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Original research article

The role of nurses in interprofessional pharmaceutical care: a qualitative descriptive study of international expert perspectives

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Abstract
Introduction: Pharmaceutical care has evolved from a pharmacist-led model to an interprofessional approach involving doctors, pharmacists, and nurses. Effective collaboration is key to patient safety and treatment optimisation, yet it is often hindered by hierarchical systems, unclear roles, and poor communication. A lack of formalised frameworks further limits collaboration.
Aim: This study explores interprofessional collaboration in pharmaceutical care, focusing on the role of nurses, their involvement in collaborative practice, and the competencies essential for effective teamwork as identified by international experts.
Methods: A qualitative study using semi-structured interviews was conducted with five international experts, selected through purposive sampling. Data were thematically analysed using Atlas.ti. Rigour was ensured through triangulation, multiple coding, and participant feedback. The COREQ checklist guided reporting.
Results: Five themes emerged: (1) Interprofessional collaboration, (2) Roles and responsibilities, (3) Barriers to collaboration, (4) Education and competencies, and (5) Organizational support.
Discussion: Despite the recognized value of collaboration, systemic and educational obstacles persist. Structural backing, clarified roles, and integrated training are essential for improving teamwork.
Conclusion: Interprofessional collaboration is vital to enhancing pharmaceutical care. Addressing educational gaps, formalising procedures, and using digital tools can strengthen care delivery and patient outcomes. Nurses play a key role in pharmaceutical care through treatment monitoring and identifying medication-related problems. Expanding their roles within teams can improve safety. Policymakers should prioritize role clarity, interprofessional education, and digital support systems.

Keywords: Healthcare teamwork; Interprofessional collaboration; Nursing role; Pharmaceutical care; Policy development

Introduction

Pharmaceutical care, which focuses on optimizing medication use and improving patient health outcomes, has become an essential component of public healthcare today (Dilles et al., 2021; Petrović et al., 2021). Collaboration, mutual respect, and agreement among all stakeholders regarding responsibilities in this complex process of pharmaceutical care are crucial for patients to fully benefit from modern medicine (Dilles et al., 2021).

Pharmaceutical care was long defined as the exclusive domain of pharmacists. However, over time, it has become evident that it is not an isolated field but rather one that requires interprofessional collaboration among various healthcare professionals who interact with medications (Petrović et al., 2021). In 2020, the Council of Europe adopted a new resolution on pharmaceutical care, defining it as the responsible provision of pharmacotherapy to achieve outcomes that enhance patients' quality of life (Council of Europe, 2020). Core outcome sets for pharmaceutical care commonly include medication-related hospitalisations, inappropriate medication use (overuse or underuse), potentially inappropriate prescriptions, clinically significant drug interactions, adverse drug reactions, falls, pain management, quality of life, medication regimen complexity, mortality, and other medication-related outcomes (Coenen, 2024; Dilles et al., 2021).

Implementing pharmaceutical care is key to improving outcomes for both patients and healthcare systems. Patients, along with their family members or informal caregivers, are regarded as essential partners in care, actively collaborating with healthcare professionals to set care goals and evaluate their achievement (Dilles et al., 2021). In this context, the Council of Europe (2020) resolution highlights the potential for opti-

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mising pharmaceutical care through interprofessional collaboration among doctors, pharmacists, and nurses. This approach promotes patient-centred care while also acknowledging existing challenges. The resolution outlines the key steps involved in the pharmaceutical care process: (1) assessing the patient's medication regimen, health problems, and overall health status; (2) identifying and prioritising medication-related issues; (3) selecting appropriate interventions and developing a pharmaceutical care plan; (4) agreeing on, implementing, and monitoring the care plan in collaboration with the patient; (5) continuously monitoring the patient's progress (Council of Europe, 2020).

In recent years, the role of nurses has been formally integrated into the pharmaceutical care model alongside physicians and pharmacists, reinforcing the importance of interprofessional collaboration in ensuring safe and effective patient care (De Baetselier et al., 2020; Dijkstra et al., 2021). Coordinated and high-quality teamwork among healthcare professionals significantly reduces the likelihood of professional errors related to treatment and medication administration (Helgesen et al., 2024). To achieve such collaboration, it is essential that team members understand each other's roles, skills, and competencies, and engage in mutual respect and effective communication (Alhawsawi et al., 2023; Sudeshika et al., 2022). Aligned with these principles, the American Pharmacists Association has outlined six key elements of high-quality pharmaceutical care: (1) knowledge, skills, and appropriate personnel; (2) robust systems for data collection, documentation, and information sharing; (3) efficient workflows supported by adequate resources and equipment; (4) strong communication skills; (5) a commitment to continuous quality improvement; and (6) structured assessment and evaluation processes (Aljamal and Alrowili, 2019). These elements serve as a comprehensive framework to support interprofessional collaboration and enhance the delivery and quality of pharmaceutical care.

Today, the implementation of pharmaceutical care is supported by knowledge and skills in assessing patients' health conditions, clinical information, communication, educational principles, and psychosocial aspects of care. Therefore, defining roles and responsibilities in interprofessional collaboration within pharmaceutical care is essential (De Baetselier et al., 2021; Dijkstra et al., 2021).

Effective collaboration among healthcare professionals enhances teamwork and mitigates issues in professional relationships. Nevertheless, research highlights persistent shortcomings in interprofessional collaboration in practice (Vestergaard and Nergaard, 2018). Professional hierarchies continue to privilege certain groups, thereby hindering effective teamwork (Gleeson et al., 2023). To address these barriers, changes should be introduced early in healthcare education to challenge stereotypical beliefs that negatively affect collaboration. In the Slovenian context, most research has focused on collaboration between physicians and nurses, while the role of the broader healthcare team remains insufficiently examined (Šanc and Prosen, 2022). Consequently, a comprehensive model of interprofessional collaboration, particularly in pharmaceutical care, has yet to be fully developed. However, early studies (Petrović et al., 2021, 2023) indicate a strong willingness among professionals in medicine, pharmacy, and nursing to engage in such collaborative practice. Although previous studies have examined interprofessional pharmaceutical care within individual national contexts, little is known about the broader international expert perspectives on the role of nurses. This study addresses this gap by exploring general international experiences and insights into interprofessional collaboration.

Study aim

The purpose of this study was to investigate the factors that shape interprofessional collaboration in the provision of pharmaceutical care and to explore the attitudes and beliefs of physicians, pharmacists, and nurses regarding the role of nurses in this process. The study aimed to provide insights into professional, systemic, and contextual conditions that enable or hinder collaborative pharmaceutical care across healthcare settings.

- What contextual characteristics influence interprofessional collaboration among physicians, pharmacists, and nurses in the provision of pharmaceutical care, and in what ways do these characteristics shape collaboration?
- Which key aspects, competencies, and principles of interprofessional collaboration in pharmaceutical care are emphasized by international experts?

Materials and methods

Study design

A qualitative descriptive research method was used, as it allows for a deeper insight into individuals' thoughts, understanding, and behaviour due to the nature of the studied phenomenon (Renjith et al., 2021). The Consolidated Criteria for Reporting Qualitative Research (COREQ) (Tong et al., 2007) were used in this article.

Sample

A purposive sample of key informants, selected as experts in the field of pharmaceutical care, was used. A purposive sample was chosen because its advantage lies in obtaining targeted information on matters relevant to the research through individuals who are most familiar with or involved in the studied phenomenon (Asiamah et al., 2017). Hence it was suitable for this research paradigm.

The study included five internationally recognized experts – one from the UK and four from the EU – in the field of pharmaceutical care, with whom individual interviews were conducted. Guidelines suggest that a small number of interviews (e.g., 5–8) may be appropriate for highly focused studies or where experts share relatively homogeneous experiences and perspectives (Bogner et al., 2009). The sample was balanced in terms of gender, with both female and male experts, and spanned a wide age range (35 to 65 years), contributing a rich combination of clinical, academic, and managerial perspectives. Their professional experience in healthcare-related roles ranged from nearly two decades to over four decades, with an average of more than 24 years. All participants had actively contributed to national or international initiatives aimed at advancing pharmaceutical care and interprofessional collaboration and had firsthand experience with interprofessional practices in primary, secondary, or tertiary care settings. To protect anonymity, individual characteristics are presented in aggregate, and no identifying information is linked to specific quotes.

To ensure the relevance and expertise of the collected data, experts included in the study met the following criteria: (1) active professionals in the field of pharmaceutical care and/or interprofessional collaboration in healthcare, (2) at least five years of work experience in clinical pharmacy, nursing, medicine, or healthcare management, (3) experts who have previously participated in projects or research related to pharmaceutical care or interprofessional collaboration, (4) a pharmacist, physician, nurse, or researcher actively engaged

in pharmaceutical care and interprofessional collaboration research, (5) practice or research focused on improving pharmaceutical care and optimizing patient treatment, and (6) proficiency in spoken English.

Data collection

The data were collected with the method of expert interview. This is an important qualitative method used in empirical social research to collect specialized knowledge from individuals considered experts in their respective fields (Döringer, 2020). Its primary goal is to gain insight into specific, often hidden knowledge related to decision-making processes and systemic structures. The expert interview is recognized for its ability to systematically reconstruct expert knowledge through guided, often semi-structured formats. This research method is particularly well-suited for studies in the field of health sciences, where understanding professional behaviour and decision-making is of critical importance (Döringer, 2020).

The interview guide included open-ended questions structured around four main themes: (1) Current experiences: participants were invited to describe their present experiences with interprofessional collaboration in pharmaceutical care and identify the healthcare professionals (e.g., doctors, nurses, pharmacists) involved in such collaborations. They also reflected on the frequency and nature of these interactions in everyday clinical practice. (2) Effectiveness of collaboration: questions addressed perceived challenges in collaborative practice, including communication gaps, the existence of formal procedures, and key factors contributing to successful collaboration. (3) Impact on patients and quality of care: this section explored participants' views on how interprofessional collaboration influences patient care quality, including specific examples of positive outcomes. Participants also considered the role of patient involvement in collaborative pharmaceutical care. (4) Opportunities for improvement: the final section asked participants to identify opportunities for enhancing interprofessional collaboration and to suggest ways in which healthcare systems could better support collaborative practices.

In addition to the interview questions, general socio-demographic data were collected, including gender, age, years of work experience, level of education, country of residence, additional qualifications in pharmaceutical care, previous work settings, and current field of work (e.g., clinical practice, research, education, policy, or management). Experts were invited to participate via email invitation, along with a description of the study. The interviews were conducted remotely using online audio-video tools (e.g., Zoom, Microsoft Teams).

All interviewees were informed about the purpose and objectives of the study, and their identities were anonymized by assigning pseudonyms (Expert_1, Expert_2, etc.). Before the start of the interview, all participants signed an informed consent form. All interviews were conducted in English between December 2024 and January 2025, recorded, and subsequently transcribed verbatim. This approach ensures the systematic processing of data and facilitates further analysis (Kiger and Varpio, 2020).

Data analysis

The analysis was based on thematic analysis following Thorne's (2016) methodological framework. The analytical process included: (1) Inductive coding – data were reviewed and divided into meaningful units without predefined categories. (2) Category development – similar units were grouped into broader categories that described key aspects of the studied phenomenon. (3) Theme identification – based on the categories, themes were formed to interpret and explain the findings. (4) Ensuring credibility – the analysis included data triangulation, multiple coding verification, and participant feedback. The analysis was conducted using the ATLAS.ti software (Scientific Software Development GmbH, Federal Republic of Germany).

Rigor and trustworthiness

To ensure the rigor and reliability of the study, the data collection process was conducted in accordance with a predefined and standardized research protocol, ensuring methodological consistency across all research settings. In the analytical phase, a systematic process of coding and categorization was applied, based on a unified analytical framework. After the initial analysis, the data were translated into English, and a subgroup of researchers was established to further develop the key themes. Linguistic accuracy and semantic consistency were ensured, preserving the original meanings of concepts and eliminating potential ambiguities in interpretation (James et al., 2024). To enhance the credibility of the results, repeated meetings of the research team were conducted, during which themes were iteratively refined and aligned with the original data. Additionally, the analysis was supported by the verification of key themes using direct excerpts from the transcripts, allowing for the validation of consistency and relevance of the findings (Halme et al., 2024). An audit trail was implemented to ensure traceability of the analytical process from raw data to final interpretations. This measure enhanced the transparency of the study, reinforcing its reliability and reproducibility.

Ethical consideration

The study was conducted in accordance with the principles of the Helsinki-Tokyo Declaration (World Medical Association, 2013). The research was carried out under the ethical approval of the University of Primorska, Commission for Research Involving Human Subjects, as part of the overarching study "Health of the Working Population" (Reference No: 4264-19-6/23).

Results

The final sample consisted of five international experts in the field of pharmaceutical care, including professionals from various European countries and the United Kingdom. Of the five experts, four were female and one was male. The experts' ages ranged from 35 to 65 years, with an average age of 46 years. Their professional experience ranged from 17 to 47 years, with an average of 24.6 years of work experience in healthcare-related roles. Participants represented diverse professional backgrounds, including clinical pharmacy, medicine, nursing, research, and healthcare policy.

Due to the nature of the study, the analysis yielded results categorized into five themes: (1) Interprofessional collaboration in pharmaceutical care, (2) Roles and responsibilities, (3) Challenges in interprofessional collaboration, (4) Education and development, and (5) Organizational support (Table 1).

Table 1. Defined themes

Theme	Subtheme	Sample quotations
Interprofessional collaboration in pharmaceutical care	Communication gaps	*"Doctors work with the same patient as I do, but we have no communication bridges"* (Expert_2)
	Digital tools for communication	*"Tools such as electronic health records enable real-time collaboration"* (Expert_4)
	Benefits of collaboration	*"If people know each other, the barrier to establishing contact is lower"* (Expert_4)
	Functioning of multidisciplinary teams	*"Multidisciplinary teams enable better treatment coordination, especially for chronic patients"* (Expert_1)
Roles and responsibilities	Unclear roles and responsibilities	*"They often do not know who is responsible for a specific task"* (Expert_5)
	Interdependence of professionals	*"Nurses play an important role in observing medication-related issues"* (Expert_5)
	Role of the doctor	*"Doctors are the primary prescribers of medications, but they often lack detailed knowledge of pharmacotherapy"* (Expert_1)
	Role of the pharmacist	*"Pharmacists are often not present in hospital wards, so communication with them is not regular"* (Expert_1)
	Role of the nurse	*"Nurses have the most contact with patients, giving them a unique insight into their condition"* (Expert_1)
	Importance of patient involvement in collaborative decision-making	*"When patients participate in decisions about their treatment, their adherence to therapy significantly increases"* (Expert_1)
Challenges in interprofessional collaboration	Lack of time	*"Time is a key challenge in improving collaboration"* (Expert_3)
	Hierarchical barriers	*"Some doctors feel threatened when we ask them about prescribing"* (Expert_4)
	Technological barriers	*"Different systems make information sharing more difficult"* (Expert_5)
Education and development	Lack of interprofessional educational programs	*"There are too few interprofessional courses, and they are often limited to smaller projects"* (Expert_5)
	Adapting educational content to practical needs	*"Nurses do not receive enough knowledge about pharmaceutical care during their studies"* (Expert_5)
	Development of interprofessional skills	*"Simulations and workshops help healthcare professionals learn how to collaborate"* (Expert_1)
Organizational support	Supportive leadership	*"Leadership must create conditions where collaboration is supported with resources and time"* (Expert_3)
	Policies and protocols	*"Formalized protocols for information sharing improve teamwork"* (Expert_4)
	Resource allocation	*"Organizations must ensure sufficient time for team meetings"* (Expert_1)

Theme 1: Interprofessional collaboration in pharmaceutical care

The experts recognized interprofessional collaboration as essential for effective pharmaceutical care. However, in practice, it faces multiple challenges, such as communication gaps, inconsistent use of digital tools, and insufficient utilisation of the potential of interprofessional collaboration among healthcare professionals.

Three experts exposed communication issues between doctors, pharmacists, and nurses, which often complicate the coordination of pharmaceutical care. They emphasized that a lack of clear communication channels can lead to duplicated work or suboptimal decisions in patient management.

"Doctors work with the same patient as I do, but we have no communication bridges" (Expert_2).

"Nurses are not always included in communication, despite having important information" (Expert_5).

"Pharmacists say they cannot reach the clinic because their calls go unanswered" (Expert_3).

Experts recognize digital tools as a key asset for improving interprofessional communication, yet their implementation remains inconsistent. Participants pointed out the need for a unified system that would enable real-time access to critical data.

"Tools such as electronic health records enable real-time collaboration" (Expert_4).

"Data-sharing platforms are essential for improving communication" (Expert_5).

"We need a unified system where everyone can access key information" (Expert_3).

Two experts noticed that interprofessional collaboration offers numerous benefits, particularly in reducing medication errors and improving the quality of pharmaceutical care.

"When pharmacists, doctors, and nurses collaborated in treatment planning, medication prescribing errors were significantly reduced" (Expert_1).

"Collaboration allows for more efficient use of resources and improved patient care, as confirmed by the results of our studies" (Expert_2).

Experts believe that multidisciplinary teams enhance treatment coordination, especially for complex patients and chronic conditions.

"When a pharmacist is included in a multidisciplinary team, treatment oversight improves, and the risk of errors decreases" (Expert_3).

"Regular multidisciplinary meetings enable faster problem-solving and better monitoring of patient progress" (Expert_4).

"In a multidisciplinary team, information can be shared more effectively, reducing duplicated work and medication errors" (Expert_5).

Overall, experts agreed that poor communication and fragmented digital systems remain the most critical obstacles, whereas regular multidisciplinary meetings represent the most effective enabler of collaboration.

Theme 2: Roles and responsibilities

Clearly defined roles and responsibilities among healthcare team members are very important. However, in practice, there are often overlaps in tasks, uncertainties regarding authority, and insufficient involvement of certain professionals in the decision-making process.

Experts emphasized that unclear task allocation leads to duplicated work or errors in patient care.

"They often do not know who is responsible for a specific task" (Expert_5).

"Nurses observe issues but do not always report them to doctors" (Expert_2).

"There is a lack of clear division of responsibilities between doctors and pharmacists" (Expert_4).

Based on expert input, the findings suggest that all team members have unique competencies that are essential for safe and effective treatment.

"Nurses play an important role in observing medication-related issues" (Expert_5).

"Pharmacists have the most expertise in drug interactions" (Expert_3).

According to the experts, physicians play a key role in prescribing medications but often require support from pharmacists and nurses.

"Doctors are the primary prescribers of medications, but they often lack detailed knowledge of pharmacotherapy" (Expert_1).

"Coordination of medication prescribing between doctors and pharmacists is crucial" (Expert_2).

Two experts indicated that pharmacists are critical for ensuring the safe use of medications, but they are often not systematically integrated into clinical processes.

"Pharmacists are often not present in hospital wards, so communication with them is not regular" (Expert_1).

"Communication between pharmacists and other professionals is essential, yet it often does not function effectively" (Expert_4).

In addition, experts emphasized that nurses have direct contact with patients and play an important role in monitoring treatment effects.

"Nurses often recognize problems that others overlook, but they do not always report them" (Expert_3).

"Nurses are often the first to notice adverse drug reactions" (Expert_4).

Experts also highlighted that involving patients in the decision-making process leads to better treatment outcomes and adherence.

"When patients participate in decisions about their treatment, their adherence to therapy significantly increases" (Expert_1).

"Patients who understand their treatment plan experience fewer complications and achieve better outcomes" (Expert_3).

Theme 3: Challenges in interprofessional collaboration

Although interprofessional collaboration is widely acknowledged as beneficial, its implementation in pharmaceutical care is often constrained by persistent structural and systemic barriers, such as limited time availability, entrenched hierarchies, and insufficient technological integration.

Experts noted that one of the main challenges in improving collaboration in pharmaceutical care is the lack of time, as healthcare professionals often cannot allocate additional hours for coordination and multidisciplinary meetings.

"Time is a key challenge in improving collaboration" (Expert_3).

"Everyone is too busy for additional meetings" (Expert_2.)

"Time constraints make it difficult to implement changes" (Expert_4).

Experts pointed out that hierarchical structures of healthcare institutions often hinder equal collaboration among healthcare professionals, as lower-level staff find it more difficult to participate in clinical decision-making.

"Some doctors feel threatened when we ask them about prescribing" (Expert_4).

"Nurses are often less willing to challenge doctors' decisions" (Expert_3).

"Hierarchy is one of the main barriers to collaboration" (Expert_5).

Experts further stressed that the use of digital systems and access to data are crucial for effective collaboration, yet healthcare professionals face technological limitations, such as inconsistent information systems and restricted data access.

"Different systems make information sharing more difficult" (Expert_5).

"We need a unified electronic system" (Expert_4).

"Technological solutions are not accessible to everyone" (Expert_1).

Taken together, time constraints, professional hierarchies, and technological fragmentation were consistently recognized as the main systemic barriers to interprofessional collaboration.

Theme 4: Education and development

The advancement of interprofessional collaboration in pharmaceutical care relies heavily on targeted education and ongoing professional development. While the inclusion of interdisciplinary content in healthcare curricula is increasingly advocated, experts identified notable gaps and limitations in current educational structures and practices.

Experts emphasized the lack of programs that systematically address interprofessional collaboration and facilitate a better understanding of different professional roles within the healthcare team.

"There are too few interprofessional courses, and they are often limited to smaller projects" (Expert_5).

"Healthcare professionals often do not understand the roles of other specialists due to a lack of joint training" (Expert_4).

"Integrating interprofessional modules into education would improve collaboration" (Expert_2).

Moreover, experts pointed out that current educational programs often do not include content that reflects the real needs of clinical practice and pharmaceutical care.

"Nurses do not receive enough knowledge about pharmaceutical care during their studies" (Expert_5).

"*Programs for doctors and pharmacists do not include enough content on teamwork"* (Expert_3).

"Education should be focused on solving practical problems in patient care" (Expert_4).

Interprofessional collaboration requires specific skills that can be developed through interactive learning methods, simulations, and practical training.

"Simulations and workshops help healthcare professionals learn how to collaborate" (Expert_1).

"Interactive training increases confidence in interprofessional communication" (Expert_3).

"New forms of education, such as group projects, improve interprofessional connections" (Expert_4).

Theme 5: Organizational support

The study findings confirm that organizational support is equally important for effective interprofessional collaboration in pharmaceutical care. Supportive leadership, clear protocols, and optimal resource allocation are key factors influencing successful collaboration.

Expert emphasized several aspects of supportive leadership:

"Leadership must create conditions where collaboration is supported with resources and time" (Expert_3).

"Organizational culture should promote equality among all team members" (Expert_2).

Clear policies and protocols were identified by experts as essential for structured interprofessional collaboration. Experts highlighted the following points:

"Formalized protocols for information sharing improve teamwork" (Expert_4).

"Legislation on information sharing is a good start, but further practice is needed" (Expert_3).

Finally, experts emphasized that, adequate allocation of resources, both financial and technological, facilitates more effective collaboration:

"Organizations must ensure sufficient time for team meetings" (Expert_1).

"Lack of financial resources hinders the implementation of innovations" (Expert_3).

"Adequate technological support is essential for coordination" (Expert_5).

Discussion

This study investigated the contextual characteristics that define interprofessional collaboration among doctors, pharmacists, and nurses, and identified the key aspects, competencies, and principles most emphasized by international experts. The findings highlight that while interprofessional collaboration is increasingly recognized as essential for safe and effective pharmaceutical care, its practical implementation remains inconsistent and challenged by systemic, educational, and organizational barriers.

Our findings differ from previous studies as they show how nurses' contribution to pharmaceutical care is systematically underutilized, despite their critical role in monitoring adherence and detecting adverse medication reactions. This perspective extends existing European research by showing that differences between healthcare systems shape the degree of nurses' integration into pharmaceutical care teams.

In the Slovenian healthcare context, collaboration among healthcare professionals in pharmaceutical care is not yet widespread. Currently, structured interprofessional collaboration is only systematically applied within a single clinical department in Slovenia (Petrović et al., 2021). This limited implementation suggests that contextual factors such as organizational readiness, professional hierarchies, and systemic support significantly shape the extent and quality of collaboration. The persistence of hierarchical structures, as noted in both this study and previous literature (Gleeson et al., 2023; Vestergaard and Nergaard, 2018), undermines efforts toward equal participation of nurses and pharmacists in clinical decision-making. Similarly, a European-wide scoping review has shown that ambiguity in role descriptions remains a critical barrier across many countries, often leaving nurses in a subordinate or undefined position in pharmaceutical care teams (De Baetselier et al., 2021).

Furthermore, interprofessional collaboration is shaped by existing communication cultures and the degree to which digital solutions facilitate or hinder information exchange (Alhawsawi et al., 2023; Sudeshika et al., 2022). In successful European initiatives, such as those studied in Belgium, a bottom-up approach combined with consistent team consultations and shared documentation emerged as pivotal enablers of sustainable interprofessional collaboration. These initiatives benefited from supportive meso- and macro-level conditions, including dedicated coordination, flexible ICT systems, and aligned political frameworks (Coenen et al., 2024).

Experts consistently stressed the importance of clearly defined roles and responsibilities. This supports findings from De Baetselier et al. (2021), who argue that effective pharmaceutical care depends on mutual recognition of each professional's competencies. In this study, it became evident that nurses are frequently underutilized, despite their critical role in monitoring medication adherence and observing adverse drug reactions. This observation echoes the findings of the NuPhaC-EU framework study, in which over 80% of professionals from 14 countries recognized nurses' roles in medication safety, adherence monitoring, and patient education – yet many of these roles were not formalized in clinical protocols or job descriptions (De Baetselier et al., 2021). Similarly, pharmacists are not always integrated into the clinical environment, limiting their ability to contribute to decision-making processes. This reinforces the need for systemic change that includes formal recognition of roles, supported by clear protocols and institutional policies (Council of Europe, 2020). When examining healthcare systems, the degree of nurse integration into pharmaceutical care varies. In the UK and Nordic countries, expanded nursing roles and prescribing rights provide stronger structural support for collaboration, while in Slovenia and parts of Central Europe, interprofessional pharmaceutical care remains less formalized and more dependent on individual initiatives (De Baetselier et al., 2021; Petrović et al., 2023; Vestergaard and Nergaard, 2018).

Educational preparation emerged as a key theme influencing collaboration. Our findings indicate a clear deficiency in interprofessional content within existing educational programmes in Slovenia. This aligns with international evidence from a cross-sectional study covering 14 European countries, where 84% of nursing students indicated that their curricula insufficiently prepared them for pharmaceutical care responsibilities (De Baetselier et al., 2020). A critical issue here is not merely the inclusion of pharmacology but the explicit integra-

tion of interprofessional modules, shared simulations, and collaborative problem-solving into nursing education. Countries with more advanced nurse prescribing policies, such as the UK, Finland, and Ireland, offer postgraduate programmes that blend clinical pharmacology with decision-making and communication training – components lacking in Slovenia (Petrović et al., 2023).

Evidence underscores the critical need for joint training and interprofessional education within multidisciplinary teams (Aljamal and Alrowili, 2019; Dijkstra et al., 2021). A key observation of experts in this study is that healthcare professionals often have a limited understanding of each other's roles, which impedes effective collaboration. To address this gap, the integration of interprofessional modules, simulation-based learning, and collaborative projects into formal education programmes is essential. Such educational strategies can significantly strengthen teamwork competencies and better equip future professionals for the realities of integrated pharmaceutical care delivery.

The study also points out the pivotal role of organizational support. Experts emphasized that supportive leadership, sufficient resource allocation, and well-developed communication structures are prerequisites for effective collaboration. These findings reflect earlier studies that advocate for leadership-driven initiatives to embed interprofessional practices into everyday routines (Bollen et al., 2019; Gleeson et al., 2023; Vestergaard and Nergaard, 2018). In this regard, Slovenian healthcare institutions must prioritize structural reforms that facilitate multidisciplinary meetings, shared decision-making, and interprofessional planning.

From an international perspective, key competencies and principles identified by experts include communication, mutual respect, shared responsibility, and understanding of roles. These are consistent with the six elements of high-quality pharmaceutical care proposed by the American Pharmacists Association, which include functional personnel, communication skills, quality improvement, and assessment (Aljamal and Alrowili, 2019). The Delphi study, which informed the NuPhaC-EU competence framework, similarly highlighted these attributes, proposing a harmonized structure of nursing tasks across European contexts to enhance clarity and mobility (Bollen et al., 2019; De Baetselier et al., 2021).

Moreover, the EUPRON and NuPhaC studies repeatedly draw attention to the gap between the expected and actual contributions of nurses to pharmaceutical care. Experts call for regulatory harmonization, sustained investment in education, and a cultural shift that positions nurses as co-responsible agents in the medication process, not just assistants in administration (De Baetselier et al., 2020, 2021; Dijkstra et al., 2021).

Our study highlights a gap between the recognized value of interprofessional collaboration in pharmaceutical care and its practical realisation in Slovenia. Contextual characteristics, such as limited institutional support, fragmented communication systems, hierarchical professional structures, and underdeveloped interprofessional education, present concrete barriers. At the same time, insights from international experts provide clear guidance on the principles, competencies, and structural conditions necessary for successful collaboration. Bridging this gap requires targeted educational reform, policy development, and organizational transformation to build sustainable and effective interprofessional pharmaceutical care teams. As the European evidence shows, progress is possible, but it demands a strategic commitment to clarity, equity, and trust across all levels of the healthcare system.

Study limitations

Much of the data is based on participants' self-assessments, which may introduce bias, such as socially desirable responses or personal interpretations. A similar issue may arise in the qualitative part of the study, where subjective perceptions f interprofessional collaboration in pharmaceutical care and potential biases of interviewees could lead to misinterpretation of results. There is also a risk that interviewees may adjust their responses to align with the perceived expectations of the researcher.

Although anonymity was ensured for all participants, and this was explicitly communicated to them, the sensitive nature of interprofessional collaboration in pharmaceutical care may still lead to cautious or less candid responses. Some healthcare professionals may fear potential professional or hierarchical consequences if their perspectives on collaboration were to become publicly known. These factors should be considered when interpreting the findings, as they may influence the accuracy and reliability of the reported experiences and attitudes toward interprofessional collaboration in pharmaceutical care.

Implications

The study findings have significant implications for healthcare practice and policy development. Enhancing interprofessional education is crucial, as healthcare institutions should integrate interprofessional training programs for doctors, pharmacists, and nurses to improve collaborative competencies. Developing clear collaboration protocols by establishing standardized communication channels and formalizing the roles of healthcare professionals in pharmaceutical care can enhance efficiency and reduce medication errors. Additionally, leveraging technology for better coordination through improved digital infrastructure, such as shared electronic health records and clinical decision support systems, can facilitate better communication and real-time collaboration among healthcare providers. In particular, the integration of interoperable electronic health records accessible to physicians, pharmacists, and nurses was highlighted as a practical step to improve coordination and reduce medication errors.

To further strengthen interdisciplinary pharmaceutical care, organizational support should be prioritized by ensuring that hospital and healthcare administrators allocate resources and time for interprofessional collaboration, including routine multidisciplinary meetings and consultations. Policy reforms to support nurse involvement are also essential, as recognizing and defining the role of nurses in pharmaceutical care will enable them to actively participate in medication management and decision-making processes. Finally, encouraging patient-centred care by engaging patients as active participants in pharmaceutical care can improve adherence to therapy and enhance treatment outcomes.

By implementing these recommendations, healthcare systems can transition towards more integrated and collaborative pharmaceutical care models, ultimately improving patient safety and treatment effectiveness.

Conclusion

Our study confirms that interdisciplinary pharmaceutical care is essential for improving patient safety and treatment effectiveness. However, in practice, several barriers persist, including unclear communication pathways, insufficient integration of healthcare professionals' roles, and a lack of educational support. To improve the current situation, systemic measures

are needed, including the introduction of interprofessional education programs, enhanced digital support for information exchange, and the establishment of formal organizational structures that promote collaboration among healthcare professionals. However, the study is limited by the small international sample size, which is typical for qualitative research but restricts generalizability. Findings are also based on self-reported perceptions, which may include subjectivity. These limitations should be considered when interpreting the results. Further research is necessary to gain a deeper understanding of the impact of interdisciplinary collaboration on long-term patient health outcomes and to develop tailored collaboration models that can be implemented in various healthcare settings.

Ethics approval and consent to participate

Ethical approval for this study was granted by the University of Primorska Commission for Research Involving Human Subjects (Approval No: 4264-19-6/23). All participants provided written informed consent prior to participation.

CRediT authorship contribution statement

M. Petrović: Conceptualization, Data Collection, Data Analysis, Writing – Original Draft Preparation. *M. Petrović* and *M. Prosen:* Interpretation of Data, Writing – Reviewing and Editing. *M. Prosen:* Methodology, Supervision, Finalization of Manuscript.

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Conflict of interest

The authors have no conflict of interest to declare.

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