessment in the AFREhealth-FAIMER Interprofessional Education and Collaborative Practice Student Elective Exchange Program in Health Professions Education in Africa (IPECP Program).

used. Paired-sample t-tests were conducted to assess the statistical significance of students' ICCAS scores pre- and post-IPECP Program participation. Data analysis was done using SPSS Statistics version 29 (IBM Corp, Armonk, New York).

Descriptive statistics (for closed-ended questions) and content analysis (18) (for open-ended questions) were utilized in the Faculty Survey to identify challenges they faced in the IPECP Program. Content analysis was manually done deductively. Themes were predetermined, followed by reviewing the texts, identifying codes, and quantifying the findings from the themes (18).

3 Results

3.1 Sociodemographic characteristics of the student participants of the IPECP Program

All 180 students from the IPECP Program (2021–2023) completed the ICCAS scale, achieving a 100% response rate. The majority of the students (80.5%, $n = 145$) reported no prior experience with IPE at their training institutions while a few, (19.5%, $n = 35$) reported prior experience with IPE. The participants represented 16 health professions, with medicine (31.1%, $n = 56$) and nursing (23.3%, $n = 42$) being the most common, as shown in Table 2.

3.2 Students' IPECP competency

There was an increment in the total mean score of the students, 85.63 (±8.75) on the post-ICCAS score compared to the mean pre-ICCAS score of 79.27 (±12.24). The paired sample t-test showed a statistically significant improvement in the IPECP competency of the students compared to their pre-IPECP Program baseline ($t(179) = 7.48$, $p < 0.001$). Follow-up analyses on pre-and post-IPECP Program scores on each of the 20 items in the ICCAS scale were performed using Bonferroni correction adjusted alpha levels of 0.0025 (0.05/20 items). A p-value less than 0.0025 was considered statistically significant. The results (see Table 3) indicate a statistically significant increase in post-program ICCAS scores in most of the 20 items on the ICCAS scale. No significant difference was detected for the items *Include the patient/family in decision-making* and *Be accountable for my contributions to the IP team* after the Bonferroni correction.

The last question, i.e., the 21st question in the ICCAS tool assessed students' ability to collaborate interprofessionally as compared to their ability before the IPECP Program. After participating in the IPECP Program, 81.6% ($n = 147$) of students perceived that their ability to collaborate interprofessionally was better, 2.2% ($n = 4$) saw no change, and 16% ($n = 29$) perceived that their ability to collaborate interprofessionally was worse than before participating in the IPECP Program.

3.3 Feedback from faculty of the IPECP Program

3.3.1 Faculty characteristics

Out of the 27 faculty members who participated in this program, 18 responded to the survey, yielding a 67% response rate. Figure 2 depicts the professional distribution of the participating faculty. More than half of the faculty respondents were nurses/midwives ($n = 5$ out of 18) and physicians ($n = 5$ out of 18). More than half of the faculty

TABLE 3 Students' ICCAS total and item mean scores pre- and post-participation in the AFREhealth-FAIMER Interprofessional Education and Collaborative Practice Student Elective Exchange Program in Health Professions Education in Africa (IPECP Program) (*N* = 180).

Interprofessional Collaborative Competency Attainment Scale (ICCAS)	Pre-IPECP program score Mean (±SD)	Post-IPECP program score Mean (±SD)	*t*(df)	*p* value
Total score	79.27 (±12.24)	85.63 (±8.75)	7.48 (179)	< 0.001*
Promote effective communication among members of an interprofessional (IP) team	4.03 (±0.83)	4.47 (±0.61)	5.68 (179)	< 0.001*
Express my ideas and concerns without being judgmental	4.07 (±0.93)	4.53 (±0.67)	5.42 (179)	< 0.001*
Provide constructive feedback to IP team members	4.10 (±0.89)	4.47 (±0.64)	4.52 (179)	< 0.001*
Express my ideas and concerns in a clear, concise manner	4.14 (±0.89)	4.46 (±0.96)	3.64 (179)	< 0.001*
Seek out IP team members to address issues	4.03 (±0.94)	4.45 (±0.69)	5.04 (179)	< 0.001*
Work effectively with IP team members to enhance care	4.34 (±0.77)	4.56 (±0.63)	3.17 (179)	< 0.001*
Learn with, from, and about IP team members to enhance care	4.38 (±0.72)	4.62 (±0.55)	3.61 (179)	< 0.001*
Identify and describe my abilities and contributions to the IP team	4.05 (±0.83)	4.43 (±0.69)	4.88 (179)	< 0.001*
Be accountable for my contributions to the IP team	4.32 (±0.82)	4.50 (±0.64)	2.39 (179)	0.009
Understand the abilities and contributions of IP team members	4.13 (±0.80)	4.51 (±0.65)	5.17 (179)	< 0.001*
Recognize how others' skills and knowledge complement and overlap with my own	4.23 (±0.77)	4.56 (±0.68)	4.7 (179)	< 0.001*
Use an IP team approach with the patient to assess the health situation	4.06 (±0.98)	4.49 (±0.71)	5.27 (179)	< 0.001*
Use an IP team approach with the patient to provide whole-person care	4.07 (±0.93)	4.46 (±0.73)	4.78 (179)	< 0.001*
Include the patient/family in decision-making	4.20 (±0.99)	4.41 (±0.79)	2.21 (179)	0.014
Actively listen to the perspectives of IP team members	4.43 (±0.75)	4.68 (±0.51)	4.11 (179)	< 0.001*
Take into account the ideas of IP team members	4.34 (± 0.79)	4.65 (±0.55)	4.40 (179)	< 0.001*
Address team conflict in a respectful manner	4.19 (±0.88)	4.47 (±0.71)	3.28 (179)	< 0.001*
Develop an effective care plan with IP team members	4.12 (±0.863)	4.55 (±0.67)	5.37 (179)	< 0.001*

(Continued)

TABLE 3 (Continued)

Interprofessional Collaborative Competency Attainment Scale (ICCAS)	Pre-IPECP program score Mean (±SD)	Post-IPECP program score Mean (±SD)	*t*(df)	*p* value
Negotiate responsibilities within overlapping scopes of practice	4.05 (±0.87)	4.36 (±0.06)	3.96 (179)	< 0.001*

Each item is scored on a scale of 1–5. The total score summed up the scores of all 20 items. The probability level to establish a statistical relationship is set at < 0.05 for the total mean score comparison, and < 0.0025 for the item mean score comparison. *t* is the *T* value and the df is the degree of freedom related to the sample size.
* Denotes statistical significance.

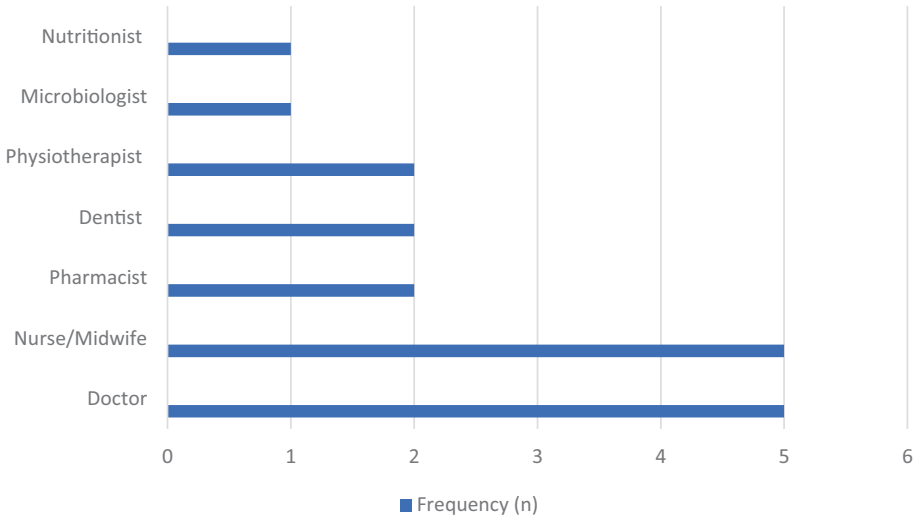

FIGURE 2
Distribution of the faculty participants who responded to the survey, by professional discipline (*N* = 18), regarding the AFREhealth-FAIMER Interprofessional Education and Collaborative Practice Student Elective Exchange Program in Health Professions Education in Africa (IPECP Program).

(*n* = 10 out of 18) had prior experience and training in IPE while (*n* = 8 out of 18) did not have prior training. Nonetheless, the online workshop enabled all faculty to be equipped with the skills required to guide students' learning.

3.3.2 Faculty perspectives of the IPECP Program

Faculty perspectives of the IPECP Program Survey are presented in the following sections. The results are a representation of the number of faculty respondents and not all the faculty that participated in the program.

3.3.2.1 Overall program functionality and virtual implementation

All (*n* = 18) of the faculty respondents agreed or strongly agreed that the virtual approach was functional for the program's implementation during and after the COVID-19 pandemic. The majority (*n* = 17 out of 18) of the respondents agreed or strongly agreed that the pre-program faculty training workshops focusing on IPECP teaching, assessment skills, and program goals provided them with suitable preparation for the program, and one faculty member responded as neutral. The majority (*n* = 14 out of 18) of respondents agreed or strongly agreed that the 6-week duration was adequate for the smooth operationalization of the IPECP Program, while three faculty members were neutral, and one disagreed.

3.3.2.2 Teaching resources and tools

All (*n* = 18) respondents agreed or strongly agreed that the country-specific case studies were useful learning tools for teaching IPECP skills. All (*n* = 18) respondents agreed or strongly agreed that the creation of teaching plans at each institution enabled well-organized and synchronized learning activities. The majority (*n* = 17 out of 18) of the respondents agreed or strongly agreed that the Zoom platform was adequate for synchronous learning, demonstrating the program's adaptability to a virtual learning format, and one faculty member responded as neutral.

3.3.2.3 Communication methods

The majority (*n* = 17 out of 18) of the respondents agreed or strongly agreed that communication via WhatsApp was considered adequate for communication between faculty and students, and only one faculty member responded as neutral. All (*n* = 18) found email communication adequate in sharing learning materials and introducing students to host institution faculty.

3.3.2.4 Student learning experience

Most respondents (n = 16 out of 18) agreed or strongly agreed that the pre-orientation and 6-week virtual elective format was adequate and that the program structure effectively met the learning objectives, and two faculty members responded neutrally. The majority of the respondents (n = 17 out of 18) agreed or strongly agreed that the assessment approaches including using the ICCAS scale pre- and post-IPECP Program, report submissions, and virtual group presentations, were effective; one faculty member responded neutrally to this.

3.3.2.5 Faculty skills and commitment to IPECP continuation

All (n = 18) of the faculty respondents agreed or strongly agreed that they could mentor and teach IPECP to more students after teaching in the IPECP Program. They would also like to see their institutions continue to participate in the IPECP Program.

3.3.2.6 Program benefits

All (n = 18) respondents agreed or strongly agreed that the IPECP Program contributed to (1) promoting regional collaboration on various health issues; (2) equipping health professions students in Africa with cross-country regional IPECP skills; (3) breaking student elective barriers that exist in various countries in Africa, especially during the COVID-19 pandemic; and (4) strengthening of intra-Africa institutional partnerships. Fourteen respondents agreed or strongly agreed that the IPECP Program contributed to enhancing international exposure to African students through exchanges; four faculty members responded neutrally to this.

3.3.2.7 Challenges

Content analysis of open-ended responses revealed that many of the faculty respondents (n = 12 out of 18) reported challenges related to the virtual mode of delivery, primarily due to unstable internet connectivity. To manage this, participants often turned off videos to optimize connectivity, and extended session times to complete courses.

3.4 Feedback from program managers of the IPECP Program

Out of the 13 program managers, 10 responded to the Manager Survey, yielding a 77% response rate. The Manager Survey data reflected the experiences of the managers who responded to the survey of the IPECP Program and not all the managers under the following sections.

3.4.1 Virtual participation and preferred delivery

Nine managers agreed or strongly agreed that the online application management system was viewed as adequate in enabling the centralization of applications for outgoing and incoming students while enabling easy visibility of elective opportunities at the various training institutions. More than half (n = 6 out of 10) of the program managers reported that it was their institution's first time participating in virtual IPECP electives. Despite positive experiences with a virtual mode of delivery, the majority (n = 9 out of 10) reported that they would have preferred a blended approach that incorporated both online and in-person interaction after the COVID-19 pandemic.

3.4.2 Students' skills development

All the IPECP Program managers who responded to the survey (n = 10 out of 10), agreed or strongly agreed that the IPECP Program enabled students to gain IPECP skills.

3.4.3 Reciprocity and partnerships

Most program managers (n = 9 out of 10) reported that the multilateral agreement enabled reciprocity, with equal opportunities being available to all students and participating institutions. Most (n = 9 out of 10) also reported that more regional institutional partnerships were formed through participation in the program.

3.4.4 Program benefits

All the IPECP Program managers (n = 10) agreed or strongly agreed that the IPECP Program contributed to global exposure for the students, and enabled students to acquire knowledge that is applicable back home given the similarity in disease and health systems among various African countries. The program benefits reported by the managers were similar to those reported by the faculty.

3.4.5 Degree academic credit

Although the IPECP Program offered a very imperative learning experience for the students, almost all the program managers (n = 9 out of 10) reported that the students did not gain academic credit toward their final university degree programs for their participation.

3.4.6 Challenges

The challenges reported by the managers included internet connectivity (n = 9 out of 10), students not being responsive on time (n = 5 out of 10), and faculty not being responsive on time (n = 1 out of 10).

4 Discussion

This study examined students' self-assessed IPECP competencies before and after their participation in the IPECP Program and gathered feedback from program faculty and managers on the IPECP Program's design, implementation, benefits, and challenges.

Results from the students' self-assessed post-program ICCAS scores compared to pre-program ICCAS scores were statistically significant, indicating that the virtual program design and country-specific case studies enhanced students' IPECP competencies. Specifically, students reported improved competencies in roles and responsibilities, values and ethics, communication, teamwork, patient-centered care, and conflict resolution. The IPECP Program fostered interdisciplinary collaboration, enhanced students' knowledge for application in African institutions, and promoted transcultural understanding and future partnerships. These findings align with previous studies (17–19) which reported that regional electives in Africa enhance knowledge relevant to students' home countries.

The findings further evidence that international elective spaces could be a viable ground to advance innovation in Health Professions Education, including IPECP. This is similar to the findings in another study by Estevez (20), in which international electives were found to be a viable platform to advance interprofessional education but were often not utilized. Furthermore, the findings of this study confirm the

positive perception of interprofessional education among faculty (20, 21) and students (22) in the African region.

Most managers at participating institutions viewed this program as the first of its kind, as international electives are typically health professional-specific, connecting students with their professional counterparts and faculty at host institutions (23). The positive survey results from the IPECP Program can create confidence that international electives can effectively enhance IPECP skills. However, IPECP expertise remains limited among faculty in many African health training institutions (24). This was addressed in the IPECP Program by providing training to faculty prior to the start of the program, which was identified by the faculty as a key support for teaching. A framework for IPECP implementation in sub-Saharan Africa has been developed that incorporates faculty training as an important element and has the potential for adoption throughout Africa and globally (25).

The program's virtual mode of delivery enabled more students to participate affordably in international electives. The cost of travel, accommodation, and meals often impedes some African students from participating in international electives (19), despite the added value of learning they offer. The IPECP Program enabled institutions to leverage the virtual mode of delivery to foster international elective learning within Africa and thus address one of the biggest barriers to participation in international electives by African health professions students.

While the IPECP Program received positive feedback from students, faculty, and managers, challenges emerged, particularly related to language barriers at a non-English-speaking host institution. English-speaking students struggled with communication, affecting collaboration. Similar challenges were reported in other international placements in sub-Saharan Africa (23). English-fluent faculty later provided additional support and extra session time, which should be integrated from the program's outset for early intervention. The impact of this on the students' acquisition of IPECP competencies was not studied; however, it is possible that it could affect their understanding, learning, and acquisition of the intended IPECP competencies.

Faculty and program managers cited poor internet connectivity as a challenge. Although managed by turning off videos and extending sessions, it still reduced engagement and hindered instructors' ability to monitor understanding. Internet connectivity issues are common in online training across Africa (26); nevertheless, initiatives like Eduroam have improved the bandwidth at various training institutions (26, 27). Besides internet connectivity issues, the limited focus on IPECP in African health professions curricula remains a challenge, requiring attention at accreditation and quality assurance levels (28).

Despite the economic advantage of the virtual mode of delivery, there was still a preference for a blended mode of delivery to enable real-time physical experiences. While the blended mode of delivery is key in advancing learning, especially in the clinical domain (29), institutions should be able to choose the virtual, blended, or physical mode of delivery based on the resources available to enable more students to participate in international elective placements.

Program managers reported that most of the students did not gain credit toward their university degree for their participation in the IPECP Program. This is not uncommon for international electives in various health professions training institutions, where most of the time, students do not gain credit for participation (19). Some African institutions have added international electives to the curriculum, recognizing the valuable learning experiences and knowledge gained (29, 30, 31). However, more effort needs to be made to achieve this goal at the various training institutions in Africa.

The study has some limitations. First, it was conducted among AFREhealth member institutions in sub-Saharan Africa, making findings relevant to similar settings but not generalizable to all of Africa. Second, the sample size of the faculty and managers was small and may be seen as a limitation in reporting the findings quantitatively. Nevertheless, the triangulation of evidence by surveying everyone was key despite the faculty and managers being a small sample size thus enabling all-around feedback among all stakeholders. In addition, it is possible to study a small sample size especially when the primary focus is mainly to establish the relative proportions of the categories within the data set as in this study, and not comparisons within categories and other data sets (32). However, a mixed methods approach would be more appropriate with a bigger sample size. Third, the ICCAS scale's reverse scaling on the last 21st question that measured students' overall ability in interprofessional collaboration could have caused response bias, and self-reporting may have led to acquiescence bias. Looking at other studies using the ICCAS scale to assess IPE competencies among health professional students, they only utilized the first 20 items of the scale and often exclude the findings on the last 21st question (33–36) despite it having been added to the revised ICCAS 2018 version to enable learners to evaluate their overall experience in the IPE training intervention they have participated in (37). This could be due to the fact that the developers of the scale only provided the scale to use, with hardly any mention of the limitations it could have (37). Furthermore, there is hardly any literature documenting the challenge of response bias given the reverse scaling of the 21st question compared to the rest of the 20 Items.

Reflection time and a validated tool to assess competencies were used to mitigate these biases, with additional input from faculty and managers for cross-validation. The study emphasized IPECP competency gains and stakeholder perspectives. For the students, given the response bias that may come from self-assessment with the ICCAS tool, more assessment methods were adopted, including group presentations by each cohort of students to the teaching faculty at the end of the program and submission of reports. These were specific to each group since the case studies used varied and thus the findings were not reported as an aggregate. However, future research should include more objective assessments of competencies and a longitudinal study to evaluate the IPECP Program's long-term impact. Furthermore, a study to describe how the various demographic characteristics including English proficiency vary with the IPECP competency gains and stakeholder perspectives with a bivariate and multivariate analysis approach would provide valuable insights with a bigger sample size.

5 Conclusion

This evaluation of the AFREhealth-FAIMER IPECP Student Elective Exchange Program in Africa indicates it has enhanced students' interprofessional education and collaborative skills while exploring diverse population health issues across African countries. Faculty-guided, country-specific case studies can support IPECP in

virtual international electives, offering a cost-effective solution for African health professions institutions and students. While this study used a self-assessment tool, more objective assessments are required to enable quality assurance and improvement of IPECP assessment methods during international electives. Long-term longitudinal studies would enable researchers to track the various behavioral changes of the participants throughout their careers, given that IPECP has a lot of behavioral aspects that often require ample time to appreciate the change.

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

Ethics clearance was granted by the Mulago Hospital Research and Ethics Committee (MHREC-2024-156) and the Uganda National Council for Science and Technology (HS4461ES). Administrative approval was secured through Memoranda of Understanding (MOU) between FAIMER, AFREhealth, and the 13 participating institutions. Informed consent was sought from every participant and password protection of the database using the Intealth data privacy policy was done to observe confidentiality. The later steps were taken because the study involved human subjects.

Author contributions

FN: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. RV: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. EK: Writing – review & editing. SY: Formal analysis, Writing – original draft, Writing – review & editing. DB: Writing – original draft, Writing – review & editing. PA: Funding acquisition, Writing – review & editing. RP: Writing – review & editing. JD: Writing – review & editing. JS: Writing – review & editing. FS: Conceptualization, Funding acquisition, Writing – review & editing.

Funding

The author(s) declare that financial support was received for the research, authorship, and/or publication of this article. This study was funded by the AFREhealth National Institutes of Health (NIH) grant award number R25TW011217-3. FAIMER received funding from AFREhealth to develop, implement, and evaluate the program among the various training institutions. FAIMER allocated $2,800 to each host institution for internet, faculty time, and administrative costs. With the AFREhealth NIH grant soon ending, the evaluation outcomes will enable both FAIMER and AFREhealth to determine a potential path moving forward in alignment with each institution's strategic priorities.

Acknowledgments

The authors acknowledge the support received from AFREhealth, participating institutions, program faculty, program managers, and students who participated and responded to the surveys. We also acknowledge the technical, operational, and financial support provided by FAIMER, a division of Intealth, throughout the implementation of this program. The authors acknowledge the support provided by Dr. Shara Steiner, Deputy Director of FAIMER Global Programs in editing the manuscript, and Phionah Ashaba, the administrator for FAIMER Africa programs for her role in the implementation of the program.

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.

Generative AI statement

The authors declare that no Generative AI was used in the creation of this manuscript.

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