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Continuing professional development

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Continuing professional development

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Editorial: Continuing professional development

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Editorial on the Research Topic
Continuing professional development

Introduction

The WHO (1) has long maintained that healthcare professional education is integral to the delivery of safe high quality patient care, that is delivered in an equitable, just, and sustainable manner. Continuing Professional Development (CPD) is a vital aspect of healthcare professional education that helps to continually improve the quality and safety of patient care (1–3). This aligns with the view that CPD translates scientific discovery into better care for populations (4). Given the incessant pace of innovation, powered by digital technologies and artificial intelligence, there is an urgent imperative to consider the nature of CPD as a pillar of health professions education.

This Research Topic explores the developments, innovations, and research shaping the future of CPD. In these nine articles from different countries, we characterize four overarching themes: (1) New horizons; (2) Design and Implementation; (3) Context; and (4) Data informed CPD. As a group, these articles demonstrate the evolution of CPD across the world, driven by how scholars and researchers with astute curiosity undertaking work with methodological rigor to drive forward improvement. We invite you to explore the articles within this Research Topic in greater detail and join your voice to this scholarly conversation.

New horizons

Three articles (Guo et al., Leyland et al., Womack-Adams et al.) bring innovative perspectives from other fields to enrich CPD. One experimental study (Guo et al.) combines humanities into simulation practices in emergency training. This study (Guo et al.) revealed that the observation group ($n = 40$), which participated in a simulation integrated with medical humanities, significantly outperformed the control group ($n = 39$) in both assessment scores and satisfaction levels, highlighting the positive impact of incorporating humanities into simulation training. These results support the necessity for a paradigm shift in continuing professional development (CPD), emphasizing a holistic, competence-based approach rather than focusing solely on skills. Another study (Leyland et al.) in this theme uses Ways of Thinking and Practicing (WTP)

(10), an analytic lens from undergraduate biology, to explore medical students' reflections. Although used in the medical student context, WTP brings insights into students' preparedness for practice relevant for CPD, and WTP could also be of value in exploring CPD-related reflections.

The final article in this theme focuses on micro-credentials (Womack-Adams et al.); these are portable credentials that are widely used in other areas of vocational education. This research (Womack-Adams et al.) brings a much-needed rapid review of the use of micro-credentials in CPD across health professions education. A total of 11 articles out of an initial search of 437 were included in the final review, with the majority focused on one profession ($n = 7$, 64%), with nursing being the most commonly discussed health profession ($n = 5$, 45%) (Womack-Adams et al.). The authors (Womack-Adams et al.) call for increase in consistent terminology and coordination on a broader scale in this area. In summary, these three research pieces open the door for a conversation on CPD that drives its impact from the integration of multiple disciplines, multiple theoretical perspectives, and learning practices from other fields of education.

Design and implementation

In the past, too much CPD has focused on what—new drugs, guidelines—rather than the show of learning (5, 6). If the aim is improved patient outcomes, the how matters at least as much as the what. Two studies (Yingxia et al., Mueller et al.) in this theme do exactly that, in different ways, bringing our attention to the fact that how we design CPD matters for its efficacy both from an individual and wider systems perspective. Yingxia et al.'s literature and policy mini-review emphasizes that post-competency types of training for post-registration nursing and its impact on transition to practice; concluding that implementation and evaluation are critical to success. Mueller et al. compares two commonly used modalities of delivery of CME/CPD—in-person vs. livestream. Participants showed significant improvements in post-COVID knowledge (47% correct pre-course to 54% correct post-course, $p = 0.004$) but did not differ significantly between in-person vs. livestreamed sessions (Mueller et al.). Given the results, the authors (Mueller et al.) suggest that distance learning, which is less resource-intensive and has no detrimental impact on quality, may be a feasible option for content delivery.

Context

Three articles (Edmealem et al., Suleiman, Al-Haqan et al.) in this Research Topic demonstrate the importance of considering the various contexts in which CPD operates: professional, geographical, regulatory. These articles are methodologically varied and address different questions; however, all demonstrate how important it is to consider the context to ensure research findings are both valid and relevant for practice. Edmealem et al. conducted a systematic review and meta-analysis of 11 studies researching professionalism in nursing in Ethiopia between 2004 and 2024. The definitions of professionalism used demonstrate well how being attuned to the context is important even in complex synthesis works. Focusing their review on the Ethiopian perspective offered important insights for nursing in Ethiopia and for the scholarly conversation on CPD and professionalism globally. Suleiman's study demonstrates that adverse drug reaction (ADR) underreporting in Jordan is impacted by factors that can be addressed with CPD. This study paves the way for the design of CPD interventions that are contextually relevant and evidence-based, linking both the call for context in CPD and its call for evidence-based. Finally, Al-Haqan et al. developed and validated the Kuwait Advanced Competency Framework (KACF), based on the International Pharmaceutical Federation (FIP) Global Advanced Development Framework (GADF). The GADF is a validated tool intended to support the professional development and recognition of the pharmacy workforce globally (7). This study is an excellent example of how global frameworks can be adapted to identify gaps in local CPD contexts, while using global standards as scaffolding for national competency development.

Data informed CPD

Data-driven CPD is a concept that has been part of the conversation for a while (8). In this Research Topic, Pizzuti provides a perspective article that offers an invigorating view on what could be achieved. This article presents a view of how electronic health records could hold the key to developing adaptive CPD that responds to the real needs of healthcare systems, based on data from practice and education systems.

Conclusion

This Research Topic contributes to previous conversations on how to reimagine CPD (5, 9). Here we bring together contributions that examine the how; elevate context; operationalise evidence-based and data-driven approaches; and broaden the horizons, shifting paradigms and theoretical lenses. As the challenges and opportunities brought to us by for example, Artificial Intelligence and new technologies lie ahead, the research here presented reflects a field rigor in its methods and forward-thinking in its approach.

The task now is collective: to design, deliver, embed, evaluate, and sustain CPD that translates learning into better practice and improves patient outcomes. As we bring this Research Topic to a close, we encourage continued dialogue to interrogate assumptions and to move toward embracing new paradigms that are evidence-based, contextual, and oriented toward outcomes.

Author contributions

AD: Conceptualization, Writing – original draft, Writing – review & editing. RS: Conceptualization, Writing – original draft, Writing – review & editing. MC: Conceptualization, Writing – original draft, 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.

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Competency development for pharmacy: adopting and adapting the FIP global advanced development framework

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Background: Pharmacy education shifts toward competency-based training to meet healthcare demands. This study aims to develop and validate the Kuwait Advanced Competency Framework (KACF) for pharmacists. The study adopts the FIP Global Advanced Development Framework (GADF) to develop a country-specific framework, emphasizing the importance of aligning with global standards while adapting to local contexts. The developed framework builds upon the Kuwait Foundation Competency Framework to address the need for advanced pharmacy services.

Methods: This is a mixed methods study that employed an "adopt and adapt" approach. The KACF was adopted from the FIP GADF and adapted following four phases. Phase one involved checking and validating the Arabic version of the FIP GADF. Phase two employed a series of focus groups to validate accuracy and relevancy of competency statements. Phase three utilized a workshop with different stakeholders as a final step of validation. Phase four involved a national survey to assess the national pharmacy workforce against the framework competencies. Qualitative feedback from focus groups and workshops informed competencies modifications. Quantitative data were analyzed using descriptive and multiple correspondence analyses (MCA).

Results: The translation phase verified a bilingual framework that could be utilized by pharmacists in Kuwait. The initial and final validation phases identified 20 behavioral statements (out of 22 in the original document) that are relevant to pharmacy practice in Kuwait. The national survey, comprising 169 respondents, validated the KACF's applicability, revealing variations in career stage progression across competency clusters. Findings highlighted associations between career stages and practice settings, offering insights for tailored workforce development strategies.

Conclusion: The KACF emerges as a pivotal tool for advancing pharmacy services in Kuwait, aligning with global trends toward competency-based education. Findings underscored the necessity for context-specific approaches in advancing pharmacy practice, providing a comprehensive understanding of competency progression and readiness for advanced roles.

KEYWORDS

Kuwait, workforce development and training, mixed methods, research methodology, competency based education, pharmacy, advanced pharmacy practice

Introduction

The changing needs of patients and healthcare systems necessitate that pharmacy workforce education and training goes beyond the traditional emphasis on attaining and applying knowledge, to focusing on learner outcomes and the competencies required for practice (1). In recent years, competency-based education and training (CBET) has been commonly employed for pharmacists (2–4). Competence and competencies are terms becoming increasingly accepted at a global level in healthcare and are being directly linked to professional roles. Competency-based approaches put professional practice at the core of education and practitioner development program. Competency frameworks have become increasingly popular due to the need for transparency in the training, development, and accreditation of healthcare professionals. A competent pharmacy workforce is fundamental for ensuring the provision of high-quality healthcare services. Maintaining competence means a commitment to deliver the full range of pharmaceutical services and to meet the challenges facing global health and patient care.

The International Pharmaceutical Federation (FIP) has created early career maps and developed competency frameworks to support a seamless transition into early career practice and toward advanced practice (5). Moving from the foundation level of practice toward providing more advanced and specialized services dictates the provision of support and guidance. Competency frameworks have been shown to facilitate improvement in pharmacists' performance (4). In 2020, the FIP presented the Global Advanced Development Framework (GADF), which is a validated tool intended to support the professional development and recognition of the pharmacy workforce everywhere (6). The framework's primary purpose is to identify broad areas for professional development and advancement so that pharmacists can develop their careers in a structured manner. The GADF was used as a precursor for developing country-specific framework (2).

In Kuwait, pharmacy practice has long been identified as a sector that is yet to be developed. With the announcement of the 'new Kuwait vision 2035', planning for pharmacy practice and workforce development and improvement has become imperative. Previous work done in Kuwait has identified the priority goals for pharmacy workforce development, with competency development, early career training, and continuing professional development as the top three priorities for pharmacy workforce development in the country (7). To tackle the first priority several projects were conducting by the College of Pharmacy (CoP) at Kuwait University and the Ministry of Health (MoH). At the undergraduate level the CoP recently transformed its curriculum from a 5-year Bachelor of Pharmacy program to a competency-based 7-year professional doctorate (PharmD). The CoP had successfully developed and implemented an undergraduate competency framework with entrustable professional activities (EPAs) and competency-based assessment methods to support its competency-based education efforts, tailored to meet the needs of Kuwait (8). After graduation and to ensure the continuum of competency-based education, another study was conducted to target the second and third priority and to develop the Kuwait Foundation Competency Framework (KFCF) (9). In 2019, the KFCF was developed (9), and since then, it has been utilized as a developmental tool to support pharmacists' performance at the foundation level and used as a guide for developing CBET programs for pharmacists in Kuwait. In the same year, the Kuwait Ministry of Health (MoH) established a steering committee that overlooks pharmacy profession expansion and development. In its mandate, the committee was responsible for designing and delivering professional development programs and strategies for the workforce in the pharmaceutical sector. One deliverable to achieve this objective was to develop and validate an advanced competency framework for pharmacists.

Pharmacy services in Kuwait are experiencing a paradigm shift toward advanced practice to meet the evolving healthcare needs of its population. With a growing burden of chronic diseases, an aging population, and increasing demand for specialized care, there is a pressing need to enhance pharmacy services to optimize patient outcomes. Advanced pharmacy services encompass a broad spectrum of clinical activities beyond traditional dispensing, including medication therapy management, therapeutic drug monitoring, and collaborative care with other healthcare providers. These services are integral to promoting rational medication use, improving medication adherence, preventing medication-related complications, and achieving therapeutic goals. Moreover, advanced pharmacy practice aligns with global trends toward expanding the role of pharmacists as essential members of the healthcare team, contributing to interprofessional collaboration and comprehensive patient care. In Kuwait, the implementation of advanced pharmacy services can enhance the efficiency and effectiveness of healthcare delivery, reduce healthcare costs, and ultimately improve patient satisfaction and health outcomes. Therefore, recognizing the importance of advancing pharmacy services is crucial for addressing the complex healthcare needs of Kuwait's population and ensuring the delivery of high-quality, patient-centered care.

A previous study (9) developed the Kuwait Foundation Competency Framework (KFCF) for pharmacists in order to set the solid groundwork for advancing the pharmacy workforce in Kuwait. This study is a continuation of the development of competency frameworks for pharmaceutical service provision in Kuwait. This study aimed to develop and validate the Kuwait Advanced Competency Framework (KACF) for pharmacists using the FIP GADF with an adopt and adapt approach (2, 9). The KACF would aid in refining and expanding the scope of practice, reforming the pharmacy workforce development, and providing the support required to create an accountable, flexible, and adaptable workforce.

For this study, competencies have been defined as "the knowledge, skills, attitudes and behaviors that an individual develops through education, training, development and experience (10)". Moreover, advanced practice has been defined as "Advanced Practice is a practice that is so significantly different from that achieved at initial registration that it warrants recognition by professional peers and the public of the expertise of the practitioner and the education, training, and experience from which that capability was derived (11)."

Methods

This is a mixed methods study that employed an "adopt and adapt" approach similar to Al-Haqan et al. (9) and Meilianti et al. (2). The KACF was adopted from the FIP GADF and adapted to develop a country-specific framework following four phases (Figure 1). The development and validation of the KACF was carried out from February 2022 to January 2023.

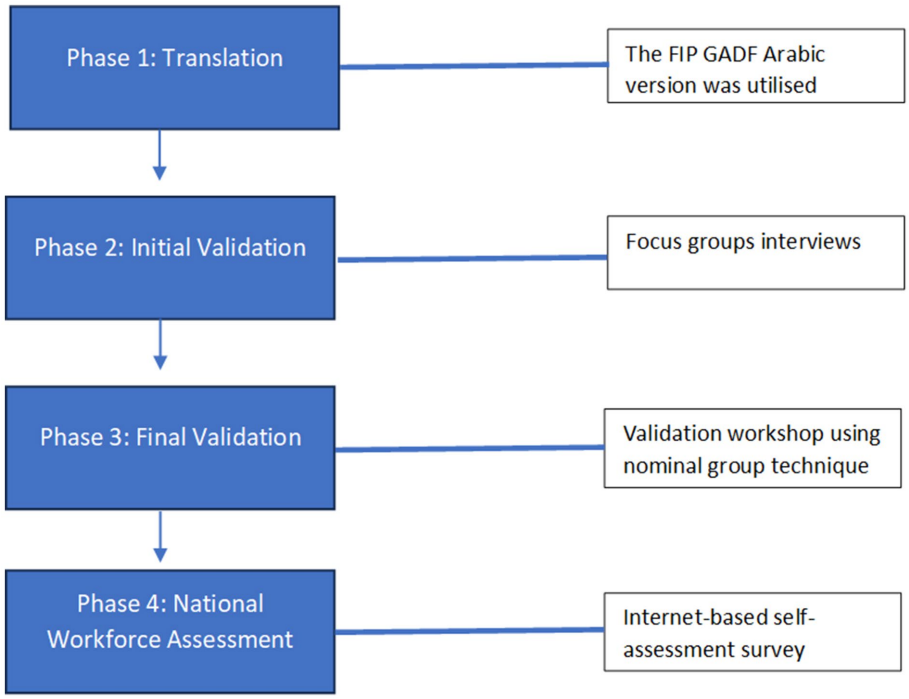

FIGURE 1
The development process of the Kuwait Advanced Competency Framework (KACF).

Phase 1: translation

Translation into Arabic was performed to ensure proper utilization of the developed framework by pharmacists in Kuwait, as the official language of the country is Arabic. The FIP GADF was translated into seven languages, including Arabic. Therefore, in this phase, the authors utilized the FIP GADF Arabic version and aimed to validate it throughout other phases. The authors initially checked and validated the Arabic version of the FIP GADF separately. The Arabic translation was then revised by all authors and discussed in several sessions. The revision took into consideration the clarity of the sentences, grammar, wording, and that the meaning, aim, number and order of the sentences match the English phrases. Discrepancies and synonyms were discussed between the authors, and they agreed on a selection of edits. The authors did a second revision following the initial revision through a group meeting to proofread the final draft of the framework.

Phase 2: initial validation

The initial validation of the study was conducted through qualitative focus group interviews. Three focus group interviews were conducted with two aims: (1) to validate the Arabic translation adopted from the FIP GADF and (2) to investigate the relevancy of the included competencies to Kuwait practice. Three focus groups ($n = 14$) were conducted between February and March 2022. Characteristics of focus group members are presented in Table 1. The focus groups were done online using the Zoom platform. Participants were recruited using purposive sampling according to their practice settings and years in practice and were asked to discuss the following questions: (1) Are competency elements/statements clear and understandable? If not, what modifications/amendments could be made? (2) Is the Arabic translation understandable? If not, what modifications/amendments could be made? (3) Do the competencies belong to the defined cluster? (4) Would you like to add any additional competencies? (5) Do stages (advanced stage 1, advanced stage 2,

TABLE 1 Characteristics of focus groups participants.

Focus group 1 ($N = 4$)	Focus group 2 ($N = 5$)	Focus group 3 ($N = 5$)
Hospital Pharmacist	Head of departments in healthcare area offices (all health area)	Clinical Pharmacist
Clinical pharmacist		Hospital Pharmacists
Assistant professor		Clinical Pharmacist – Specialized services
Regulatory body - MoH		Primary care Pharmacist
		Community pharmacy

Primary care pharmacists: pharmacists working in primary care centers, usually dealing with mild and stable conditions and focusing on dispensing medications and patient counseling.
Hospital Pharmacist: work in hospitals, dealing with more complex cases and includes pharmaceutical services for the in-patients, outpatient and medication management.
Clinical Pharmacist: clinical pharmacist in general hospital settings including medical wards and/or general medicine.
Clinical pharmacist with specialized services: clinical pharmacist working in a subspeciality setting such as cardiology, nephrology, geriatric, ambulatory care and other specialized settings.
Head of departments in healthcare area offices: leaders of administrative departments from different healthcare regional administrative offices overseeing and coordinating healthcare hospitals and primary care clinics within that region.
Community pharmacy: retail pharmacy in the private sector that primarily focuses on dispensing medications and providing counseling services to patients.

advanced stage 3) make sense to you? (6) Rate the list of evidence. If not relevant to Kuwait, what do you suggest being included in the list? After each focus group, the research team consolidated all participants' comments and refined the competencies according to the participants' suggestions. Comments from one focus group were not presented in the original document but were incorporated into the discussion for other focus groups. After three focus groups, the research team created a draft of the 'Kuwait Advanced Competency Framework (KACF)' based on the outcomes of the interviews.

Phase 3: final validation

In June 2022, a face-to-face workshop was conducted to validate KACF. In this workshop, 20 pharmacists were invited through purposive sampling and a nominal group technique was employed. Participants' characteristics are presented in Table 2. Participants were divided into six groups, and each group was assigned to a specific cluster to discuss extensively the competencies in that cluster (translation and relevancy). The authors discuss the previous steps taken and the results from the focus groups and highlighted that this is a unified competency framework that can be equally applied across different work settings. The participants were asked to discuss and write their thoughts on each statement included in the cluster assigned to them, as well as its relevancy, applicability, translation to Arabic, and clarity. The last session of the workshop involved discussing each cluster with the comments from each group with all the participants and asking for further feedback, which was also transcribed separately. After the workshop, the research team discussed all changes, modifications and suggestions received from all participants and created a final version of the 'Kuwait Advanced Competency Framework (KACF)' based on the workshop outcomes (Supplementary file 1).

TABLE 2 Characteristics of workshop participants.

#	Cluster	Place of work	Years of experience
1	Expert prof.	Hospital	10 years
2	Expert prof.	Hospital	2 years
3	Expert prof.	Community	19 years
4	Expert prof.	Hospital	16 years
1	Working with others	Hospital	24 years
2	Working with others	Hospital	22 years
3	Working with others	Hospital	9 years
4	Working with others	Polyclinic	6 years
1	Leadership	Hospital	20 years
2	Leadership	Central medical stores	17 years
3	Leadership	Polyclinic	24 years
1	Management	Hospital	22 years
2	Management	Hospital	20 years
3	Management	Polyclinic	23 years
1	Education	Kuwait University, COP*	20 years
2	Education	Polyclinic	16 years
3	Education	Hospital	3 years
1	Research	Kuwait University, COP*	20 years
2	Research	Polyclinic	6 years
3	Research	polyclinic	10 years

*COP, College of Pharmacy.

Phase 4: national workforce assessment—national survey

A cross-sectional internet-based survey was conducted to assess the validity and practicality of the KACF as a self-assessment tool for pharmacists. The survey tool was adopted and adapted from a survey conducted by Albinana (12) and Meilianti et al. (2). The survey had three sections. Section 1 collected demographic data and information pertaining to the current professional practices of pharmacists. Section 2 was self-assessment utilizing the KACF framework. The final section included an open-ended question asking participants to write any comments related to the framework competencies. Due to the lack of updated list of pharmacist's emails, the survey distribution followed a similar approach of other studies conducted in Kuwait (9, 13, 14). The anonymous link to the web-based questionnaire was disseminated within established Kuwait pharmacy groups on social media platforms such as Facebook and WhatsApp. Pharmacists were additonally encouraged to share the anonymous link with other eligible participants. Subsequent reminders were dispatched at biweekly intervals over a three-month period (at total of 8 reminders) to promote participation.

Data analysis

Qualitative data from the focus groups and the workshop were discussed extensively by the research team and added to the modified document after each session. Participants from each focus group were able briefed about the comments and corrections suggested by the previous groups and had the chance to add their own comments and suggestions for further analysis.

The quantitative data obtained from the survey were transferred from the online platform to SPSS version 29.0.0. The data were cleaned and coded before the analysis. For determining the combined stage of each cluster applicable to individual respondents (comprising a total of 6 clusters within the framework), the median staging value within the specific cluster was computed. The descriptive analysis was conducted to illustrate the distribution of cluster staging. A multiple correspondence analysis (MCA) was utilized to explore the relationship between cluster staging, overall cluster staging, and participants' practice sector.

Ethical consideration

Ethical approval for this study was obtained from the Ministry of Health's scientific research ethics committee (1786/2021).

Results

Phase 1: translation

In this initial phase, the authors discussed some of the concepts that could be misunderstood or not clear to pharmacists in Kuwait. These concepts were discussed in the subsequent phases with no major changes done on the original FIP GADF document.

Phase 2: focus groups

After incorporating feedback from three focus groups, a series of modifications were made, primarily minor adjustments, including translation revisions for consistency between the English and Arabic versions. The three focus groups had similar comments on the competency framework, with most feedback focusing on the Arabic translation or simplifying the sentences. Within the fourth competency cluster, the title of competency 4.8 was changed from "Strategic Planning" to "Operational Planning." Furthermore, competency 4.9 was removed, with its content being merged into the remaining competencies within the same cluster. Similarly, in the sixth competency cluster, competency 6.2 was eliminated, and its aspects were integrated into other competencies within that cluster.

Additional minor refinements involved breaking down some lengthy statements into two separate ones for clearer interpretation, mainly within the second cluster, "Working with Others." The language used in the fifth competency, "Education, Training, and Development" cluster, was also simplified for better comprehension and understanding. Adjustments were made to the competencies in the fourth and sixth clusters to incorporate elements from the deleted competencies, ensuring comprehensive overall competencies.

Phase 3: final validation

Participants in the workshop suggested several modifications in all clusters. Majority of participants' comments were related to improving Arabic translation, and adding more clarification to some wording to make them more understandable,

In cluster 1: Expert Professional Practice, participants emphasized the importance of aligning Arabic translations with English statements, particularly regarding terminology such as "core areas" and "applies." They suggested adjustments to highlight the necessity for advanced pharmacists to not only develop complex programs but also apply them effectively. One participant noted, "*Evidence does not comply with all clusters and subclusters, therefore it's very hard to define the situation.*" *Another participant remarked, "The Arabic translation should be clearer.*"

In cluster 2: Working with others, recommendations centered on refining language to promote a more positive reading experience. This included replacing negative terminology with more neutral or positive alternatives and ensuring accurate Arabic translations. For example, Participants in group 2 wrote, "*The table is written in a negative language* [competency statement 2.1]. *It's not comfortable to read and causes discomfort. We suggest using fewer negative commands and phrases, should not use words like aggression, antagonism, emotive,* etc. *alternatively, use words like challenging situations.*" They also suggested replacing the words "patients and colleagues" with "healthcare providers and recipients" under stage 1.

Moreover, in cluster 3: Leadership, minor adjustments were made to Arabic wordings to maintain consistency with English phrases, reflecting a focus on linguistic accuracy and clarity. One participant remarked, "*I think we need to add more evidence to this cluster such as: Have you been in enough workshops/courses? Develops protocols in emergency cases as leaderships (pandemic corona), special policy for special drug groups,* e.g., *PPIs and if they worked on any special training programs for pharmacists and updating guidelines.*"

Cluster 4: Management, participants suggested minor rewording and restructuring of competencies, with a specific emphasis on understanding the needs of change rather than the principles of change (competency statement 4.7). A participant mentioned, *"It would be clearer if we can change the sequence of the clusters.*"

For cluster 5: Education, training, and development, participants proposed that education should proceed by "continuous" to imply the importance of continuous education rather than education alone. They suggested adding the term "continuous" throughout the cluster title and definitions. Moreover, minor changes were made to the Arabic wordings to accurately express the meaning of the English phrases. Participants noted, "*Some of the competencies here are hard to achieve, very limited candidates,*" and *"Mentorship needs more definition, like 'the 3 a's' and how to be a good mentor.*"

Finally, in cluster 6: Research and evaluation, recommendations included refining the cluster definition to better express the goal of improving pharmaceutical practice through evidence-based research. Specific language adjustments were proposed to clarify the responsibilities of research project supervisors and to align with professional standards. As with other clusters, Arabic translations were edited to ensure consistency and accuracy. Group 6 recommended adding to the definition of the cluster "Improving the Pharmaceutical Practice and Performance Using Evidence-Based Research" to further express the goal and meaning of this cluster. One participant suggested, "*The evidence is hard to apply here, maybe we can have more examples?*"

Overall, participants provided general comments expressing support for the KACF framework while suggesting improvements, such as providing definitions alongside evidence within each cluster. Concerns were raised regarding the accessibility of evidence for certain competencies and the potential challenges of compliance without incentives for pharmacists.

Phase 4: national survey

A total of 169 responses were included in the analysis (see Table 3), revealing a diverse distribution across sectors of practice. The majority of participants were affiliated with general public hospitals (42.6%), followed by primary care (25.4%). Other sectors included specialized public hospitals (10.7%), community pharmacies (5.3%), and academia (2.4%), among others. Gender distribution showed

TABLE 3 Demographics of survey participants.

Demographics	Categories	Respondents (%) (*N*: 169)
Sector of practice	Primary care (policlinic)	43 (25.4%)
	General public hospital	72 (42.6%)
	Private hospital	6 (3.6%)
	Specialized public hospital	18 (10.7%)
	Community pharmacy	9 (5.3%)
	Central medical store	4 (2.4%)
	Food and registration department	3 (1.8%)
	Academia	4 (2.4%)
	Private sector	5 (3.0%)
	Others	5 (3.0%)
Gender	Male	67 (39.6%)
	Female	102 (60.4%)
Nationality	Kuwaiti	106 (62.7%)
	Non Kuwaiti	63 (37.3%)
Age	36.78 ± 9.200 (Mean ± Standard Deviation)	
Years of experience	12.02 ± 8.817 (Mean ± Standard Deviation)	

39.6% males while the remaining majority were females (60.4%). In terms of nationality, 62.7% were Kuwaiti, and 37.3% were non-Kuwaiti. The respondents' average age was approximately 36.78 years, with a standard deviation of 9.200, while their mean years of experience stood at 12.02 years, with a standard deviation of 8.817.

Distribution of cluster staging

Figure 2 provides an illustration of the distribution across cluster staging, revealing variations in the progression of expertise across clusters. Four out of six clusters revealed similar distributions where the majority of sample respondents were in stage 2: Expert professional practice, working with others, leadership, management and education and training development. On the other hand, for "working with others" and "research and evaluation" clusters, most respondents were at stage 1, followed by stages 2 and 3. Only 9% of respondents were in stage 3 of the research and evaluation cluster, which showed a lesser readiness of pharmacists for research and evaluation activities.

Multiple correspondence analysis (MCA) of KACF mapping

Utilizing a two-dimensional MCA model, an exploration of the correlation between cluster staging and the workplace was conducted. The Cronbach's values computed for both dimensions surpassed the established threshold of 0.5, in accordance with prior research standards, which are 0.894 and 0.780, respectively (15). The analysis summary indicated that this model was robust for association pattern discovery. The joint category plot of the MCA, as depicted in Figure 3, provided a descriptive visualization of the self-assessed staging and corresponding sectors within the surveyed sample. The outcomes of the 'blue' groupings highlight the distinct grouping and separation of self-assessed career stages. These results underscore the IADF's capability, when employed as a self-assessment tool, to effectively differentiate between various stages of career development within this specific sample. The relationship with the practice site showed that the central medical store and food registration department were closely related to stage 1. In contrast, specialized public hospitals, primary care, and academia were closely related to stage 2, and private hospitals were between stage 2 and stage 3.

Discussion

The study focused on adopting and adapting the FIP GADF to develop a country-specific competency framework. This study employed a series of focus group discussions involving different professional groups and a national survey to assess the pharmacy workforce across cluster staging, illustrating the progression of expertise across clusters. To our knowledge, this framework validation process was the first validation of an advanced competency framework in the Middle East Region. The results revealed several key insights and recommendations for implementation and improvement.

An evolving pharmaceutical workforce is one that can adapt its core roles and responsibilities to meet the new and emerging needs of patients and civil society (5). Competency-based education and training (CBET) in pharmacy aims to equip pharmacists with diverse skills beyond knowledge acquisition to meet evolving patient needs. CBET fosters professionalism, effective communication, and patient-centered care, preparing pharmacists to excel in dynamic healthcare settings and contribute to improved patient outcomes and pharmacy services quality. A study by Koster et al. (16) has demonstrated the effectiveness of competency-based pharmacy education (CBPE) in improving the preparedness of pharmacy graduates for professional practice. Similarly, the work by Austin and Gregory (17) on the Canadian pharmacy practice framework underscores the importance of continuous evaluation and adaptation of competency frameworks to ensure their relevance and efficacy.

In the present study, the FIP GADF was selected as the foundational basis for developing the Kuwait Advanced Competency Framework due to its universal recognition as a benchmark for pharmacy practice and education. Adopting the GADF facilitates alignment with international standards, ensuring that Kuwait's pharmacists are equipped with globally competitive skills. The subsequent adaptation of the GADF allowed for a nuanced integration of Kuwait's specific healthcare needs, cultural considerations, and the unique challenges faced by the local pharmacy sector. This careful customization process ensures the framework's relevance and applicability within Kuwait, significantly enhancing its potential to improve pharmacy practice. Moreover, by outlining key competencies and areas for advancement, the framework supports pharmacists in structuring their professional development and career planning to achieve both local excellence and global competitiveness. For instance, some countries have successfully implemented the GADF, demonstrating its versatility across different healthcare systems (6).

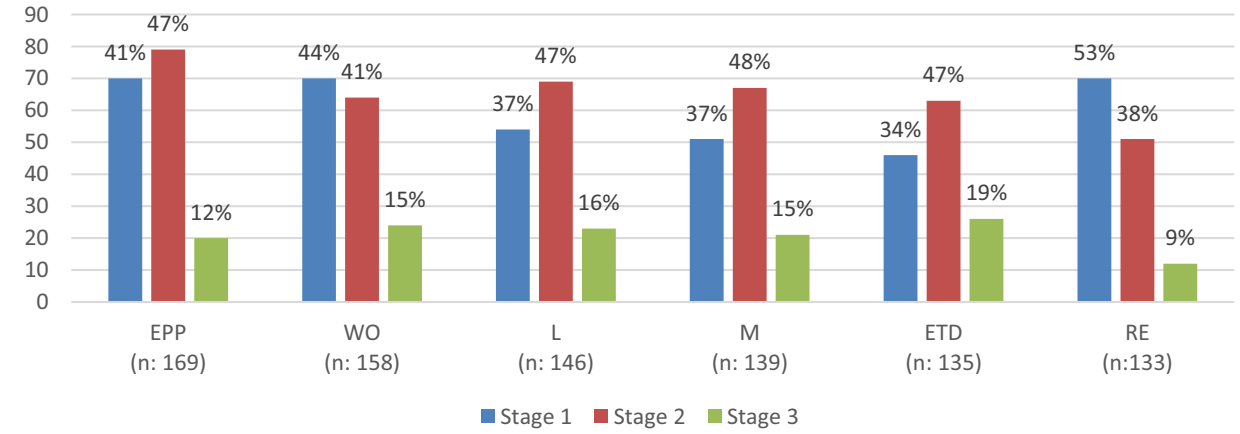

FIGURE 2
Illustration of the distribution across cluster staging. EPP, Expert professional practice; WO, Working with others; L, Leadership; M, Management; ETD, Education, training and development; RE, research and evaluation.

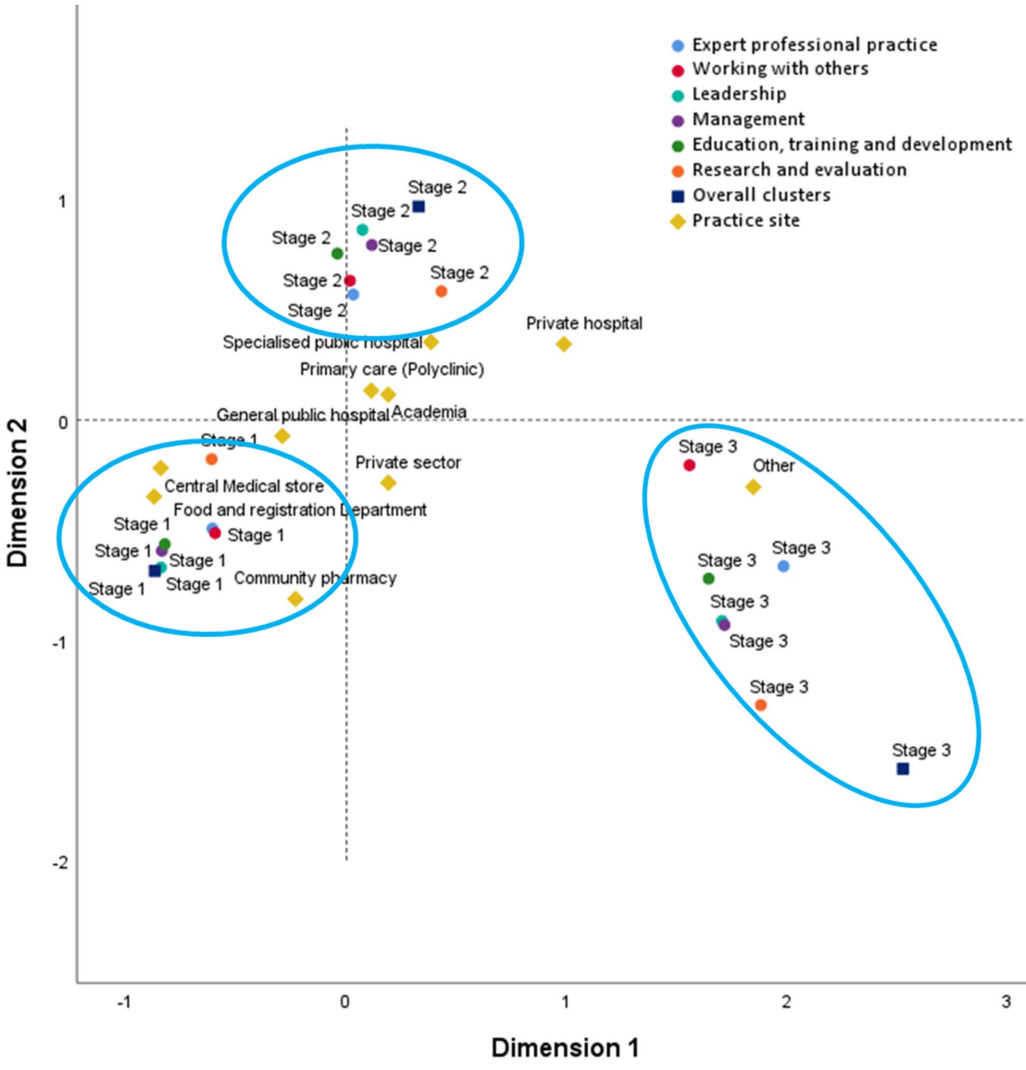

FIGURE 3
A descriptive visualization of the self-assessed staging and corresponding sectors within the surveyed sample.

Australia and the UK, with their established pharmacy infrastructures, focused on refining advanced practice stages and ensuring the framework addressed both early-career and experienced professionals. Their approach involved extensive stakeholder engagement and iterative modifications to ensure the framework's relevance and applicability across various pharmacy sectors. In contrast, countries like Indonesia and Jordan adapted the GADF to bolster the foundational competencies of their pharmacists. They concentrated on integrating the framework into existing educational and professional development programs, ensuring that it addressed local practice needs and regulatory requirements.

To meet the unique requirements of Kuwait's pharmacy sector, we carefully selected participants holding various senior positions for the focus group. Similar to Meilianti et al. (2), the translation process was structured into two different sessions, during which participants were given the opportunity to scrutinize every aspect of the framework in depth. This included a thorough review of the Arabic translation to ensure not only alignment with the original English version but also that the language used was naturally suited for Arabic-speaking pharmacists. This careful approach guaranteed that the translation was both accurate and culturally appropriate, enhancing its accessibility and relevance to the local pharmacy workforce. Other studies done in the region provide a relevant comparison. The work done by Saker et al. (18), and Almaghaslah et al. (19), highlight the importance of customizing these tools to address local needs and contexts. Their experience underscores the value of integrating international standards with local healthcare requirements, mirroring our approach in Kuwait.

In the final phase of our study, 169 pharmacists utilized a newly developed self-assessment framework to determine their competency levels in various areas, providing invaluable feedback on its practicality and effectiveness. Our investigation into cluster staging distribution and its correlation with workplace dynamics shed light on career progression pathways and professional readiness. While our findings align with Meilianti et al. (2) in highlighting prevalent distribution among 'working with others' and 'research and evaluation' clusters, showing a majority of respondents in Stage 1, a discrepancy emerged. Specifically, our study noted a higher proportion of pharmacists in Stage 2 across four other clusters. Nonetheless, both studies agree on the identified lower readiness among pharmacists.

Differences in competency ratings can stem from various factors, including work context, professional experience, and individual perspectives on competency. Our study observed a modest correlation between workplace settings and staging, suggesting that workplace is associated with how pharmacists self-assessed their career development in Kuwait. For instance, pharmacists working in different settings, such as hospitals, community pharmacies, or academic institutions, may prioritize different competencies based on their specific roles and responsibilities. They may also experience varied opportunities for professional development and skill enhancement, affecting their self-assessed competency levels. Those in hospital settings might report higher competencies in clinical skills, while those in community pharmacies might excel in patient communication and management skills. Professional experience also plays a crucial role in competency assessments. More experienced pharmacists are likely to have developed a broader range of skills and competencies over time, which can influence their self-assessment ratings. Conversely, less experienced pharmacists may identify areas for further development, highlighting the need for targeted training and support.

Implications for practice

The implications of the study for pharmacy practice are significant and multifaceted. This study yielded a country-specific competency framework and represented a pivotal step toward modernizing pharmacy practice in Kuwait. By aligning with international standards while considering local healthcare needs and cultural nuances, the KACF ensures that pharmacists are equipped with the competencies necessary to excel in their roles and meet the evolving needs of patients and society. The KACF plays a crucial role in preparing pharmacists for contemporary healthcare environments. By prioritizing learner outcomes and practical skills development, KACF empowers pharmacists to navigate complex healthcare landscapes effectively and contribute meaningfully to patient care. The KACF outlines key competencies such as effective communication, professionalism, teamwork, and patient-centered care, reflecting the complex nature of modern pharmacy practice.

The structured approach taken in the development and validation of the KACF ensures its relevance, applicability, and effectiveness within the local pharmacy sector. Through careful selection of participants, meticulous translation processes, and validation through self-assessment frameworks, the KACF has been tailored to meet the unique needs of Kuwait's pharmacy workforce. The active engagement and support of the pharmacy sector are crucial for the successful adoption and implementation of the KACF, which promises to significantly enhance healthcare quality, address challenges in chronic disease management, and advance pharmacy practice in Kuwait.

Future research should focus on observing the implementation of the KACF within the pharmacy sector and assessing pharmacists' willingness to adopt it. Longitudinal studies tracking changes in pharmacists' competency levels over time and evaluating the impact of the KACF on healthcare outcomes will provide valuable insights into its effectiveness and contribution to advancing pharmacy practice in Kuwait. By continuously monitoring and evaluating the framework's implementation and impact, stakeholders can ensure its ongoing relevance and effectiveness in meeting the evolving needs of patients and society.

Limitations

While this study benefits from the use of a mixed-methodology approach, allowing for the collection of data through focus groups and a survey to increase the diversity of the data, it is not without limitations. A notable concern is the inherent bias of social desirability present in both the focus groups and the self-administered survey. Participants in focus groups may tailor their responses to align with perceived group norms or to avoid judgment, while individuals completing surveys might similarly report a competency level they believe is more acceptable to their peers. This bias can influence the authenticity of the data collected. Despite efforts to mitigate these

biases through careful question design and facilitation techniques, the impact of social desirability cannot be entirely eliminated and represents a limitation to this study.

Another significant limitation concerns the recruitment strategy for survey participants. The study aimed to distribute the web-based survey to all pharmacists (around 4,000 registered pharmacists) in Kuwait via social media and messaging apps, with the hope of achieving wide-reaching participation. However, the response rate of 169 pharmacists suggests potential challenges in dissemination, such as not all pharmacists being reached or aware of the survey. Additionally, it raises the concern that the respondents might predominantly comprise individuals who are particularly enthusiastic or invested in the topic rather than a broad cross-section of the pharmacy workforce. This limitation indicates that the sample may not be representative of the entire pharmacist population in Kuwait, potentially affecting the generalizability of the findings.

Conclusion

This research sought to establish the Kuwait Advanced Competency Framework (KACF), employing a data-driven methodology to craft precise and meaningful post-graduate education initiatives, aiding in the career development and progression of pharmacists. The KACF is a pivotal tool in modernizing pharmacy practice, aligning international standards with local healthcare needs. Through meticulous development and validation, it equips pharmacists with essential competencies to excel in patient care. Stakeholders' active support is crucial for successful adoption, ensuring improved healthcare quality and addressing chronic disease challenges. Embracing the KACF signifies commitment to advancing pharmacy practice and enhancing overall health outcomes for Kuwaiti citizens.

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 approval for this study was obtained from the Ministry of Health's scientific research ethics committee (1786/2021). 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

AA-H: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Supervision, Validation, Writing – original draft, Writing – review & editing. SW: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Validation, Writing – original draft, Writing – review & editing. IA: Data curation, Formal analysis, Investigation, Methodology, Validation, Writing – original draft, Writing – review & editing. SM: Data curation, Formal analysis, Writing – original draft, Writing – review & editing. JS: Conceptualization, Investigation, Resources, Validation, Writing – review & editing.

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Conflict of interest

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

Publisher's note

Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fmed.2024.1442643/full#supplementary-material

SUPPLEMENTARY TABLE 1
Kuwait Advanced Competency Framework for Pharmacists.

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A post-COVID syndrome curriculum for continuing medical education (CME): in-person versus livestream

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Background: Nearly 30% of patients with COVID-19 infection develop post-COVID Syndrome. Knowledge of post-COVID Syndrome is evolving, creating the need for adaptable curricula. Flipped classrooms (FC) are flexible and dynamic with demonstrated utility in continuing medical education (CME), yet there has been no research on application of FCs, or comparisons between livestream and in-person learning, in post-COVID CME.

Methods: We implemented a novel post-COVID curriculum using FCs for in-person and livestream participants at four Mayo Clinic CME conferences. Outcomes were validated measures of knowledge; perceptions of FCs and CME teacher effectiveness; and learner engagement. Pre-conferences surveys were a post-COVID knowledge test and the Flipped Classroom Perception Inventory (FCPI). Post-conference surveys were a post-COVID knowledge test, the FCPI, the CME Teaching Effectiveness Instrument (CMETE), and the Learner Engagement Inventory (LEI). Pre-post knowledge and FCPI scores were analyzed using linear mixed models. CMETE and LEI were compared for in-person versus livestream participants using the Wilcoxon rank-sum test.

Results: Overall, 59 participants completed the pre-test, and 72 participants completed the post-test, surveys. Participants were predominantly female (58%), were in nonacademic group practices (65%), and lacked prior experience with flipped classrooms (83%). Following the presentations, participants showed significant improvements in post-COVID knowledge (47% correct precourse to 54% correct postcourse, p-value = 0.004), and a trend toward improved FCPI scores. Teaching effectiveness, learner engagement, and pre-post change in COVID knowledge did not differ significantly between participants of in-person versus livestream sessions.

Conclusion: This post-COVID FC curriculum was feasible and associated with improved knowledge scores among a diverse population of physician learners in CME, without any apparent compromise in learner engagement, or in perceptions of teaching effectiveness and FCs, among livestream versus in-person participants.

KEYWORDS

flipped classroom, post-COVID "long-haulers," in person learning, livestream learning, continuing medical education (CME)

Background

Amidst the COVID pandemic there is an increased need for novel methods to disseminate rapidly evolving medical information effectively and safely (1–3). Post-COVID syndrome (PoCoS) is a constellation of symptoms persisting greater than three months after initial onset of acute COVID symptoms (4). PoCoS is characterized by fatigue, orthostatic intolerance, or diffuse pain disproportionate to objectively measured markers of tissue damage. In addition to being significantly function limiting, PoCoS is common, affecting an estimated 10–30% of patients with COVID (5, 6). Barriers to disseminating information on PoCoS include lack of standardized information, rapidly evolving data and treatment recommendations, and limited existing curricula.

There is growing interest in flipped classroom (FC) models as a flexible, dynamic, and accessible teaching modality to disseminate information safely, effectively, and rapidly during in the setting of the COVID pandemic. As opposed to traditional models, FC models require that course attendees prepare before class participation and then use face-to-face learning time to apply key concepts. FC models incorporate higher order Bloom's taxonomy functions such as application, analysis, and evaluation in the face-to-face settings, which enhances opportunities for feedback and knowledge assessments (7–10).

Previously, FC models have been successfully studied and implemented at the Mayo Clinic through a QI curriculum for residents and in a CME setting primarily involving academic faculty members (11, 12). To our knowledge, utilization of FC methodologies in the setting of PoCoS curricula has not been studied.

Project design/methods

Setting: We conducted a cross-sectional survey with pre/post-test analyses of all participants at the post-COVID talks at the following Mayo Clinic CME events: The Practice of Internal Medicine Conference (POIM) on 3 May 2022, the Medically Unexplained Symptoms Conference on 18 August 2022, the Updates in Internal Medicine Conference on 22 October 2022, and the Medically Unexplained Symptoms Conference on 10 August 2023. These courses are all accredited by the Mayo School of Continuous Professional Development, range in attendance from 60 to 220 attendees, and qualify for between 19.5 and 26.25 h of CME credit. Each course consisted of 30 to 60-min podium presentations and small-group breakout sessions, and all courses were offered in both in-person and livestream formats. This study was deemed exempt by the Mayo Clinic Institutional Review Board (ID 21-012865).

Study variables: Demographic variables of course participants, collected on the pre-survey, included age (years: 20–30, 31–40, 41–50, 51–60, $\geq$ 61), sex (M/F), practice setting (academic, group, training program, other), specialty (internal medicine, family medicine, medical specialty, non-medical specialty), practice location (northeast, southeast, midwest, southwest, west, international), pre-FC module completion ($<$ 50%, $\geq$ 50%), and prior FC experience (Y/N). The outcome variables were a 10-item multiple choice post-COVID knowledge questionnaire, the 8-item Flipped Classroom Perception Inventory (FCPI), the 8-item CME Teaching Effectiveness Instrument, and the 8-item Learner Engagement Inventory (11, 13–15). Please see Supplementary Addendums 1–4 for the actual instruments.

Before the conference, participants received the multiple choice post-COVID knowledge questionnaire which was reviewed, revised, and updated for accuracy prior to each CME course. In addition, participants received the Flipped Classroom Perception Inventory (FCPI), which was designed to measure baseline knowledge and perceptions of flipped classroom curricula. After the conference, participants again received the multiple choice questionnaire. They also received the FCPI, the CME Teaching Effectiveness instrument, and Learner Engagement Inventory, all of which have been validated and published by Mayo authors (11, 13).

Study design: This was a two-group group, pre/post-test comparison study of a post-COVID curriculum using FCs among attendees at four Mayo Clinic CME courses.

Study intervention: Before the conference, participants were given access to online didactic materials reviewing key concepts to understanding post-COVID syndrome (see Supplementary Addendum 5 for a copy of the didactic material used). Modules were developed, reviewed, and revised by experts who designed and staff the Mayo Clinic Post COVID Care Clinic, and they were updated for accuracy prior to each CME course. The in-person conference presentation for post-COVID syndrome consisted of case-based presentations by the experts listed above, followed by a 30-s "think, pair, share" discussion among conference participants. Livestream participants were given a 30-s pause for reflection prior to proceeding to the next case.

Data analysis: Categorical data are presented as numbers and percentages. Continuous data are summarized as mean and SD. Knowledge and FCPI scores were analyzed using linear mixed models with time (pre vs. post) as the explanatory variable of interest and participant included as a random effect to account for the repeated measures design. These analyses were performed using all available data and also using data only for those who completed both the pre- and post-surveys. In order to assess whether changes from pre to post differed between those who attended in person versus livestream, a secondary analysis was performed which included mode of attendance (in person vs. livestream) and the mode of attendance—by—time interaction. CMETE and LEI were available for those who completed the post-survey and were compared for in-person versus livestream participants using the Wilcoxon rank-sum test. Statistical Significance was set at $\alpha < 0.05$. Statistical analyses were conducted with SAS version 9.4 software (SAS Institute Inc., Cary, NC, USA).

Results

The pre-survey was completed by 59 participants and the post-survey was completed by 72 participants; with 26 participants completing both surveys. Demographics of those who completed the pre-survey are presented in Table 1. The majority of participants were from a group practice (65%), and most reported their specialty as internal medicine generalist (42%) or family medicine (38%).

Results of the analyses of the FCPI and knowledge scores are summarized in Table 2. From the analysis which included all

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TABLE 1 Respondent characteristics.

Characteristic	All pre-survey respondents (*N* = 59*)	Those who responded to both pre- and post-surveys (*N* = 26*)
Gender		
Female	32 (58%)	11 (46%)
Male	23 (42%)	13 (54%)
Age, years		
20 to 30	1 (2%)	1 (4%)
31 to 40	16 (30%)	2 (8%)
41 to 50	11 (20%)	6 (25%)
51 to 60	12 (22%)	5 (21%)
61 or greater	14 (26%)	10 (42%)
Practice setting		
Academic practice	12 (22%)	5 (21%)
Group practice	36 (65%)	13 (54%)
Training program	2 (4%)	2 (8%)
Other	5 (9%)	4 (17%)
Specialty		
Internal medicine—generalist	23 (42%)	12 (50%)
Internal medicine—subspecialist	4 (7%)	2 (8%)
Family medicine	21 (38%)	6 (25%)
Non-internal medicine	1 (2%)	1 (4%)
I do not practice medicine	6 (11%)	3 (13%)
Location		
US Northeast	3 (5%)	1 (4%)
US Southeast	6 (11%)	1 (4%)
US Midwest	24 (44%)	11 (46%)
US Southwest	8 (15%)	4 (17%)
US West	13 (24%)	6 (25%)
Outside the US	1 (2%)	1 (4%)
How much of the precourse material did you review?		
< 50%	38 (70%)	15 (63%)
> 50%	16 (30%)	9 (38%)
Have you had experience with prior flipped classroom curricula?		
No	45 (83%)	23 (96%)
Yes	9 (17%)	1 (4%)

*Due to missing data the sum of the number of respondents across categories for a given characteristic may be less than the total N.

available data, the mean knowledge score increased significantly from pre to post (mean change = 0.8, 95% CI 0.3 to 1.3, p = 0.004), and the FCPI score was also observed to increase (mean change = 0.2, 95% CI 0.0 to 0.3, p = 0.053). Similar results were obtained from the analysis which was restricted to participants who completed both the pre- and post-surveys. From supplemental analysis, the changes from pre to post were not found to differ significantly between those who attended in person versus livestream (interaction p = 0.932 and p = 0.458 for knowledge and FCPI, respectively). For participants who completed the post-survey the CMETE and LEI scores are summarized in Table 3. For these outcomes, there were no significant differences found between those who attended in person versus livestream (P = 0.967 for CMETE score, p = 0.805 for LEI score).

Discussion

To our knowledge, this is the first study to demonstrate the feasibility and effectiveness of a post-COVID FC curriculum among postgraduate clinicians. The FC curriculum was associated with improved knowledge scores for both in person and livestream attendees. Furthermore, teaching effectiveness scores were not significantly different for in person versus livestream attendees, suggesting that this post-COVID FC curriculum is equally effective for distance learners.

Approximately 10 to 30% of patients with COVID-19 develop post-COVID Syndrome, which results in 2 to 4 million unemployed and $170 billion in lost wages annually in the United States (16–18). Few post-COVID curricula exist, and developing these curricula is challenging due to lack of standardization and rapidly evolving treatment recommendations (16), which highlights a need for post-COVID curricula that are effective, adaptable, and feasible.

We are unaware of previous curricula—let alone with the incorporation of FC methodology—for the management of post-COVID Syndrome. This curriculum was associated with similar knowledge gains for both in person and livestream models, and for attendees at multiple CME courses over 16 months, which speaks to the curriculum's adaptability. Prior experience with FC models did not impact on knowledge gains. Finally, there was nonsignificant trend toward pre-post course perceptions of the FC approach, which is consistent with prior FC research (12).

Studies have suggested that learner engagement and teaching effectiveness are strongly correlated (13), and that in-person flipped classroom sessions are generally favored over online sessions (11, 12). However, this study did not reveal significant differences between in person versus livestream attendees with respect to teaching effectiveness or learner engagement scores, which indicates that, at least for this post-COVID FC curriculum, livestream attendance may be just as feasible and effective as the more resource intensive, in person sessions. Moreover, CME Teaching Effectiveness scores for this curriculum compared favorably with what was previously reported in the literature (15).

This study has several limitations. According to some traditional models, flipped classroom teachers interact with their students to check in, confirm understanding, and/or correct mistakes. A limitation of this study is that the instructors were teaching large audiences from the podium within strict time constraints, which precluded any informal interaction with the learners. Decreased learner engagement may have hampered the effectiveness of the extensive, precourse, FC learning materials.

TABLE 2 FCPI and knowledge scores from pre-survey and post-survey.

	All responses				Participants who responded to both pre-survey and post-survey			
Characteristic	Pre (N = 59†)	Post (N = 72†)	Delta (95% CI)*	P*	Pre (N = 26)	Post (N = 26)	Delta (95% CI)*	P*
FCPI score	3.7 ± 0.5	3.8 ± 0.8	0.2 (0.0, 0.3)	0.053	3.7 ± 0.6	3.9 ± 0.7	0.2 (0.0, 0.4)	0.058
Knowledge score	4.7 ± 1.5	5.4 ± 1.7	0.8 (0.3, 1.3)	0.004	4.8 ± 1.2	5.9 ± 1.4	1.0 (0.3, 1.7)	0.006

*Data were analyzed using a linear mixed model with time (pre vs. post) as the explanatory variable, and participant included as a random effect to account for repeated measurements. Results are summarized by presenting the estimate and 95% confidence interval for the difference between time periods (post—pre). † participant had missing data for FCPI in the pre-survey and one participant had missing data for the knowledge questionnaire in the post-survey.

TABLE 3 CMETE and LEI scores from post-survey: Overall and according to mode of attendance.

Characteristic	Overall (N = 72†)	Livestream (N = 30)	In person (N = 42†)	P*
CMETE score				0.967
Mean ± SD	4.4 ± 0.8	4.4 ± 0.7	4.4 ± 0.9	
Median (25th, 75th)	4.5 (4.1, 5.0)	4.4 (4.3, 4.9)	4.6 (4.0, 5.0)	
LEI score				0.805
Mean ± SD	4.3 ± 0.8	4.4 ± 0.7	4.3 ± 0.9	
Median (25th, 75th)	4.5 (4.0, 4.9)	4.6 (4.1, 4.9)	4.5 (4.0, 4.9)	

*Wilcoxon rank sum test.
† participant had missing data for CMETE.

Future research should endeavor to improve learner engagement and satisfaction by implementing more streamlined course materials, and by offering greater incentives (19, 20). Participants were primarily older and practiced in nonacademic settings, which may limit the generalizability of flipped classroom data to other populations. The study relied on self-reporting of precourse material review, which could not be verified objectively. Moreover, although there were significant improvements in knowledge scores following the curriculum intervention, the absolute percentages correct on the knowledge assessments were not very high. Another potential explanation for the low knowledge scores is that that post-COVID syndrome is a very new and recent disorder; therefore, there remains little experience with this topic among general clinicians, and the pathophysiological mechanisms are still being determined. Finally, the surveys had generally low response rates.

In summary, we present the results of research on a novel post-COVID FC curriculum. The curriculum intervention was associated with increased pre-post knowledge scores, and with CME Teaching Effectiveness scores that compared favorably with prior CME research. Validated outcome measures for knowledge acquisition, teaching effectiveness, and learner engagement were similar for in person and livestream participants, suggesting that distance learning, which is less resource intensive, may be a feasible option for content delivery. We anticipate that future endeavors to streamline the precouse FC material will lead to further enhancements in knowledge acquisition and learner engagement.

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 Mayo Clinic Institutional Review Board. 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

MM: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Visualization, Writing – original draft, Writing – review & editing. RG: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Supervision, Visualization, Writing – original draft, Writing – review & editing. DS: Data curation, Formal analysis, Software, Writing – original draft, Writing – review & editing. TJB: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Supervision, Visualization, Writing – original draft, Writing – review & editing.

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Conflict of interest

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

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Supplementary material

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Improving ADR reporting in Jordan: a qualitative exploration of pharmacists' perspectives

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Background: Community pharmacists are most accessible to patients. Hence, they have a crucial role in ensuring drug safety by detecting and reporting adverse drug reactions (ADRs). However, there may be gaps in their knowledge of ADR reporting systems and barriers they face in reporting.

Objective: This study aims to assess community pharmacists' knowledge of ADR reporting systems in the Kingdom of Jordan, identify the barriers they face in reporting ADRs, and explore the broader factors that influence their involvement in pharmacovigilance activities.

Methods: In-depth, semi-structured, face-to-face interviews were held with 20 community pharmacists from different regions of Jordan to evaluate their understanding of ADR reporting, the obstacles they encountered, and the elements that could motivate them to report ADRs. The interviews were transcribed and subjected to thematic analysis to find recurrent themes and insights. The thematic analysis highlighted opportunities for continuing education and an absence of formal training as the main barriers to ADR reporting.

Results: Pharmacists reported dissatisfaction with time limits in their hectic work situations and the complexity of reporting procedures, especially the length and information demanded by ADR reporting forms. Another factor influencing low reporting rates was a perceived lack of acknowledgment and feedback. Participants proposed that encouraging ADR reporting with professional recognition or compensation and improving and digitizing the reporting process would promote increased participation.

Conclusion: ADR reporting presents considerable difficulties for community pharmacists in Jordan, mostly because of administrative obstacles and an absence of official support and training. Enhancing pharmacovigilance efforts in Jordan could be achieved by providing incentives, simplifying the reporting procedure, and incorporating reporting into the current pharmacy management software.

KEYWORDS

adverse drug reaction, community pharmacist, pharmacovigilance, medication safety, Jordan

1 Introduction

Adverse drug reactions (ADRs) pose a significant healthcare challenge due to the increasing complexity of therapeutic options, the aging global population, and the growing prevalence of comorbidities. Polypharmacy, especially in elderly patients, increases the risk of ADRs, making it harder to manage and monitor these patients effectively. The increasing

complexity of healthcare elevates both the risk and impact of ADRs, emphasizing the need for dynamic risk management strategies (1). While randomized controlled trials (RCTs) are crucial for assessing drug efficacy and safety, their limited duration and homogeneous populations restrict their ability to monitor ADRs fully (2, 3). Consequently, continuous post-marketing surveillance is essential to optimize therapeutic benefits and confirm treatment effectiveness in a broader, more diverse patient population (4, 5).

Systematic reporting of adverse events during clinical trials is vital for building and updating each medication's safety profile (6). Once a drug is on the market, healthcare systems increasingly rely on spontaneous ADR reporting to track safety, especially for uncommon or late-occurring ADRs (7). ADRs and adverse drug events (ADEs), as defined by the Institute of Medicine (IOM) pose a significant global health burden. ADEs refer to any harm caused by a drug-related medical intervention, including overdoses, allergic reactions, ADRs, and medication errors (8). ADRs in particular, notably contribute to morbidity and mortality (9, 10), highlighting the need for effective pharmacovigilance systems and continuous drug safety monitoring. Improved monitoring can reduce health risks by enabling early detection and prompt intervention. Research shows that hospitalization rates due to ADRs vary significantly between countries and regions. In Europe, rates can be as high as 12.8%, whereas in Australia, ADRs make up 2–12% of hospital admissions (11). Comparably, in the United Kingdom ADRs account for 6.5% of hospital admissions (12), and in Sweden, 12% of internal medicine department admissions are due to ADRs (13). Remarkably, ADRs were the sixth most common cause of death in industrialized nations, including the US, in 2002 (14). Furthermore, in a study of hospitalized patients between 2010 and 2019, significant reductions were noted in the annual rates of adverse events, including those due to ADRs, in conditions such as acute myocardial infarction, heart failure, pneumonia, and major surgeries (15).

Preventable ADRs occur at a rate of 37.9% in the Western region, highlighting their significant financial impact (16). A 2011 study by Paudel et al. (17) estimated that ADR-related hospitalizations in the US cost nearly US$38.9 billion. These figures underscore the urgent need for improved pharmacovigilance systems to reduce unnecessary patient suffering and the financial burden of inappropriate prescriptions (18). Most studies on post-marketing withdrawals are older, reflecting a gap in more recent research, and provide valuable insights into the patterns of drug withdrawals, it is important to note that the data is based on medicinal products withdrawn between 1950 and 2014, and the findings may be influenced by the period covered (19). ADRs, a leading cause of hospitalizations, morbidity, mortality, and delaying treatment also increase healthcare expenses (20). While regulatory bodies require marketing authorization holders to gather and share safety information (7), healthcare providers' involvement is crucial, as patients are more likely to report ADRs to their physicians or pharmacists than to pharmaceutical companies. However, ADR reporting rates among healthcare practitioners remain low, primarily due to the lack of mandatory reporting in many countries, with up to 94% of practitioners in the European Union underreporting (21–23).

The Jordanian National Pharmacovigilance Center (JNPC) was established in 2001 by the Jordan Food and Drug Administration (JFDA), followed by the creation of the Jordan Pharmacovigilance Centre (JPC) in 2002 to gather and assess ADR reports. In 2006, ADR guidelines were introduced based on International Conference on Harmonization (ICH) standards. The JPC system is accessible to healthcare professionals, enabling timely interventions to protect patient safety. Despite efforts to decentralize pharmacovigilance activities with regional centers established between 2011 and 2015, a study by Onakpoya et al. (19) found only 428 ADR reports submitted to the JFDA, indicating underreporting. This gap was due to limited understanding and engagement with pharmacovigilance principles among healthcare professionals (24). The study emphasized the need for better educational initiatives to encourage ADR reporting.

A 2023 study by Mhaidat et al. (25) analyzed ADR reports submitted to the pharmacovigilance database of the JFDA from 2015 to 2021 revealing a total of 2,744 reports. Despite broad data collection, community pharmacists contributed only a small percentage of the total reports, with 28.4% of these classified as serious. The most common drug types associated with ADRs were antineoplastic and immunomodulating therapies (24.0%), systemic antibiotics (14.2%), and gastrointestinal and metabolic medications (12.1%). Interestingly, with 22.8% of reports, COVID-19 vaccines were the most often reported item. Fatigue (6.3%), injection site pain (6.1%), and headache (6.0%) were the most frequent particular ADRs. 4.7% of the ADRs for which outcome data was available had a fatal outcome. The consistently low rates of ADR reporting pose a serious healthcare challenge, delaying regulatory actions to restrict unsafe medications. Under-reporting, however, is still a major problem in Jordan and is linked to several issues, including inadequate training, a lack of awareness of the reporting system, and a reliance on other medical professionals to report (4, 5, 10).

In Jordan, community pharmacies follow a fee-for-service model, where pharmacists are paid for medications. However, there is limited financial support for clinical services, including ADR reporting, and reimbursement policies do not cover ADR reporting or patient counseling. These limitations can impact pharmacists' motivation and participation in ADR reporting systems (26). Pharmacists' reporting of suspected ADRs is a critical component of Jordan's pharmacovigilance system, led by the JFDA and the Rational Drug Use & Pharmacovigilance Department. These reports even those with a limited number of incidents are essential for spotting any drug safety concerns and improving the country's ADR database. However, there is a lack of published studies addressing the understanding and challenges of ADR reporting among community pharmacists in Jordan (27). Prior studies indicate that many pharmacists are unaware of the ADR reporting system (25). Effective pharmacovigilance is key to identifying the risks of new medications, supporting evidence-based prescribing, preventing adverse reactions, and optimizing patient therapy at reduced costs. This study aims to explore community pharmacists' knowledge and barriers to ADR reporting in Jordan, emphasizing their crucial role in ADR detection, improving post-marketing surveillance, and enhancing pharmacovigilance awareness among healthcare providers in community pharmacies.

2 Methods

2.1 Study design

This qualitative study aimed to explore the perspectives of Jordanian community pharmacists on their knowledge and experiences with reporting Adverse Drug Reactions (ADRs). The

primary goal was to gain in-depth insights into pharmacists' awareness of pharmacovigilance, barriers to ADR reporting, and the potential facilitators that could encourage greater participation in ADR reporting systems. The research employed an exploratory qualitative design, which was conducted between August 2023 and February 2024.

2.2 Sampling technique

A purposive sampling technique was employed to ensure a broad representation of experiences and viewpoints. Pharmacists with 7–10 years of experience, primarily working in chain pharmacies across northern, central, and southern regions of Jordan, were selected. This approach was intended to capture a wide range of demographic diversity and professional experiences relevant to the study. The sample size was determined by data saturation, meaning no new insights were gained after a certain number of interviews.

2.3 Data collection

Data were collected through semi-structured, in-depth interviews conducted in-person, allowing flexibility in capturing participants' perspectives on ADR reporting. Each interview lasted between 30 and 45 min, conducted in locations convenient to the participants to accommodate their schedules and preferences. With the participants' consent, all interviews were audio-recorded to ensure accurate data capture.

The interview guide, developed after reviewing the literature on pharmacovigilance and ADR reporting, included open-ended questions regarding pharmacists' knowledge of ADRs, barriers to reporting, and recommendations for improvement. After the interviews, participants were allowed to review the recordings and transcripts for accuracy.

2.4 Data analysis

Data were analyzed using inductive thematic analysis, a widely recognized method in qualitative research for identifying patterns and themes within textual data (28). The analysis process began with a verbatim transcription of the interview. The interviews were transcribed verbatim by a member of the research team. This was done manually. To ensure a thorough understanding of the data, the research team listened to the audio recordings multiple times and reviewed the written transcripts repeatedly. This immersion in the data helped the researchers in understanding the data. The research team, consisting of experts in pharmacy practice, pharmacovigilance, and qualitative research, systematically coded the data, extracting relevant details from each interview and applying specific codes to capture key elements of participants' responses. These codes were refined through discussions within the research team to ensure consistency and relevance. The team was selected based on their expertise in community pharmacy and ADR reporting systems, ensuring the analysis was informed by their professional backgrounds. However, their familiarity with the subject matter may have influenced the interpretation of the findings, so cross-checking was performed at every stage to ensure the credibility and reliability of the results. After repeated readings, the team organized the codes into broader themes, minimizing redundant codes and refining the structure to ensure each theme accurately reflected the data. Throughout the analysis, cross-checking was performed at every stage to ensure the credibility and reliability of the findings, enhancing the consistency and rigor of the thematic analysis (29).

2.5 Ethical considerations

Ethical approval for the study was secured from the Research Health and Medical Committee under reference R0002412, and all participants provided informed consent before taking part in the study. Participants were assured that their involvement was voluntary and that all information would be treated confidentially.

3 Results

Table 1 shows the demographics of participants. A total of 20 pharmacists participated in the study whose mean age was 28. Fifty percent of the participants were female, and 50% of them put in more than 40 h a week at work. Seventy five percent of the group had a bachelor's degree, and 45% had 5–10 years of experience. There is a notable discrepancy between ADR observation and reporting while

TABLE 1 Demographics of participants.

Variable	*n* = 20 (%)
Age	Mean = 28 years ±2.7 range (23–36 years)
Gender	
Male	8 (40.0)
Female	12 (60.0)
Hours worked per week	
<24 h	1 (5.0)
24–48 h	9 (45.0)
>48 h	10 (50.0)
Highest level of qualification	
Bachelors	15 (75.0)
Post-graduate	5 (25.0)
How long have you been working as a pharmacist?	
0–5 years	7 (35.0)
5–10 years	9 (45.0)
More than 10 years	4 (20.0)
How many adverse medication reaction (ADR) cases have you observed in your present practice?	
Less than 5	18 (90.0)
6–12	1 (5.0)
More than 12	1 (5.0)
In the past year, have you ever reported any ADRs that you have observed in your patients?	
Yes	1 (5.0)
No	19 (95.0)

90% of respondents had seen less than five ADR incidents, only 5% had reported any ADRs in the previous year.

The qualitative investigation highlights important challenges and obstacles that Jordanian community pharmacists encounter while reporting ADRs. These barriers can be categorized into five primary themes: Lack of Awareness and Training, Complexity of Reporting Procedures, Perceived Impact and Motivation, Professional Environment, and Suggestions for Improvement. These themes are discussed below, with supporting categories and participant quotations.

3.1 Theme 1: lack of awareness and training

Pharmacists described gaps in both their initial education and ongoing professional development concerning ADR reporting, impacting their ability to effectively participate in the process.

3.1.1 Insufficient formal training

Participants reported not receiving formal instruction on ADR reporting during their academic training. They also expressed that additional emphasis on ADR reporting in the curriculum would be beneficial.

> *"I have not received any formal training on how to report ADRs. Everything I know has been picked up informally, through trial and error." (Pharmacist: 2) "ADR reporting was mentioned during pharmacy school but wasn't covered in sufficient depth to navigate the reporting process properly." (Pharmacist: 4).*

3.1.2 Lack of continuing education

Participants also emphasized the lack of possibilities for ADR-focused continuing education. This suggests that there is a need for continued professional development so that pharmacists are aware of changing medication safety regulations and reporting guidelines.

> *"There aren't any training or revision sessions on ADR reporting accessible for us. We require constant updates." (Pharmacist: 1).*
>
> *"Continuous pharmacovigilance education should be provided to pharmacists. It would assist us in remaining up to date on new medications and reporting guidelines." (Pharmacist: 7).*

3.2 Theme 2: complexity of reporting procedures

Pharmacists noted that the ADR reporting process was complicated and time-consuming, with multiple barriers hindering their willingness to report ADRs.

3.2.1 Lengthy and complex forms

Participants reported that the forms required for ADR reporting were often too detailed and required information that was difficult to obtain in a busy pharmacy environment.

> *"The reporting forms ask for so much knowledge that I cannot usually provide, like details from the patient's medical history." (Pharmacist: 5).*
>
> *"With my hectic schedule, I do not have time to fill out this lengthy paperwork. They ask for far too much information." (Pharmacist: 6).*

3.2.2 Time constraints

Due to the high demands of patient care, many pharmacists explained that finding the time to fill out ADR reports was challenging.

> *"I am always occupied with patients, and it takes too long to complete an ADR report. People are constantly in line." (Pharmacist: 17).*
>
> *"In our pharmacy, we are overloaded with duties, and ADR reporting is a low concern compared to urgent patient care." (Pharmacist: 5).*

3.2.3 Lack of system integration

Pharmacists suggested that the lack of integration between ADR reporting and their current pharmacy management software created an additional layer of complexity and reduced their likelihood of reporting ADRs.

> *"If ADR reporting had been built into the software that we employ for dispensing, I would be much more likely to report." (Pharmacist: 3).*
>
> *"A direct link among pharmacy management programs and the ADR report system would make the procedure simpler and faster." (Pharmacist:8).*

3.3 Theme 3: perceived impact and motivation

Pharmacists expressed that the lack of feedback and recognition for their ADR reports diminished their motivation to participate in the process.

3.3.1 Lack of feedback and visibility

Participants mentioned that after submitting ADR reports, they rarely received any feedback, leaving them unsure about the outcomes or effectiveness of their submissions.

> *"I have previously reported a few ADRs, but I never received a response. I'm not sure if my reports had any impact." (Pharmacist: 17).*
>
> *"Without knowing the outcomes of our reports, it feels like a futile exercise." (Pharmacist:9).*

3.3.2 Limited recognition

Pharmacists felt that there were no incentives or recognition for reporting ADRs, which contributed to their reluctance to engage in the process.

> *"There's no incentive to report ADRs. It's just extra work with no benefit for us." (Pharmacist:18).*

> *"If there were rewards like professional points or certificates, I would be more motivated to participate in ADR reporting." (Pharmacist: 5).*

3.4 Theme 4: professional environment

The professional environment, including peer support and encouragement from supervisors, was seen as an important factor in influencing ADR reporting practices.

3.4.1 Lack of peer support

Many participants indicated that there were limited opportunities to discuss ADR reporting with colleagues, which could help increase their confidence and understanding of the process.

> *"I would like there was a way to talk about ADRs with my colleagues, perhaps an online group or regular meetings." (Pharmacist: 14).*

> *"Having peer support would help us feel more confident in reporting ADRs." (Pharmacist: 15).*

3.4.2 Lack of supervisory encouragement

Some pharmacists mentioned that supervisors did not emphasize the importance of ADR reporting, instead focusing on other priorities such as sales targets.

> *"ADR reporting is never brought up by my supervisor; we are only concerned with achieving our sales goals." (Pharmacist: 20).*

> *"Patient safety is important, but it becomes an afterthought when management does not emphasize it." (Pharmacist: 16).*

3.5 Theme 5: suggestions for improvement

Pharmacists provided several suggestions for improving ADR reporting, including simplifying the reporting process, integrating it with existing systems, and offering incentives for participation.

3.5.1 Simplification of forms

Participants suggested that simplifying the forms and digital reporting system could make ADR reporting less burdensome and more efficient.

> *"A simple, digital form that I can fill out quickly on my phone or computer would make a big difference." (Pharmacist: 11).*

> *"Digitalizing the reporting process would reduce the burden and make it easier for us to report ADRs." (Pharmacist: 1).*

3.5.2 Integration with software

Many pharmacists recommended that ADR reporting should be integrated into existing pharmacy management systems to streamline the process and save time.

> *"If the system we use for dispensing could also be used for ADR reporting, it would be so much easier." (Pharmacist: 7).*

> *"Electronically integrating patient information into the ADR reporting form could save us a lot of time." (Pharmacist: 13).*

3.5.3 Incentives and recognition

Pharmacists felt that offering rewards or recognition for ADR reporting would boost participation. *"It takes a lot to get recognition. We would feel that our efforts are appreciated even if we only received a certificate or other recognition." (Pharmacist: 20).*

> *"Benefits, even small ones, would significantly boost our willingness to participate in ADR reporting." (Pharmacist: 17).*

4 Discussion

This study offers insightful information about the attitudes, practices, and knowledge of Jordanian community pharmacists about reporting ADRs. According to the results, the majority of participants did not have the necessary knowledge or formal training to report ADRs. This indicates that there are still significant weaknesses in the nation's pharmacovigilance education system. The JNPC and ADR reporting are not well known, which indicates that there is still more effort to be done to incorporate ADR reporting into standard pharmacy practice. This lack of awareness mirrors findings from previous studies (30), where over half of the health professionals were similarly uninformed about their respective national pharmacovigilance programs (31). Comparable studies in Saudi Arabia have also highlighted a deficiency in knowledge among health professionals, despite generally positive attitudes toward ADR reporting. This includes limited awareness of the various types of ADRs, such as those related to antibiotics, herbal medicines, and vaccines, which require specific attention and reporting protocols (32). Similarly, in Turkey, ignorance of the national pharmacovigilance system has been cited as a primary cause for the under-reporting of ADRs (33). These observations unequivocally suggest that there is a pervasive global trend of inadequate awareness regarding spontaneous reporting systems among health professionals, necessitating strategic interventions to bridge this knowledge gap.

The study examining pharmacists' attitudes toward ADR reporting in Jordan highlights several factors influencing their reporting practices, including legal obligation, regular guidelines, feedback from authorities, simple reporting methods, and patient requests. Addressing these issues collectively could enhance ADR reporting efficacy and improve patient safety outcomes. As a result, these pharmacy owners may not emphasize the idea of services or reporting ADRs, which is probably the situation in many underdeveloped nations (4, 34).

In the examination of barriers to ADR reporting among pharmacists, the primary obstacle identified was a lack of knowledge about how to report, which significantly hinders their participation in pharmacovigilance. This is compounded by systemic issues such as the absence of reporting forms and their absence of integration with the JNPC system, which was the second most significant barrier. Furthermore, the pharmacists reported that the process of reporting ADRs is problematic, aligning with commonly cited barriers such as the perceived complexity of the reporting procedures. Additionally, the time required to complete reports was also a notable deterrent, reflecting the

broader challenge of time constraints faced by healthcare professionals. Consistent with findings from prior research, which identified logistical challenges as the main deterrents to community reporting of ADR pharmacies within the same region, this study also highlights similar issues (35). However, it additionally reveals that community pharmacists exhibit both enthusiasm and confidence in their ability to report and categorize ADRs, aiming to improve patient welfare.

In Jordan, the community pharmacy sector is predominantly business-oriented, which may result in the relegation of ADR reporting and service provision to a lower priority by pharmacy entrepreneurs. This issue of priority aligns with international observations; for instance, community pharmacists in Hong Kong, Holland, and the UK have shown an absence of awareness about the ADR reporting programs in their respective countries (36–38). Furthermore, the effectiveness of regulatory authorities in enforcing ADR reporting regulations in community pharmacy practice remains a concern, highlighting a potential gap in regulatory oversight. The study participants all agreed that reporting ADRs could improve drug safety, but they did not see a difference in the quality of life for patients who regularly visited community pharmacies. To maintain a strong ADR reporting system, routine inspections by Jordan's health authorities are considered vital to guarantee medication safety and detect possible drug-related dangers within the Jordanian population. Furthermore, requiring pharmacists to complete ADR reporting training before receiving their licenses might significantly raise the knowledge of Jordan's ADR reporting procedures among pharmacists working both domestically and abroad. The entire healthcare system depends on community pharmacies having a methodical approach to ADR reporting. To promote a culture of spontaneous ADR reporting in Jordan, pharmacists should get frequent training and ongoing education (39, 40). The use of incentives, including monetary prizes, may improve the effectiveness of ADR reporting even more (37, 39). Additionally, community pharmacies that have internet access may be able to report ADRs online to drug regulatory bodies, which would simplify the procedure and possibly improve compliance and efficacy.

Pharmacists have not, as anticipated, made a substantial contribution to ADR reporting. This observation is consistent with research by El-Dahiyat et al. (27), who pointed out that pharmacists have not done much in this field. This result is especially unexpected since, as prior studies have shown, pharmacists are considered to be specialists in drug information and are essential in maximizing medicine therapy (41, 42). Furthermore, research has shown that pharmacist-led healthcare interventions can improve the caliber of ADR reporting while dramatically lowering pharmaceutical and prescribing errors (43, 44). Therefore, it improves Jordanian pharmacists' ability to identify, track, and report ADRs.

5 Limitations

This study provides important insights into the views of community pharmacists in Jordan on ADR reporting, but several limitations must be considered. First, the sample size was relatively small and may not fully represent the broader population of pharmacists across Jordan. As a result, the findings reflect the experiences of those who participated and may not generalize to all pharmacists in the country. Second, the study may be influenced by personal biases. Participants may have responded in a way they perceived regarding their knowledge and practices related to ADR reporting. Additionally, the study utilized qualitative methods (such as interviews). The data captured is specific to the themes identified within the sample, and other factors influencing ADR reporting may not have been fully explored. Lastly, the study did not investigate structural or organizational factors within the healthcare system that might also affect ADR reporting. Future studies could consider exploring these broader contextual factors to provide a more comprehensive understanding of the challenges and opportunities in improving pharmacovigilance in Jordan.

6 Conclusion

This study provides insights into the perceptions of Jordanian community pharmacists regarding ADR reporting, highlighting areas where improvements in training and awareness could be made. While pharmacists generally have a positive attitude toward pharmacovigilance, many are not sufficiently trained or knowledgeable about the ADR reporting system. The results suggest that ADR reporting is underutilized, with barriers such as lack of motivation, complex procedures, and time constraints identified as key factors. These findings point to the potential benefits of simplifying the reporting process, enhancing pharmacist education, and incorporating ADR reporting into pharmacy management systems. Additionally, providing incentives and offering continuous training may help overcome these challenges. Addressing these barriers is crucial for improving pharmacovigilance and ensuring better patient safety outcomes in Jordan.

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 Ethics approval for this study was secured from the ACU Research Health and Medical Committee under reference ACU-R11-02412. All procedures performed in the study were in accordance with the ethical standards of the institutional research committees and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. All ethical considerations were followed throughout the study. The participants received a detailed explanation of the study's objectives and sufficient time to complete the interview. Data were collected solely for research purposes, with participation being voluntary and the right to withdraw at any time. 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

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

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Conflict of interest

The author declares 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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A review of microcredentials in health professions continuing professional development

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Microcredentials are an emergent tool to support knowledge and skill development. Despite their growing popularity in medical education – and higher education more broadly – it is unclear how these strategies have been utilized to support continuing professional development in the health professions. A rapid systematic review was conducted to explore the current relevant literature due to the timely and evolving nature of microcredentials. PubMed, Embase, and ERIC were used for the article search. Of the 290 relevant articles found from the searches, a total of 11 articles were included after abstract and full-text screenings. All articles used in this review were published within the past 10 years. Microcredentials were used across various professions, covered a wide range of topics, and employed various teaching strategies. The definitions used for key terms like microcredential were inconsistent across articles.

KEYWORDS

microcredential, digital badge, microcertification, health professions, continuing professional development

1 Introduction

Microcredentials – including digital badges, micro-learning with certifications, and micro-certifications – are an emerging strategy for incentivizing and verifying knowledge and skill acquisition across various disciplines. Despite their growing popularity in medical education – and higher education more broadly – it is unclear how these strategies have been specifically utilized to support continuing professional development in the health professions (1–3).

Microcredentials are typically awarded after completion of short courses or training modules to indicate that an individual has demonstrated mastery of a specific skill or topic (1, 3, 4). The terms microcredential, digital badge, and microcertification may be used interchangeably to represent a learning experience that is significantly shorter than a traditional academic degree or license; for simplicity and consistency, the term microcredential will be used in this paper moving forward (3). Micro-learning is a microcredential learning structure involving smaller units of learning such as questions with explained solutions or brief modules for learning specific content (5).

Scholars from various disciplines have described the use of microcredentials, including education, welding, and engineering (6–8). Research touts microcredentials for personalized professional development that individuals can use to more accurately demonstrate skills and competencies to employers (3, 6, 7). Due to the personalized nature of microcredentials, there is often substantial variety between microcredentials. Microcredentials are also frequently used to reskill and upskill, including learning new concepts (9). Some disciplines are also implementing them as supplementary to traditional degree pathways, helping candidates differentiate themselves more effectively with potential employers (7, 10).

Challenges with microcredentials include inconsistent terminology, varied credential goals and outcomes, as well as low awareness of this approach to workforce development (3, 9, 10). Variation within different microcredentials and the importance of each individual certification of microcredentials also varies significantly (3).

Despite these challenges, there is a prominent view that microcredentials are beneficial, particularly in post-pandemic learning (3, 11). The literature on microcredentials in higher education increased notably after 2020, representing a rapid increase in interest post-pandemic (11). This may be because the pandemic led to many career shifts, with employees needing certifications to indicate their skills, and accessible learning for them (11). The short course nature of microcredentials made flexible and timely professional development feasible, especially when offered through virtual platforms.

As an emerging topic, there is still much to be learned about the use of microcredentials, especially for specific fields like health professionals. The purpose of this study was to review how microcredentials have been utilized to support the development of health professionals and more broadly understand how they might be integrated into continuing professional development (CPD). Ultimately, this work will provide an evidence-based foundation upon which CPD programs can build microcredentialing systems that address current and emerging challenges to knowledge and skill acquisition among healthcare providers.

2 Methods

Due to the current and rapidly evolving nature of microcredentials, a rapid review was utilized for this study. A rapid review involves the same rigorous methodology as a systematic review but is completed on a condensed timeline, an average of 3.2 months compared to typically a year or more for a systematic review (12). This methodology is beneficial for timely questions that require quicker answers.

2.1 Search terms and databases

To better understand microcredentials in the health professions, the following search terms were used:

> (micro-cred* OR microcredential* OR micro-cert* OR microcertification* OR "digital badge" OR "digital badges" OR micro-learning* OR microlearning) AND (health education OR health profession* OR healthcare OR medicine OR medical OR doctor OR physician OR pharmacy OR pharmacist OR nurse OR nursing OR dentistry OR dental OR dentist

The search terms and their variations helped ensure we were finding as many articles as possible related to microcredentials in healthcare CPD. The search was conducted in September 2024 using PubMed, EMBASE, and ERIC to allow for a breadth of possible articles related to microcredentials in healthcare CPD. ERIC, for example, is a database for all research and journal articles related education in any capacity, including medical education. The references for included articles were also reviewed by hand to source additional relevant articles that may have been published in unindexed journals.

2.2 Article evaluation and inclusion criteria

All search results were uploaded to Covidence and duplicates were removed. Title and abstract screening was conducted independently by two researchers (KWA and CO). Disagreements were settled through discussion until consensus was reached. The same two researchers conducted full text review. There was 94% agreement for the full text review and the two researchers met to discuss any disagreements until full consensus was reached.

Articles were included that:

1. Described a microcredential, digital badge, microcertification, or microlearning that provided credit designed for continuing education or professional development.
2. Included healthcare professionals as learners.
3. Were empirical studies, including qualitative, quantitative, and mixed-methods research that focused on outcomes or perspectives of one of the types of continuing education listed in inclusion criteria [1].
4. If the article discussed a specific microcredential, to be included in this review, it had to also include discussion after implementation, i.e., evaluations or reflections.
5. Were published in English.

Articles were excluded that:

1. Focused on health professions education (e.g., graduate, postgraduate, or undergraduate programs).
2. Did not focus on health professionals' learning.
3. Focused on traditional certifications, degrees, or other forms of credentialing not related to microcredentials, digital badges, microcertifications, or continuing education microlearning that provided credit.
4. Were opinion pieces, editorials, books, dissertation and theses, literature reviews, conference abstracts, and non-empirical articles.

A key focus for this review was on what is currently understood about the effectiveness and implementation of microcredentials in CPD. This meant that articles that focused only on the design or preparation of a specific CPD were not included.

2.3 Data extraction

A data extraction tool was developed and used in Excel. The codes in the tool were developed *a priori* and were guided by the codebook developed by Noyes and colleagues in their review of digital badges (13). The codebook used in this rapid review can be seen in the Supplementary material. Text-based data was copied and pasted into Excel from the articles for analysis.

Two researchers (KWA and JM) independently extracted data from 3 articles. Given high agreement between researchers (96% agreement), and following consensus building, the remaining data was extracted by one researcher (KWA). Deductive thematic analysis based on the *a priori* codes was used to find patterns in the coded data. Findings are represented with frequency and percentage.

3 Findings

From the search terms, 182 articles were found on PubMed, 245 on EMBASE, and 10 from ERIC. One article was identified through our references search by hand and included in the review. A total of 148 duplicates were removed, leaving 290 articles for evaluation. Of those found, 192 were deemed irrelevant during the title and abstract screening. After full text evaluation, 86 were excluded and one article was not able to be obtained, which left 11 articles for extraction (Table 1). The search strategy is summarized in the PRISMA diagram in Figure 1. Summary of the findings are listed in Table 2.

The health profession most commonly discussed in the articles was nursing ($n = 5$, 45%). Pharmacy and general medicine were each included in four (37%) articles while clinical research was included in three (27%). Three articles (27%) related to other health professions such as public health professionals, respiratory therapists, or personal care assistants. About a third of articles incorporated multiple professions ($n = 4$, 36%) while others focused on one profession ($n = 7$, 64%). All the articles included in the review were published within 10 years of the search, with eight of the 11 articles (73%) published after 2021.

Of the 11 articles, two (18%) focused on health care professionals' perceptions of microcredentials and their use in CPD. One article (9%) described patients' perceptions of a specific digital badge a provider had on their professional profile. Two of the 11 articles (18%) focused on clinical research basics for the microcredential or digital badge. Two of the 11 articles (18%) discussed unspecified content areas within pharmacy since their main focus was on perceptions of microcredentials. The rest ($n = 7$, 64%) instructed learners on unique, specific topics (e.g., bladder cancer management).

Of the 11 articles, eight (73%) were focused on learning outcomes from specific programs that provided participants with a microcredential, CPD credit, or digital badge. Those eight articles all involved asynchronous and online activities as part of the requirements to receive the microcredential, digital badge, or CPD credit. One of those eight articles, one also included an in-person activity that was needed for measuring skill performance (i.e., Laerdal ResusciAnne and ResusciBaby simulators) (14). Of those eight, four (36%) required competency demonstration through either assessments of knowledge or demonstration of skill; three (27%) were participatory in nature, awarding credit for completion of activities without demonstration of knowledge or skill mastery; and one (9%) was not clear whether credit was awarded by task completion or via a competency-based demonstration. The remaining three (27%) were focused on professional or patient perceptions of microcredentials.

Across these papers, the terms microcredential and digital badge were used to represent the same idea. Noyes and colleagues discussed how a microcredential represented the cumulative completion of a learning while a digital badge indicated progress toward the final completion of learning (13). However, in other articles, a digital badge indicated cumulative completion of a training, such as clinical research basics or LGBT+ safe zone training (15, 16). One article even referred to what the participants gained at the end of the training as a "digital badge microcredential" (17). The use of terminology for the credit received was inconsistent across articles.

In consideration of effectiveness of the microcredentials in this review, the outcomes were variably measured. Two articles focused on professional perceptions of microcredentials indicated a favorable outlook on their possibilities (1, 17). A study of patient perceptions indicated that patients were more likely to trust healthcare providers with the LGBTQ+ digital badge (16). Four studies measured participant perceptions of the knowledge gained from the microcredentials and all indicated increased confidence in their understanding of the designated content (17–20). One of those four also included assessment scores and there was a significant increase in scores throughout the program (18). One study only used assessment scores as indicators of understanding and did not have a statistically significant difference in the measures they used to indicate CPR mastery (14). One study looked at average scores on assessments at the end of each module as well as completion rates (21). The average score was 70% on the end of module assessments for that study (21). Two studies were evaluating the difficulty of their material. One through compliance with rubric standards and the other in relation to a difficulty index (15, 22). Indicators of microcredential effectiveness varied across the articles in this review.

TABLE 1 List of articles included in this rapid review.

Citation	Focused type of credential*	Focused Healthcare Discipline
Goodenough et al. (2020) (20)	Certificate for Professional Education Credits	Nurses, Personal Care Assistants
Bobbitt et al. (2023) (18)	CPD Credits for Microlearning	Nurses, Pharmacists, Physicians
Romero-Clara et al. (2024) (19)	Professional Credits for Microlearning	Nurses, Physicians, Researchers, Pharmacists
Rohan et al. (2017) (22)	Digital Badge	Nurses
DeMarco et al. (2024) (15)	Digital Badge	Clinical Research Coordinators
Chang et al. (2019) (14)	Digital Badge	Physicians, Respiratory Therapists, Nurses, Technicians involved with CPR
Perrault et al. (2024) (16)	Digital Badge	Physician
Lee-Chavarria et al. (2023) (17)	Digital Badge Microcredential	Clinical Research Professionals
Mashford-Pringle et al. (2023) (21)	Microcredential	Public Health Professionals
Lok et al. (2022) (1)	Microcredential	Pharmacists
Marra et al. (2022) (4)	Microcredential	Pharmacists

*Terms used in the respective article, found through data extraction.

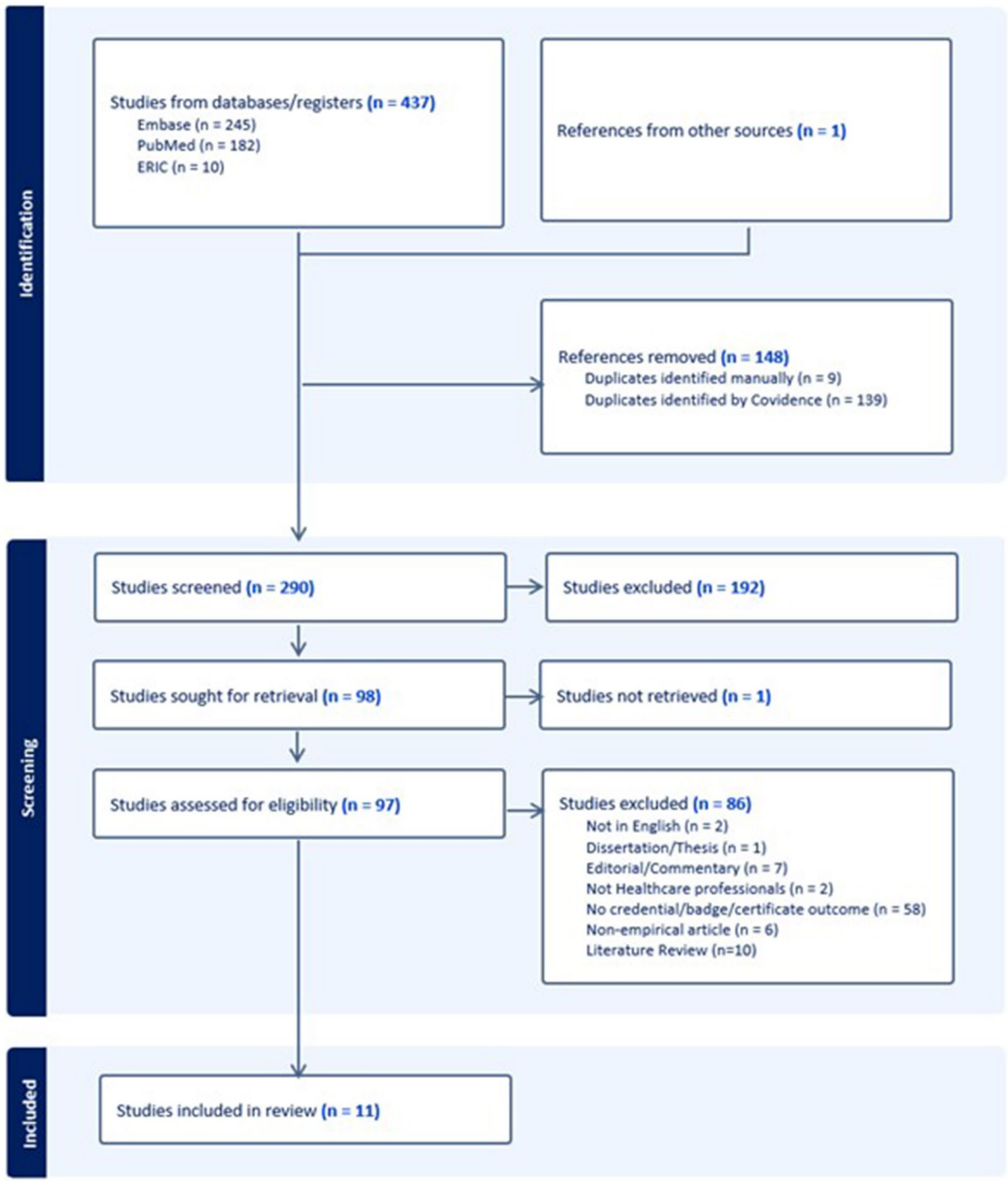

FIGURE 1
PRISMA diagram for literature review on microcredentials in health professions continuing education.

4 Discussion

Microcredentials are an emerging approach to learning in the health professions that warrant further consideration as an effective and efficient tool for workforce development. Of note, this review suggests that microcredentials are widely applicable across professions, useful for a wide-range of medical topics, and flexible enough to accommodate various learning modalities. This aligns with Tamouliune et al. who emphasized the flexible nature of microcredentials (11). Hunt et al. also emphasized personalization in CPD with microcredentials, allowing employees to properly prepare for the evolving needs of the workforce across professions (6). However, none of the articles made connection to the possibilities artificial intelligence could provide with microcredentials. There also is current inconsistency in the use of terminology for these professional developments across articles in this review.

TABLE 2 Summary of characteristics across articles.

Discipline	Number of articles	Percent
Nursing	5	45%
Medicine	4	36%
Pharmacy	4	36%
Clinical Research	3	27%
Other (e.g., respiratory therapist, public health, personal care)	3	27%

Year	Number of articles	Percent
2017	1	9%
2018	0	0%
2019	1	9%
2020	1	9%
2021	0	0%
2022	2	18%
2023	3	27%
2024	3	27%

Type of credential	Number of articles	Percent
Microcredential	4*	36%
Digital Badge	5*	23%
Microlearning for CPD Credit	2	18%
Certificate of Completion	1	9%

Focus of Credential/Badge	Number of articles	Percent
Clinical Research Basics	2	18%
General (focus on perceptions of pharmacy microcredentials)	2	18%
Antimicrobial Stewardship (AMS)	1	9%
Patient Navigation/Navigator Role	1	9%
Indigenous Cultural Safety	1	9%
Bladder Cancer Management (Urothelial Cancer)	1	9%
Working with Dementia Patients in the Evening	1	9%
CPR Performance	1	9%
LGBTQ+ Safe Zones	1	9%

Structure of the learning	Number of articles	Percent
Asynchronous	8	73%
Online activities	8	73%
In-person activities	1	9%
Not Applicable**	3	27%

Requirement to receive credential	Number of articles	Percent
Participatory	3	27%
Competency	4	36%
Unclear	1	9%
Neither	3	27%

*One article called the type of credential a "digital badge microcredential." **Not a training, but a study of perceptions of microcredentials.

The majority of the articles in this review involved professions with established licensing education standards (e.g., nursing), which suggests that microcredentials add value beyond traditional continuing education credits required for licensure. As such, researchers and educators should give consideration to the various ways in which microcredentials might be leveraged to support the development of

health professionals beyond traditional training mechanisms. In K-12 education, for example, teachers can earn microcredentials as an "alternative pathway for licensure renewal" [(6), p. 34]. For health professions with existing licensure qualifications, microcredentials may allow for licensed professionals to gain specialized knowledge in emerging areas or niche skills that may not be covered in traditional degree programs or continuing education (23). By earning microcredentials in specific areas, licensed professionals are also able to demonstrate their expertise and readiness for career progression, often in a more flexible and time-efficient option compared to traditional degree programs or continuing education (10, 24).

In professions without licensing requirements, such as clinical research, microcredentials enable the workforce to enhance their skills and signal their capabilities to employers, as demonstrated by the clinical research microcredentials in this review (7, 15). This provides a distinct advantage to webinars or in-person seminars, which do not always signal outwardly the competencies of the learner. By earning multiple microcredentials, health professionals in non-licensed roles can build a portfolio of skills that may lead to new career paths or specializations within health care. As microcredentials continue to gain traction, they also have the potential to serve as a form of industry-recognized qualification, potentially filling gaps where formal licensure does not exist (10, 25).

Similar to the variety of professions using microcredentials, the microcredential topics identified in this review were diverse, including working with dementia patients in the evenings and Indigenous cultural safety. This suggests that microcredentials are versatile and suitable for a diverse range of topics focused on showcasing a specific competency or demonstrating a continued commitment to education. They are also typically low stakes and affordable, allowing learners the opportunity to explore new skills in a manner that will not negatively affect their career or reputation (3, 11).

The papers reviewed in this study described the use of online and asynchronous microcredentials, demonstrating their flexibility in implementation. This flexibility is what makes the microcredentials so attractive to learners, who can then upskill or reskill in a manner that fits their lifestyle or career aspirations (3, 10, 26). For any topic that does not require in person attendance, online and asynchronous microcredentials are a possible method of demonstrating one's skills to employers (3). A hybrid approach, while not currently discussed in the literature, could be utilized for practical skills that require an in-person assessment. Practical skills, such as first aid or safety-related skills (in a chem lab for example), could be assessed in person while having an online asynchronous component.

Interestingly, the use of artificial intelligence (AI) did not come up in this review, even though it can be supportive of personalized health professional education (27). AI may enhance the effectiveness of microcredentials by tailoring content and learning pathways to individual learners' needs and preferences, potentially improving completion rates and skill acquisition. AI-powered assessment tools could streamline the evaluation process for microcredentials, allowing for more efficient and scalable credentialing programs (25, 27). AI algorithms even have the potential to analyze job market trends and individual learner profiles to recommend relevant microcredentials for the learner, ensuring aligning between workforce needs and skill development (25). However, this integration raises important considerations, including data privacy concerns regarding the collection and protection of learner information, potential for algorithmic bias in recommendations or assessments, and the need to maintain quality standards for the credential. Striking a balance between leveraging AI's benefits and addressing these challenges will be crucial for the effective implementation of AI in microcredentials (25, 28).

The language used to describe the microcredentials in this review was inconsistent, a finding consistent with reviews of microcredentials beyond health professions (3). The lack of consistency in terminology puts the validity of microcredentials at risk. With clearly defined characteristics and a framework, the distinction between microcredentials and digital badges can be more easily understood by employers as well as learners. Without a clear understanding, microcredentials could fade out like an educational fad rather than having long lasting impact that could enhance CPD for many professions. The lack of consistent measures of effectiveness also makes it difficult to understand the overall value of the various microcredentials. To address this issue, collaboration is needed to develop a consistent taxonomy and definitions for various types of microcredentials (29). Microcredential providers should clearly articulate the specific competencies, assessment methods, and value of their offerings, while efforts to align microcredential terminology with established qualification frameworks could improve understanding and recognition across organizations and employers (10). Microcredentials could end up going the way massive open online courses (MOOCs) have, where they were initially lauded as the next educational wave but have largely fallen out of favor in part due largely to the lack of understanding between higher education and industry (10, 30). If industry and higher education can reach agreement about terminology and generate market demand, microcredentials would likely experience continued success and growth. For now, microcredentials aspire to demonstrate a person's commitment to learning and professional development, however more work is need to optimize the emerging approach to workforce development.

5 Limitations

Due to the rapid nature of this review, it is possible that literature was missed in the searches. New literature could have also been published on the topic of microcredentials since the database searches were conducted. This review was also limited to articles published in English which could have limited the research found from non-English-speaking countries. This review focused on peer-reviewed studies of microcredentials; however microcredential hosting platforms, such as Credly and Accredible, could further inform understanding of types of microcredentials being offered to health care professionals. Further, academic credit from microcredentials was not considered in this review, due to the exclusion criteria, but would also be another avenue of focus for future understanding of microcredentials.

6 Conclusion

Microcredentials provide promising opportunities for versatile continuing professional development in health professions. Many are

optimistic about the possibilities for reskilling and upskilling in a variety of topics across multiple professions. However, the need for consistent terminology and consistent views of their market value are prominent challenges in the effective implementation of microcredentials on a broader scale.

Author contributions

KW-A: Conceptualization, Data curation, Formal analysis, Investigation, Project administration, Visualization, Writing – original draft, Writing — review & editing. KM: Conceptualization, Writing – review & editing. CO: Formal analysis, Writing – review & editing. HC: Conceptualization, Writing – review & editing. JM: Conceptualization, Methodology, Project administration, Supervision, Writing – original draft, Writing – review & editing.

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

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The authors declare that no Gen AI was used in the creation of this manuscript.

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Supplementary material

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The application of integrating medical humanities education into emergency skill-training scenario simulation teaching

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Objective: To explore the value of integrating medical humanities education into emergency skill training scenario simulation teaching.

Method: 69 first-year professional master's students studying at Fujian Medical University(China) were selected as research subjects. They were randomly divided into control (n = 39) and observation (n = 40) groups. All students received emergency skills training. The control group adopted the scenario simulation teaching method, while the observation group integrated medical humanities education based on the control group. Assessment scores and satisfaction with the teaching mode were compared between the two groups.

Results: The observation group outperformed the control group in practical, theoretical, and comprehensive grades, and were more satisfied with the teaching mode, with both differences being statistically significant ($p < 0.05$).

Conclusion: Incorporating medical humanities education into emergency training simulations can enhance teaching quality, boost students' ethical literacy, and improve teaching satisfaction, making it worthy of widespread application.

KEYWORDS

emergency skill-training, scenario simulation teaching, medical humanities education, communication skills training, curriculum integration, experiential learning

1 Introduction

Medical education is a continuous and lifelong process, and postgraduate medical education is an important part of this process (1). With the rapid development of degrees and postgraduate education in China, the training mode of medical postgraduates has undergone tremendous changes after the combination of medical professional degree postgraduate training and resident standardized training (2). However, when postgraduates start clinical practice, their courses are still based on traditional teaching content, and the clinical courses set up by the resident training base are still in the exploratory stage and are still mainly based on spoon-feeding teaching methods. Frequent tests and high-intensity content in traditional teaching courses lead to high stress, increased anxiety, and reduced enthusiasm for learning. Spoonfeeds residents emphasizes the coverage of knowledge and ignores students' understanding and application, which may affect students' clinical decision-making ability and empathy cultivation. Although traditional teaching methods are important, they lack interaction and practical application and cannot meet the needs of modern medical education.

This has become a major problem that restricts the improvement of the clinical ability of postgraduates after they are incorporated into residents' standardized training. With the progress and development of medical education and the continuous increase in China's aging population, the quality requirements for doctors are constantly improving (3). Therefore, the standards for the training of clinical medical professional degree postgraduates have expanded, covering professional ethics, basic medical knowledge, clinical thinking, clinical skills, doctor-patient communication ability, and other contents. However, in the actual training mode, students' dominant position in teaching is often ignored, and their clinical thinking, professional characteristics, and practical ability are not highlighted, especially in the cultivation of humanistic qualities, which are relatively weak. In the humanistic education of medical postgraduates, training hospitals face many problems and practical difficulties. It cannot meet the requirements of professional and personalized training for professional postgraduates. Around the world, medical schools are incorporating humanities into their curricula to address the need to train compassionate doctors by developing personal attributes such as integrity and respect (4).

Medical humanities education is an educational system aimed at cultivating medical students' humanistic literacy, ethical concepts, and empathy abilities. Its core lies in integrating humanities and social sciences with the medical profession to cope with the trend of modern medical technology and dehumanization, and to cultivate medical talents who possess both professional skills and humanistic care.

Emergency medicine is a professional discipline with strong practicality and involves multi-disciplinary knowledge. In clinical diagnosis and treatment, it mainly involves the treatment of all kinds of acute and critical diseases and has high requirements for professional operation skills and thinking modes. Therefore, strengthening the training of students' first-aid skills is of great significance. Scenario simulation teaching mainly refers to the use of various technical methods to simulate the situation of common clinical cases, taking students as the center, and teaching through practical multiple activities. Compared with the traditional teaching mode, the application of scenario simulation teaching helps to mobilize students' initiative and enthusiasm, combine students' knowledge with practice, and then help them fully grasp the first-aid process and methods (5, 6). In addition, in the actual teaching stage, we also need to pay attention to medical humanities education, which not only helps students master medical humanities-related knowledge at the theoretical level but also improves their humanistic quality in the process of practice. Traditional "spoon-feeding" methods and siloed clinical courses fail to prepare learners for the complexities of emergency medicine, where technical expertise must coexist with empathy, ethics, and adaptability. Integrating medical humanities into scenario simulation teaching bridges this gap, fostering clinicians who are not only skilled but also compassionate and reflective. This paradigm shift aligns with global trends in healthcare education, which increasingly prioritize holistic competence over rote knowledge. At present, medical humanities education is widely valued and has achieved remarkable results. Based on this, this study analyzes the application value of medical humanities education in scenario simulation teaching of emergency skills training.

Abbreviations: DOPS, Direct Observation of Procedural Skills; Mini-CEX, Mini-Clinical Evaluation Exercise.

2 Materials and methods

2.1 General material

96 first-year professional medical postgraduates from Fujian Medical University (China) were selected as research subjects, and 16 non-clinical postgraduates (including medical images, dermatology and venereology, and stomatology) were excluded. They were randomly divided into control and observation groups, with 40 postgraduates in each group. Due to illness, one control group postgraduate was unable to complete the training. 79 postgraduates were included in this study (Figure 1): 39 postgraduates in the control group and 40 postgraduates in the observation group. The number of male and female patients in the control group was 22 and 17, with an average age of (23.52 ± 0.61) years old ranging from 20 to 23 years old; There were 25 males and 15 females in the observation group, with an average age of (23.41 ± 0.77) years old ranging from 20 to 23 years old. There were no significant differences between the two groups in the baseline data of the students ($p > 0.05$), such as category ($p = 0.926$), major ($p = 0.843$), sex ($p = 0.581$), and admission score ($p = 0.500$), which can be used for comparative analysis (Table 1). There was no significant difference between the two groups in terms of student category, major, gender, and admission score ($p > 0.05$), which means that the baseline data of the two groups were consistent and had no difference. The research protocol was approved by the Medical Ethics Committee of Fujian Provincial Geriatric Hospital in China (No. 20240401). Before conducting the study, we obtained written informed consent from all participants. Participants were assured that their participation in the study would not affect their current or future studies. There was no potential harm to participants.

2.2 Methods

Both groups received first aid skills training. The control group adopted the scene simulation teaching method (Two groups of students have the same course taught by the same teacher, and the training will be conducted from March to August 2024, with each class lasting 90 min.): first, the teacher imparted theoretical knowledge, and according to the requirements of the syllabus, taught the operation process of cardiopulmonary resuscitation, trauma treatment, poisoning rescue, and other first-aid skills by using PPT, video, etc. At the same time, the students were divided into groups with corresponding scenes. Design corresponding scenarios that emphasize the need for scenarios to be close to real emergency situations (emergency situations before the hospital and doctor-patient conflicts in the emergency room, etc.), while incorporating ethical dilemmas (such as prioritizing treatment decisions when resources are limited). Set different roles, including medical staff, patients, family members, social workers, etc., and require students to handle composite tasks such as doctor-patient communication and team collaboration in the simulation. And design progressive tasks, such as synchronously calming the emotions of family members during cardiopulmonary resuscitation. Therefore, teachers should focus on guidance. After the scenario simulation (About 25 min), teachers should comment on the deficiencies, help students recognize the problems in time, strengthen their understanding of relevant theoretical knowledge, and improve their practical operation ability.

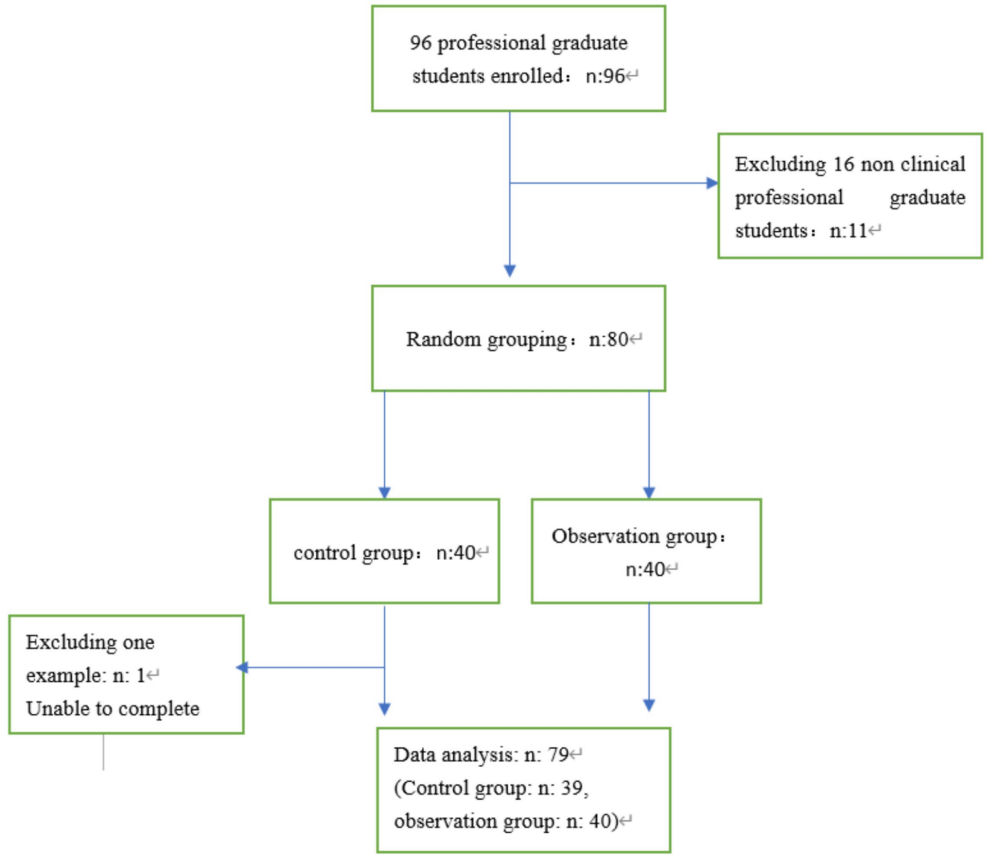

FIGURE 1
Study flow chat.

TABLE 1 Comparison of baseline data between control group and observation group.

Items	Categories	Group(%)		Total	χ^2	*p*
		Control group	Observation group			
Category	Full-time professional master's degree*	23(58.974)	24(60.000)	47(59.494)	0.009	0.926
	Full-time professional master's degree (5 + 3)**	16(41.026)	16(40.000)	32(40.506)		
Major	Clinical medicine	16(41.026)	16(40.000)	32(40.506)	4.155	0.843
	Pediatrics	1(2.564)	0(0.000)	1(1.266)		
	General practice	1(2.564)	2(5.000)	3(3.797)		
	Internal medicine	5(12.821)	7(17.500)	12(15.190)		
	Surgery	11(28.205)	13(32.500)	24(30.380)		
	Obstetrics and gynecology	1(2.564)	0(0.000)	1(1.266)		
	Emergency medicine	2(5.128)	1(2.500)	3(3.797)		
	Ophthalmology	1(2.564)	0(0.000)	1(1.266)		
	Neurology	1(2.564)	1(2.500)	2(2.532)		
Gender	Female	17(43.590)	15(37.500)	32(40.506)	0.304	0.581
	Male	22(56.410)	25(62.500)	47(59.494)		
Admission score	Excellent	10(25.641)	6(15.000)	16(20.253)	1.386	0.500
	Fair	5(12.821)	6(15.000)	11(13.924)		
	Good	24(61.538)	28(70.000)	52(65.823)		

*Full-time professional master's degree: Completed 5 years of undergraduate studies and participated in and passed the national graduate entrance examination after graduation. **Full-time professional master's degree (5 + 3): From enrollment to graduation, it is a bachelor's and master's degree program without passing the examination of national unified master's degree.

Observation group: Medical humanities education was integrated based on the control group and the main contents were as follows:

(1) Hospital internship. Strengthening students' awareness of the reverence of life. Emergency department may be the workplace in the future, and emergency department internships are also a key part of medical education. In clinical practice teaching, we should not only pay attention to the teaching of skills, but also to the transmission of humanistic ideas. It is difficult for students to have direct access to the first-aid scene when studying at school, so they do not have a deep understanding of life and death. The situation of emergency patients is complex, and each life may be in danger of death under different circumstances. Teachers should avoid arranging a certain situation in advance and should strengthen the education of students in combination with the situation of the emergency department and the medical humanities theory of professional graduate students in emergency learning. For example, when a traffic accident occurs, students should be taught first-aid skills on-site, and humanistic education should be strengthened to enhance their awareness of the reverence of life. During the study, students were allowed to have close contact with the scene, improve their cognition of life and death, and strengthen their awareness of reverence in life.

(2) Simulate a scene of unsuccessful rescue so that students can treat death objectively. For example, if a patient with sudden heart disease was sent to the emergency department, the doctor failed to save the patient's life after first aid and needed to go out of the loss by gaining an understanding of the family members through communication. Through this kind of scenario simulation, students can realize the limitations of medicine, cultivate their communication abilities, and improve their humanistic quality (7).

(3) Simulate emergency safety events and cultivate students' communication and decision-making abilities Natural disasters, large traffic accidents, and public health emergencies are all emergency medical tasks. During scenario simulation teaching, some scenes can be simulated from films and television plays, such as large-scale traffic accidents, in which each student can be guided to participate without designed-in-advance lines and processes. One group pretended to be medical staff, and one group pretended to be patients and family members. The second is to exchange roles to complete teaching. In the process of scenario simulation, students can use humanistic theory reasonably when communicating and making decisions, and there may be problems such as not being calm or hesitant to deal with the tasks. During the teaching process, teachers guide students to summarize on their own and encourage them to critically reflect on technical performance and humanistic dimensions. Divided into the following stages.

I Simulation practice stage: High fidelity simulation scenarios (such as cardiopulmonary resuscitation, team handling of poisoning cases), pause at key nodes, insert 1–2 min of "micro reflection" (e.g., checking team division of labor).

II Instant reporting stage (time allocation: single simulation and reflection ratio: 1:1 to 1:2, for example: 20 min of simulation+15–30 min of reflection): Reflection was anchored in the PEARLS framework (Promoting Excellence and Reflective Learning in Simulation), which systematically guides learners through three phases:

1) Description: Form: Students verbally summarized their actions during the simulation, What clinical steps did I prioritize during the trauma recovery.
2) Analysis: Instructors posed targeted questions to dissect decision-making, such as: "How did the patient's emotional state (e.g., anxiety, cultural background) influence your communication strategy?"

"What ethical dilemmas arose when balancing procedural efficiency with pain management?"

3) Application: Learners articulated actionable insights for future practice (e.g., "Next time, I will allocate more time to family counseling before initiating invasive procedures").

III Written reflection stage: Students upload electronic reflection summaries on the Chaoxing learning platform, and teachers provide structured annotations and feedback.

(4) Give full play to the guiding role of teachers. Teachers have a direct impact on their teaching quality. To mobilize students' subjective initiative, teachers should give full play to their guiding roles. Therefore, the humanistic education of scene simulation first-aid skills training should select teachers with strong professional ability, rich experience, and high humanistic quality to improve teaching quality, strengthen the cultivation of students' humanistic quality, and make students truly feel humanistic care.

(5) Integrating narrative medicine into teaching. The emergency department is not only an important carrier of emergency medicine, but also an important place in the hospital. It displays stories of death, pain, aging, joy, and gratitude after a successful rescue every day. With the development of humanistic medicine and diversification of patients' needs and values, the use of narrative medicine can enable emergency medical staff to fully understand and respect patients. Different patients had different characteristics. Instead of using the conventional single mode, patients should receive personalized medical care. Through the integration of narrative medicine in teaching, students can fully consider the personal and family factors of patients and give them an appropriate and intimate diagnosis and treatment, so that patients can feel care, warmth, and dignity.

2.3 Teaching assessment

In this study, the improvement of teaching quality is evidenced by advancements in learners' empathy, moral reasoning, communication

efficacy, and clinical processing skills, alongside improvements in students' academic performance and their satisfaction with the educational experience.

2.3.1 Process assessment

After the first aid skills training and teaching, the performance of postgraduates in the experimental and control groups in the process of skill operation was scored by formative evaluation. The scoring work is completed by a team of clinical physicians with intermediate or higher professional titles, and each evaluation includes at least 2 independent evaluators (such as attending physicians or associate chief physicians). To ensure standardized scoring, all evaluators must receive unified training before the evaluation: (1)Standardized training: Familiarize oneself with the scoring rules of Mini CEX and DOPS through simulated assessments, with a focus on strengthening the consistency of subjective dimensions such as humanistic care and communication skills in scoring; (2) Calibration assessment: Use standard cases for simulated scoring, verify inter rater consistency through intra group correlation coefficient (ICC), and require ICC $\geq$ 0.8 to participate in formal evaluation; (3) Regular refresher training: Update the interpretation of scoring criteria every quarter to reduce scoring bias caused by differences in clinical experience.

The mini CEX developed by the American Board of Internal Medicine (ABIM) and the DOPS designed by the Royal College of Physicians (RCP) were used to evaluate the clinical skills of residents. The Min CEX was evaluated from seven aspects, including the ability of medical history inquiry, physical examination, humanistic care, clinical judgment, communication skills, organizational effectiveness, and overall performance; Through the 3-level 9-point system, the overall evaluation of students' ability to care for patients, medical knowledge application, learning and improvement in clinical work, interpersonal and communication skills, professionalism, and professional ability (8, 9). DOPS was assessed in 11 aspects: understanding the indications and contraindications of this skill operation, informing patients in detail and obtaining consent before operation, preparation work before performing clinical operation skills, good aseptic concept, standardized and correct operation procedures, accurate and skilled operation techniques, appropriate assistance seeking, relevant disposal after performing clinical operation skills, communication skills, whether taking into account patients' feelings and professional quality, and the performance of clinical operation skills. The clinical skill performance and humanistic care professional quality of students were evaluated using a 3-level 9-point system. The Mini-CEX and DOPS scores are 1–3 points for unqualified, 4–6 points for qualified, and 7–9 points for excellent (10).

2.3.2 Performance assessment after training

After the study, the two groups of postgraduate students were evaluated for their knowledge of several common critical illness rescue skills in the emergency room (cardiopulmonary resuscitation, hemostasis bandage, poisoning gastric lavage, fracture fixation, spinal trauma transport, airway opening support, etc.), mainly including theoretical achievement, full score of 50, practical operation achievement, and full score of 50. The comprehensive score equals the theoretical achievement plus practical operation achievement, with a full score of 100.

2.3.3 Satisfaction survey

After the training, the two groups were surveyed using anonymous and independent questionnaires. Comparing the satisfaction of the two groups with the teaching mode, the main evaluation contents include the following aspects: whether it helps to improve the operation skills, whether it helps to improve the learning interest, whether it helps to improve the communication ability, whether it helps to improve the understanding of the disease development process and whether it helps to improve the problem-solving ability. These can be divided into satisfaction and dissatisfaction. Satisfaction = number of satisfied cases/total number of cases×100%. Among them, 69 questionnaires were distributed to the control and observation groups, and 69 were recovered, with a recovery rate of 100%.

2.4 Statistics

The data obtained from the study were processed and analyzed by spss22.0, using $X \pm s$ to represent the measurement data, and using t-test, % to represent the count data, and x^2 for inspection. $p < 0.05$, indicating that there was a statistically significant difference between the groups.

3 Results

3.1 The min-CEX scores of the two groups after the first aid skills training and teaching

Table 2 shows that the abilities of the control group and the observation group for medical history inquiry, physical examination and other abilities are significant ($p < 0.05$), which means that there are significant differences among different grouped samples, and the score of the observation group is higher.

TABLE 2 Comparison of min CEX scores between two groups.

	Groups (Mean ± Std. deviation)		t	p
	Control group (n = 39)	Observation group (n = 40)		
Medical-history inquiry	5.385 ± 1.067	6.875 ± 0.822	−6.966	0.000***
Physical examination	4.692 ± 0.977	6.475 ± 0.847	−8.67	0.000***
Humanistic care,	4.256 ± 0.850	6.400 ± 0.928	−10.699	0.000***
Clinical judgment,	4.769 ± 0.902	6.400 ± 0.955	−7.797	0.000***
Communication skills	4.641 ± 0.811	6.750 ± 0.776	−11.812	0.000***
Organizational effectiveness	4.667 ± 0.898	6.775 ± 0.832	−10.828	0.000***
Overall performance	4.692 ± 0.863	7.000 ± 0.751	−12.687	0.000***

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

TABLE 3 Comparison of DOPS scores between two groups.

	Groups (Mean ± Std. deviation)		t	p
	Control group (n = 39)	Observation group (n = 40)		
Understanding of the indications and contraindications of this skill operation	4.692 ± 0.893	6.750 ± 0.927	−10.045	$p < 0.05$
Detail informing and obtaining consent before operation.	4.641 ± 0.873	6.875 ± 0.911	−11.122	$p < 0.05$
Preparation work before performing clinical operation skills	4.769 ± 0.706	6.750 ± 0.809	−11.588	$p < 0.05$
Good aseptic concept	4.718 ± 0.944	6.775 ± 0.862	−10.116	$p < 0.05$
Standardized and correct operation procedures	4.846 ± 0.961	6.700 ± 0.992	−8.433	$p < 0.05$
Accurate and skilled operation techniques	4.615 ± 0.990	6.775 ± 0.832	−10.51	$p < 0.05$
Seeking assistance appropriately	4.821 ± 0.854	6.650 ± 0.864	−9.462	$p < 0.05$
Relevant disposal after performance	4.410 ± 0.850	6.600 ± 0.810	−11.725	$p < 0.05$
Communication skills	4.359 ± 0.873	6.750 ± 0.742	−13.123	$p < 0.05$
Concept of injury caring	4.256 ± 1.069	6.850 ± 0.893	−11.714	$p < 0.05$
Overall performance	4.821 ± 0.970	7.050 ± 0.846	−10.897	$p < 0.05$

3.2 Comparison of DOPS scores between the two groups after first aid skills training and teaching

Table 3 shows that the DOPS scores of the two groups are significantly different ($p < 0.05$), and the score of the observation group is higher.

3.3 Comparison of examination results of two groups

The observation group had significantly higher practical operation, theoretical, and comprehensive scores than the control group ($p < 0.05$; Table 4).

3.4 Comparison of satisfaction levels between two groups

The satisfaction of the observation group with the teaching mode was significantly higher than that of the control group ($p < 0.05$; Table 5).

4 Discussion

Medical humanities is an interdisciplinary field that includes anthropology, sociology, Ethics, psychology, literature, art, and history, as they integrate medical practice (11). Its theoretical framework includes four dimensions: instrumentality (enhancing clinical skills such as communication and empathy), internalization (balancing science and human education), criticality (reflecting on power relations in medical practice), and epistemology (exploring the cultural and social construction of medical knowledge). For example, narrative medicine cultivates empathy by listening to patients' stories, while medical ethics courses strengthen professional ethics (12, 13).

Emergency medicine is a major component of clinical practice. As a specialized discipline, it requires the use of minimal data and the shortest time to save lives and alleviate pain. It has characteristics such as criticality and randomness and involves a wide range of professional knowledge and operational skills (5, 14). Students will be healthcare workers in the future. Medical humanities education determines the comprehensive quality. Only with the spirit of humanistic care can they value the safety of patients' lives. When cultivating emergency medical personnel, it is necessary to consider humanities as a key skill, strengthen their professional ethics, and strengthen their emergency care. Research has shown that both hospital and school teaching require active promotion of medical humanities education, with a focus on cultivating students' humanistic qualities (4, 15, 16).

Medical practice should include humanistic care, so medical technology and medical humanities are closely related, and the two promote and complement each other. Although medical technology is developing rapidly, humanistic care in the medical profession is becoming increasingly weak. There is a clear lack of humanistic care in medical development and practice, as well as a lack of cultivation of humanistic spiritual literacy in medical education. For a qualified doctor, it is not only necessary to have a solid theoretical knowledge system and master professional operational skills but also to have noble humanistic literacy (17–19). The integration of empathy and compassion into medical curricula is critical to address the growing concern of dehumanization in clinical practice, particularly in high-stakes emergency settings. Studies reveal significant gaps in current training: only 3.1% of medical students demonstrate familiarity with narrative medicine, a cornerstone of empathy development, and 63.1% lack interest in further learning despite recognizing its clinical value (20). Furthermore, longitudinal research highlights empathy erosion during traditional clinical training, especially in programs with delayed patient interaction, whereas curricula emphasizing early patient engagement and reflective practices show stabilized or improved empathy levels (21). Compared to other medical activities, emergency medicine places higher demands on the humanistic literacy of medical personnel.

Richard Shin, Kent Li, et al. found through multi center emergency resident physician simulation training (such as cardiovascular

TABLE 4 Comparison of assessment scores between two groups ($x \pm s$, points).

Group	Numbers	Theoretical scores	Operation scores	Comprehensive scores
Control group	39	38.18 ± 2.97	37.92 ± 2.08	76.10 ± 4.38
Obsercation group	40	43.68 ± 2.48	42.03 ± 2.34	83.90 ± 3.75
t		−6.368	−8.230	−8.508
p		<0.05	<0.05	<0.05

TABLE 5 Comparison of teaching mode satisfaction between two groups [n (%)].

	Groups (Mean ± Std. deviation)		x^2	p
	Control group(n = 39)	Observation group(n = 40)		
Whether it helps to improve the operation skills	29(74.36)	37(92.50)	4.727	$p < 0.05$
Whether it helps to improve the learning interest	25(64.10)	35(87.50)	5.918	$p < 0.05$
Whether it helps to improve the communication ability	25(64.10)	36(90.00)	7.528	$p < 0.05$
Whether it helps to improve the understanding of the disease development process	26(66.67)	35(87.50)	4.872	$p < 0.05$
Whether it helps to improve the problem-solving ability.	27(69.23)	36(90.00)	5.274	$p < 0.05$

emergency team collaboration) that participants' teamwork and communication skills significantly improved, which is consistent with the goal of "doctor-patient communication in emergency settings" in this study, but it focuses more on technical skills rather than internalization of humanistic theories (22). Javier González-Blázquez et al. emphasized the impact of bioethical education on medical decision-making, pointing out that problem-based learning (PBL) (23) can enhance students' ethical reflection ability, but its research scenarios are mostly traditional classrooms and have not been combined with high fidelity simulation environments. This study combines high fidelity scenario simulation with ethical practice to demonstrate the unique promoting effect of scenario simulation on ethical practice ability. This study combines the current characteristics of emergency medical education and introduces scenario simulation teaching, narrative medicine, and medical humanities education into the process of emergency skills training. The research showed that the observation group's practical skills operation score (42.03 ± 2.34), theoretical score (43.68 ± 2.48), and comprehensive score (83.90 ± 3.75) were significantly higher than those of the control group (37.92 ± 2.08, 38.18 ± 2.97, 76.10 ± 4.38, respectively; $p < 0.05$). The patient situation in the emergency department has the characteristics of rapid disease development, hidden conditions, and multi-disciplinary knowledge. In the traditional teaching mode, when students acquire emergency rescue knowledge, they may have only partial understanding and theoretical difficulties. This study introduces scenario simulation teaching and medical humanities education, which are more conducive to students' understanding and mastery of the causes and pathogenesis of diseases. For example, in patients with acute myocardial infarction, the symptoms may only be "chest tightness" when they come to the emergency room, but during the treatment process, malignant arrhythmias can occur at any time, leading to sudden cardiac and respiratory arrest. Special simulations of successful and unsuccessful rescue scenarios and intuitive learning of such patients in the emergency room can raise questions and respect for life about why patients suddenly experience cardiac and respiratory arrest during the treatment process. Be more proactive in asking questions and searching for relevant literature after class to understand the causes and processes of diseases and understand why effective cardiopulmonary resuscitation can improve the success rate of patient rescue. This will make the mastery of theoretical knowledge more detailed and solid, and pay more attention to details and standardization in the process of skilled operation.

In this study, the Min CEX scores of the observation group showed that abilities in medical history inquiry (6.875 ± 0.822, $p < 0.05$), physical examination (6.475 ± 0.847, $p < 0.05$), humanistic care (6.400 ± 0.928, $p < 0.05$), clinical judgment (6.400 ± 0.955, $p < 0.05$), communication skills (6.750 ± 0.776, $p < 0.05$), organizational efficiency (6.775 ± 0.832, $p < 0.05$), and overall performance (7.000 ± 0.751, $p < 0.05$) were all higher than those of the control group (5.385 ± 1.067, 4.692 ± 0.977, 4.256 ± 0.850, 4.769 ± 0.902, 4.641 ± 0.811, 4.667 ± 0.898, 4.692 ± 0.863, respectively). In the DOSP scores, the observation group had a clear understanding of the indications and contraindications for this skill operation (6.750 ± 0.927, $p < 0.05$), informed patients and obtained consent before the operation (6.875 ± 0.911, $p < 0.05$), familiarized themselves with the operation preparation (6.750 ± 0.809, $p < 0.05$), good aseptic concept (6.775 ± 0.862, $p < 0.05$), standardized and correct operation procedures (6.700 ± 0.992, $p < 0.05$), and accurate operation techniques proficiency (6.775 ± 0.832, $p < 0.05$), seeking assistance appropriately (6.650 ± 0.864, $p < 0.05$), post-operative processing (6.600 ± 0.810, $p < 0.05$), communication skills (6.750 ± 0.742, $p < 0.05$), concept of injury caring (6.850 ± 0.893, $p < 0.05$), overall performance (7.050 ± 0.846, $p < 0.05$), and other aspects were all higher than the control group (4.692 ± 0.893, 4.641 ± 0.873, 4.769 ± 0.706, 4.718 ± 0.944, 4.846 ± 0.961, 4.615 ± 0.990, 4.821 ± 0.854, 4.410 ± 0.850, 4.359 ± 0.873, 4.256 ± 1.069, 4.821 ± 0.970, respectively). In the process of practical skill learning, through role exchange and the integration of narrative medicine in teaching, students can better understand the anxiety of patients and their families in an empathetic way. During the operation process, they paid more attention to some details and humanistic care during the first aid process. They can fully consider the personal and family factors of patients, provide them with appropriate and considerate diagnosis and treatment services, and enable them to feel care, warmth, and dignity. Owing to the mastery of theoretical knowledge and understanding of disease development, it is beneficial for students to master better communication skills, resulting

in significant improvements in practical operations, theoretical scores, and comprehensive scores. This indicates that the integration of medical humanities education into emergency skills training scenario simulation teaching has a definite effect, which helps improve teaching quality and students' comprehensive abilities. However, at the same time, in this study, the observation group students showed a significant improvement in various aspects of learning. However, except for the overall performance score, which is in the range of 7–9, which is considered excellent, the other aspects of the content are still in the range of 4–6, which is considered qualified. Further improvement is needed in the future of teaching research to strengthen interaction and adaptation with students.

Medical humanities education is not an accessory to skills, but a value coordinate system that shapes clinical decision-making. In emergency simulation teaching, humanistic literacy is achieved through contextualized embedding rather than skill based segmentation, such as synchronously training 'technical accuracy' and 'patient dignity maintenance' in trauma assessment. In scenario simulation teaching, the teaching methods of scenario simulation are optimized by integrating medical humanities education. Medical humanities education was integrated in terms of scenario design, creation, and performance. By using methods such as unsuccessful rescue scenario simulation and sudden safety incidents' simulation, students' enthusiasm is mobilized, and their humanistic literacy is further improved. The particularity of medical care determines the essence of humanistic care, and the object of medical services is the human being. It is not only necessary to pay attention to diseases but also to the individual patient, understand their needs, and fully reflect the humanitarian and humanistic care of medical care. In the process of emergency skills training, humanistic education should be actively integrated, and continuous innovation should be achieved to endow humanistic education with new connotations to cultivate high-quality professional talent and meet the talent needs of clinical emergency rescue. Medical humanities education plays an important role in improving the professional competencies of medical personnel. Integrating medical humanities education into teaching can help to cultivate students' comprehensive qualities. This study conducted a follow-up survey on the satisfaction of two groups of students in the teaching mode after teaching, and found that the observation group had several aspects, including whether it helped improve operational skills ($p < 0.05$), whether it helped to increase learning interest ($p < 0.05$), whether it helped to improve communication skills ($p < 0.05$), whether it helped to improve understanding of the disease development process ($p < 0.05$), and whether it helped to improve problem-solving ability ($p < 0.05$). Satisfaction with the teaching mode was significantly higher than that of the control group. Integrating humanistic education into simulation teaching of emergency skills training scenarios has a definite effect and can improve student satisfaction.

5 Insufficient

There still remains shortcomings in this study has some limitations. (1) Although non-medical clinical majors (such as imaging and dentistry) were excluded from the 69 first-year clinical postgraduate students who participated in this teaching research, their own mastery of emergency medical knowledge, emergency skills, and medical humanities knowledge was also different, which affected the evaluation of the two teaching modes to some extent. (2) This study only involved a few emergency operations, such as cardiopulmonary resuscitation, trauma management, and poisoning rescue. The content still needs to be enriched, and further research should be conducted to increase the teaching and medical humanities content of other emergency skill operations. (3) The interaction between teachers and students still needs to be strengthened, and the exchange of roles between teachers and students can be arranged. Students can collect information and share their medical humanities knowledge about the first-aid process, thereby enhancing their understanding of the essence of humanistic care in the medical process. (4) Potential confounding factors such as lack of unified mentor training in the early stage, asynchronous student training times, and data acquisition methods may affect the results. Unified mentor training or optimized research design for future research to improve comparability of results.

6 Conclusion

In summary, the integration of medical humanities education into emergency skills training scenario simulation teaching has extremely high application value, which helps improve teaching quality and is worthy of promotion and application.

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

HG: Data curation, Formal analysis, Writing – original draft. HL: Writing – original draft. YY: Data curation, Formal analysis, Writing – original draft. YL: Writing – original draft, Writing – review & editing. YH: Writing – review & editing.

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Conflict of interest

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

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Integrating eHealth data analytics into Continuing Professional Development for medical practitioners: an ecosystemic perspective

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This perspective explores the evolving landscape of Continuing Professional Development (CPD) for medical practitioners, focusing on the use of eHealth data analytics to strengthen CPD programs and practices. Traditional didactic approaches to CPD have demonstrated limitations, prompting a shift toward outcome-focused and workplace-based CPD activities. This trend aligns with medical regulations that emphasize integrating clinical performance and patient health data into professional learning for practice change and improved care. Leveraging eHealth data analytics for self-assessment, improved clinical performance, and effective CPD is emerging as an opportunity. Both academia and industry are actively working to link clinical performance data, continuous learning, and CPD to promote safer, higher-quality care. eHealth data analytics enables personalized CPD by addressing specific performance gaps and clinical needs, enhancing learning impact and health outcomes. However, current research highlights challenges such as data accessibility, availability, and quality, technological interoperability, and resistance to change—both organizationally and at the individual level. These obstacles underscore the need for a holistic approach, innovative thinking, and evidence-based solutions in the ever-changing fields of medical regulation and continuing education. Further research is essential to substantiate the value of eHealth data for CPD, build a comprehensive depiction of the CPD ecosystem, and guide successful implementation and cultural shifts. Building a data-driven CPD ecosystem requires interdisciplinary collaboration and a commitment to real-world solutions. Future efforts must focus on both theoretical and applied exploration to fully realize the value of eHealth data analytics, enabling personalized, impactful CPD in a fast-moving healthcare environment.

KEYWORDS

Çontinuing Professional Development (CPD), eHealth data analytics, medical practitioners, ecosystemic perspective, CPD ecosystem

Introduction

Over the past two decades, there has been a slow yet steady shift toward strengthening Continuing Professional Development (CPD) for medical practitioners (1–5).

It has been widely acknowledged that conventional didactic and educational CPD activities (also called CME, Continuing Medical Education) have limited effectiveness in enhancing clinical practice and improving patient outcomes (6–8). Moreover, during this time, a consensus has emerged among health professionals' educators on the value of CPD activities

that promote the use of external assessment and feedback for self-reflection on practice and behavior change (9–12).

As part of this ongoing shift, some current debates in the field focus on the evolving role of CPD and its integration into broader healthcare systems and medical education principles and practices. A key aspect of these discussions highlights the need to anchor CPD within real-world professional environments, emphasizing the importance of workplace and practice settings in facilitating meaningful learning and the acquisition of professional competencies (13–15). Another major focus is the application of the Competency-Based Medical Education (CBME) paradigm (16, 17) and Entrustable Professional Activities (EPAs) frameworks (18) to CPD, aiming to enhance patient care and outcomes while building continuity of assessment and continuous improvement from undergraduate and postgraduate medical education into CPD (19–21).

In response to these developments, more emphasis is currently being given to CPD activities related to daily practice (22), aligned with professional standards (21) and workplace assessment (23, 24), and based on health outcomes measurement (25, 26) and quality improvement (19, 27).

Both academia and industry are presently engaged in research to strengthen the linkage between clinical performance data, medical practitioners' learning and CPD, and practice change (28–38). Concurrently, a number of medical regulatory bodies have recently launched CPD policies aimed at strengthening CPD through:

i) the development of CPD programs more aligned to practitioners' scope of practice and clearly interrelated to quality care and patient safety (39–43); and
ii) a focus on workplace based CPD activities that require the use of clinical performance data and patient health data analytics, such as Audit and Feedback (A&F) interventions, Quality Improvement (QI) projects, and Mortality and Morbidity Meetings (MMM) (44–47).

To achieve these goals, it is also crucial to recognize the fundamental role and needs of both patients and medical practitioners, ensuring that their perspectives and lived experiences will shape the evolution of CPD with the ultimate aim of effectively supporting the delivery of safer and higher-quality care.

In this context, the use of eHealth data analytics to support self-reflection on clinical practice, promote performance improvement, and strengthen CPD represents an opportunity that should not be underestimated. eHealth data analytics could enhance workplace learning by identifying specific areas for improvement and fostering a culture of continuous professional development within practice settings. Moreover, it would support the effective implementation of CBME and EPAs in CPD by providing real-time outcome data and enabling personalized feedback, ensuring that CPD activities remain relevant and aligned with the competencies required in contemporary healthcare.

In light of the lack of a universally accepted definition and to maintain a comprehensive scope, this perspective uses the term "eHealth data" to encompass any personal information in digital or electronic format that relates to an individual's health status, risks, or outcomes, as well as data associated with the delivery of healthcare services and interventions (48–51). Given this, "eHealth data" broadly includes various types of health-related digital records, such as Electronic Medical Records (EMRs), Electronic Health Records (EHRs), registries, routinely collected administrative data, claim and billing data, electronic prescriptions, Patient-Generated Health Data (PGHD), Patient-Reported Outcome Measures (PROMs), and Patient-Reported Experience Measures (PREMs).

A key challenge for this emerging field is that it operates in a pre-existing complex environment–the "CPD landscape" or "CPD ecosystem." According to international medical educators, the CPD ecosystem is made of several stakeholders, i.e., medical practitioners, patients, health professions education academics and researchers, medical regulators and policy-makers, CPD providers and educators, healthcare service organizations and health care systems' leaders (52). Also, there is agreement on the collective responsibility and action of all stakeholders to strengthen CPD for improved practice and safer care (53).

Despite this, there is little research on how these stakeholders operate and interact within the whole CPD ecosystem (54). In particular, there is no previous research on digital health innovation and implementation within the CPD ecosystem.

In order to address this gap, this perspective examines the roles and interrelationships of key stakeholders in the CPD ecosystem, specifically exploring how their functions and contributions can foster the integration of eHealth data analytics to strengthen CPD. The goal is to propose a more holistic, interconnected approach to CPD research, governance, and practice.

eHealth data analytics and CPD: an ecosystemic perspective

The insights presented in this perspective are drawn from the integrated findings of a multi-study project titled "Using eHealth data to strengthen Continuing Professional Development (CPD) for medical practitioners: an exploration of regulatory and organizational factors influencing eHealth data analytics implementations within the CPD ecosystem" (55), which examined the roles of three key stakeholders in the CPD ecosystem: the scholarly and research community, medical regulators, and CPD providers (illustrated in the green circles in Figure 1). This project consisted of three interrelated studies (56–58), contributing to the exploration of six distinct areas of investigation across targeted jurisdictional settings (Figure 2). These areas of focus provide a structured framework for analyzing how each stakeholder contributes to promoting the integration of eHealth data analytics into CPD.

While the primary focus of this project was on three central stakeholders, the research also offers valuable insights into the roles of additional stakeholders within the broader CPD ecosystem. These include healthcare organizations, patients, and other actors whose involvement plays a crucial role in the successful implementation and adoption of eHealth data analytics in CPD.

Scholarly and research community: value and opportunity vs. uncertainty

Most CPD stakeholders acknowledge the value of and the opportunity in using eHealth data analytics for CPD. This recognition aligns with scholarly research, which presents recommendations for linking clinical performance data (including eHealth data) and workplace-based assessment with continuous

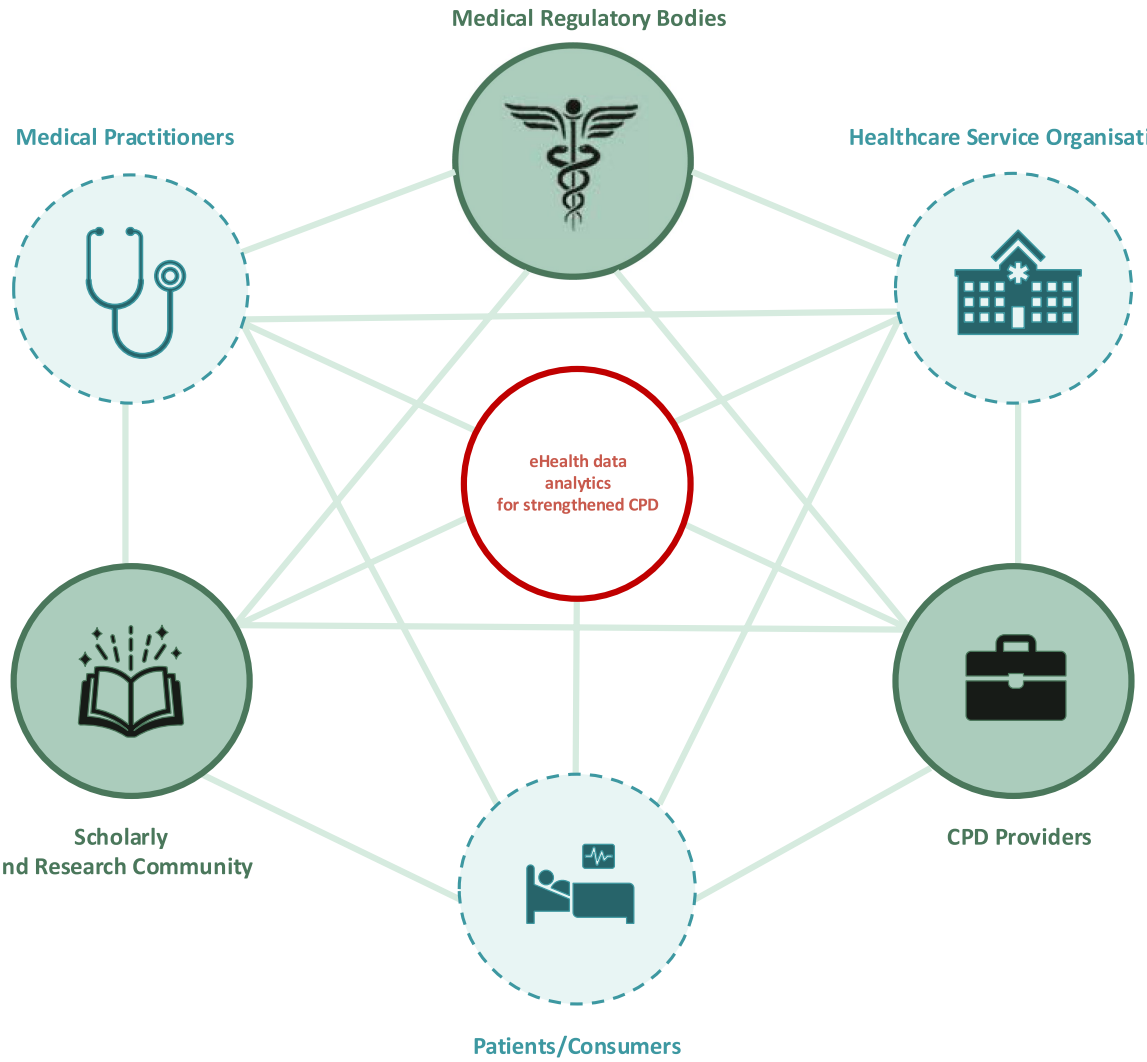

FIGURE 1
CPD ecosystem.

learning, CPD, and practice change (21, 23, 28, 59, 60). Moreover, a body of literature exists on the exploration of current ecosystemic and cultural factors that might influence data-driven CPD practices (30–32, 37, 61, 62) and on potential implementation of eHealth data analytics technologies to strengthen CPD (35, 36, 63).

However, it is worth noting that these research outputs are largely speculative or in their infancy. In addition, latest research findings in this space emphasize how practical implementation of eHealth data analytics use for CPD poses significant challenges (7, 56), describing this "theory-to-practice challenge as a potential conceptual misstep" (33) (p. 20). These developments would suggest that the concepts of "value" and "opportunity" in using eHealth data analytics for CPD are mainly grounded in theoretical principles rather than being substantiated by robust applied research (33).

This existing gap between theory and practice holds significant implications. First, the scarcity of practical evidence introduces uncertainty regarding the effectiveness of the use of eHealth data analytics for CPD, and could potentially lead to a conservative approach with regards to regulatory support, industry adoption, and medical practitioners' acceptance. Second, policymakers and industry CPD stakeholders may exercise caution in promoting the use of eHealth data analytics for CPD and investing in its implementation due to the absence of evidence supporting its benefits for practice improvement and better patient outcomes.

These implications underscore the pressing need to bridge the divide between theory and practice in eHealth data analytics for CPD, as it is crucial to enable informed decision-making and to ensure strategic investments that harness the full potential of this field.

On top of this reflection, it has to be noted that, in addition to the gap between theory and practice, significant uncertainty remains regarding both the theoretical foundations and practical applications of eHealth data analytics for CPD.

Findings from Pizzuti et al. (56, 64) detail a lack of agreement on both underlying conceptualizations and real-world operationalization of eHealth data analytics principles and technologies for strengthened CPD. Interestingly, the industry sector—including medical regulators and CPD providers— appears to have an active interest in the use of

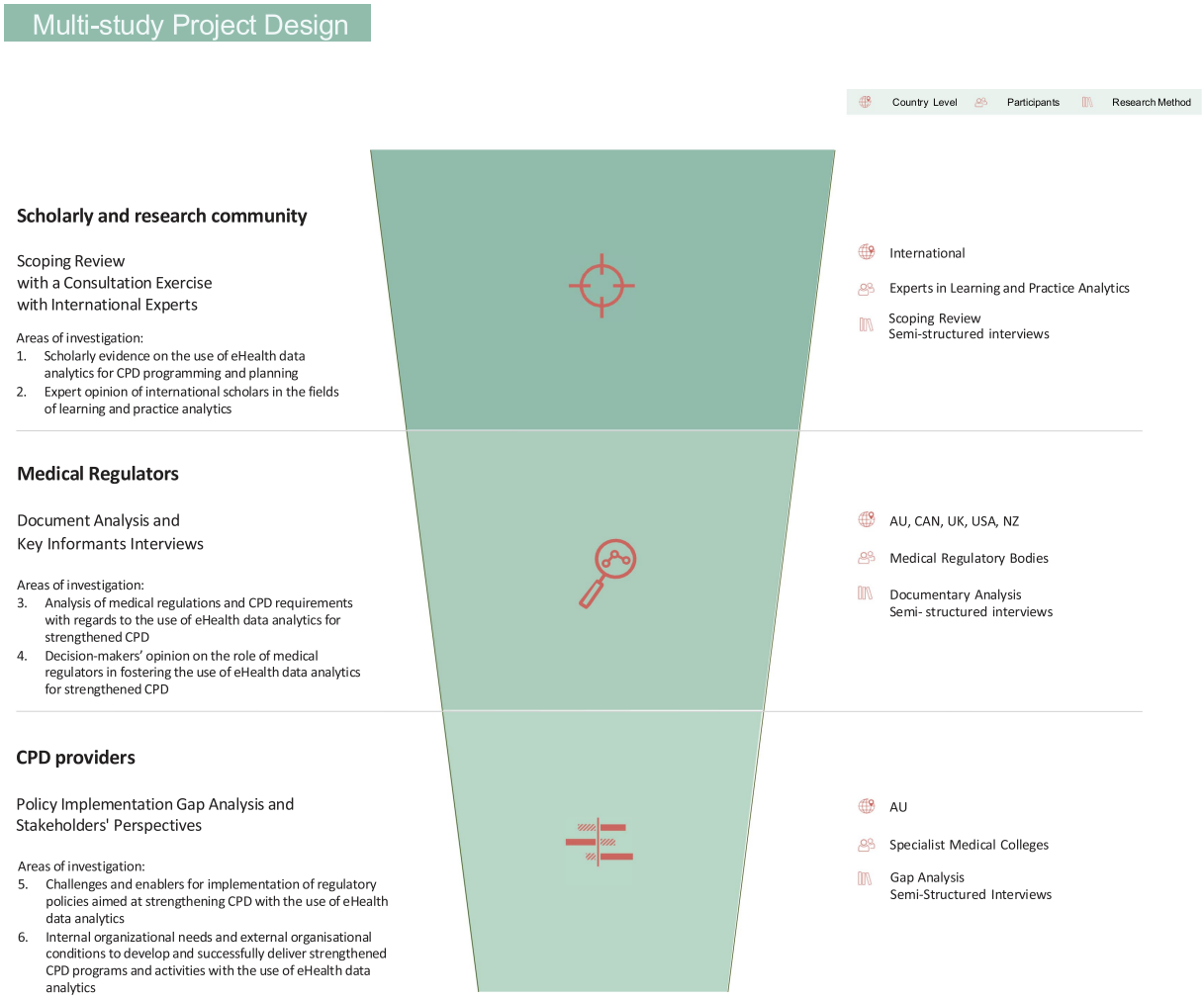

FIGURE 2
Design of the multi-study project titled "Using eHealth data to strengthen Continuing Professional Development (CPD) for medical practitioners: an exploration of regulatory and organizational factors influencing eHealth data analytics implementations within the CPD ecosystem".

eHealth data analytics for CPD, even though accompanied by concerns around conceptual and theoretical underpinnings, as well as meaningful, feasible, and effective application.

A critical point of uncertainty is the conceptual ambiguity surrounding the term "performance data." This ambiguity appears to hinder effective communication among stakeholders and is delaying the successful implementation of eHealth data analytics for CPD in real-world scenarios.

According to Tavares et al. (33), the umbrella term "performance data" is used to encompass both feedback and patient health data, though questions remain about whether this term is the correct conceptual linchpin for using workplace-based assessment for learning and CPD. Furthermore, findings from Pizzuti et al. (57) show that this conceptual uncertainty is also present in current regulatory policies and CPD requirements for medical practitioners. Regulators view "performance data" as not only encompassing eHealth data analytics' outcomes, but also results from colleagues' and patients' questionnaire derived from Multi-Source Feedback (MSF) tools, as well as assessments from peers or non-physician observers during practice visits.

This lack of distinction between *patient health data-based CPD activities* and *feedback-based CPD activities* creates potential for miscommunication among CPD stakeholders, especially between scholars and researchers, and industry professionals in specialized domains like digital health, data science, and eHealth data management.

The focus in these specialized fields has predominantly been on leveraging patient eHealth data and digital technologies to enhance clinical practice and healthcare (64, 65), not on the use of MSF tools, the analysis of colleagues' and patients' questionnaire results, or the documentation resulting from practice visits. As a result, the lack of distinction between these types of data can cause misalignment in research aims, outcomes, and expectations for the future use of eHealth data analytics technologies in CPD.

Further support for these findings comes from Pizzuti et al. (58), where CPD providers report that the lack of differentiation between *feedback-based* and *patient health data-based* CPD activities presents a significant barrier to the full implementation of regulatory policies aimed at strengthening CPD with the use of eHealth data analytics.

In light of these issues, it is clear that more research is needed to resolve the ambiguity surrounding the term "performance data" and to propose a more precise conceptual framework. Collaboration between scholars, regulatory bodies, and CPD providers is essential to create common ground, share knowledge, and develop effective

definitions that will support the implementation of eHealth data analytics in the CPD ecosystem.

Medical regulatory bodies: current policy content, regulators' potential role, and future regulatory policy development

According to Pizzuti et al. (57), the *content* of current CPD requirements revolves around two main concepts:

i) The broad conceptualization of the term "data" as any piece of information pertaining to medical practitioners' practice and/or performance–thus including patients' and colleagues' feedback, and not only patient health data.
ii) The acknowledgement of eHealth data as a *potential* data source for CPD completion and compliance.

These aspects stem directly from the institutional *role* of medical regulators in the CPD ecosystem (66–69) and their *current stance* on eHealth data use (57):

i) Regulatory bodies offer overarching guidance concerning CPD requirements.
ii) While acknowledging the potential of eHealth data analytics to strengthen CPD, regulators perceive its exclusive use for performance assessment purposes as limiting, supporting a more diversified data approach.

Given this perspective, the current discretionary use eHealth data for CPD will likely persist unless regulators reassess their own role and responsibilities within the CPD ecosystem—particularly concerning CPD requirements. A more proactive stance on the use of eHealth data analytics for CPD, alongside policy development and implementation, is necessary for its effective integration.

In light of this, medical regulators are called to assume a leadership role in the CPD ecosystem to address the barriers to adopting eHealth data analytics for CPD (57). Key responsibilities include advocating for eHealth data usage, collaborating with stakeholders such as governments, healthcare sectors, and organizations responsible for eHealth data management, and establishing partnerships with data experts and research groups to integrate eHealth data into medical regulatory processes.

When it comes to policy development, universally applicable recommendations for medical regulators is challenging due to the need for further research on key policy concepts, as well as gaps in understanding of organizational culture, vision, legislative environments, and jurisdictional variances (57).

Despite these challenges, the following recommendations can guide policy decision-making for medical regulatory bodies:

i) Develop and incorporate a precise definition for critical terms such as "data" in regulatory policies and related supporting documents.
ii) Clearly articulate policy intentions concerning regulators' expectations for eHealth data utilization and analysis, as well as their plans for future policy development and implementation within the CPD ecosystem.

The first recommendation carries specific weight due to the current ambiguity surrounding the term "performance data," as discussed above. The second recommendation is crucial for creating clear regulatory policies and transparent communication of intent, which can open opportunities for regulators to:

i) Contribute to the ongoing discourse on strategies centered on performance-based assessment and data-driven CPD (25).
ii) Promote digital health innovation within CPD practices.
iii) Clarify the formative use of eHealth data analytics and its educational benefits so to address concerns among medical practitioners regarding potential punitive actions in the case of poor performance outcomes.
iv) Encourage other key CPD stakeholders to engage in the current discussion, consider their own roles in advancing the use of eHealth data analytics for CPD, and assume responsibilities for supporting its implementation.

Healthcare service organizations: data issues and business and legal priorities

All CPD stakeholders investigated in the multi-study project describe the existence of various data and/or data system issues within the CPD ecosystem, identifying them as the primary challenges inhibiting the adoption of eHealth data analytics for CPD (56, 57, 64). These findings confirm existing research documenting the less-than-optimal state of data quality and infrastructure in the health system (70–77) and align with recent scholarly insights by Tavares et al., who emphasizes "data infrastructure" as a pivotal but unresolved issue for leveraging eHealth data analytics in CPD (33). Specifically, Tavares et al. characterize "data infrastructure" as a "leap" in the field – an "underlying assumption that may be necessary for successful integration but may not yet be resolved" (33) (p. 13).

The integrated findings from the multi-study project also suggest that research participants consider "data issues" as pertaining to healthcare service organizations. Further investigation into this crucial CPD stakeholder is currently necessary. Future research in this area will not only deepen existing insights but also help formulate practical solutions to address the challenges surrounding data infrastructure.

In addition to these data challenges, a reflection on the findings of Pizzuti et al. (56) would suggest that the business and legal imperatives that govern the healthcare system and its operating framework are having a hindering effect on the implementation of eHealth data analytics in the CPD ecosystem. These imperatives, coupled with the absence of political and motivational drivers for using eHealth data analytics for CPD, reflect a limited focus on education and professional development at the healthcare service level.

In this context, establishing robust partnerships between healthcare service organizations and other CPD stakeholders—particularly CPD providers—proves challenging.

Further investigation is necessary to validate these considerations. Also, active involvement and contributions from healthcare service organizations are crucial to deepen these insights and to avoid inter-organizational silos in the CPD ecosystem.

CPD providers: current challenges and future action

Currently, several internal organizational characteristics and a number of ecosystemic factors are hindering CPD providers' efforts in implementing the use of eHealth data analytics for CPD (64).

At the organizational level, one significant issue is the allocation of internal resources to CPD offices. Despite advancements in educational technologies (78–80) and evidence on CPD cost-effectiveness (81, 82), many CPD providers still face resource constraints in managing and delivering CPD programs effectively. Furthermore, engagement with members and communication about CPD activities remain areas in need of improvement. The effectiveness of CPD programs in improving care quality and patient safety is another concern, with limited evaluation processes currently in place (22, 83). Additionally, accountability measures for CPD compliance are often insufficient, with international trends (84) showing an increasing focus on mandatory requirements such as appraisals (85) and annual conversations (40). Governance and approval processes, particularly in organizations that are predominantly self-regulated (i.e., specialist medical colleges and professional associations), also contribute to the complexities faced by CPD providers (64).

On the ecosystemic level, external factors such as data fragmentation, availability, and accessibility in the healthcare system (74) pose significant challenges. Among other issues, the lack of standardization of existing performance assessment and measuring outcomes tools and activities at healthcare service level (86, 87) and the immature feedback and reflective practices in medical education and practice (88, 89) hinder the effective implementation of eHealth data analytics for CPD.

Given the clear identification of the key challenges, urgent action and focused research are now essential to overcome these barriers and ensure the successful integration of eHealth data analytics into CPD practices.

Medical practitioners' attitudes and the cultural impact of medical self-regulation

The attitudes of medical practitioners toward CPD and the use of eHealth data analytics for CPD have been identified as significant challenges across the studies conducted in the multi-study project (56, 57, 64). This aligns with existing literature, which similarly highlights difficulties in engaging medical practitioners with CPD (90–92)—with many viewing it merely as a "tick-box" exercise (58, 93). Additionally, exploratory research reports the prevalent distrust among medical practitioners regarding eHealth data analytics, and their apprehensions about potential punitive uses of such data (31, 33, 37, 56, 58, 61).

Recent advancements in Health Professions Education (HPE) underscore the critical role of *trustworthiness* in the field of eHealth data analytics for CPD - considering it as another "theory-to practice leap" (33). Despite this, the issue of trust remains unresolved, with limited evidence or recommendations on how to address it effectively.

This gap represents a problem as medical practitioners have expressed interest in accessing routinely collected clinical data for education and professional development (37). This interest stems from the potential of data analytics results, which may enable clinicians to compare their performance with peers, encourage team reflective discussions, and support practice change (61).

In examining these challenges, two key factors emerge as central to the successful adoption of eHealth data analytics for CPD by medical practitioners. First, the current lack of robust evaluation processes to assess the impact of CPD activities on medical practice and quality of care (64) directly correlates with the negative attitudes that medical practitioners hold toward CPD. Without comprehensive assessment mechanisms, practitioners may remain skeptical about the value and impact of CPD activities. Second, the presence of multiple data issues at the healthcare service level contribute to medical practitioners' distrust of eHealth data analytics. Addressing these limitations is crucial to fostering more positive attitudes toward data-driven CPD among medical practitioners.

Furthermore, there is a causal relationship between the cultural aspect of self-regulation, which characterizes the medical profession, and the implementation of eHealth practice analytics for strengthened CPD (57, 64). The professional culture within medicine has historically upheld self-regulation as a cornerstone (94), which in turn shapes how CPD is approached and influences the adoption of innovative methods, such as the use of eHealth data analytics.

Within this cultural framework, self-regulation not only aligns with but also significantly influences the scarcity of established accountability measures related to CPD compliance, particularly with regard to completing patient health data-based CPD activities (57). Moreover, self-regulation can reinforce the discretionary use of eHealth data analytics among medical practitioners due to their autonomy and professional independence. The absence of stringent guidelines or mandated requirements for utilizing eHealth data analytics in CPD (57) fosters an environment where practitioners have the choice to determine the extent and manner in which they engage with eHealth data and eHealth data analytics technologies.

A deeper investigation into the cultural aspects of the medical profession is essential to understanding how these factors influence the uptake of eHealth data analytics in CPD. Such research would provide critical insights into how cultural norms shape the integration of new technologies and practices in continuing medical education and professional development.

Patients: a missing perspective

The integrated findings of the multi-study project (55–58) reveal a lack of recognition regarding patients' importance, contribution, or role in the conceptualization and implementation of eHealth data analytics for strengthened CPD.

Some research evidence is available on patients' insight on and involvement in medical practitioners' CPD (95, 96), and on patients' perspectives on the use of eHealth data for self-reflective practices (34). However, an extensive body of literature on these matters is currently lacking, indicating the need for more research in this space.

eHealth data system vendors: key stakeholders in the CPD ecosystem

Insights gleaned from international experts in learning and practice analytics highlight the prevalence of proprietary approaches in data analytics technology (56). This underscores the pivotal role of eHealth data system vendors within the CPD ecosystem, and the necessity of positioning them as key stakeholders in CPD.

Recent research, exemplified by Pusic et al. (28), further supports this notion by advocating for the enhancement of existing health information systems to actively foster learning. The electronic health record, often underestimated as an educational tool, holds significant potential to elevate education and evidence-based healthcare.

Acknowledging this potential, vendors' role, influence, and potential contributions to strengthened CPD through the use of eHealth data analytics should be thoroughly examined, and integrated into future decision-making and collaborative efforts aimed at advancing the use of eHealth data analytics for CPD.

Conclusion

The integration of eHealth data analytics into CPD is widely regarded as a valuable opportunity to enhance medical practitioners' professional development and to foster CPD activities linked to clinical practice. Despite its potential, implementing eHealth data in CPD presents several challenges, particularly due to the multifaceted nature of the issue, the involvement of diverse stakeholders, and uncertainties in practical application.

As highlighted throughout this perspective, the complex nature of this subject requires a holistic approach, innovative thinking, and collaboration across stakeholders, with a steadfast commitment to evidence-based and real-world solutions. Importantly, it will be critical to acknowledge and integrate the perspectives and contributions of patients, medical practitioners, and healthcare teams to ensure that the evolution of CPD through the use of eHealth data analytics remains relevant and effective.

The pursuit of leveraging eHealth data for strengthened CPD remains a work in progress, but one that is essential in the evolving landscape of medical regulation and continuing education for medical practitioners. Further research, both theoretical and applied, is necessary to substantiate the value of using eHealth data for CPD purposes, refine our understanding of the CPD ecosystem, and provide guidance for successful implementation and a meaningful cultural shift in CPD practices.

Looking ahead, the future success of eHealth data analytics in CPD will depend on the ability to promote communication, collaboration, and engagement among all stakeholders within the CPD ecosystem.

Data availability statement

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

Ethics statement

The studies involving humans were approved by University of Sydney Human Research Ethics Committee (Protocol Number 2020/722). 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

CP: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Visualization, Writing – original draft, Writing – review & editing.

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Conflict of interest

The author declares 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 author(s) declare that no Gen AI was used in the creation of this manuscript.

Publisher's note

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Professionalism in nursing in Ethiopia: systematic review and meta-analysis

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Background: In any field, professionalism is essential. A profession can fulfill its responsibilities when professionals develop their knowledge in various ways, such as continuing professional development, expanding their skill levels, adhering to the norms of the profession, and demonstrating high levels of commitment. Developing professionalism in nurses is a key strategy for improving the quality of nursing care and healthcare. However, no study has shown a comprehensive overview of professionalism in nursing in Ethiopia. Thus, this systematic review and meta-analysis aim to present a comprehensive assessment of the overall level of professionalism in nursing in Ethiopia.

Methods: The Preferred Reporting Items for Systematic Review and Meta-Analysis standard was followed in the reporting of this systematic review and meta-analysis. An extensive exploration of digital repositories, including PubMed (MEDLINE), EMBASE, Cochrane, Africa Journal of Online, Google Scholar, and an advanced Google search, was conducted to obtain published studies detailing professionalism in nursing in Ethiopia. STATA version 17 commands created the pooled estimate with a 95% confidence interval. The I^2 test and Egger's test were used to identify the presence of heterogeneity and publication bias, respectively. To manage heterogeneity, a subgroup analysis and random effect model were used.

Results: A total of 11 articles with a total of 3,581 participants were included in the final systematic review and meta-analysis. The pooled estimate of professionalism in nursing in Ethiopia was 54% (95% CI: 44, 66%). In the subgroup analysis, the highest pooled estimate of professionalism in nursing was observed in South Ethiopia, which is 64% (95% CI: 43–86%).

Conclusion: The level of professionalism in nursing in Ethiopia is suboptimal. Being female, having a higher educational level, having long years of experience, having a low workload, having favorable job satisfaction, being a member of a nursing organization, having a good working environment, working in non-stressful units, and having a good organizational culture were the major factors that had a positive association with professionalism in nursing. Therefore, healthcare professionals, the Ministry of Health, and other stakeholders should focus on interventions to enhance the organizational culture, job satisfaction, working unit, and working schedule for nurses.

KEYWORDS

nursing, nurses, Ethiopia, caring behavior, factors, professionalism in nursing

Introduction

The term 'professionalism' is broad and has various meanings. It can be characterized as possessing the necessary information and abilities to carry out tasks and roles effectively, communicate clearly, and act morally in all circumstances (1). According to other definitions, it is the collection of mindsets and ways of acting considered suitable for a specific line of work (2, 3). The American Nurses Association (ANA) lists six characteristics of nursing professionalism. These include giving care, establishing a relationship, combining expertise and objective data, using the body of knowledge to diagnose and treat human reactions, expanding nursing knowledge via research, and impacting policy (4). A profession can fulfill its obligations when its members demonstrate a high degree of dedication, grow their skill set, and use diverse methods to enhance their knowledge (3).

In nursing, professionalism is a fundamental and crucial idea that benefits both communities and patient care. Consequently, in the past few decades, nursing professionalism has gained international attention (2, 3). Despite this, the nature and emotional demands make it difficult for nurses to be true professionals. More intriguingly, the changing healthcare system, increasing societal, financial, and professional demands on the next generation of nurses, along with inadequate institutional responsiveness in both service and education, contribute to the growing concern about nursing professionalism (5). In order to become actual professionals, nurses should exhibit their profession to the public and relevant bodies through practicing (6).

In the current century, healthcare systems focus on providing quality healthcare service, satisfying customers, achieving optimal patient outcomes, improving societal perceptions, achieving health-related indicators, fostering effective collaborative practice among teams, and ensuring job satisfaction among the healthcare workforce (6). To achieve these health indicators and maintain quality healthcare service, professionalism in nursing is highly required, and it is critical to make a detailed assessment of both the entirety of the profession and the individual behaviors that comprise professionalism (7).

Providing basic professional nursing care has been reported to result in improved patient satisfaction and positive health outcomes (8). A high level of professionalism in nursing is associated with outcomes of improved nursing performance, enhanced critical thinking, the ability to reflect on practice, and increased empowerment. In addition, nurses with a higher level of professionalism have been reported to have increased job satisfaction (9). On the contrary, a lack of professionalism minimizes public expectations, as the public assumes the profession should prioritize their interests. As a result, acceptance of the profession becomes low, and its reputation suffers. This can also lead to a loss of standards and self-regulation, contributing to high turnover, burnout, fatigue, and reduced productivity (8, 10).

As a profession, nursing faces challenges such as lack of autonomy and leadership skills, healthcare risks, lack of leadership, long working hours, lack of recognition from the public, burnout, fatigue, high intention to leave the profession, and emotional load (3). Such challenges are a major obstacle to the growth and development of the profession (11). The new generation is choosing professions that are valued by society and by professionals themselves (12). Currently, nursing has become less attractive, with fewer individuals choosing the profession due to stressful working conditions, disrespect from the public, low salaries, and lack of prestige (6). Because of this, now is the right time to explore professionalism and implement corrective actions to expand and maintain the profession at the national level. Thus, this systematic review and meta-analysis were carried out to assess the pooled estimate of professionalism in nursing in Ethiopia.

Abbreviations: JBI, Joanna Briggs Institute; PRISMA, Preferred Reporting Items for Systematic Review and Meta-Analysis; PICO, Population Intervention Comparison Outcome; ICU, Intensive care unit.

Aim of the study

Overall, the aim of this systematic review and meta-analysis is to provide a comprehensive understanding of the current state of nursing professionalism in the country, identify areas for improvement, and offer insights into informed policymaking, education, and practice within the nursing profession.

Methods

Study design and setting

A systematic review and meta-analysis of published articles in Ethiopia were conducted to estimate the level of professionalism in nursing among nurses in Ethiopia. Ethiopia is one of the developing countries in the eastern part of Africa. It has 13 regions and two city administrations. The regions are Tigray, Afar, Amhara, Oromo, Ethiosomali, Benishangul-Gumuz, Central Ethiopia, Sidama, South West Ethiopia, South Ethiopia, Gambela, and Hareri. The two city administrations are Addis Ababa and Dire Dawa (13).

Eligibility criteria

Inclusion criteria

In this systematic review and meta-analysis, all published articles in Ethiopia were included. All studies that reported on the level of professionalism in nursing or the caring behavior of nurses were included. All types of studies published in English and conducted in all specialties of the nursing profession and those published from 10 January 2004 until 10 January 2024 were included.

Exclusion criteria

Studies that failed to report professionalism in nursing were excluded from this review. Additionally, studies such as case reports, case studies, editorial letters, and reports were excluded from the study.

Data source and search strategy

Before going through the extensive search, a systematic review and meta-analysis protocol on professionalism in nursing and caring behavior at PROSPERO was checked. After that, all published articles that reported the level of professionalism in nursing or the caring behavior of nurses in all regions of Ethiopia were used as data sources. The review was conducted using the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidelines (14). The

search strategy was developed using the Population Intervention Comparison and Outcome (PICO) search guide. An intensive search of online databases such as PubMed (MEDLINE), EMBASE, Cochrane, Africa Journal of Online, Google Scholar, and an advanced Google search was carried out. During a systematic search in the PubMed engine, the MeSH words "professionalism" OR "caring behavior" AND nursing OR "nurses" AND "factors" were used. All articles in the reference lists were searched to include additional studies and reports in the review and analysis. A systematic search of the literature was carried out from 1 January 2024 to 10 January 2024.

Measure of outcome

Professionalism in nursing refers to the actions, conduct, and mannerisms exhibited by professional nurses that convey concern for patients, ensure safety, provide attention, and uphold the integrity of the profession.

Quality assessment and critical appraisal

In this systematic review and meta-analysis, the included studies were cross-sectional studies. Therefore, the quality of included studies was assessed by an 8-item critical appraisal tool for cross-sectional studies adopted from the Joanna Briggs Institute (JBI) (15) and was considered high quality if the JBI score was above 70. This is a tool used for the evaluation of prevalence studies. **AE** and **TL** assessed the methodological quality of eligible articles independently. The differences in extraction were managed through discussion. All articles that scored above half of the score were included in the systematic review and meta-analysis.

Data extraction/abstraction

A Microsoft Excel spreadsheet was used to generate the pre-piloted format in which AE and SA extracted the data from the included literature. First author names, year of publication, region, sample size, study design, prevalence of professionalism, and factors associated with professionalism were retrieved from each article. Following a conversation among the authors to resolve any disagreement, AE collated the data extracted from the authors.

Statistical analysis

The extracted data were exported from the Microsoft Excel spreadsheet and entered into the STATA version 17 command window. Using the I-squared statistic, the presence of statistical heterogeneity within the included papers was evaluated before conducting the primary meta-analysis. I-squared values in the approximate range of 0–40%, 30–60%, 50–90%, and 75–100% may indicate low, moderate, substantial, and considerable heterogeneity, respectively. Additionally, Egger's tests and a funnel plot were used to determine whether publication bias existed. Following that, the STATA meta set command was used to complete the pooled estimate. To control heterogeneity, a subgroup analysis of the included studies was conducted based on the categories of populations and the cutoff point. Additional advanced statistical analyses, such as meta-regression to identify the potential sources of heterogeneity and sensitivity analysis to investigate the influence of a single study on the overall pooled estimate, were performed. The trim and fill tests were conducted to minimize publication bias. The findings of this study were presented using tables and forest plots with a 95% confidence interval (CI).

Results

Identification of studies

Using advanced searching, a total of 739 articles were found in PubMed (MEDLINE), EMBASE, Cochrane, Africa Journal of Online, and Google Scholar. Reference tracing was used to add articles to the overall number of articles. A total of 43 articles were left after removing duplicates. A total of 27 articles were screened using their abstract after removing 16 articles by their title. Following that, a total of 12 articles were screened by reading their full text, and finally, a total of 11 articles passed the eligibility requirements, and quality assessment was included in the final systematic review and meta-analysis (Figure 1).

Description of the included studies

A total of 11 articles with 3,581 study participants were included in the final systematic review and meta-analysis. All the searched articles were published from 2014 to 2023. Of the total included studies, two of them were conducted in the Amhara region (11, 16), and four studies were conducted in the Oromia region (7, 17–19). The other two articles were conducted in South Ethiopia (20, 21), and the two articles were conducted in the Hareri region (22, 23). The remaining article was conducted in the Tigray region (24). Regarding sampling technique, two articles used simple random sampling to select their participants (17, 23), and five articles used systematic sampling (7, 11, 16, 20, 21). The other four articles used a non-probability sampling technique (18, 19, 22, 24). The largest sample size was 465, which was obtained from a study conducted in the Hareri region in 2022 (23) (Table 1).

Heterogeneity test and publication bias

Before pooling the estimated effect, the presence of heterogeneity and publication bias was evaluated. The heterogeneity between the included articles was assessed statistically using the I-squared statistic. According to the results, there was high heterogeneity between the included studies ($I^2 = 98.19$; $p = 0.00$). The presence of publication bias was statistically assessed using Egger's weighted regression and the funnel plot. The p-value of Egger's and Begg's test was 0.5239, which indicates that there is no publication bias. However, the funnel plot showed the asymmetrical distribution of studies inside the funnel, which implies that there is a publication bias (Figure 2).

Professionalism in nursing in Ethiopia

After testing for heterogeneity and publication bias, the effect size was pooled using STATA version 17 from 10 included studies. The remaining article was excluded from the analysis as it did not report the overall professionalism, although it was included when extracting factors. Since there was considerable heterogeneity between the studies ($I^2 = 98.19$; $p = 0.00$), the main meta-analysis was performed using a random effect model. As shown in Figure 3, the pooled

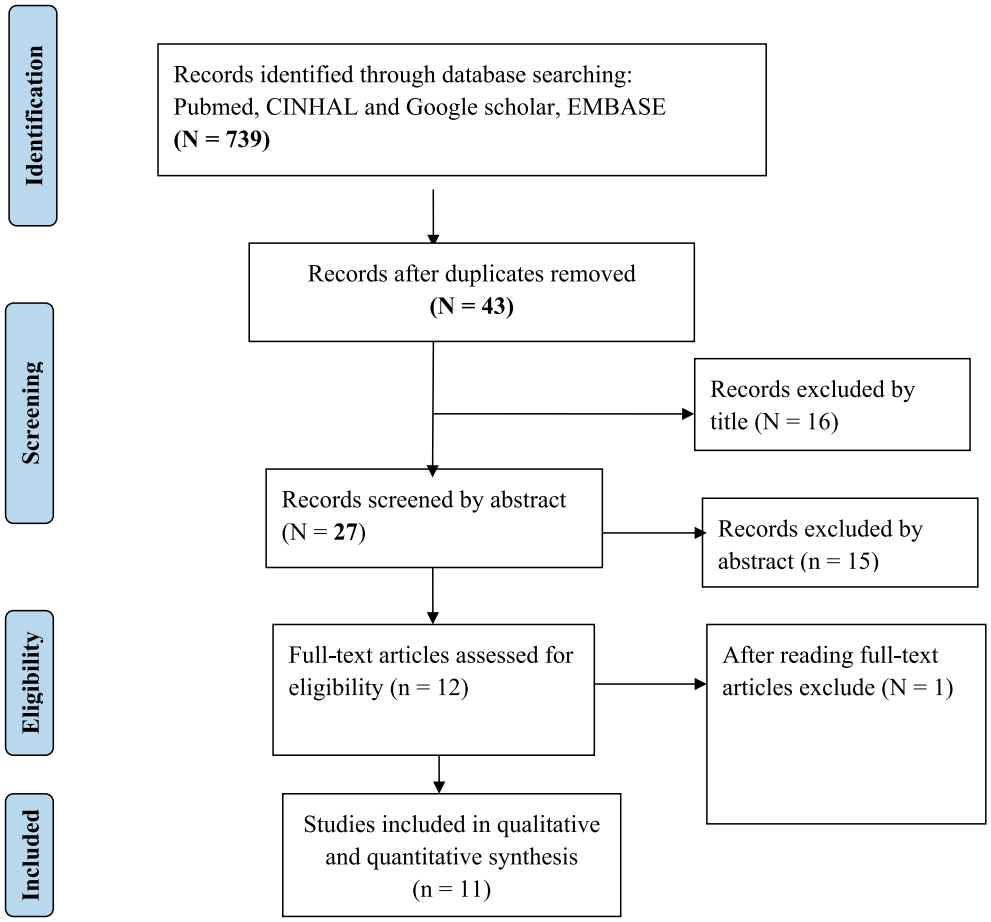

FIGURE 1
PRISMA flow diagram shows study selection for meta-analysis professionalism in nursing in Ethiopia, 2024.

estimate of professionalism in nursing in Ethiopia was 54% (95% CI: 42–66%) (Figure 3).

Meta-regression

Meta-regression was performed to identify the sources of heterogeneity between the studies. In this systematic review and meta-analysis, meta-regression was performed using the region and sampling technique to evaluate whether these variables are sources of heterogeneity between the studies. However, none of them were sources of heterogeneity, in which the *p*-value was above 0.05 (Table 2).

Subgroup analysis for professionalism in nursing

Subgroup analysis was performed using region and sampling techniques to minimize heterogeneity between the included studies. As shown in Figure 4, the highest pooled estimate of professionalism was observed in studies conducted in South Ethiopia, at 64% (95% CI: 43–86%). The pooled estimate of professionalism in studies that used probability sampling (simple random sampling and systematic sampling) was 61% (95% CI: 44–78%). However, there is no difference between the pooled estimate of each subgroup and the overall pooled estimate. All the pooled estimates of professionalism in each subgroup were between 42 and 66% (Figure 4).

Sensitivity analysis

Sensitivity analysis was performed to evaluate whether the pooled effect size was influenced by individual studies. As shown in Figure 5, there is no study that influences the overall pooled professionalism in nursing. The pooled effect size after omitting the individual study was within the confidence interval of the overall pooled effect size (all the effect sizes after omitting a single study were between 42 and 66%) (Figure 5).

Factors associated with professionalism in nursing

In this systematic review and meta-analysis, different factors that had a significant association with professionalism in nursing were extracted. These factors were categorized into sociodemographic characteristics, profession-related characteristics, and organizational factors. However, none of the factors had significant associations in the main meta-analysis.

TABLE 1 Characteristics of included studies for professionalism in nursing in Ethiopia, 2024.

Author	Publication year	Region	Sampling technique	Sample size	Professionalism in nursing (%)	Factors associated with professionalism in nursing
Abate et al. (11)	2021	Amhara	Systematic Sampling	407	24.8	Experience > 10 years, working on the day shift, being a member of the organization, having life insurance
Gizaw et al. (18)	2018	Oromia	Census	321	36	Holding a position, organizational commitment, job satisfaction
Ashagere et al. (21)	2023	South Ethiopia	Systematic sampling	360	53.3	Being married, work experience (0–5, 6–10), satisfaction with motivation and prospect, and satisfaction with the nursing
Fikre et al. (23)	2022	Hareri	Simple random sampling	465	63.4	Degree and above, low workload, being satisfied with the job, having collaboration with others
Kibret et al. (22)	2022	Hareri	Census	300	51.6	Good working environment, favorable job satisfaction, low workload
Tola et al. (12)	2020	Oromia	Census	380	58.7	Being female, job satisfaction, having training
Oluma et al. (17)	2020	Oromia	Systematic	224	80	Personal satisfaction, professional job satisfaction, working environment (satisfaction by nurse managers, satisfaction by nursing staff and support negatively), collaboration with nurses and physicians, working unit (surgical ward negatively and ICU negatively)
Solomon et al. (7)	2015	Oromia	Systematic sampling	303	30.3	Organizational culture, being female, self-image, being single, high level of education, salary
Fantahun et al. (24)	2014	Tigray	Convenient	210		Longer years of experience, old age, being a member of the organization, diploma nurses, working in military hospitals, having a moderate attitude toward the nursing profession, lack of health insurance, less attention from nursing associations, and workload
Bekalu et al. (16)	2023	Amhara	Systematic	350	68.6	Being female, having association membership, having a positive self-image, having a good organizational culture, and having job satisfaction
Assefa et al. (20)	2022	South Ethiopia	Systematic	261	75.1	Old age, job satisfaction, cooperation, and a low workload

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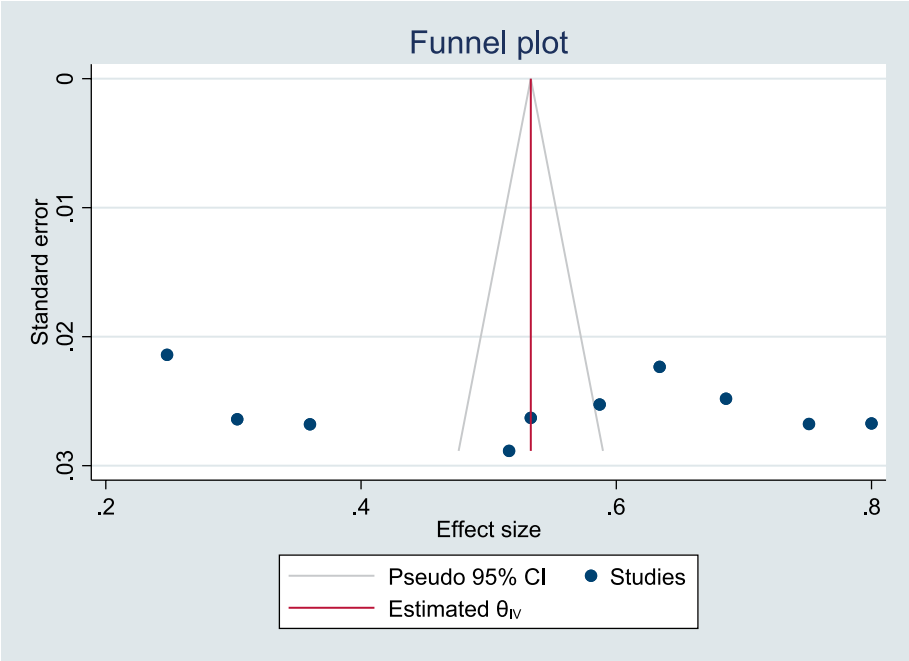

FIGURE 2
Funnel plot to see the presence of publication bias, 2024.

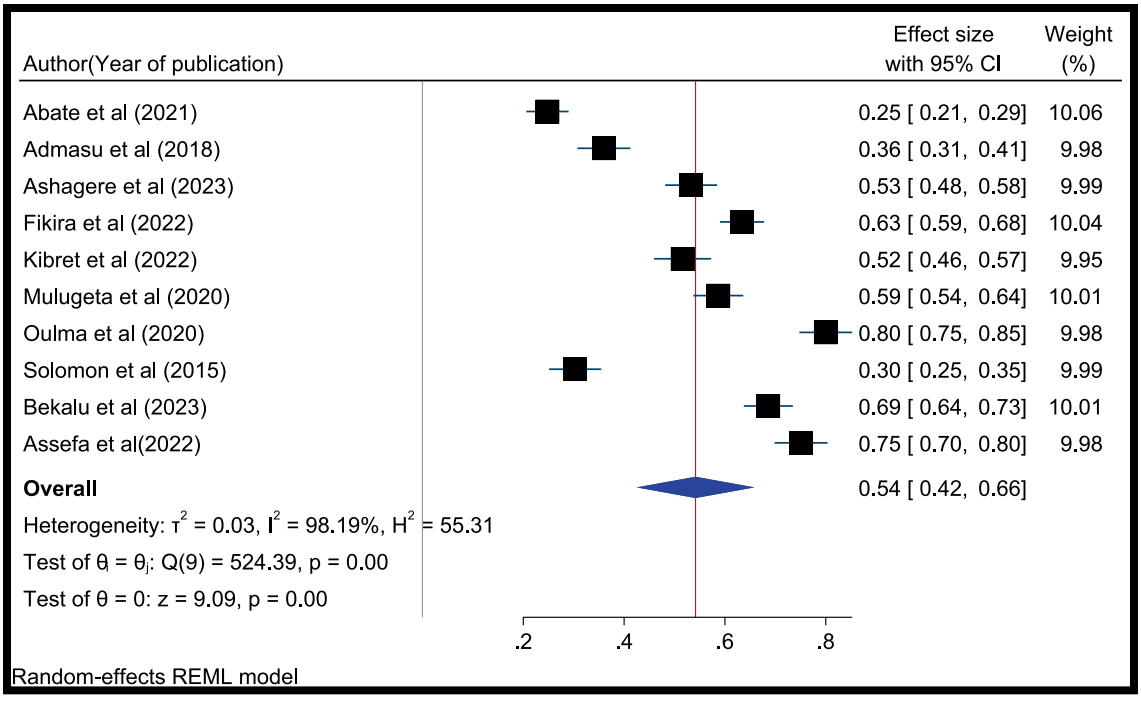

FIGURE 3
Forest plot depicting the pooled prevalence of professionalism in nursing in Ethiopia, 2024.

Sociodemographic characteristics

One of the sociodemographic characteristics is the sex of the participants. In this systematic review, three studies reported that the odds of having a high level of professionalism were higher among female nurses than male nurses (7, 16, 19). Another factor identified was age. Two studies reported a significant association between age and professionalism, with one study indicating that professionalism

increased as nurses' age increased by 1 year (24). However, another study reported that the odds of professionalism decreased when the nurses' age increased (20). Two other studies reported that marital status was significantly associated with the level of professionalism. Being single (7) and being married (21) in marital status increase the level of professionalism compared to the other marital statuses. The odds of professionalism were higher among nurses with a degree or higher education than nurses with a diploma (7, 23). However, in one study, diploma nurses had a higher level of professionalism than nurses who had a degree or higher education (24). According to the report of one study, the level of professionalism decreased when the monthly salary increased (7).

Profession-related characteristics

Longer work experience (11, 21, 24), personal satisfaction (17, 21), holding a position (18), membership in a nursing organization (11, 16, 24), collaboration with other healthcare teams (17, 20, 23), training on professionalism (19), a favorable attitude toward the nursing profession (24), strong support from the nursing organization and Ministry of Health (24), and a positive self-image (7, 16) were profession-related characteristics that had a significant association with professionalism in nursing. Another very important factor that had an association with professionalism was job satisfaction, although it is not significant in meta-analysis. According to a report on eight studies (16–23), the odds of having a high level of professionalism were increased when the work experience of nurses was above 5 years

TABLE 2 Meta-regression of selected variables for professionalism in nursing in Ethiopia, 2024.

Heterogeneity sources	Coefficients	Std. error	*P*-value
Region	0.017	0.047	0.364
Sampling technique	−0.130	0.067	0.151

Organizational factors

Low workload (23), working in other than surgical and ICU wards (17, 24), working in the day shift (11), good organizational culture (7, 16, 17, 22), working environment (24), having a high level of organizational commitment (18), and having life insurance (11) were factors that had an association with professionalism in nursing.

Discussion

In any profession, including nursing, professionalism is crucial to fulfilling responsibilities effectively. This involves continuous learning, skill development, adherence to professional norms, and a high level of commitment. Improving professionalism among nurses is vital to enhancing healthcare quality. However, there is a lack of comprehensive studies on nursing professionalism in Ethiopia. Therefore, this systematic review aims to provide a thorough understanding of nursing professionalism among Ethiopian nurses.

According to the results, the pooled estimate of the studies on professionalism in nursing in Ethiopia was 54% (95% CI: 42–66%). This finding is in line with a systematic review and meta-analysis

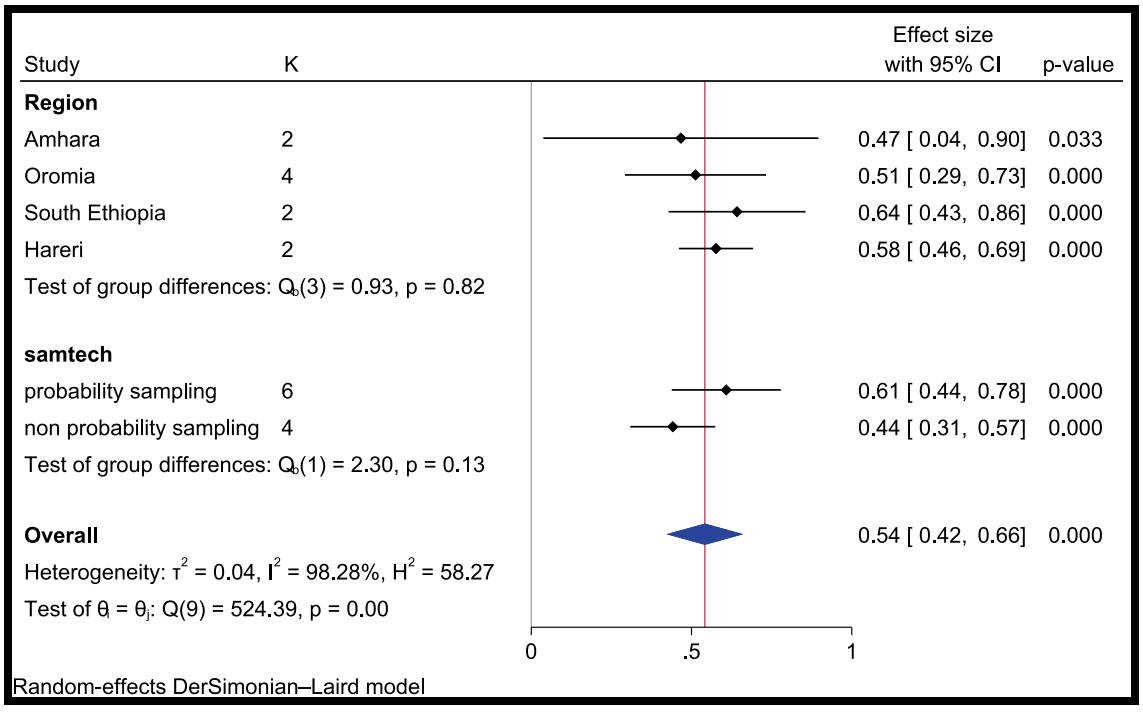

FIGURE 4
Subgroup analysis to minimize heterogeneity of included studies, 2024.

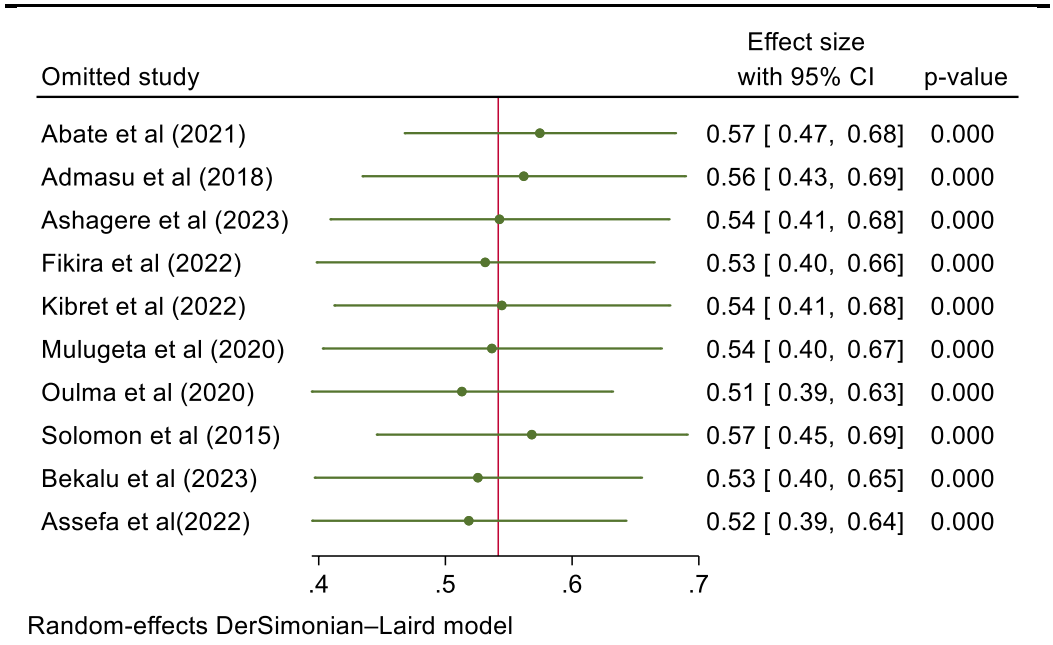

FIGURE 5
Leave-one-out meta-analysis to observe the influence of each study on the pooled effect size of professionalism in nursing, 2024.

performed in Indonesia, which reported that 60% of nurses possess good caring behavior (25), as well as another study in Türkiye (26).

Being female and having a higher educational status were the main factors that had a positive association with professionalism in nursing. As nurses advance in their education, they gain an adequate understanding of the theoretical frameworks and concepts of the nursing profession. This, in turn, improves their intention to love the nursing profession and behave according to its conduct and regulations. This finding is supported by studies conducted in Japan (8), Iran (27), and Türkiye (28).

Several studies have reported that factors such as long years of work experience, membership in a nursing organization, and good cooperation with other healthcare teams are positively associated with professionalism. When nurses have worked in their field for a long period, they have the opportunity to receive ethics and code of conduct training. Additionally, nurses have the chance to care for different types of patients and witness their healing and good prognosis, which may increase their interest in the true essence of the nursing profession. Being members of a nursing organization also allows nurses to meet experienced nurses and share insights from the activities of the nursing organization. Nurses are the heart of hospitals, interacting with different individuals during their time in the hospital. When these interactions are smooth and frequent, they help reduce the tension within the profession. As a result, nurses behave like true nursing professionals and try to improve the quality of the profession. The other very important factor that is associated with professionalism is job satisfaction. Studies show that nurses with favorable job satisfaction are more likely to exhibit a high level of professionalism. This is largely due to increased motivation, high commitment (29), and a greater intention to remain in the profession. Additionally, professionalism and job satisfaction have a bidirectional association. When the level of professionalism is decreased, nurses' job satisfaction and success are also decreased, and vice versa (30, 31).

Organizational factors are key contributors to professionalism, as reported by different studies. Among these, a low workload is the most significant organizational factor positively associated with professionalism in nursing. The possible justification for this may be that the high workloads lead to fatigue and burnout (26, 32, 33). The other factor is working units, particularly those other than surgical wards and intensive care units (ICUs). Nurses who work in a favorable working environment other than the surgical ward and ICUs are more likely to have a high level of professionalism than nurses working in the surgical ward and ICUs. This may be due to the high workload and stress among nurses working in the ICUs and surgical wards (32). This finding is supported by a study conducted in the United States of America among Korean-American (34), Chinese (35), and Korean (35) nurses.

Limitations

This systematic review and meta-analysis has its limitations. The primary limitation is the high level of heterogeneity among the included studies, as they use different tools to measure professionalism in nursing. This variability could have an impact on the report.

Conclusion

The level of professionalism in nursing in Ethiopia is suboptimal. Factors positively associated with professionalism in nursing include

being female, having a higher educational level, having long years of experience, having a low workload, having favorable job satisfaction, being a member of a nursing organization, having a good working environment, working in non-stressful units, and having a good organizational culture. Therefore, healthcare professionals, the Ministry of Health, and other stakeholders should focus on interventions to enhance the organizational culture, job satisfaction, working environment, and working schedule for nurses. Moreover, researchers should study the level of professionalism regularly and identify the barriers to improving it.

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

AE: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. TA: Writing – original draft, Writing – review & editing. SAy: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – review & editing. BT: Methodology, Writing – review & editing. SAd: Conceptualization, Writing – review & editing. DE: Supervision, Writing – review & editing. AG: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – review & editing. TL: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – review & editing.

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Conflict of interest

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

Generative AI statement

The author(s) declare that no Gen AI was used in the creation of this manuscript.

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Research on the application of post competency training for new nurses: current status and considerations

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The job competence of newly employed nurses is of crucial importance for nursing quality and patient safety. Nurse job competence emphasizes the comprehensive qualities of nursing knowledge, skills, attitudes, traits, and abilities that can achieve excellent work results in the actual nursing position and be competent for clinical nursing work. This article comprehensively analyzes relevant literature and elaborates on diverse training modalities for enhancing the job competency of newly recruited nurses. These encompass enhancements to conventional training approaches, simulation-based training, information-driven training, teamwork training, and scenario simulation cases. Additionally, it delves into the advantages, key implementation aspects, and associated challenges of these methods, with the objective of furnishing a reference for optimizing the training regimens of newly employed nurses.

KEYWORDS

post competency, new recruit, training method, online training, nurse

1 Introduction

In the ever-evolving and highly dynamic realm of healthcare, the role played by nurses is of paramount importance in guaranteeing the provision of high-quality patient care. As stipulated in the Training Outline for New Nurses in China (Trial), new nurses refer to those who commence nursing positions subsequent to their graduation from colleges and universities and are required to undergo a 24-month training period (1). They are confronted with the arduous task of promptly acclimating to their professional roles and cultivating the requisite competencies. Nurse job competency encompasses a broad spectrum of knowledge, skills, attitudes, and capabilities that are indispensable for the effective execution of clinical duties (2, 3). The American Association of Colleges of Nursing (AACN) (4) has characterized job competency as a collection of multi-faceted and dynamic proficiencies that are molded through a diverse array of experiences and learning opportunities. In the context of Chinese nursing practice (5), it is accentuated as the proficiency to proficiently conduct clinical nursing tasks and attain outstanding performance outcomes. Given the escalating intricacy of healthcare systems and the burgeoning demands of patients, it is of utmost significance to investigate and implement efficacious training methodologies to augment the job competency of new nurses. The present review endeavors to conduct a comprehensive analysis of the existing state of post-competency training for new nurses and thereby establish a groundwork for prospective enhancements.

2 Training methods for new nurses

2.1 Traditional training methods and their enhancements

Traditional classroom lectures have long constituted a fundamental component in nurse training. Nevertheless, they frequently fall short in generating the requisite level of engagement for the effective transmission of complex information. To surmount this obstacle, the incorporation of multimedia elements, such as video demonstrations of procedures like cardiopulmonary resuscitation, can markedly augment the learning experience. When aptly employed, case analyses can furnish real-world contexts, rendering theoretical knowledge more accessible and comprehensible. For example, a research study conducted by Jangland et al. demonstrated that case-based learning enhanced the understanding and practical application of knowledge among novice nurses (6). Interactive elements such as group discussions and question-and-answer periods not only animate the classroom atmosphere but also stimulate critical thinking and promote active engagement.

Clinical rotation represents another crucial facet of traditional training. It acquaints new nurses with a diverse range of patient conditions and clinical scenarios, thereby broadening their comprehension of various medical and nursing practices. During rotations in departments such as the emergency room and intensive care unit, new nurses acquire the ability to adapt to distinct work environments and cultivate problem-solving capabilities. A meticulously designed rotation program, buttressed by research findings (7), can enhance the proficiency of new nurses in managing complex patient situations. However, the traditional one-to-one teaching model employed in clinical rotations may face challenges due to the variation in teaching quality among instructors. By standardizing the teaching process and implementing regular training and evaluation for teaching staff, this issue can be effectively addressed. Research by Chung, JYS. et al. argues that the utilization of a blended learning approach, which combines face-to-face training and online handover practice modules, has improved the communication skills and self-efficacy of nurses (8).

2.2 Manikin of mannequin in nurse training

The utilization of manikin dummies in nurse training has witnessed a growing prevalence. High-fidelity manikins are capable of replicating an extensive array of clinical scenarios, spanning from fundamental to intricate, thereby enabling new nurses to hone their skills within a risk-free milieu. For example, in a simulated cardiac arrest scenario, new nurses can execute chest compressions, operate defibrillators, administer medications, and concurrently practice communication with the patient's family. Research has indicated that simulation training employing manikins can enhance the confidence and proficiency of new nurses in managing emergency situations (9). When combined with the standardized training of medical simulation teaching, it can augment the clinical job competence and teaching satisfaction of new nurses, yielding a remarkable teaching effect. In this manner, the emergency response capabilities of new nurses in critical situations are comprehensively enhanced, and they can acquire practical experience prior to attending to real patients.

2.3 Standardized patients in training

Standardized patients, who are trained individuals with the ability to precisely mimic patient symptoms and behaviors, occupy a vital position in the training of new nurses, particularly in relation to the development of communication and physical examination skills. Via interactions with standardized patients, new nurses are afforded the opportunity to practice obtaining medical histories, delivering patient education, and conducting physical examinations within a realistic context. This approach has been demonstrated to augment the communication and clinical skills of new nurses (10). The employment of standardized patients in conjunction with objective structured clinical examinations (OSCEs) has likewise proven efficacious in the evaluation and enhancement of the core competencies of new nurses.

2.4 Information-based training approaches

In the wake of the swift advancement of technology, online course platforms have emerged as highly valuable assets for nurse training. A multitude of hospitals and institutions presently present a diverse range of nursing courses in an online format, affording new nurses the flexibility to learn at their own pace and convenience. These courses encompass theoretical knowledge, practical skill demonstrations, as well as case analyses. For instance, an online course devised by Michel et al. (11) furnished comprehensive training in geriatric nursing and incorporated elements such as online testing and personalized feedback. The Small Private Online Course (SPOC) model has also attained significant popularity, empowering students to tailor their learning experiences and access top-notch educational resources. In a study by Tao et al. (12), Wang et al. (13), and Zhang et al. (14), it was ascertained that the SPOC model could enhance the learning outcomes and self-directed learning capabilities of nursing students. In the research carried out in China, the teaching model of SPOC maximizes the sharing of high-quality teaching resources, economizes on teaching costs, and alleviates the substantial workload of clinical teachers.

Mobile learning applications have further instigated a revolutionary transformation in nurse training (15). These apps present features like nursing knowledge databases, animated demonstrations of procedures, and daily quizzes. They facilitate new nurses in leveraging fragmented time for learning and offer a platform for the exchange of experiences and knowledge. Nevertheless, the efficacy of these apps hinges on the quality and evidence-based nature of the content. Research is requisite to validate the influence of mobile learning applications on the competency development of new nurses.

2.5 Teamwork training initiatives

Effective teamwork is of fundamental significance in healthcare settings. Interdisciplinary team training initiatives for new nurses entail collaboration with physicians, pharmacists, and other healthcare professionals. Via activities like case discussions and joint patient care planning, new nurses can acquire a more profound comprehension of the roles and obligations of other team constituents and refine their teamwork capabilities. A study conducted by Yeh et al. (16) revealed that such training programs augmented the communication and coordination proficiencies of new nurses, thereby resulting in

enhanced patient outcomes. Teamwork simulation exercises, such as responding to a simulated ward fire, can also assist new nurses in cultivating practical skills within a team framework. Moreover, instituting a reward mechanism for teamwork can motivate new nurses to actively partake in collaborative undertakings.

2.6 Reflective practice and its significance

Reflective practice serves as a fundamental cornerstone for the professional development and growth of new nurses. Subsequent to clinical experiences, engaging in group discussions and maintaining reflective diaries can assist new nurses in dissecting their actions, pinpointing areas that warrant improvement, and deriving valuable learning from their experiences. For instance, in a qualitative research study conducted by Colman et al. (17), new nurses attested that reflective practice augmented their self-awareness and clinical judgment. The application of models such as the Perinatal Bereavement Care Training Program (PBCTP), which incorporates elements of reflective learning, has been demonstrated to effectively address the emotional and professional requisites of nurses within specific clinical domains (18).

2.7 Scenario simulation case competitions

Scenario simulation case competitions present a distinctive opportunity for new nurses to apply their acquired knowledge and skills within a competitive yet collaborative milieu. These competitions, which are founded on actual nursing cases, necessitate teams of new nurses to formulate and execute comprehensive nursing care plans. Research has demonstrated that such competitions have the capacity to enhance the clinical reasoning, communication, and teamwork capabilities of new nurses (19, 20). They also play a role in augmenting the motivation and fostering a sense of professional identity among new nurses. A case simulation was conducted based on the application for newly employed nurses, establishing a fundamental and universal language for delirium assessment and management and facilitating communication among medical staff. The research posits that scenario simulation represents an efficacious strategy for clinical skills training in infectious diseases (21). The cooperation within the actual ICU environment in Italy is conducive to effective experiential learning and heightens the familiarity of newly employed nurses with the environment and equipment, which is highly advantageous for the enhancement of their technical and non-technical skills (22).

2.8 Mentorship and social support

In numerous healthcare systems, mentorship programs assume a crucial role in the professional advancement of new nurses. Take South China as an instance, where social support and mentorship have been demonstrated to boost the self-efficacy and job satisfaction of new nurses (23). The Nurse Residency Training Program (NRTP), overseen by seasoned nurse educators, is capable of furnishing new nurses with structured backing and direction during their shift to clinical practice. Incorporating mentorship into residency programs can assist new nurses in acclimating to the organizational culture and cultivating the requisite competencies in a more efficient manner.

2.9 Comprehensive training approaches

Drawing upon an exhaustive literature review, semi-structured interviews, and questionnaire surveys centered around job competence, an online nurse training curriculum was devised and put into effect. This initiative has demonstrably augmented the comprehensive practical proficiencies and home care aptitudes of online nurses (24). The index framework for the standardized training of newly enlisted neurosurgery nurses, which was formulated through semi-structured interviews and the Delphi expert consultation technique, can function as a valuable benchmark for the specialized training of neurosurgery nurses during the standardized training phase (25). The research anchored in the ADDIE model, distinguished by its flexible modalities and salutary experiences, encompasses five sequential stages: analysis, design, development, implementation, and evaluation. In accordance with the actual clinical exigencies, the teaching content, teaching modality, and instructional hours were meticulously developed and executed, and the self-efficacy and core competencies of nurses were appraised (26). Through the integration of the workshop teaching paradigm and the virtual simulation practice methodology, a training regimen for newly recruited critical care nurses was contrived, thereby endowing the training program with enhanced allure and scientific rigor and laying a theoretical bedrock for the training of specialized nurses. The six-step standard communication protocol, which was conceived by Chinese scholars via the Chinese localization and refinement of the CICARE communication model, namely "connect - introduce - communicate - question - respond - exit" (27), was implemented. Based on this "six-step standard communication process," a communication skills training program for newly employed nurses was constructed. This program assimilates the nursing idiosyncrasies and clinical requisites of cancer patients, streamlines and standardizes each interaction between nurses and patients. It serves as an efficacious communication stratagem to cultivate trust and engender harmony between nurses and patients. As a result, the professional caliber and communication skills of nurses have been expeditiously enhanced, and their faculty to dissect and resolve practical problems has been honed.

3 Key considerations in training implementation

3.1 Training needs assessment

Prior to the execution of any training program, a comprehensive and meticulous assessment of the training requisites of new nurses is of utmost significance. This process entails the collection of information regarding their educational backgrounds, extant knowledge and skillsets, as well as their career aspirations. Instruments such as questionnaires, interviews, and skills evaluations can be employed to amass this data. Grounded on the outcomes of the assessment, individualized training blueprints can be formulated to guarantee that the training is pertinent and efficacious. For instance, a study by Qia and Liu (28) underscored the criticality of needs

assessment in customizing training programs to precisely meet the specific exigencies of new nurses.

3.2 Training staff development

The caliber of the training personnel directly exerts an influence on the efficacy of the training. Regardless of whether it pertains to traditional or contemporary training modalities, trainers are required to possess current and updated knowledge, along with outstanding pedagogical skills. Regular training sessions and professional development prospects ought to be furnished to the training staff to ensure their alignment with the most recent nursing practices and educational methodologies (29). Incentive frameworks, such as the acknowledgment and recompense for exemplary teaching, can also augment the motivation and job performance of the training staff.

3.3 Training effect evaluation

The establishment of a sound and comprehensive evaluation system is of cardinal importance for gauging the success of the training program. Evaluation metrics should encompass theoretical knowledge attainment, practical skills competence, patient satisfaction levels, and teamwork competencies. A multiplicity of evaluation techniques, including written examinations, clinical skills appraisals, and patient feedback questionnaires, can be employed to acquire a holistic comprehension of the training efficacy. In light of the evaluation outcomes, prompt modifications to the training approaches and content can be effected to perpetually refine and optimize the training program. For example, a research endeavor by Zhang et al. (30) and Shang et al. (31) formulated an evaluation index system for new nurse training and illustrated its application in enhancing the quality of the training regimen.

4 Challenges faced

Both the procurement of simulation training apparatus, the development and upkeep of information platforms, and the establishment of a high-caliber teaching faculty demand substantial resource allocation. In the case of certain small hospitals or primary medical institutions, financial constraints may emerge, thereby impeding the utilization of advanced training modalities.

Newly recruited nurses bear a substantial workload in clinical practice, and the judicious scheduling of training time poses a formidable challenge. An overly protracted training period might disrupt the normal work and rest patterns of new nurses and precipitate work-related exhaustion; conversely, an excessively brief training interval would compromise the attainment of training objectives. It is imperative to orchestrate the training schedule in a scientific manner, while ensuring the seamless progression of clinical operations.

The cultural milieu and organizational governance structure of a hospital can exert an influence on the implementation of training methodologies. Some hospitals may lack an organizational culture that fosters innovation and teamwork, potentially dampening the enthusiasm of new nurses toward novel training approaches. Concurrently, suboptimal organizational management could result in the ineffective execution of training plans and a significant diminution in training efficacy (32) reported that the introduction of the Japanese standardized clinical training system in the Vietnam pilot project augmented the capabilities of nurses and instigated organizational transformation, thereby exerting a salutary influence on nursing practices and the professional standing of nurses.

5 Conclusion

In order to enhance the job competency of newly hired nurses, it is essential to adopt a comprehensive approach by applying a diverse range of training methods. Continuous refinement and innovation of traditional training paradigms are required, along with the full exploitation of modern training techniques such as simulation training, information-driven training, and team collaboration training. During the training implementation process, particular attention should be given to training needs assessment, the integration of multiple methods, the development of the teaching workforce, and the evaluation of training outcomes. Challenges in areas such as resource allocation, time management, and cultural and organizational aspects must be surmounted to foster nursing professionals with high job competency, thereby providing a robust safeguard for elevating nursing quality and ensuring patient safety. Looking ahead, further exploration of more efficacious training methods and models remains necessary to keep pace with the perpetually evolving medical landscape and nursing requirements.

Author contributions

LY: Conceptualization, Formal analysis, Investigation, Methodology, Project administration, Resources, Writing – original draft. LM: Conceptualization, Formal analysis, Investigation, Methodology, Project administration, Resources, Writing – original draft. BJ: Conceptualization, Investigation, Methodology, Resources, Writing – original draft. ZA: Project administration, Supervision, Writing – review & editing.

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Conflict of interest

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

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Using "ways of thinking and practising" to analyse final year medical student reflections and underlying concepts in preparedness for practice

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Introduction: Ensuring that medical students are prepared for future practice is challenging for all medical schools. Most studies of preparedness involve newly qualified doctors and use quantitative methods such as self-report surveys focused on defined competencies, and often find graduates are unprepared for the complex and challenging areas of real-world practice. Qualitative methods, using conceptual ideas linked to learning such as 'Ways of Thinking and Practising' (WTP) are little explored in this area but could offer rich and useful insights about graduates' preparedness. WTP recognises that, in addition to specific knowledge and skills, students need to understand the complex links between theory and practice and what it means to be part of their disciplinary community, in terms of culture, values and ways of seeing and being in the world. This study explored the written reflections of final year medical students on the threshold of practice, as they looked back at reflections from their previous years of study. It aimed to identify disciplinary WTP described by students and gain insights into their developing grasp of these.

Methods: Thirty six reflections were analysed and a thematic analysis undertaken, using WTP as a sensitising concept.

Results: Six inter-related WTP were identified. Illustrative quotes are provided which demonstrate how grasping each WTP involved students making connections between different elements of their learning and the 'what', 'how' and 'why' of knowing. Students reflected on the factors that facilitated their learning. Two resulting 'changes in self' were identified: a sense of confidence and self-efficacy, and a feeling of readiness for responsibility.

Discussion: Grasping the WTPs identified may be a helpful part of preparing for practice, and understanding what facilitates this may be of use in informing future curricular design.

KEYWORDS

ways of thinking and practising, preparedness for practice, medical education, healthcare education, medical students, reflection

Introduction

Ensuring that graduates are prepared for the complexity and unpredictability of future practice is a challenge for all medical schools, and how to achieve this remains uncertain. Even the term 'preparedness' has different meanings and the question 'prepared for what?', different answers. Stakeholders may conceptualise preparedness as short-term 'hitting the ground running' (1) or long-term, which includes practical and emotional aspects. Most studies employ quantitative methods (2) such as surveys of newly qualified doctors' self-reported sense of preparedness with respect to defined competencies, or specific knowledge, skills and behaviours detailed in national competency frameworks such as the UK General Medical Council's Outcomes for Graduates (3). Fewer studies have used qualitative approaches, such as audio-diaries and narrative interviews, yet these have the potential to provide rich, contextualised insights into graduates' preparedness for practice (1, 4).

'Ways of thinking and practising' (WTP) (5) is a process-focused idea that recognises that, whatever their field, students need more than specific skills and knowledge to work effectively in the real world. They need to come to terms with those concepts which are central to the mastery of their discipline, as well as its culture, values, customs, forms of discourse, ways of acting and being, and how its members see and think about the world (6, 7). Moreover, they need to appreciate the complex links between disciplinary knowledge and practice, between 'knowing what and knowing how,' as well as 'knowing why.' (8). WTP have been little studied within medical education but may provide a useful conceptual framework (9) to understand those learning experiences that help prepare medical students for the complex, challenging and wicked problems they will encounter in healthcare (10–12). Identifying those WTP which enable students to 'transition from thinking and practising like a medical student to thinking and practising like a [doctor],' (13) (p. 182) and to understand what it means to be a doctor who works effectively as part of a healthcare community (6), could help medical schools design curricula and teaching which better prepares students for practice.

Most preparedness studies explore the experiences of newly qualified doctors; there is less literature about the views and perceptions of final year medical students as they approach the transition to clinical work. One such qualitative study, however, describes students bracing themselves for an abrupt 'reality shock' at transition (14) (p. 699). Coakley et al. found that, while some students were excited, many were anxious about assuming responsibility and apprehensive about the ordeals they expected to face, often planning dysfunctional approaches for dealing with those challenges (14). This aligns with Dornan's description of newly qualified doctors experiencing a 'baptism of fire' (15). New graduates from our medical school regularly score highly in UK GMC preparedness for practice surveys and our study seeks to explore whether our final year students' reflections provided any insights into this. Indeed, medical graduates enter an increasingly demanding and complex world of changing societal healthcare needs. Additionally, financial and staffing challenges in healthcare, and risks of burnout in junior doctors are increasing (1). Therefore, identifying factors which help prepare students for these issues is imperative.

Study context

As part of their professionalism module, our medical school requires students to undertake reflective writing throughout their 5-year undergraduate programme. They reflect on a series of professionalism topics, linking these to their own individual experiences, most commonly those in the clinical setting. Toward the end of their final year, as part of a summative reflective writing assignment, students are asked to review, reflect on and refer to their personal written reflections from previous years and drawing on these, they respond to specific questions as below:

'Review your previous reflections and drawing on these where appropriate, please reflect on the following (800–1,000 words):

- How have you changed since beginning at medical school?
- What is the most important concept you have understood since beginning medical school that enables you to think like a doctor?
- What is the most difficult concept about being a doctor you have encountered?'

These questions were adapted from a 2018 study exploring threshold concepts in third year paediatric clerks' reflections (16).

Study aims

This qualitative study aimed to:

- use WTP as a sensitising concept to analyse how final year students, through written reflection, articulate their evolving understanding of the challenges and underlying concepts which they consider important in their transition from student to doctor.

In doing so we also hoped to:

- identify WTP in medicine as described by fifth year medical students on the threshold of clinical practice.
- Gain insights into students' developing grasp of these WTP during their medical course.
- Gain insights into students' sense of preparedness for practice.

Methodology

Starting in 2019 and following ethical approval, all year 5 students ($n = 83$) were invited to take part in this study in an address to the whole cohort. Students had already submitted and received results of their summative writing assessments and were asked to volunteer consent for their anonymised scripts to be analysed. Some research team members were known to them, but none had a direct role in assessing these students. All submissions were blinded and students were informed about confidentiality and that participation or non-participation had no influence on student progression. The School has an existing, confidential process to act on safeguarding or well-being concerns in the rare circumstances of these arising within students' written reflections and researchers were aware of these. The research team comprised three clinical educators (two General Practitioners and an anaesthetist), one educationalist (a sociologist) and a research assistant with a background in psychology. The team independently read and re-read different selections of consenting students' reflections and an initial coding

scheme was developed (17). Coding frameworks were discussed and continuously adapted until consensus was reached. Data was coded using Lumivero (2020) NVivo 13 and an initial analysis undertaken to reveal themes, which were further discussed, negotiated and adapted by discussion (18). An initial study aimed to identify important and difficult concepts and personal change. During this analysis the research team decided that 'Ways of Thinking and Practising' would be an appropriate 'sensitising concept' and undertook this secondary analysis, reanalysing the data through the same iterative process to establish new themes (18). Making such a decision during data analysis is an approach known as theory informing inductive data analysis (9). Unlike definitive concepts, sensitising concepts are not prescriptive in nature (19) but can offer a sense of guidance, enhance sensitivity to nuances in the data and show how people give meaning to concepts in the context being studied (18). As the analysis progressed, the team continued to iteratively discuss, negotiate and refine the new themes emerging, whilst continuously reviewing them against the existing WTP literature and ensuring the themes remained grounded in the data.

Results

36/83 students consented to their anonymised reflections being analysed. In all 36 reflections, students described coming to terms with new concepts during their undergraduate course, regularly linking their grasp of these concepts to their real-world experiences. As the analysis progressed it became apparent that many of the emerging themes fitted well to the descriptions of WTP within the literature. We identified six distinct WTP themes with some inevitable overlap between them (Figure 1). Students also often reflected on the factors that had helped them grasp these WTP, referring to the crucial role of clinical experiences, role models, the taught curriculum, support, and reflective practice. Alongside these six themes, we identified two 'changes in self' themes which appeared to be the result of grasping these WTPs, rather than WTPs in their own right (Figure 1). We considered WTPs to be discipline-specific approaches to understanding, reasoning and ways of being and seeing the world. They include frameworks and cognitive strategies (6). Separate to these 'ways of being', the 'changes in self' themes related to

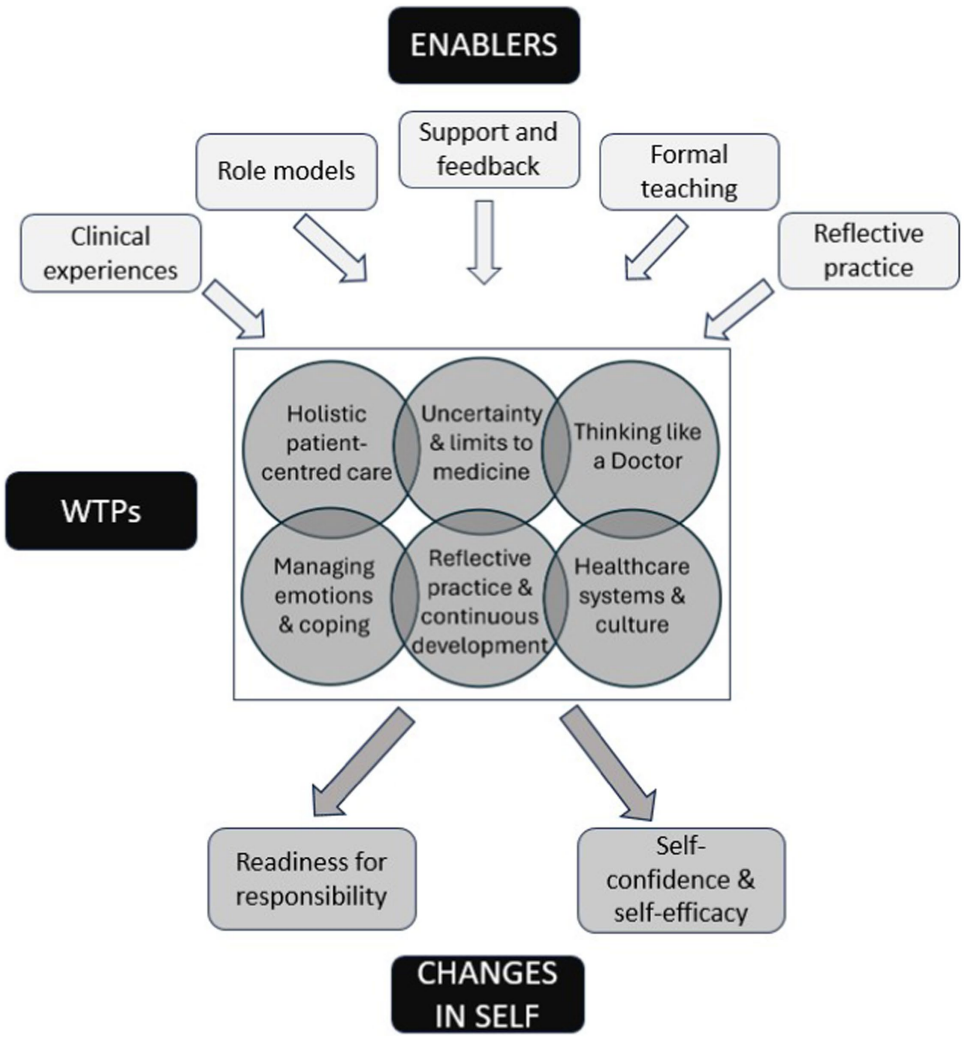

FIGURE 1
Ways of thinking and practising, with enablers and resultant changes in self.

students' descriptions of personal growth and changes in self-perception and confidence. These were more akin to the broader personal transformation that occurs through learning (20). These changes were often related to grasping the WTPs identified. While students largely appeared to see their new understandings and changes in themselves as positive and helpful, some described ongoing struggles, particularly in relation to the 'systems and culture' theme.

WTP one: the importance of holistic, patient-centred care

In this major theme in the data, students described major changes over time in how they thought about their patients, with one student suggesting that the importance of putting *"the patient at the centre of their care"* was *"the biggest concept I have learnt since the beginning of medical school"* (S22). Sometimes this shift in thinking was influenced by clinicians. One student, for example, described regularly hearing the phrase *"treat the patient not the [scan/test result/bloods/imaging]."* (S28).

Aligned to this, grasping the importance of holistic care was a big shift for some students, who came to medical school expecting "*to learn all about diseases, the art of diagnosis and treatments from textbooks. It seemed a simple mathematical equation almost.*" This same student describes quickly learning "*that patients and their diseases are not separate entities. To be a good doctor, you must treat the patient as a whole. This starts with understanding the whole story.*"" (S24).

Students described how learning about the biopsychosocial model, taking "countless histories," having conversations with patients in different clinical settings, small group discussions and reflective practice had helped them appreciate complexity and question their pre-conceptions of patients. One student describes becoming aware of their own biases: *"I found it difficult initially when I saw patients walk through the door smelling of cigarettes or alcohol, or those grossly obese or using drugs. These are people, many with issues I cannot begin to imagine or as I have come to realise just daily struggles of real people."* (S13). Another reflected on how *"behind every frustrating or rude patient, there is a reason. Maybe they are scared? Maybe they are tired of suffering from chronic pain? Maybe they have a mental health condition contributing to their behaviour?"* (S15).

Students commonly described how observing senior doctors communicate with patients, especially where time was limited, had helped them appreciate the importance of active listening, ensuring understanding and making decisions with patients. As one student reflected, "*It is easy for us to assume that the patient has understood and processed everything about an intervention within the 5 min they are seen within a ward round.*" (S16).

Another student considered how it was not always easy to respect patient autonomy, describing clinical experiences where "*what I think is best for the patient's health contradicts what the patient themselves want. For example, an elderly lady diagnosed with cancer, who decided to go on holiday with her family before starting treatment. This delayed her treatment by a few weeks but brought her enormous happiness.*" (S32).

WTP two: thinking like a doctor

In this significant theme, students described significant changes in their ways of thinking, including their development of clinical reasoning and the importance of drawing on underpinning scientific concepts and principles: "*I try to go back to the structure and function.…This helps me to understand how patients can develop particular symptoms but also helps me understand what investigations need to be done and why.*" (S10).

Students also reflected on their future role as decision-makers and the need to incorporate ethical principles, science and evidence into these decisions. One student described that *"From what I have seen in medicine, making complex decisions is the cornerstone of the profession…. Most importantly, it means I have had to learn to understand my own decision-making mechanisms, and to see what I use to justify my choices.*" (S36).

Some students described focusing on medical knowledge in their early years but that they now recognised the value of thinking as well as knowing. One student reflected on this, and the importance of remaining open-minded: "*Doctors need to be thinkers. I can so easily become pigeon-holed into a certain mindset or diagnosis without thinking about the wider picture or what else could be going on with a patient… …it puts me at risk of missing important signs and therefore mis-managing patients.*" (S4). Students highlighted how deep noticing, and thinking critically and 'outside the box' were often skills they had learnt from role models: "*The question 'what else could it be?' is one I have heard asked repeatedly by clinicians.*" (S31)

WTP three: accepting and managing uncertainty and the limits to medicine

In this prominent theme, students reflected on how their views about uncertainty and ambiguity had evolved during their course. They commonly described struggling with these concepts at first, for example how patients may not "*present as they do in textbooks.*" (S10). One student reflected on how "*there can be multiple right answers, and with it the idea that people can come to different conclusions from the same information but both still be right in their circumstance*" (S36) and that this was the hardest concept they had encountered in medicine.

Others described becoming more confident with uncertainty, acknowledging, as one student stated, that it "*is a fundamental part of medicine.*" (S10). They linked these reflections to their approaching sense of responsibility, often suggesting approaches for managing uncertainty in the clinical setting. One student, for example, suggested "*It is about making sure that patients are safe—whether this is by safety netting, or escalating appropriately.*" (S7), while another described how "*Sometimes this involves being truthful with patients when you do not have the answers about a disease progress, treatment outcomes or prognosis.*" (S33).

Related to uncertainty, some students explored the nature of risk in relation to their future roles as a junior doctor "*such as discharge planning or deciding whether a patient should have a scan requested.*" (S19). They recognised the implications of the choices they would face, for example how, as one student reflected, "*the difference between sending someone home and admitting them for tests may be the difference between life and death.*" (S27).

Some students described how time on placements had changed their understandings around the limits to medicine and how they had come to recognise that they might not always be able to fix patients, predict or control all things. "*Before medical school, I used to think of doctors almost like gods. They could save everyone. Now, at the end of medical school, I know… how sometimes, you cannot do anything…Sometimes, you will be helpless. There are limits to medicine.*" (S34). They often linked this understanding to the ethical decision-making discussed in WTP2, with one student reflecting on how "*our attempts to fix… can do more harm than good and that the best thing may be to do nothing at all.*" (S14). Others' reflections linked to WTP1 (patient-centred, holistic care), with one student highlighting the importance of "*being able to see the patient as a whole and understand the concept of a good death and producing the best outcome for them and their family holistically.*" (S23).

WTP four: reflective practice and continuous development

Most students ($N = 30$) referred specifically to at least one past written reflection on experience, while the remaining six referred more generally to past reflections. Looking back at these appeared to help students see how they had changed, and how grasping a new concept could at times be sudden, associated with a specific experience or, more commonly, a more gradual shift in thinking, occurring over time and multiple experiences.

Looking back at their past reflections led students to reflect on past struggles, subsequent growth and transformed understandings and there was a strong sense of students seeking meaning.

Students often discussed how they had come to understand the value of reflection in medical practice and how their ability to reflect deeply and usefully had developed over their time at medical school. One student described comparing their recent reflective template to the first they completed in Year 3 and how their reflective skills had *"vastly improved."* Previously, they described "*I would simply recount the details of an experience or superficially reflect on how it made me feel. Now I am able to reflect in much more detail, addressing how I felt, why I felt this way, the impact of the event and these emotions and also the knock-on effect on others such as colleagues and patients.*" (S12). A few students, however, still struggled with aspects of reflective practice, describing it, for example, as "*difficult and time consuming.*" (S21).

Several students highlighted how their new understandings of reflective practice informed their understandings of continuous professional development. As one student wrote: *"I used to see [reflection] as a tick box exercise with little meaning. Now I see it as a learning tool, a prompt and a platform to make change. I find reflection useful whether it be formal or informal. Simply sitting down quietly at the end of the day thinking about what went well and what could be improved is a useful and simple way of keeping on top of things and personal development.*" (S5).

Others recognised the importance of reflection and learning for healthcare with one, for example describing how, "*over the past few years I have become an independent learner… …I no longer learn for the sake of passing assessments, but I am now driven by the responsibility towards patients.*" (S24).

WTP five: working within healthcare systems and culture

Of all the themes, this was the one where a number of students struggled, in two main areas. The first involved coming to terms with the demands of life as a junior doctor in the NHS. One, for example, reflected how they perceived "*a kind of hidden curriculum throughout medical school is that you will have to sacrifice things that you do not necessarily want to sacrifice in order to succeed.*" (S09). Another described warnings from doctors "*about the long antisocial hours and the fatiguing physical and emotional nature of the job.*" This same student, however, along with several others, felt this was balanced by the rewards of being a doctor, reflecting on how "*I have also seen how rewarding and stimulating medicine can be.*" (S01).

Just as in WTP3 where students came to acknowledge the limits of medicine, in this theme they also realised the limits of healthcare systems, and how bottlenecks and resource constraints can impact on the availability and quality of care they could provide. One student described *"…the stark pressures placed on the NHS due to patient demand and financial pressures is something that I see play out on a near daily basis."* As a result, this student reflects, "*there's a tension between trying to do tasks quickly and doing them in a safe manner that provides good quality patient care and also balance between caring for the patient in front of you at that particular moment against all the other patients under your team's care.*" (S11). Coming to terms with this could be hard: "*I find this difficult to swallow. I want to give the best to patients without restriction and have had to realise that this is not always possible.*" (S18).

Students also highlighted a second area within this theme: the culture of healthcare including hierarchy, bullying and discrimination. Some linked this to learning about the hidden curriculum during their course. One student describes a series of experiences:

"After being told in Orthopaedics that I have 'tiny lady hands' I have to remind myself that I will still be able to perform an examination of a hip joint. After seeing a consultant call a registrar a 'baby doctor' and demanding to speak to a 'big boy', I must remember that my clinical concerns as an F1 [newly qualified doctor] will be just as justified as if I were a consultant… …this is something I have reflected on in small groups and [written reflections]… …as soon as I understood there was a term for 'hidden curriculum' I became very passionate about respect in the workplace." (S25).

Again, some students struggled with this culture: "*I have come to dislike the attitude many doctors have towards one another, to get to [wherever] they want to go. We are indoctrinated to believe that to become the best you can be, you will need to put others down along the way.*" (S08). Others, however, sought to understand why these negative experiences might occur: "*I no longer find ['scary seniors'] intimidating or take it personally anymore… …I recognise that people may act in certain ways irrespective of my own behaviour; perhaps they are sleep deprived, stressed, hungry or just like that sometimes.*" (S26).

A strong positive element of this WTP was how a culture of good teamworking, and their own role as part of a team, was seen to be key in providing good patient care and peer support: "*I have come to value the importance of reflection and debriefing with other team members, particularly after dealing with acutely unwell patients. Relationships with work colleagues are of paramount importance to both patient safety and clinician well-being.*" (S35). Others reflected on how teams may not always work effectively, with this student considering ways of addressing this: "*I learned about how easily poor teamwork can affect*

the atmosphere and proficiency of a team and that damaging a team's cohesiveness can have knock on effects on patient care. Therefore for the sake of both my colleagues, patient experience and patient outcomes I will always try my best to be professional, calm and kind to my team members." (S12).

WTP six: managing emotions and coping

Within this WTP students frequently discussed how they had previously struggled with upsetting situations and being able to 'let go.' They often made links to the WTP identified above, such as the emotions involved in maintaining patient centred, holistic care (WTP1) and accepting limitations in a challenging health system (WTP5). One student, for example, reflected how "*My view of death has evolved over the past years. In my year 4 [reflective template], I spoke about the first time I did CPR on a real patient… …who eventually died in front of us. I was in complete shock, felt disappointed in myself and very emotional when I came home.*" The same student then describes witnessing a recent patient death: "*This time round, there was less immediate emotion and a greater understanding of our limitations as a medical team.*" (S08).

Students often highlighted the importance of peers and team members in supporting them and of making time for reflection. One student, for example, looking back on their past reflections on the deaths of a newborn baby and a young woman, states: "*In both cases, only after talking to colleagues, did I feel unburdened.*" She also reflects "*where such discussion is not an option, I have found writing to help. When formally typing my [reflective template] I was able to analyse the situation from different perspectives which I found to be helpful. This is something that I can continue to carry out with future challenging patients.*" (S15).

Central to this WTP, students recognised that looking after a patient requires you to also look after yourself. They described a range of approaches for coping with the stresses of being a doctor, including eating well and making time to relax and exercise. Others described how time management techniques, such as allocating time to each task, would help when managing the demands of being a junior doctor: "*I have found passion in medicine and I am happy to give it time beyond my working hours, but I did not realise that if I was not organised or prepared then the amount of time needed would quickly increase.*" (S06).

Another student learnt when challenged by a small group peer for dismissing self-care: "*Though I was defensive at first, it became apparent that simple measures such as taking a five-minute break or ensuring I eat lunch would reap better long-term outcomes. Indeed, I have noticed that by integrating these steps into my day I am able to complete tasks more promptly as I am less fatigued.*" The student then reflects how "*This awareness has reiterated the importance of caring for oneself when caring for others.*" (S17).

A particular worry raised by a number of students was that, as they progressed through medical training, they might become desensitised and lose their compassion. One student reflects back on "*how much it terrified me coming home after spending the day in [the] oncology clinic breaking diagnoses of terminal cancers to patients without being as phased about it as I would normally be.*" (S02). This same student then discusses how using positive coping mechanisms, learning about intellectual empathy and having support systems in place have helped. The student reflected that: "*The most important concept that I have understood since beginning medical school is developing resilience without the loss of empathy,*" while acknowledging that "*It is imperative to be aware that resilience and empathy will both be indefinitely a work in progress, and I will continuously develop and work on protecting and nurturing both.*" (S02).

Changes in self

In addition to the WTP themes emerging from the data, we identified two consequential 'changes in self' themes (Figure 1).

Change in self one: increased confidence and self-efficacy

Students frequently reported how they had often written about their anxiety, self-doubt or a lack of confidence in their early years' reflections. Most, like this student, described how this had been replaced by an emerging sense of confidence and self-assurance. "*In reading my portfolio pieces from year one of medical school, it's highly sobering to see just how much my confidence and outlook has developed… Not only am I now a team member who can offer her ideas and decisions to her team; I also have the confidence to advocate and work for the good of my patients as a foundation doctor.*" (S18).

Students often linked their growing confidence to coming to terms with the WTP above, such as accepting their limitations. For example, this student reflects: "*Nobody expects you to have all the answers, but if you can approach things calmly and sensibly you can hopefully get a good idea of what's going on and make a suitable plan for the next step. I thought I had to be perfect and know everything and it [led] me to thrash around feeling helpless at times*" (S3) while another describes how "*over the past five years… I've learnt my limitations and when to seek help. Too much confidence can be dangerous.*" (S5).

Students frequently highlighted how clinical experiences including "*increased interactions with patients and healthcare professionals from a wide* var*iety of backgrounds*" had contributed to their "*growing sense of professional identity and responsibility*" (S16). They also cited academic support, including assessments during placements and feedback, alongside an increasing openness to learn from this, (WTP4). As one student reflects: "*When I receive feedback now, rat*her *than dwelling on the negatives and taking it personally, I now seek it out to find ways in which I could improve.*" (S24).

A few students described feeling less confident or sure of themselves in clinical situations. Most had considered how they would deal with this. One student, for example, reflecting on her anxiety when managing unwell patients reported "*[taking] steps to prepare myself for situations that I know I will find difficult.*" (S28). Another recognised that their lack of confidence stemmed from limited clinical experience and felt that "*as I build my experience as a junior my confidence in myself should continue to improve.*" (S21).

Change in self two: readiness for responsibility

Closely linked to confidence was a sense of readiness for the responsibilities students would face as doctors and the implications of

this. Most described this with cautious optimism, sometimes tempered by a degree of excitement or apprehension, and a sense of being "a*t the point where I feel ready to act as an F1 [newly-qualified] doctor.*" (S27). One student, for example, describes feeling *"as though I will be safe and have been given the skills required by the medical school to work safely and efficiently whilst also developing myself as a medical clinician and importantly a person next year too."* (S13), while another reflects on the feeling of "*satisfaction that I get from doing the job well and can see the responsibility and purpose that I have craved for the last 4 years in the work.*" (S1) Students often reflected on the many connected elements of their learning that would enable them to manage this new responsibility. One, focusing on working in a multi-disciplinary team reflected how *"I have had to develop my appreciation of different perspectives, and challenged myself on my own perspectives. It has allowed me to face dilemmas and conflict and reflect on how I can manage it better in the future, knowing that there is not always a right answer.*" (S10). (links to WTP3 and WTP4).

A few students described a sense of trepidation about the degree of responsibility they would soon face in a less than perfect health system (WTP5): "*I have seen junior doctors breaking bad news to patients and they are often the only doctor on the ward for most of the day…and they are often responsible for dealing with the fallout from an underfunded and overwhelmed medical system.*" (S30). Others highlighted how mistakes and adverse outcomes would sometimes happen and that "*knowing that my actions will have a direct consequence on a patient's outcome is generally quite frightening.*" (S29).

Another student, while accepting that "*mistakes are inevitable, and things will not always go the way you expect them to,*" reflected on how understanding this *"makes life that much easier as you will not be so hard on yourself as long as you remain transparent"* (S24) (link to WTP3). Other students pointed to the reassuring availability of support and advice if they feel out of their depth, while still accepting that in *"few months the bottom line stops with me."* (S29).

Discussion

This study of final year medical students' reflections on learning and change during their undergraduate training, including the most important and most difficult concepts they had encountered or understood, provides valuable insights into their learning over time and readiness for practice. The use of WTP as a sensitising concept seemed to resonate with the data as well as facilitating analysis. It encouraged us to ask new questions of the data: to better understand how students described the concepts they identified as important or difficult, and how they attached meaning to these and to the changes they described in themselves. It helped us understand what appeared to help them to develop these new ways of thinking like, feeling and being a doctor (1).

The extensive preparedness for practice literature, involving a range of stakeholder groups, generally finds new graduates well-prepared for history taking, examination and simple diagnosis but often unprepared for unexpected and complex situations, knowing their limitations, prioritisation and the psycho-social elements of patient care (21). Medical board examinations in many countries worldwide typically focus on the acquisition of medical knowledge, or assess specific competencies in controlled settings (22). There is far less emphasis on learning and assessments which support students to develop the capabilities they need to provide holistic care to complex patients (23), to work effectively in a multi-disciplinary team (24) and to integrate skills and knowledge in different, authentic settings (22). Higher scores in the MCQ component of board exams, do not show correlation with reports of perceived preparedness (25). Rather, Chaou et al. argue, junior doctors struggle more with "real-life patient care" than medical knowledge (p. 7). This illustrates "the issue of preparedness is not clear-cut." (26) (p. 9) WTP provides an opportunity to think in more expansive and contextualised ways about the curriculum, looking beyond disaggregated subject competencies and learning outcomes to consider how learners integrate these to gain bigger picture understandings and learn what it might mean to be part of their disciplinary community (6).

In this study, using WTP as a lens helped us to see how students made connections between different elements of their learning, including knowledge (knowing what), its application in practice (knowing how) and reflection and critical thinking (knowing why). For example, when reflecting on the WTP 'holistic patient-centred care' they critically reflected on why and how good communication skills, an awareness of personal bias, and the need to accept constraints such as time and workload, are all important in achieving this. When discussing decision-making ('thinking like a doctor WTP'), students frequently considered its complexity and why, and how to use, critical thinking skills, underpinning scientific and ethical principles and consideration of different people's perspectives. They often combined these with an acceptance of uncertainty, risk, not being able to fix everyone and knowing when to ask for help.

It is notable that the WTP and 'changes in self' themes identified in this study relate to, and may offer further insights into, the elements of Padley et al.'s work-readiness conceptual model (27). This was developed through a narrative view of the international literature on what constitutes work-readiness in medical graduates and includes 'confidence,' 'capability,' 'responsibility,' 'reflexivity,' and 'resilience.' The WTP identified in this study are also similar to threshold concepts previously reported in studies with medical students (16, 28). These include 'Sometimes there is not a right answer,' 'Medicine is not black and white but grey and complex,' 'Treating the whole patient' and 'You cannot save everyone.' In these studies, most students, who were in the earlier years of medical training, were still grappling with these concepts, recognising them as important but showing little evidence of transformation or irreversibility. Threshold concepts (TCs) are considered fundamental to the understanding of a discipline (29) and it is recognised that grasping them can take time as students traverse a 'liminal space' in learning (30), which usually involves struggle. While TCs describe transformative conceptual understandings, WTP are more concerned with how new and distinct disciplinary understandings can be applied in the workplace. However, there are parallels between the two (8). In our study, students commonly reflected on how grasping their new and complex ways of thinking and practising had involved a gradual shift over time. Evidence of change in how they saw themselves and their role as a doctor, as well as changes they described in their own behaviour, suggests our students had crossed conceptual thresholds and, in doing so, had grasped these new ways of thinking in practice. This may be fundamental to being prepared for practice.

Studies have found that graduates are often unprepared for the increase in responsibility and the psychological and emotional issues they will face (2, 4, 21). In this study some of our students recognised,

but found hard, the idea that they would continue to encounter issues such as resource and time constraints, bullying and hierarchy, and that these could impact both on their own health and on patient care. Despite this most students described a feeling of confidence, readiness, and even excitement, for the imminent shift to much greater responsibility as a junior doctor. This is very different from the idea of final year students, braced for an abrupt 'reality shock' (14) (p. 699), where Coakley et al. describe students, balancing some positive anticipation with significant apprehension. Where students expressed a sense of readiness, it was often linked to a feeling of confidence, a term which can have different meanings. Confidence can mean 'self-confidence,' an optimism about their overall, global performance (31). This, in itself, can help a new graduate "[perceive themselves] as a doctor" and integrate better into the medical team, a "virtuous cycle" which improves the junior's relationship with their supervisors (25) (p. 6). It may, however, carry with it the risk of students feeling more confident than their competence should allow (32). In this study, however, when students described feeling 'confident,' this aligned more closely with the notion of 'self-efficacy' i.e., a judgment as to their ability to address foreseeable specific situations (33). Self-efficacy has been associated with higher motivation and perseverance (34, 35) and may be an important element in students' successful transition to clinical practice. Corfield et al. report up to a quarter of newly qualified doctors showed over-confidence in ethical decisions and suggests that preparedness involves recognition of difficulty and acknowledging doubt (32). Our data suggests that, in grasping the 'acceptance and management of uncertainty and limitations' WTP, students recognised both that they do not need to be perfect and that they would be continually learning. As one student explicitly stated, 'too much confidence can be dangerous.'

In Ottrey et al.'s recent qualitative study, medical graduates described feeling unprepared in a number of areas including managing their time, responsibility, their own health, stress and emotions (4). Similarly, a 2017 GMC report cited significant challenges for newly qualified doctors, who felt stressed and unprepared for responsibility, multitasking, asking for help and unprepared for their own emotional responses (26). Therefore, it is relevant that in this study, one of the WTP identified was 'managing emotions and coping.' Within this theme students highlighted the importance of self-care, time management and the valuable support offered by their multi-disciplinary team. Wiese et al. highlight that managing emotions and self-care are ongoing skills, requiring further development in the new environment of clinical practice (36) (or as one of our students suggested "a work in progress.") Ensuring that the facilitating factors identified in our study, including supportive teams, role models and helpful feedback, are in place is likely to be important in the newly qualified trainee environment.

Our study has allowed us to identify curricular activities and strategies which appear to aid development of key WTPs which may be related to students' confidence in other areas with which newly qualified doctors struggle: managing complexity, ethical dilemmas, and maintaining holistic, patient centred care (28). Small group reflective discussion was frequently cited by students as helping them make sense of clinical learning experiences and make links to the theory learnt during teaching sessions. Indeed, reflection is a thread running through this study, both as a WTP itself and as a facilitator of learning and we have analysed this theme in more depth in a recent paper (37). Reflection has been identified as a critical element of health professions' education (38). Such activities allow students to explore uncertainty and complexity. They also encourage the examination of the hidden curriculum, personal biases and thorny issues such as empathy, resilience, resource constraints, boundaries and limitations. This study may provide evidence of positive, potentially under-recognised, value of curricular activities focussed on reflection, which arguably aid development of key WTP.

In this study, role models were also cited as a strong facilitator of student learning and were largely, but not always, seen as positive. Several students in this study highlighted difficult issues they experienced in the clinical setting such as hierarchy, tribalism, poor team-working, and work-life conflicts, and made explicit links in their reflections to the 'hidden curriculum'. All students in our school learn about, and reflect on examples of, the hidden curriculum during their course (39). Providing students with a tool to critically reflect on their clinical experiences and identify which modelled behaviours to emulate or not, may be particularly helpful in supporting the transition from student to doctor. Finally, our study also identified concepts such as heuristics, understanding decision making, and cognitive biases, as areas of significant learning. Curricular activities helping students understand this in theory and practice may help them in 'thinking like a doctor'.

Strengths and weaknesses

This study explores WTP, a conceptual framework little discussed in medical education, although it has been usefully explored in physiotherapy (40), history and biology (41). WTP can, it is suggested, be a useful approach for educators, particularly when looking beyond narrow competencies and learning outcomes to consider how best to prepare students for complexity of read real-world practice (42). While the WTP concept can be criticised for being open and hard to define (43), this is also true of the concept of preparedness' (1). This may be why WTP seemed to resonate with our data, in that it provides a more sophisticated approach for understanding the nuanced and multifaceted nature of being work ready.

This study has a number of strengths; it builds on previous related studies and uses a qualitative methodology, under-represented in the preparedness for practice literature. The analysis of 36 students' reflective writing offered rich and contextualised data. Quotes from all but one student have been used in this report, reflecting a breadth of data across the students studied and most students could have supplied several. The use of WTP offered us a new way to analyse the data and to study WTPs as they are learned (8). However, there are limitations. Some students' reflections on how their understandings had developed and changed over time may have been subject to memory issues and hindsight bias, although the majority did draw on past reflections which had been written soon after their experiences. It is also important to note that students' perceptions of readiness may change once practising and self-reported readiness can be shown to change in focus and degree during the first few months of work (4). The reflections of our final year students can be considered alongside findings that this cohort of students in this study did go on to score highly in the GMC trainee survey on perceptions of preparedness, reporting their perceptions some months after entering clinical practise (44).

All students were volunteers so we cannot be sure they are representative of the whole student cohort. A further limitation is that students' reflective tasks were assessed by their tutor and this may have led some to 'go through the motions' (45) and tell their tutor what they thought they wanted to hear. However, students were assessed on the process, not the content, of their reflections, and would be aware from previous years that failing was rare and that they had the opportunity to re-write their reflection if needed. Another limitation is that students were not specifically asked about how prepared they felt for practice. The advantage is that students were not trying to write their reflections to fit this question, but it may be that important issues related to preparedness were not mentioned.

Conclusion

This study suggests that Ways of Thinking and Practising may be a useful qualitative approach for medical educators to better understand how students view their learning and development during their undergraduate course. WTP may also offer educators and students a perspective on preparedness that, alongside competencies and skills, renders concrete the abstract activity of meaning-making. In this study, using WTP as a sensitising concept helped us to identify the conceptual understandings, personal changes and curricular elements that supported students towards thinking, acting like, and being a doctor. It enabled us to examine students' capacity for metacognition, critical thinking, and above all their ability to make connections (for example between experience and knowledge and between different elements of the curriculum), and the relationship between this and their developing feelings of confidence and readiness for responsibility. In doing so this study may offer insights into how students make sense of medical practice at the point of entry into medicine.

While being competent may be an important element of preparedness, becoming aware of and comfortable with the disciplinary WTP identified in this study may also be key to work readiness. Quantitative analyses of preparedness disaggregate the experiences of new doctors into discrete measurable sets of competencies and skills. Results of such studies may contribute to educational practices that orient educators towards specific, focused behaviours at the expense of emphasising processes and 'ways of doing.' Unawareness of processual issues and their complexity in real time are likely to contribute to the initial shock reported by new doctors as they enter the workplace for the first time.

We cannot draw conclusions from this study as to how prepared our students really were, or whether they were able to implement the ideas they shared once working as junior doctors. The WTPs they report, however, may have aided their transition to their new role, where they later scored highly in self-reported preparedness, compared to peers from most other schools. Further studies, examining how WTP develop alongside their professional identity through undergraduate courses, and into the workplace beyond, could be valuable in establishing further insight into the enablers of preparedness. Conducting studies at other institutions could determine the generalisability of our findings for WTP in medicine and identify other curricular activities which appear to help students internalise these.

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 Research Ethics and Integrity Committee, Faculty of Health and Humans Sciences and Faculty of Medicine and Dentistry, University of Plymouth. 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

RL: Conceptualization, Formal analysis, Investigation, Methodology, Project administration, Software, Writing – original draft, Writing – review & editing. HN: Conceptualization, Formal analysis, Investigation, Methodology, Supervision, Writing – original draft, Writing – review & editing. ED: Formal analysis, Investigation, Writing – original draft, Writing – review & editing. TC: Conceptualization, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing.

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