



Perceptions and expectations of health professionals regarding hospital pharmacy services and the roles of hospital pharmacists: A qualitative systematic review and meta-synthesis

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ABSTRACT

Background: Pharmacists have become increasingly integrated within the interprofessional hospital team as their scope of practice expanded in recent decades. However, limited research has explored how the roles of hospital pharmacists are perceived by other health professionals.

Aim/Objective(s): To identify what is known about the perceptions of hospital pharmacists' roles and hospital pharmacy services held by non-pharmacist health professionals.

Methods: A systematic literature search was conducted in August 2022 in MEDLINE, Embase, and CINAHL to identify peer-reviewed articles published between 2011 and 2022. Title/abstract and full-text screening, by two independent reviewers, identified eligible articles. Inclusion criteria included qualitative studies in hospital settings that reported perceptions regarding the roles of hospital pharmacists held by non-pharmacist health professionals. Data were extracted using a standardised extraction tool. Collated qualitative data underwent inductive thematic analysis by two independent investigators to identify codes, which were reconciled and merged into over-arching themes through a consensus process. Findings were assessed to measure confidence using the GRADE-CERQual criteria.

Results: The search resulted in 14,718 hits. After removing duplicates, 10,551 studies underwent title/abstract screening. Of these, 515 underwent full-text review, and 36 were included for analysis. Most studies included perceptions held by medical or nursing staff. Hospital pharmacists were perceived as valuable, competent and supportive. At an organisational level, the roles of hospital pharmacists were perceived to benefit hospital workflow and improve patient safety. Roles contributing to all four domains of the World Health Organization's Strategic Framework of the Global Patient Safety Challenge were recognised. Highly-valued roles include medication reviews, provision of drug information, and education for health professionals.

Conclusion: This review describes the roles hospital pharmacists performed within the interprofessional team, as reported by non-pharmacist health professionals internationally. Multidisciplinary perceptions and expectations of these roles may guide the prioritisation and optimisation of hospital pharmacy services.

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1. Introduction

In an era of the growing complexity of healthcare and increasing healthcare staff shortages, the role of hospital pharmacists has become important more than ever; with an increasing need for pharmacists to work collaboratively in multidisciplinary settings and for effective pharmacy service prioritisation. Multidisciplinary collaboration can be enhanced when a team of health professionals forms a trusting relationship through the process of role clarification, role valuing, and evaluation of team satisfaction.¹ The positive impacts of collaborative practice on patient outcomes have been shown in numerous intervention studies and meta-analyses;² meanwhile a lack of collaboration is known to risk patient safety.^{3,4} Thus, it follows that interprofessional perspectives regarding the role of hospital pharmacists are important to investigate. In the qualitative literature published worldwide, several studies captured the thoughts of other health professionals on hospital pharmacy services within a single clinical unit/ward or with a focus on the perspectives of a specific profession.^{5,6} However, to date, there is a paucity of studies reflecting upon the perceptions and understanding of pharmacist roles and services in the hospital setting in its entirety, encompassing views from an extensive range of health professional stakeholders.

Given limitations in healthcare resourcing are common, there is a need to prioritise and ensure alignment of the activities undertaken by hospital pharmacists to facilitate the greatest impact on service delivery and patient outcomes. Currently, there are no comprehensive reviews that bring together data to explore which of the pharmacist's roles are perceived to provide the greatest value by other health professionals in tertiary or higher care settings. Therefore, exploring how hospital pharmacy practice is perceived and valued by other health professionals

within hospitals is important for service prioritisation and for developing a future practice framework for hospital pharmacists to work collaboratively with other disciplines to maximise the benefits to patients and the health care system.

The objective of this study was to conduct a systematic review to synthesise and critically assess evidence from the qualitative literature published worldwide, and to identify the perceptions of hospital pharmacist roles and hospital pharmacy services held by other health professionals.

2. Methods

This qualitative systematic review and meta-synthesis were conducted according to the Cochrane Qualitative and Implementation Methods Group (CQIMG)⁷ and PRISMA 2020⁸ methodology. The initial search was conducted in September 2021 and was re-run prior to the final analysis in August 2022 using the following databases: MEDLINE, Embase, and CINAHL Complete. The selection of these databases was informed by a recent review of methodological studies which recommended combining MEDLINE + CINAHL or Embase + CINAHL for best performance.⁹ Studies were reviewed against the inclusion/exclusion criteria outlined in [Table 1](#) (see Appendix A for full search strategy used in MEDLINE).

Identified studies were imported into Covidence (Veritas Health Innovation, Melbourne, Australia), for de-duplication, screening and extraction. Two reviewers independently screened the title and abstract of each study. Relevant full-text articles were subsequently screened by two for final inclusion. The quality and limitations of the methodology used in the included studies were assessed independently by two reviewers using the Critical Appraisal Skills Programme Qualitative Studies Checklist (CASP).¹¹ Disagreements at any stage were resolved by a third reviewer.

Table 1
 Inclusion and exclusion criteria for review eligibility.

	Inclusion criteria	Exclusion criteria
Phenomena of interest	Studies with the primary aim of investigating the expectations, perceptions, or feedback of health professionals regarding hospital pharmacists' roles.	Studies that were not related to the perceptions of health professionals. Hospital pharmacy services that do not involve direct contact or collaboration with other health professionals.
Types of participants	Studies involving health professionals registered to practice within each country's jurisdiction. They must be practising in a tertiary or higher-level care centre where pharmacy services were provided at the time of each study. NOTE: "Pharmacy services" are defined in this review as any professional services provided by pharmacist(s) employed by the hospital(s), regardless of the physical location of their patients.	Studies involving pharmacists and non-health professionals. e.g., health professional students and patients.
Context	Hospital settings worldwide where tertiary or higher-level care was provided. To avoid ambiguity, the hospital setting included but was not limited to inpatient, outpatient, public, and private hospital settings.	Studies that were not based in tertiary care settings e.g., community pharmacies, general practice clinics, and residential care.
Types of studies	Peer-reviewed journal articles containing primary qualitative data, published from 2011 to 2022. The publication date limit was placed to explore the recent trend in attitudes of health professionals toward hospital pharmacy practice and hence to strengthen relevancy in current practice. ¹⁰ Studies were included if both qualitative data collection (e.g., focus groups, open text surveys, interviews) and qualitative data analysis (e.g., thematic analysis, framework analysis) were used. The qualitative component of mixed-methods studies was included if it was possible to distinguish and extract data resulting from the qualitative component of the methods. There was no limit on the language used.	Studies reporting only quantitative data were excluded as the review question does not require any numerical data. 'Grey' literature (e.g., theses, letters, editorials, conference abstracts) was excluded to ensure that the final selection of studies would only contain peer-reviewed, non-partisan data. Studies that did not contain primary data (e.g., reviews) were excluded.

A standardised form adapted from the Cochrane Effective Practice and Organisation of Care: Qualitative Evidence Syntheses¹² and the Joanna Briggs Institute Manual for Evidence Synthesis,¹³ was developed to extract study information as follows:

- **General information:** title, name of first three authors, publication year, countries in which each study was conducted, hospital type, work setting (e.g., inpatient, outpatient), the timing of study (e.g., before/after service implementation), geographical classifications (e.g., metropolitan/rural),
- **Methods:** aim(s), study design, duration, participant characteristics (e.g., number of participants, age ranges, gender, professions), recruitment/sampling methods, inclusion/exclusion criteria, data collection, analysis methods,
- **Outcomes:** hospital pharmacist roles and services discussed in each study, and
- **Miscellaneous:** funding sources, conflicts of interest.

Quantitative data were exported to Microsoft Excel (Microsoft 365, ver. 2202) and summarised using descriptive statistics. Qualitative data and findings, including participants' opinions, perceptions, and comments addressing the study aim also were extracted and analysed using NVivo Release 1.6 (QSR International, Denver, USA). Using the inductive (open) thematic analysis method and the terminology developed by Thomas and

Harden,¹⁴ two independent reviewers initially conducted a “line-by-line coding” of each sentence of the text based on its meaning and content. The codes were then clustered into “descriptive themes”, which were subsequently categorised into over-arching, analytical themes. A consensus on generated codes and themes was reached via discussion between the two reviewers, and the broader research team as needed. Data analysis continued while writing, as the narrative findings were refined, and illustrative quotes were selected. To assist in conceptualising health professional perceptions as a whole, findings were mapped against the World Health Organization (WHO) Global Patient Safety Challenge: Medication Without Harm¹⁵ and organised into a conceptual map based on the WHO Global Competency and Outcomes Framework for Universal Health Coverage.¹⁶

Reviewers took a reflexive stance throughout the analysis process.¹⁷ All authors were registered pharmacists (two authors employed at a public hospital) at the time of writing. A reflexive journal was maintained by each reviewer throughout the analysis to facilitate reflection on content, the meaning of themes, and potential bias introduced by the reviewer's personal perspective.

Qualitative review findings were assessed for confidence (four overall ratings: High Confidence, Moderate Confidence, Low Confidence, and Very Low Confidence) using the GRADE-CERQual criteria. Confidence in synthesised findings refers to the likelihood that review statements (“findings”) are a reasonable representation of phenomena of interest based on

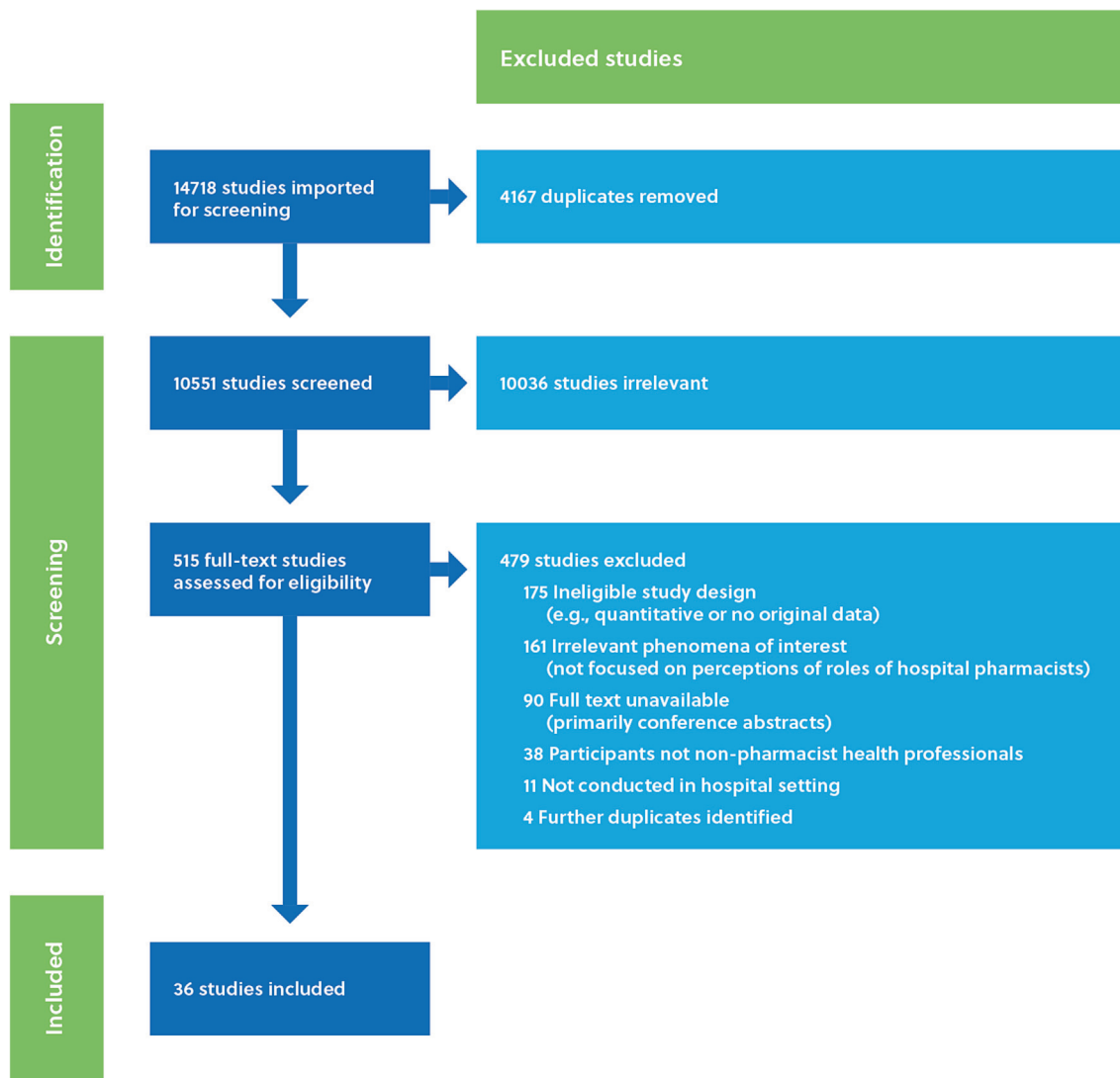


Fig. 1. Identification, screening, and inclusion steps charted to PRISMA 2020 flow diagram⁸.

Table 2

The characteristics of included studies alongside the Critical Appraisal Skills Programme Qualitative Studies Checklist (CASP) scores.

Author + Year	Country	Primary aim of study	Practice setting	Profession and number of eligible non-pharmacist health professional participants	Number of total eligible non-pharmacist health professional participants	Method of data collection	Method of data analysis	CASP overall score
Ahlam, Shubashini and Elkudssiah 2016 ¹⁹	Malaysia	To explore the perceptions of health care professionals regarding the role of pharmacist within the clinical team	Medical; Oncology and palliative care	Doctor/physician:9 Nurse: 7	16 (total = 29)	Interviews	Thematic analysis	Moderate concern
Allan et al. 2021 ²⁰	Australia	To understand hospital staff perspectives on the implementation of a Virtual Clinical Pharmacy Service in rural and remote New South Wales	Emergency department; Acute inpatients	Doctor/physician: 8 Nurse: 51 Allied health (unspecified): 4	63 (total = 67)	Focus groups	Thematic analysis	Moderate concern
Atkins and Cunningham 2018 ²¹	Malta	To explore the view of the multidisciplinary team toward the role of the clinical pharmacists within the palliative care unit of an oncology hospital	Palliative care unit of the main oncology centre	Doctor/physician: 5 Nurse:12 Physiotherapist: 5 Occupational therapist: 2 Psychologist: 1	25 (total = 30)	Focus groups	Framework analysis	No or very minor concern
Azhar, Hassali, Iqbal et al. 2015a ²²	Pakistan	To assess the perception of Pakistani doctors regarding pharmacists' role in Punjab Pakistan	Unknown	Doctor/physician: 12	12	Interviews	Thematic analysis	Moderate concern
Azhar, Murtaza, Kousar et al. 2015b ²³	Pakistan	To explore the perception of doctors regarding the quality of pharmaceutical care services in Khyber Pakhtunkhwa Province, Pakistan	Unknown	Doctor/physician: 15	15	Interviews	Thematic analysis	Moderate concern
Bakhshi et al. 2021 ²⁴	Unknown	To investigate the effects of engaging in participatory action research to improve emergency medicine clinicians attitudes to safety in medication management.	Emergency department	Doctor/physician, Nurses *breakdown not provided/deducible	85	Interviews; Focus groups	Content analysis	Minor concern
Béchet et al. 2016 ²⁵	Switzerland	To study physician-pharmacist collaboration in hospital settings, from the physicians'point of view.	Medical; Surgical; Emergency department; Outpatient/ambulatory	Doctor/physician: 12	12 (total = 13)	Interviews	Thematic analysis	No or very minor concern
Bryant, Chaar and Schneider 2018 ²⁶	Australia	To compare nurses' perceptions on the clinical pharmacist role, collaboration with and support for nurses between two models of clinical pharmacy, specifically the traditional ward-based model and the emergent team-based model, in acute medical and surgical hospital wards in Australia	Medical; Surgical	Nurse: 90	90	Surveys	Thematic analysis; Mixed-methods	Minor concern
Chevalier et al. 2016 ²⁷	Canada	To explore nurses' and physicians' opinions and expectations of clinical pharmacy services before and after their implementation within the unit; to compare the views of nurses, physicians, and pharmacists about clinical pharmacy services; and to create validated survey tools	Surgical	Doctor/physician: 43 Nurse: 67	110 (Total = 190 across two phases)	Surveys	Thematic analysis; Mixed-methods	Moderate concern
Coralic et al. 2014 ²⁸	United States of America	To assess staff perceptions of a university hospital emergency pharmacy program one year after implementation.	Emergency department	Doctor/physician: 48 Nurse: 56	104	Surveys	Mixed-methods	No or very minor concern
Díaz de León-Castañeda et al. 2019 ²⁹	Mexico	To analyse the perception of healthcare professionals (pharmacists, physicians, and nurses) regarding the quality of clinical pharmacy services provision.	Medical; Surgical; Emergency department; Outpatient/ambulatory	Doctor/physician: 13 Nurse: 6	19 (total = 22)	Interviews	Thematic analysis	No or very minor concern
Fernandes et al. 2021 ³⁰	Brazil	To develop a deeper understanding, from patients' and health professionals' perceptions, about the provision of medication review services and the role of the pharmacist in mental health in Brazilian Psychosocial Care Centers.	Outpatient/ambulatory	Nurse: 1 Social worker: 2 Other:1 (Director of Brazilian Psychosocial Care Centers)	4	Interviews	Thematic analysis	Minor concern

Table 2 (continued)

Author + Year	Country	Primary aim of study	Practice setting	Profession and number of eligible non-pharmacist health professional participants	Number of total eligible non-pharmacist health professional participants	Method of data collection	Method of data analysis	CASP overall score
Gillespie et al. 2012 ³¹	Sweden	To evaluate the perceived value of ward-based clinical pharmacists from the perspective of hospital-based physicians and nurses and to identify potential advantages and disadvantages related to the new interprofessional collaboration.	Medical	Doctor/physician: 22 Nurse: 29	51 (total = 68)	Surveys	Content analysis; Other: Descriptive analysis	Moderate concern
Gopal Krishnamoorthy et al. 2022 ⁵²	India	To identify the expectations and perceptions of Drug Information Services among healthcare professionals in India.	Unknown	Doctor/physician; Nurses *breakdown not provided/deducible	529	Surveys	Mixed-methods	Minor concern
Håkansson Lindqvist, Gustafsson and Gallego 2019 ³³	Sweden	To explore the working relationships of physicians, nurses and ward-based pharmacists in a rural hospital after the introduction of a clinical pharmacy service.	Medical	Doctor/physician: 9 Nurses: 5	14 (total = 17)	Interviews; Surveys	Mixed-methods	Minor concern
Haver et al. 2017 ³⁴	United States of America	To describe the healthcare team's perceptions of the impact of the pharmacist on the team workload, workflow, care quality, practice, and communication.	Outpatient/ambulatory; Geriatric unit	Doctors/physician: 6 Nurses: 8	14 (total = 17)	Focus groups	Thematic analysis	Minor concern
Isleem et al. 2022 ³⁵	Qatar	To investigate the perceptions of healthcare providers of the impact of tele-pharmacy services provided in critical care units during COVID-19	COVID-19 Intensive Care Units	Doctor/physician: 15 Nurse: 5	20	Interviews	Thematic analysis; Mixed-methods	Moderate concern
Jennings et al. 2017 ³⁶	France	To assess the satisfaction of physician's satisfaction with clinical pharmacy activities in a French regional hospital.	Medical; Surgical	Doctor/physician: 62	62	Surveys; Other: face-to-face surveys	Thematic analysis	Serious concern
Kharaba et al. 2020 ³⁷	Pakistan	To evaluate the perception of nurses regarding pharmaceutical care services in the healthcare system of the Khyber Pakhtunkhwa Province of Pakistan	Unknown	Nurse: 18	18	Interviews	Thematic analysis	Minor concern
Krzyzaniak, Pawlowska and Bajorek 2019 ³⁸	Australia and Poland	To explore the attitudes and perceptions of medical and nursing healthcare professionals toward the role of the pharmacist and the provision of pharmaceutical care in the Neonatal Intensive Care Unit (NICU).	Neonatal Intensive Care Unit	Doctor/physician: 42 Nurse: 33 Midwife: 2	170 (77 Australians and 93 Polish)	Surveys	Mixed-methods	Minor concern
Lee et al. 2016 ³⁹	South Korea	To explore the need for pharmaceutical care services, key features of desirable pharmacy services, and perceived barriers for advancing the services in hospital environments with doctors and nurses who are key co-workers of the interdisciplinary team care services	Medical	Doctor/physician: 18 Nurse: 15	33	Interviews	Framework analysis	No or very minor concern
Livori et al. 2021 ⁴⁰	Australia	To determine whether a cardiology pharmacist consultation undertaken prior to a cardiologist consultation reduced the time spent by the cardiologist gathering medication information, and to assess the cardiologist's experience regarding the presence of a cardiologist pharmacist in the outpatient clinic.	Outpatient/ambulatory	Doctor/physician: 4	4	Interviews	Mixed-methods	Serious concern
Lloyd, Watmough, and O'Brien 2015 ⁴¹	United Kingdom	To ascertain the views of doctors toward receiving formalized prescribing error feedback, specifically to explore what the impact has been on them as prescribers and their views on pharmacists as facilitators of prescribing error feedback.	Medical	Doctor/physician: 10	10	Interviews	Thematic analysis	Minor concern

(continued on next page)

Table 2 (continued)

Author + Year	Country	Primary aim of study	Practice setting	Profession and number of eligible non-pharmacist health professional participants	Number of total eligible non-pharmacist health professional participants	Method of data collection	Method of data analysis	CASP overall score
McDaniel et al. 2017 ⁴²	United States of America	Overall: to determine the impact the addition of a second ICU pharmacist covering 30 adult ICU beds at a large regional medical centre has on the complexity of pharmacists' interventions, the types of clinical activities performed by the pharmacists, and the ICU team members' satisfaction Focus group component: to qualitatively describe the additional pharmacists' impact on patient care, team dynamics, and the quality of pharmacy services provided.	Adult Intensive Care Unit (ICU)	Doctors/physician: 1 Nurse: 1 Respiratory therapist: 1	3	Focus group	Mixed-methods	Serious concern
Mekonnen et al. 2013 ⁴³	Ethiopia	To explore key informants' perspectives in the implementation of clinical pharmacy practice with the multidisciplinary team at Jimma University Specialized Hospital, Ethiopia.	Undefined	Doctor/physicians; Nurse *breakdown not provided/deducible	14 (estimated) total = 20	Interviews	Thematic analysis	Moderate concern
Parker et al. 2015 ⁵	United States of America	To determine views of dialysis staff toward pharmacist delivered medication therapy management (MTM) services and identify desirable components of an MTM service for dialysis patients.	Outpatient/ambulatory	Nurses: 4 Dietician: 1 Social worker: 1	6 (total = 13)	Focus groups	Thematic analysis	No or very minor concern
Ronan et al. 2020 ⁴⁴	Ireland	To assess the impact of a medication review service by a pharmacist and then explore the views of nursing staff on the role of the pharmacist	Medical; surgical	Nurses only	12	Interviews	Thematic analysis; Mixed-methods	No or very minor concern
Safitrih et al. 2019 ⁶	Indonesia	To identify the perceptions and expectations of health workers with respect to the emergency pharmacy units in hospitals located in the city of Kupang.	Emergency department	Doctors/physicians: 4 Nurses: 4	8	Interviews	Thematic analysis	Minor concern
Salgado et al. 2013 ⁴⁵	Australia and Portugal	To explore the opinions of Australian and Portuguese nephrologists toward the current and future provision of clinical pharmacy services in outpatient dialysis centres	Outpatient dialysis	Doctors/physicians: 21	21 (14 Portuguese and 7 Australian)	Interviews	Thematic analysis	Minor concern
Salgado et al. 2014 ⁴⁶	Australia and Portugal	To explore the differences in the views of Australian and Portuguese renal nurses on the provision of clinical pharmacy services in outpatient dialysis centres	Outpatient dialysis	Nurses: 18	18 (13 Portuguese and 5 Australian)	Interviews	Thematic analysis	Minor concern
Sjölander, Gustafsson and Gallego 2017 ⁴⁷	Sweden	To explore doctors' and nurses' perceptions and expectations of having a ward-based pharmacist providing clinical pharmacy services in a rural hospital in northern Sweden.	Medical	Doctors/physicians: 9 Nurses: 9	18	Interviews	Thematic analysis	No or very minor concern
Tavakoli et al. 2022 ⁴⁸	Unknown	To identify evidence-based clinical pharmacy services with an impact on patient care in the postsurgical inpatient population.	Surgical	Doctors/physicians: 5 Nurses: 2 Physician assistants: 2	9 (total = 12)	Surveys	Mixed-methods	Moderate concern
Tegegn et al. 2018 ⁴⁹	Ethiopia	To explore the challenges and opportunities of clinical pharmacy services offered in University of Gondar hospital through health practitioners' perspectives	Various	Doctors/physician: 5 Nurses: 5	10 (total = 15)	Interviews	Thematic analysis	No or very minor concern
Tran et al. 2019 ⁵⁰	Australia	To evaluate the effect of an integrated pharmacy service provided to the general medical units on patient flow and medical staff satisfaction.	Medical	Doctors/physician: 10	10	Surveys	Thematic analysis	Moderate concern

Table 2 (continued)

Author + Year	Country	Primary aim of study	Practice setting	Profession and number of eligible non-pharmacist health professional participants	Number of total eligible non-pharmacist health professional participants	Method of data collection	Method of data analysis	CASP overall score
Tran et al. 2021 ⁵¹	Australia	To explore the perceived benefits and drawbacks of pharmacist-assisted prescribing from the perspectives of hospital medical officers and nursing staff	Surgical	Doctors/physician: 6 Nurses: 6	12	Interviews	Thematic analysis; Content analysis	Minor concern
Vinterflod et al. 2018 ⁵²	Sweden	To explore physicians' perceptions regarding clinical pharmacy services performed in hospitals operated by Vasterbotten County Council	Medical; Geriatric	Doctors/physician: 9	9	Interviews	Thematic analysis	No or very minor concern

Classification of each health professional varies between countries, thus some studies may not differentiate between specialised training or positions e.g., between nurses, nurse practitioners and physician assistants; between specialised doctors/physicians and/or general doctors (including medical interns). This study has therefore used broad categories such as "Doctor/Physician" or "Nurses" to facilitate data extraction.

the following key components: Methodological Limitations, Adequacy, Coherence and Relevance.¹⁸

3. Results

The search strategy identified 14,718 titles (including duplicates), of which 36 ultimately met the eligibility criteria as shown in Fig. 1. Studies were conducted in 20 countries, across five continents (location undisclosed in two studies). The most common geographical locations were Australia ($n = 8$ combined with or without other countries, 13.9%), Sweden ($n = 4$, 11.1%), and the United States ($n = 4$, 11.1%). Studies involved a variety of health professionals as participants, including doctors, nurses, physiotherapists, psychologists, occupational therapists, midwives, and physician assistants. Eight studies involved only doctors/physicians (22.2%), four involved only nurses (11.1%), and 24 involved more than one profession (66.7%). Of the 24 studies with multiple professions, only seven included allied health professionals in addition to doctors or nurses. However, the proportion of allied health professionals in these studies was very small, averaging only 7.5% per study. The most common method of data collection was interviews ($n = 20$, 55.6%), followed by open-ended response surveys ($n = 9$, 27%) and focus groups ($n = 5$, 13.96%), two studies (5.64%) employed multiple data collection methods.

Twenty-three studies satisfied all or most of the 10 criteria for standards of qualitative methodology (CASP), and therefore were rated overall 'no or very minor concern' or 'minor concern'. Ten studies were rated 'moderate concern' and three rated 'serious concern' due to no or unclear discussion of recruitment strategy, author reflexivity, or ethical considerations. These assessments were considered when evaluating the overall confidence of summative findings using the GRADE-CERQual criteria. The characteristics of included studies and the corresponding CASP scores are shown in Table 2 (detailed CASP scores are available in Appendix C, Supplementary Table S1).

Three over-arching themes emerged from inductive thematic analysis: (1) specific roles and activities of hospital pharmacists, (2) personal attributes, skills and behaviours of pharmacists, and (3) perceptions and expectations regarding overall hospital pharmacy services.

3.1. Theme 1: specific roles and activities of hospital pharmacists

Health professionals identified and discussed various hospital pharmacist roles and activities across diverse geographical locations, encompassing Australasia, Asia, Africa, the Americas, and Europe, as summarised in Table 3. The most frequently mentioned roles of hospital pharmacists included medication reviews and/or prescribing feedback (highlighted in 26 out of 36 studies over 13 countries), drug information and education

for non-pharmacist health professionals, and proactive influence in medication-related therapy decisions. A detailed account of perceptions regarding specific hospital pharmacist roles and a summary of the associated key findings are presented in Appendix B and Appendix C (Supplementary Table S2) respectively.

To conceptualise how the roles of hospital pharmacists identified by other health professionals fit together to influence the safe and effective use of medicines and ultimately patient outcomes, roles were mapped to the World Health Organization (WHO) Global Patient Safety Challenge: Medication Without Harm.¹⁵ This mapping, shown in Fig. 2, confirms other health professionals recognise that hospital pharmacists undertake roles that contribute to all four domains of the framework supporting medication use without harm: medicines, systems and practices of medication, health professionals and patients and the public.

3.2. Theme 2: personal attributes, skills and behaviours of pharmacists

Some studies explored the perceived and desirable personal attributes, skills and behaviours of hospital pharmacists, as reported by other health professionals. The doctors, nurses, and other allied health professionals described pharmacists as valuable, useful, qualified, highly integrated, and competent (Moderate Confidence).^{19,25,29,38,39}

"Physicians mostly have a positive perception of HPs [hospital pharmacists] as competent, trustworthy specialists that work in a precise, serious way."²⁵ (Study Author).

On the other hand, some reported negative perceptions regarding the personal attributes of hospital pharmacists as described in the synthesised findings below.

- Training for pharmacists needs to be established before implementing or integrating hospital pharmacy services (Low Confidence).^{30,32,36,39,43}
- Health professionals are not convinced that hospital pharmacists are clinically competent enough to solve therapeutic problems (Low Confidence).^{21,22,24,25,27,29,38,39,42,43,45,52}
- Hospital pharmacists must not be too demanding and should refrain from intervening unnecessarily in patient care (Very Low Confidence).⁵²

3.3. Theme 3: perceptions and expectations regarding overall hospital pharmacy service

In several studies, participants discussed the hospital pharmacy service as a whole. Health professionals felt hospital pharmacy services provide a benefit to patients (Moderate Confidence), many commented on hospital pharmacy services improving workflow (Moderate Confidence). Doctors

Table 3

Roles and activities of hospital pharmacists identified by non-pharmacist health professionals, by geographical location.

Theme	Descriptive Theme	Scope of Each Theme	Country
Specific roles and activities of hospital pharmacists	Dispensing, procurement, compounding, and quality control	Activities included but were not limited to naming, labelling, packaging, purchasing, logistics, compounding, quality testings, storage, and disposal of medicines.	Australia ³⁸ Brazil ³⁰ Indonesia ⁶ Ireland ⁴⁴ Malta ²¹ Mexico ²⁹ Pakistan ³⁷ Poland ³⁸ Portugal ⁴⁵ Sweden ⁴⁷ Switzerland ²⁵ Portugal ⁴⁵
	Medication reconciliation and medication safety activities	Medication reconciliation: activities such as obtaining the patient's comprehensive medication history at admission. Medication safety: activities that involved monitoring and reporting adverse effects from medications such as pharmacovigilance and reporting of adverse drug reactions (ADR).	Australia ^{20,40,45,46,50} Canada ⁵³ Indonesia ⁶ Ireland ⁴⁴ South Korea ³⁹ USA ⁵ Malta ²¹ Portugal ⁴⁵ Unknown ⁴⁸
	Medication reviews and/or prescribing feedback	Activities that involved reviewing the medications prescribed during admission, aimed at identifying any potential medication-related problems and promoting the quality use of medicines.	Australia ^{26,45,50} Canada ²⁷ Ethiopia ^{43,49} Indonesia ⁶ Ireland ⁴⁴ Malta ²¹ Mexico ²⁹ Pakistan ^{23,37} Qatar ³⁵ Sweden ^{31,33,52} Switzerland ²⁵ UK ⁴¹ USA ^{5,28,34,42} Unknown ^{24,48}
	Proactive roles in medication-related therapy decisions	Collaborative activities or discussions between pharmacists and other members of the multidisciplinary team that occurred before prescribing any medications or making therapeutic decisions.	Australia ^{20,38,45,50,51} Ethiopia ⁴⁹ India ³² Indonesia ⁶ Malaysia ¹⁹ Malta ²¹ Pakistan ²² South Korea ³⁹ Qatar ³⁵ Sweden ^{31,33} Switzerland ²⁵ USA ^{28,34,42} Unknown ⁴⁸
	Drug information and education for other health professionals	Activities that were designed to assist health professionals in obtaining information regarding medications in general or to aid in prescribing e.g., continuing education sessions.	Australia ^{20,38,45,46} Brazil ³⁰ Canada ²⁷ Ethiopia ⁴⁹ France ³⁶ India ³² Indonesia ⁶ Malaysia ¹⁹ Malta ²¹ Mexico ²⁹ Pakistan ^{23,37} Portugal ^{45,46} South Korea ³⁹ Qatar ³⁵ Sweden ^{31,33} Switzerland ²⁵ UK ⁴¹ USA ^{28,34,42} Unknown ^{24,48}
	Patient education and communication at discharges and transitions of care	Patient education: activities designed to enhance patients' comprehension and adherence to medications. Communication at discharges and transitions of care: activities that facilitated efficient hospital discharges and transitions by involving communication with community caregivers and health professionals.	Australia ^{40,45,46} Brazil ³⁰ Canada ²⁷ Ethiopia ⁴⁹ Indonesia ⁶ Malaysia ¹⁹ Malta ²¹ Pakistan ^{23,37}

Table 3 (continued)

Theme	Descriptive Theme	Scope of Each Theme	Country
	Independent prescribing and diagnosis	Activities that involved prescribing directly by pharmacists with no or little involvement by other health professionals.	Sweden ^{31,33,47} USA ^{5,34} Unknown ⁴⁸ Australia ^{45,51} Canada ²⁷ Ethiopia ⁴⁹ Indonesia ⁶ Pakistan ²²
	Research and medication governance	Research: activities that involved research and the dissemination of findings to wider communities. Medication governance: activities that involved policy and administrative side of pharmacy including but not limited to antibiotic stewardship, decision-making in therapeutics committees, and hospital formulary development.	Australia ^{38,45,50} Ethiopia ⁴⁹ France ³⁶ Indonesia ⁶ Ireland ⁴⁴ Malta ²¹ Portugal ⁴⁵ Mexico ²⁹ Sweden ⁵²
	Emerging roles including pharmacist-led administration of medicines	Activities that were within the scope of pharmacists but were relatively new roles by the conventional standard in the pharmacy field such as virtual pharmacy services, pharmacogenomic advice, pharmacist-led outpatient services.	Australia ^{20,40} Poland ³⁸ South Korea ³⁹ Qatar ³⁵ Unknown ^{24,48}

and nurses reported that hospital pharmacy services enhance medication adherence and safety by building rapport with patients and reducing medication errors.^{6,19–21,23,24,26,27,30,31,33,38,40,43,48,49,52} One physician described the hospital pharmacy service as a “safety check”, citing that hospital pharmacy services “reduced risk of side-effects and interactions, and reduced length of stay.”⁵² Both doctors and nurses expressed that hospital pharmacy services improved overall workflow as pharmacists are responsive and readily available which was viewed to ultimately save other health professionals’ time.^{5,6,20,21,25,27–29,31,32,34,36–40,42,43,48,50}

“...having a pharmacist available on the floor has been very helpful and timesaving.”²⁷ (Canadian Nurse).

“I would say [the pharmacists’ impact on my workflow is [a] positive improvement. [The pharmacist in the outpatient office sees] the patient before me [to] give me...[an] idea and helps me to manage medication [s]...especially [the] complexity of the medications.”³⁴ (US Physician).

Health professionals also commented on the positive impact hospital pharmacists had on their professional growth, citing a general improvement in their individual practice, as a result of working alongside a pharmacist (Moderate Confidence).^{20,23,27,31,34,35,37–39,42,45,46,50,52} Many studies highlighted benefits in promoting collaboration and interdisciplinary relationships between hospital pharmacists and other health professionals (Moderate Confidence).^{24,26,30,33,38,44,49}

“[The clinical pharmacy service] improves teamwork and holistic care.”⁵⁰ (Australian Doctor).

Participants also acknowledged the educational value of engaging in professional conversations with pharmacists (High Confidence).^{20,25,33}

“Communication was described as open, discussion-based and collaborative, and therefore knowledge-building, according to the participants.”³³ (Study Author).

A review of non-pharmacy health professionals’ perceptions regarding hospital pharmacy services revealed limitations and areas for improvement. Health professionals identified a need for improvement in communication with hospital pharmacists, highlighting inadequate documentation by pharmacists (High Confidence), ineffective communication systems (High Confidence), and a lack of responsiveness (Moderate Confidence). Doctors and nurses also stated communication and rapport between

hospital pharmacists and themselves are integral to effective clinical pharmacy services (Moderate Confidence).

“Constraints on pharmacists’ documentation are a significant barrier to efficient interprofessional communication and subsequent quality of patient care.”³⁴ (Study Author).

“This restricted level of communication was attributed to leading to poor interprofessional relationships with the pharmacist.”³⁸ (Study Author).

Some non-pharmacy health professionals were either unaware or misinformed about the workflow and/or scope of practice of hospital pharmacists (Moderate Confidence).^{5,20,22,24–27,32,37,38,45–47,52} Some of them also believed that conflicts between health professionals can occur if role descriptions or professional boundaries are ambiguous (Low Confidence).^{20,25,31,33,39,45,47}

“Most physicians were unclear about the structure of the service and how it operates. For example, they did not know how to contact the pharmacist, when and how often the pharmacist visits the ward, or if the pharmacist is still coming to the ward.”⁵² (Study Author).

“One doctor also identified that education was needed for medical staff themselves to improve their understanding of the pharmacists’ role and what services they are able to provide.”³⁸ (Study Author).

Participants reported a need to review or establish financial incentives and workforce structures to promote more successful delivery of hospital pharmacy services (Low Confidence).^{6,19,21,22,24,26,28,29,32–34,38,39,48,52} Others highlighted insufficient pharmacy staffing or a lack of continuity of pharmacy services as barriers to efficient hospital services and emphasised the need for appropriate remuneration, job opportunities and hospital administration support for hospital pharmacists for successful integration of pharmacy services (Moderate Confidence).^{21,22,25,26,32,37–39,44,46,49,52}

“There should be jobs for the pharmacists; their appointment should be solely on every pharmacy so that proper collaboration should be done.”²² (Pakistani Doctor 8).

“Other barriers to the performance of clinical pharmacy services on [in] the NICU were attributed to the lack of support and structure from the

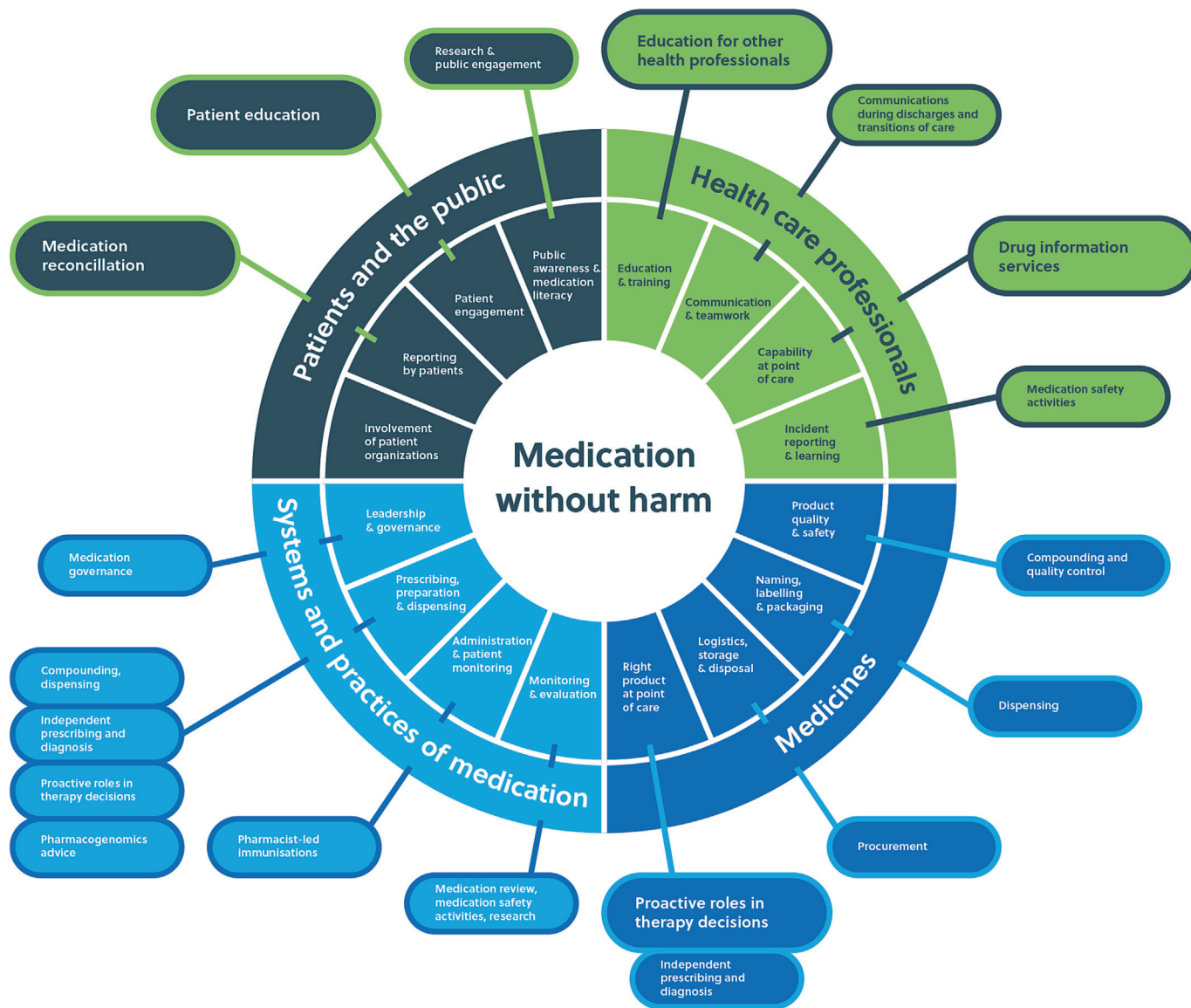


Fig. 2. Hospital pharmacist roles identified by non-pharmacist health professionals in the qualitative literature, mapped to the WHO Global Patient Safety Challenge: Medication Without Harm.¹⁵ Larger boxes highlight the roles discussed most favourably by other health professionals.

hospital administration in failing to create pediatric or neonatal-specific clinical pharmacist positions.”³⁸ (Study Author).

“Pharmacists do not have enough time for the provision of drug information to patients. They have a heavy workload. Moreover, the number of pharmacists is low when compared to the number of patients to be counselled.”³⁷ (Pakistani Nurse).

Doctors and nurses also mentioned negative impacts on their workload and the quality of collaborative relationships with hospital pharmacists due to limitations in current pharmacy service models provided in each country or each specific hospital (Low Confidence),^{6,20,26,29,32,33,35,41,43,45,47} and that current pharmacy services in some regions are unsustainable or inefficient in general (Low Confidence).^{6,37,41,44} In one Australian study, one nurse shared while reflecting on practice with a unit-based versus ward-based pharmacist, “It was better with a ward pharmacist but now we as nurses have to find time to chase drs [doctors] and pharmacists to change doses to order new medications and also for microapproval numbers.”, indicating that the new unit-based model created additional time pressures as the pharmacist was not always readily accessible.²⁶

3.4. The conceptualisation of linkages between the three over-arching themes

The themes formulated regarding the perceptions and expectations of non-pharmacist health professionals were organised into a conceptual map, modified from the World Health Organization (WHO)’s Global Competency and Outcomes Framework for Universal Health Coverage¹⁶, as shown in Fig. 3.

4. Discussion

This novel systematic review collates and synthesises the perceptions and expectations regarding the roles of pharmacists in hospital settings worldwide, encapsulating views from a range of non-pharmacist health professionals. As individual health professionals, hospital pharmacists were perceived as valuable, competent, and supportive by non-pharmacy health professionals. At an organisational level, the roles of hospital pharmacists were perceived to benefit hospital workflow and improve patient safety. Pharmacy services were further valued by the non-pharmacist health professionals, as they reported their practice was improved by education and advice provided by hospital pharmacists and by involvement in multidisciplinary teamwork. Some health professionals commented on

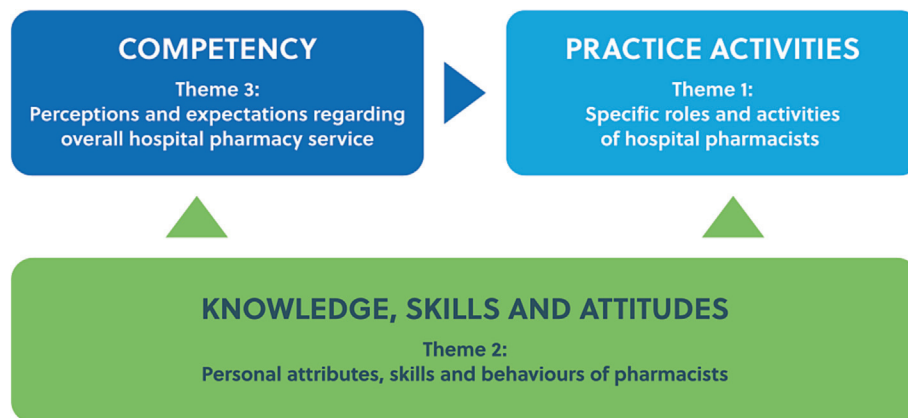


Fig. 3. Three over-arching themes mapped to a conceptual map, adapted from the WHO's Global Competency and Outcomes Framework for Universal Health Coverage.¹⁶

perceived limitations related to hospital pharmacist roles and service delivery, such as inadequate communication (particularly written documentation), lack of clarity regarding the roles of hospital pharmacists and the need for improved pharmacist staffing for priority areas.^{21,22,26,27,31,39,45,47}

The scope and extent of the roles described ranged from what could be considered 'traditional roles' e.g., dispensing, and compounding, to newer but established roles in medication reviews and education, to emerging roles such as the provision of virtual pharmacist services, pharmacogenomics advice and pharmacist-led outpatient clinics. The diverse range of roles identified by health professionals across different countries may be explained by differences in role establishment in each region. The International Pharmaceutical Federation has previously investigated international diversity in pharmacist specialisation (and thus hospital pharmacist roles), finding that specialisation pathways were proportionate to income status and pharmacist coverage per population of each country.⁵⁴ Increased exposure to hospital pharmacy services by non-pharmacist health professionals within a particular clinical setting may also influence familiarity and attitudes toward hospital pharmacists, according to the exposure effect theory in social psychology.⁵⁵ In the countries where participants identified only limited and primarily supply-based roles of hospital pharmacists, e.g., Indonesia, Pakistan,^{6,22} the extent of pharmacist coverage and specialisation pathways are quite limited.³⁸ In comparison, in regions where hospital pharmacist roles are well-established such as Australia, Canada, the UK and the USA, the participants had broader experiences with the roles of hospital pharmacists and they were able to describe more diverse responsibilities, including medication reviews, proactive roles in therapeutic decision-making and independent prescribing. Worldwide, the majority of health professionals were aware of the clinical or patient-facing roles of hospital pharmacists, such as medication reviews and patient counselling, and were optimistic that the provision or improvement of such services would lead to improved patient outcomes.^{6,38,43,45,46,52} By mapping the perceived hospital pharmacist roles and services identified by other health professionals against the WHO's Global Patient Safety Challenge: Medication Without Harm,¹⁵ this review findings suggest that the multidisciplinary team recognise the unique and important roles that hospital pharmacists perform to minimise medication-related patient harm and their degree of impact in the healthcare system.

Many findings of this review were comparable to two systematic reviews that compiled perceptions regarding the roles of community pharmacists held by health professionals in primary care settings. In Hurley et al. (2021), general practitioners around the world commented on the useful roles of pharmacists, such as education of primary health care teams and patients, medication reconciliation and medication reviews, as well as chronic disease management.⁵⁶ Another systematic review by Supper et al. (2015) explored the multidisciplinary relationship with primary care practitioners and identified the main drivers of successful interprofessional collaboration were discovering common clinical goals and defining

and raising awareness of pharmacists' roles through interprofessional education.⁵⁷ Moreover, a mixed-methods review conducted by El-Awaisi et al. (2018) identified the importance of interprofessional education as a means to enhance collaborative practice.⁵⁸ Together, these findings are aligned with the findings of the current review, in that other health professionals valued collaborative roles that contributed toward patient outcomes, such as medication reviews and patient education, while highlighting a need to raise awareness regarding the scope of practice for hospital pharmacists.

This review possesses several strengths and limitations. To enhance the qualitative data synthesis and conceptualisation of the review, systematic and transparent processes were undertaken. For example, having two independent investigators complete screening, data extraction, critical appraisal of included papers and thematic analysis of the qualitative findings promoted rigour in the review and meta-synthesis. The use of the GRADE-CERQual assessment improved the transparency of the process used to assess each included study, as well as the credibility of the overall findings that resulted from the combination of individual studies. Despite the comprehensive search strategy and subsequent broad screening of publications for inclusion in this review, grey literature was excluded and this may have resulted in the loss of some qualitative data. However, there is a greater advantage to including only peer-reviewed literature, as it reduces the risk of inheriting biased or unverified information. Secondly, a large portion of the studies included was conducted in Australia and Sweden; this over-representation may reduce generalisability to the other regions. The impact of this was minimised by assessing each review finding with the Adequacy criterion in the GRADE-CERQual assessment. This criterion emphasises the richness and quantity of study data, rather than the number of publications identified in each geographical region, as one of the recommended methodologies by the Cochrane Qualitative and Implementation Methods Group.⁵⁹ Lastly, qualitative data on the perceptions held by other health professionals who have prescribing rights in several regions, such as speech therapists and podiatrists, were lacking in the literature; the vast majority of perspectives identified belonged to doctors and nurses. More research is needed to explore the perceptions and the interprofessional collaboration between hospital pharmacists and the under-represented health professional groups.

This review has implications for pharmacy, multidisciplinary teams, hospital administrators and other healthcare stakeholders who are establishing or reviewing hospital pharmacy services. The results indicate a need to re-evaluate and optimise interprofessional communication channels, as well as the role of pharmacy in the process. This review also highlights the roles and services that are highly valued by other health professionals, such as medication reviews, provision of drug information for health professionals, and education for patients, which could be prioritised in future. Furthermore, these findings may demonstrate a necessity for the development of interprofessional education curricula for pharmacists and other health professionals during undergraduate training,

their internships and beyond to clarify role understanding and associated expectations. The review findings around emerging roles may also prompt the momentum for potential changes in service norms and scope expansion by pharmacy policymakers. The perspectives of patient and carer groups remain significant areas for future research as safe, positive experiences and high satisfaction rates are undoubtedly the ultimate goal of all health services. Moreover, further research synthesising findings from the quantitative literature on this topic would complement the qualitative findings from this review, and work stratifying the data by clinical unit or by profession could also provide valuable information for pharmacy stakeholders.

5. Conclusion

Based on the synthesised qualitative literature globally, this review provides a comprehensive summary of perspectives of non-pharmacist health professionals on the variety of roles and services hospital pharmacists perform around the world. Findings from this review may serve as a valuable resource for guiding the prioritisation of current hospital pharmacy services and generate momentum for the expansion of hospital pharmacists' roles in the health care system. Taken together, these findings suggest that non-pharmacist health professionals recognise the range of patient-facing and non-patient-facing roles that hospital pharmacists undertake to improve hospital workflow, enhance medication safety and optimise overall patient outcomes.

Protocol registration status

The protocol of this review is currently registered in the University of York's International Prospective Register of Systematic Reviews (PROSPERO Reg. no. CRD42021276415 at <https://www.crd.york.ac.uk/prospero/>).

Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Kyung Min Kirsten Lee reports financial support was provided by Australian Government Department of Education. Sangseo Kim reports financial support was provided by Australian Government Department of Education. Ivanka Koeper reports a relationship with SA Health that includes: employment. Isabella Singh reports a relationship with Northern Territory Department of Health that includes: employment. Jacinta Johnson reports a relationship with SA Health that includes: employment.

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Appendix A. Search strategy used in MEDLINE incorporating the review inclusion criteria

#	Searches	Results
1	exp "Attitude of Health Personnel"/ ((attitud* or survey* or questionnaire* or qualit* or interview* or feedback* or evaluat* or satisfa* or perspective* or perception* or opinion* or expect*) adj10 ("Health professional*" or "health	164,510
2	feedback* or evaluat* or satisfa* or perspective* or perception* or opinion* or expect*) adj10 ("Health professional*" or "health	165,513

(continued)

#	Searches	Results
	personnel" or Nurse* or physician* or Doctor* or Pharmacist* or Dentist* or Nutritionist* or "Occupational Therapist" or Optometrist* or "Physical therapist" or Physiotherapist* or Psychotherapist*)). tw,kf.	
3	1 or 2	296,235
4	Pharmacists/	18,719
5	Pharmacy/	8679
6	Pharmacy Service, Hospital/	12,085
7	exp Pharmaceutical Services/	74,714
8	(pharmacist* or pharmacy or "pharmaceutical service*" or "hospital pharmacy").tw,kf.	71,696
9	or/4-8	128,401
10	exp Hospitals/	290,940
11	exp Hospitalization/	263,993
12	(hospital* or inpatient* or outpatient*).tw,kf.	1,582,622
13	or/10-12	1,746,168
14	3 and 9 and 13	4874
15	limit 14 to last 10 years	3114

Appendix B. Detailed accounts of perceptions regarding specific hospital pharmacist roles

Many non-pharmacist health professionals thought that inventory management is an important service delivered by hospital pharmacies, in addition to supporting patient care, it contributes to minimising wastage and over-stocking of medications (Moderate Confidence).^{6,21,29,44,45} In several studies, health professionals assumed that the roles of hospital pharmacists were predominantly related to stock management, while activities in optimising prescribing and medication use were unfamiliar to them (Moderate Confidence).^{25,30,37,38,45} Nurses in Mexico perceived the roles of hospital pharmacists to include "the control of medicines supply to hospital services to avoid the overstocking of inventory, the preparation of medicines (mainly injectables and intravenous), and even medical prescription",²⁹ whereas a mental health team in Brazil "did not recognize the [hospital] pharmacist's clinical profile" and perceived the focus of pharmacists roles to be "only drug logistics and compliance with legislation that requires him to serve in the pharmacy's CAPS [Brazilian Psychosocial Care Centres]."³⁰ Similar perceptions were also revealed in Swiss and Portuguese studies as below:

"The pharmacist doesn't really have any role apart from establishing the list of drugs for the hospital, and trying to negotiate prices, and things like that."²⁵ (Swiss Physician).

"...the role of the pharmacist is very recent. We have always lived without pharmacists."⁴⁵ (Portuguese Nephrologist).

In contrast, Australian doctors in two studies recognised that hospital pharmacists provide services in both inventory management and clinical medication management (Moderate Confidence),^{38,45} while health professionals in Ethiopia, Mexico and Brazil mentioned that hospital pharmacists should be more patient-centred, shifting their focus away from product-based roles (Low Confidence).^{29,30,43}

"[Australian] Doctors appeared to have insight into the specialist knowledge of pharmacists —referring to pharmacokinetics, pharmacodynamics, drug effectiveness, off-label drug use, improving the quality of treatment, better patient care, and referred to better interdisciplinary collaboration."³⁸ (Study Author).

"... to say a health care professional, they [pharmacists] should come close to patients."⁴³ (Ethiopian Doctor).

Additionally, specific roles hospital pharmacists perform in compounding and quality control were identified by participants in

Portugal, describing pharmacists as holding “responsibility for the quality control of medicines.”⁴⁵

Medication reconciliation activities were perceived favourably by the participants in 12 studies, with health professionals noting these services improved patient safety and were time-saving.^{5,6,20,27,34,39,40,44–46,48,50} However, the GRADE-CERQual grade in this finding was rated Low Confidence due to concerns about the methodological quality and data adequacy of some of contributing studies.

“I think the clinical pharmacist was extremely thorough and advocated for the highest patient care. I think the service would be helpful. Verifying medication doses, calling PCPs [Postsurgical Clinical Pharmacist] and family for medication information and significantly improved patient safety.”⁴⁸ (“Respondent”).

“The documentation of the medications they are on is accurate compared to previously [...] It really increases the efficiency of the clinic.”⁴⁰ (Australian Doctor).

Health professionals identified and valued the roles of pharmacists in monitoring and reporting adverse reactions as they contribute to patient safety (Moderate Confidence).^{21,34,45,48}

“Both Australian and Portuguese nephrologists highlighted the importance of clinical pharmacists in monitoring and reporting adverse drug reactions—pharmacovigilance.”⁴⁵ (Study Author).

The medication review was one of the most frequently mentioned roles, highlighted in 26 out of 36 studies over 13 countries, and was described as something that saves time, reduces workload, and has an educational value, ultimately leading to enhanced patient safety (rated Moderate Confidence).^{5,6,21,23–29,31,33–38,41–45,48–50,52}

“The nurses highly valued the pharmacist-led MR [medication review] as it reassured the nurses that the patient was receiving appropriate, safe and effective medicines”⁴⁴ (Study Author).

“Overall management of patients is better...as the pharmacist is able to identify missing medications [and] identify medication dose changes.”⁵⁰ (Australian Doctor).

“Participants emphasised incontrovertible role of active presence of clinical pharmacist to build safer medication management.”²⁴ (Study Author).

Medication review was also acknowledged in Australian and UK studies to improve teamwork and workplace culture (Moderate Confidence). Nurses expressed that “ward” pharmacists had been a great ally for them as pharmacists intervened with doctors on behalf of nurses for any prescribing error that the doctors had made.^{26,41}

“In this study, the qualitative evidence suggests that the ward pharmacist liaison with doctors about potential medication errors helped nurses to overcome the ‘authority’ gradient.”²⁶ (Study Author).

“Advancing on this, some doctors reported increased teamwork and role awareness of their pharmacist as a result of prescribing error feedback.”⁴¹ (Study Author).

Doctors expressed that hospital pharmacists were important contributors in ward rounds, as pharmacists could provide advice and intervene in real-time as therapeutic decisions are made.^{19–22,25,28,31–35,37–39,42,45,48–51} This was a frequently mentioned role and was rated as Moderate Confidence in the GRADE-CERQual assessment.

“Real-time assessment of plan that translates into expedited patient care. Also, we can make a better plan with a team member [pharmacist] on board during multidisciplinary rounds.”⁴⁸ (“Respondent”).

“I welcome their appearance in our rounds; usually, I will look for the pharmacist before doing my round because I need their support if a patient asks something that I cannot answer. So they will be my backup.”¹⁹ (Malaysian Physician).

Non-pharmacist health professionals commented on hospital pharmacists' ability to provide advice aligned with treatment guidelines and alternative options, including advice regarding COVID-19-related therapies (Moderate Confidence)^{19,24,27,28,30,32,35}, and to provide the latest and comprehensive drug information regarding pharmacology, drug compatibility, and market availability (Low Confidence).^{6,19–21,23–25,28,29,31,33,35–39,45,46,48,52} Health professionals also praised the educational opportunities that hospital pharmacists created. Such education opportunities spanned from informal, organic, one-to-one teachings to formally structured education sessions and programmes (Moderate Confidence).^{24,25,28,29,31,33,34,39,41,42,45}

“The HP's [hospital pharmacist] role as a teacher is well recognised.”²⁵ (Study Author).

“Clinicians perceived that participating in courses and educational events led by pharmacists were important continuing in-service education that benefited their practice.”²⁴ (Study Author).

“[Pharmacists] are very knowledgeable and have provided an important service to the team. They also independently seek out answers and solutions for any problems/questions we ask about.”²⁷ (Canadian Physician).

“This education [provided by pharmacist] prepares professionals to collaborate more effectively with other team members by understanding and valuing each professional's roles and focusing to achieve their own competency in collaborative working.”³⁹ (Study Author).

Patient education was one of the most favourably-discussed hospital pharmacists' roles under Theme 1, with more positive perceptions reported relating to this compared with other roles. Non-pharmacist health professionals reported that counselling on medications by hospital pharmacists helped to reinforce key messages which improve adherence and treatment outcomes for patients (Moderate Confidence).^{5,6,19,21,23,27,30,31,33,34,37,40,45–49} In these studies, health professionals identified that pharmacists can fill a gap in patient education that could otherwise arise as they rarely have time for detailed conversations regarding medicines with patients. It was however suggested by some studies that different information from a variety of health professionals can cause patient confusion and may negatively affect the time and cost involved in patient care (Moderate Confidence).^{6,20,27,31,39,45,46}

“They [hospital pharmacists] have been overly helpful with questions and helping patients with all of their questions.”²⁷ (Canadian Nurse).

“The patients get good, clear information that the physicians do not have the time to provide.”³¹ (Swedish Nurse).

“One physician commented that information from different health care professionals had caused patient confusion.”²⁷ (Study Author).

In addition to communicating with patients regarding medication changes on hospital discharge, health professionals believed that hospital pharmacists play a key role in coordinating discharge prescriptions and

informing general practitioners in the community of the discharge plan (as it relates to medications) for a faster and safer discharge process (Moderate Confidence).^{21,50} The doctors and nurses in a Canadian study also strongly agreed that hospital pharmacists “should ensure a smooth transition from hospital to home” (Low Confidence).²⁷ When reflecting on the implementation of pharmacists preparing and verifying discharge prescriptions, one doctor shared that hospital pharmacists were “incredibly helpful” and “the patient discharge process has been greatly streamlined.”⁵⁰

Health professionals expressed differing expectations regarding prescribing rights of hospital pharmacists. These differences appeared to result from differences in the scope of pharmacist practice between clinical settings or between different countries/states with differing legislation (Low Confidence).^{22,27} In terms of perceptions on pharmacist prescribing, although doctor and nurse participants differed in their opinions such as the extent of prescribing authority and training requirements, both professional groups agreed that the prescribing role of pharmacists would benefit patient safety and treatment outcome (Low Confidence).^{6,27,45,49,51}

“It suits me if clinical pharmacists do prescribe as specialty pharmacists are much better updated with latest drug information.”⁴⁹ (Ethiopian Nurse).

“Nurses indicated stronger agreement with the concept of pharmacists having prescribing responsibility relative to either pharmacists or physicians.”²⁷ (Study Author).

“Some [doctors] felt that pharmacists could safely prescribe independently, but they needed to be comfortable that the pharmacists were appropriately trained and aware of unit protocols.”⁵¹ (Study Author).

Interestingly, this role was only mentioned by Australian cohorts in three of the included studies. A small number of doctor participants briefly reflected on the positive involvement of pharmacists in this activity as “crucial in approval of research projects” and great contributors in “service decisions and research” (Moderate Confidence).^{38,45,50}

Health professionals also expressed that hospital pharmacists have a positive impact on medication governance processes such as antibiotic stewardship, cost evaluations, protocol development, and listing medicines in the hospital formulary (Low Confidence).^{6,21,29,36,44,45,49,52}

“The medical staff identified various favorable changes related to the pharmacists' presence at the hospital and the operation of the Pharmacy and Therapeutics Committee, such as the development of an Internal Essential Medicines List...”²⁹ (Study Author).

This theme was the most diverse sub-theme relating to specific hospital pharmacist roles. The hospital pharmacist roles identified in this sub-theme included the provision of virtual/tele-pharmacy,^{19,24,35} pharmacogenomics advice,³⁹ pharmacist-led outpatient clinics such as cardiology clinics,⁴⁰ diabetes education, smoking cessation clinics,⁴⁸ and vaccination clinics.³⁸ Gradings for the findings under this sub-theme in the GRADE-CERQual assessment ranged from Very Low to Moderate Confidence due to low data adequacy as it is a new research field regarding the scope of pharmacists.

“Staff viewed the virtual pharmacist as an additional team member who was trusted and approachable. They valued the double checking, reminders, back-up and guidance provided as they felt it led to safer practice, fewer medication errors and improvements in patient safety.”²⁰ (Study Author).

“There was agreement it was much easier to discuss medications with the patient if they'd attended the cardiology pharmacist clinic. I must say better than what it was before. Because they've had a refresher maybe a day or week before.”⁴⁰ (Australian Doctor).

Appendix C. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.rcsop.2023.100264>.

References

- Orchard CA, Curran V, Kabene S. Creating a culture for interdisciplinary collaborative professional practice. *Med Educ Online* Dec 2005;10(1):4387. <https://doi.org/10.3402/meo.v10i.4387>.
- Chisholm-Burns MA, Graff Zivin JS, Lee JK, et al. Economic effects of pharmacists on health outcomes in the United States: a systematic review. *Am J Health Syst Pharm* Oct 1 2010;67(19):1624–1634. <https://doi.org/10.2146/ajhp100077>.
- Nelson J, Nichols T, Wahl J. The cascading effect of civility on outcomes of clarity, job satisfaction and caring for patients. *Interdiscip J Partnersh Stud* 2017;4(2):6. <https://doi.org/10.24926/ijps.v4i2.164>.
- Fogarty GJ, McKeon CM. Patient safety during medication administration: the influence of organizational and individual variables on unsafe work practices and medication errors. *Ergonomics* 2006;49(5–6):444–456. <https://doi.org/10.1080/00140130600568410>.
- Parker WM, Jang SM, Muzzy JD, Cardone KE. Multidisciplinary views toward pharmacist-delivered medication therapy management services in dialysis facilities. *J Am Pharm Assoc* (2003) 2015;55(4):390–397. <https://doi.org/10.1331/JAPhA.2015.14168>.
- Safitrih L, Perwitasari DA, Ndoen N, Dandan KL. Health workers' perceptions and expectations of the role of the pharmacist in emergency units: a qualitative study in Kupang, Indonesia. *Pharmacy* 2019;7(1):31. <https://doi.org/10.3390/pharmacy7010031>.
- Noyes J, Booth A, Flemming K, et al. Cochrane qualitative and implementation methods group guidance series-paper 3: methods for assessing methodological limitations, data extraction and synthesis, and confidence in synthesized qualitative findings. *J Clin Epidemiol* May 2018;2018(97):49–58. <https://doi.org/10.1016/j.jclinepi.2017.06.020>.
- Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021;372, n71. <https://doi.org/10.1136/bmj.n71>.
- Justesen T, Freyberg J, Schultz A. Database selection and data gathering methods in systematic reviews of qualitative research regarding diabetes mellitus - an explorative study. *BMC Med Res Methodol* 2021;21(1):94. <https://doi.org/10.1186/s12874-021-01281-2>.
- Rotta I, Salgado TM, Silva ML, Correr CJ, Fernandez-Llimos F. Effectiveness of clinical pharmacy services: an overview of systematic reviews (2000–2010). *Int J Clin Pharm* 2015;37(5):687–697. <https://doi.org/10.1007/s11096-015-0137-9>.
- Critical Appraisal Skills Programme. CASP Qualitative Studies Checklist. Accessed April 6, 2023: <https://casp-uk.net/casp-tools-checklists/> 2018.
- Effective Practice and Organisation of Care (EPOC). *EPOC Qualitative Evidence Synthesis: Protocol and Review Template*. Norwegian Institute of Public Health. 2022. Accessed April 6, 2023: <http://epoc.cochrane.org/epoc-specific-resources-review-authors>. Accessed April 6, 2023.
- Munn Z, Tufanaru C, Aromataris E. JBI's systematic reviews: data extraction and synthesis. *Am J Nurs* 2014;114(7):49–54. <https://doi.org/10.1097/01.Naj.0000451683.66447.89>.
- Thomas J, Harden A. Methods for the thematic synthesis of qualitative research in systematic reviews. *BMC Med Res Methodol* 2008;8(1):45. <https://doi.org/10.1186/1471-2288-8-45>.
- World Health Organization. *The strategic framework of the global patient safety challenge*. World Health Organization. 2023. Accessed April 6, 2023: <https://www.who.int/initiatives/medication-without-harm>.
- World Health Organization. *Global competency and outcomes framework for universal health coverage*. World Health Organization. 2022. Accessed April 6, 2023: <https://www.who.int/publications/i/item/9789240034686>. Accessed April 6, 2023.
- Braun V, Clarke V. One size fits all? What counts as quality practice in (reflexive) thematic analysis? *Qual Res Psychol* 2020;18(3):328–352. <https://doi.org/10.1080/14780887.2020.1769238>.
- Lewin S, Glenton C, Munthe-Kaas H, et al. Using qualitative evidence in decision making for health and social interventions: an approach to assess confidence in findings from qualitative evidence syntheses (GRADE-CERQual). *PLoS Med* Oct 2015;12(10), e1001895. <https://doi.org/10.1371/journal.pmed.1001895>.
- Ahlan S, Shubashini G, Nahlah Elkudssiah I. Are Malaysian nurses and doctors in cancer units happy to have pharmacists on the team? *Eur J Palliat Care* 2016;23(5):252–255.
- Allan J, Webster E, Chambers B, Nott S. “this is streets ahead of what we used to do”: staff perceptions of virtual clinical pharmacy services in rural and remote Australian hospitals. *BMC Health Serv Res* 2021;21(1):1306. <https://doi.org/10.1186/s12913-021-07328-w>.
- Atkins SR, Cunningham S. Multidisciplinary views towards the clinical pharmacist: a hospital palliative cancer care team perspective in Malta. *J Pharm Health Serv Res* 2018;9(4):327–333. <https://doi.org/10.1111/jphs.12267>.
- Azhar S, Hassali MA, Iqbal A, et al. Qualitative assessment of the pharmacist's role in Punjab, Pakistan: medical practitioners' views. *Trop J Pharm Res* 2015;14(2):323–327. <https://doi.org/10.4314/tjpr.v14i2.19>.
- Azhar S, Murtaza G, Kousar R, Khan SA. What do the doctors perceive about the quality of pharmaceutical care services in Khyber Pakhtunkhwa, Pakistan: a qualitative study. *Lat Am J Pharm* 2015;34(4):835–888.
- Bakhshi F, Mitchell R, Nikbakht Nasrabadi A, Javadi M, Varaei S. Clinician attitude towards safety in medication management: a participatory action research study in an emergency department. *BMJ Open* 2021;11(9), e047089. <https://doi.org/10.1136/bmjopen-2020-047089>.

25. Béchet C, Pichon R, Giordan A, Bonnabry P. Hospital pharmacists seen through the eyes of physicians: qualitative semi-structured interviews. *Int J Clin Pharm* 2016;38(6):1483–1496. <https://doi.org/10.1007/s11096-016-0395-1>.
26. Bryant R, Chaar B, Schneider C. Differing clinical pharmacy service models: quantitative and qualitative analysis of nurse perceptions of support from pharmacists. *Int J Nurs Stud* 2018;86:90–98. <https://doi.org/10.1016/j.ijnurstu.2018.04.003>.
27. Chevalier B, Neville HL, Thompson K, Nodwell L, MacNeil M. Health care professionals' opinions and expectations of clinical pharmacy services on a surgical ward. *Can J Hosp Pharm* 2016;69(6):439–448. <https://doi.org/10.4212/cjhp.v69i6.1606>.
28. Coralic Z, Kanzaria HK, Bero L, Stein J. Staff perceptions of an on-site clinical pharmacist program in an academic emergency department after one year. *West J Emerg Med* 2014;15(2):205–210. <https://doi.org/10.5811/westjem.2013.11.18069>.
29. Díaz de León-Castañeda C, Gutiérrez-Godínez J, Colado-Velázquez III J, Toledano-Jaimés C. Healthcare professionals' perceptions related to the provision of clinical pharmacy services in the public health sector: a case study. *Res Soc Adm Pharm* 2019;15(3):321–329. <https://doi.org/10.1016/j.sapharm.2018.04.014>.
30. Fernandes SAF, Brito GC, Dosea AS, de Lyra Junior DP, Garcia-Cardenas V, Fonteles MMF. Understanding the provision of a clinical service in mental health and the role of the pharmacist: a qualitative analysis. *Interface: Commun Health Educ* 2021;25:e200788. <https://doi.org/10.1590/INTERFACE.200788>.
31. Gillespie U, Mörlin C, Hammarlund-Udenaes M, et al. Perceived value of ward-based pharmacists from the perspective of physicians and nurses. *Int J Clin Pharm* 2012;34(1):127–135. <https://doi.org/10.1007/s11096-011-9603-1>.
32. Gopal Krishnamoorthy S, Sanjeev S, Baiju A, Manomohan A, Borra SS. Comprehending healthcare professionals' perspectives and expectations on drug information services at point-of-care: an online survey. *Drugs Ther Perspect* 2022;38(5):243–250. <https://doi.org/10.1007/s40267-022-00913-x>.
33. Håkansson Lindqvist M, Gustafsson M, Gallego G. Exploring physicians, nurses and ward-based pharmacists working relationships in a Swedish inpatient setting: a mixed methods study. *Int J Clin Pharm* 2019;41(3):728–733. <https://doi.org/10.1007/s11096-019-00812-8>.
34. Haver AE, Sakely H, Somma McGivney M, et al. Geriatrics care team perceptions of pharmacists caring for older adults across health care settings. *Ann Longterm Care* 2017;25(4):14–20.
35. Isleem N, Shoshaa S, AbuGhalyoun A, et al. Critical care tele-pharmacy services during COVID-19 pandemic: a qualitative exploration of healthcare practitioners' perceptions. *J Clin Pharm Ther* 2022;47(10):1591–1599. <https://doi.org/10.1111/jcpt.13709>.
36. Jennings P, Lotito A, Baysson H, Pineau-Blondel E, Berlioz J. Clinical pharmacy: evaluation of physician's satisfactions and expectations in a French regional hospital. *Ann Pharm Fr* 2017;75(2):144–151. <https://doi.org/10.1016/j.pharma.2016.08.003>.
37. Kharaba Z, Kousar R, Alfoteih Y, Azhar S, Khan SA, Murtaza G. Nurses perception of pharmaceutical care practice: a qualitative approach. *Trop J Pharm Res* 2020;19(4):887–892. <https://doi.org/10.4314/tjpr.v19i4.30>.
38. Krzyzaniak N, Pawlowska I, Bajorek B. Pharmaceutical care in NICUs in Australia and Poland: attitudes and perspectives of doctors and nurses. *J Perinat Neonatal Nurs* 2019;33(4):E27–E37. <https://doi.org/10.1097/JPN.0000000000000438>.
39. Lee I-H, Rhie S, Je N, et al. Perceived needs of pharmaceutical care services among healthcare professionals in South Korea: a qualitative study. *Int J Clin Pharm* 2016;38(5):1219–1229. <https://doi.org/10.1007/s11096-016-0355-9>.
40. Livori AC, Bishop JL, Ping SE, et al. Towards Optimising care of regionally-based cardiac patients with a telehealth cardiology pharmacist clinic (TOPCare cardiology). *Heart Lung Circ* 2021;30(7):1023–1030. <https://doi.org/10.1016/j.hlc.2020.12.015>.
41. Lloyd M, Watmough SD, O'Brien SV. Formalized prescribing error feedback from hospital pharmacists: Doctors' attitudes and opinions. *Br J Hosp Med (Lond)* 2015;76(12):713–718. <https://doi.org/10.12968/hmed.2015.76.12.713>.
42. McDaniel J, Bass L, Pate T, DeValve M, Miller S. Doubling pharmacist coverage in the intensive care unit: impact on the pharmacists' clinical activities and team members' satisfaction. *Hosp Pharm* 2017;52(8):564–569. <https://doi.org/10.1177/0018578717723997>.
43. Mekonnen AB, Yesuf EA, Odegard PS, Wega SS. Pharmacists' journey to clinical pharmacy practice in Ethiopia: key informants' perspective. *SAGE Open Med* September 2013;1:no pagination. doi: <https://doi.org/10.1177/2050312113502959>.
44. Ronan S, Shannon N, Cooke K, et al. The role of the clinical pharmacist in an Irish university teaching hospital: a mixed-methods study. *Pharmacy* 2020;8(1):14. <https://doi.org/10.3390/pharmacy8010014>.
45. Salgado TM, Moles R, Benrimoj SI, Fernandez-Llimos F. Exploring the role of pharmacists in outpatient dialysis centers: a qualitative study of nephrologist views. *Nephrol Dial Transplant* 2013;28(2):397–404. <https://doi.org/10.1093/ndt/gfs436>.
46. Salgado TM, Moles R, Benrimoj SI, Fernandez-Llimos F. Renal nurses' views of the potential role of pharmacists in outpatient dialysis centres: a qualitative study. *Int J Pharm Pract* 2014;22(4):300–303. <https://doi.org/10.1111/jppr.12082>.
47. Sjölander M, Gustafsson M, Gallego G. Doctors' and nurses' perceptions of a ward-based pharmacist in rural northern Sweden. *Int J Clin Pharm* 2017;39(4):953–959. <https://doi.org/10.1007/s11096-017-0488-5>.
48. Tavakoli FC, Adams-Sommer VL, Frendak LS, Kiehle ND, Dalpoas SE. Assessing the impact of a clinical pharmacist in a postsurgical inpatient population. *J Pharm Pract* 2014;22(1):32–37. <https://doi.org/10.1177/0897190020938196>.
49. Tegegn HG, Abdela OA, Mekuria AB, Bhagavathula AS, Ayele AA. Challenges and opportunities of clinical pharmacy services in Ethiopia: a qualitative study from healthcare practitioners' perspective. *Pharm Pract* 2018;16(1):1121. <https://doi.org/10.18549/PharmPract.2018.01.1121>.
50. Tran T, Johnson DF, Balassone J, Tanner F, Chan V, Garrett K. Effect of an integrated clinical pharmacy service with the general medical units on patient flow and medical staff satisfaction: a pre- and postintervention study. *J Pharm Pract Res* 2019;49(6):538–545. <https://doi.org/10.1002/jppr.1577>.
51. Tran T, Taylor SE, George J, Chan V, Mitri E, Elliott RA. Pharmacist-assisted prescribing in an Australian hospital: a qualitative study of hospital medical officers' and nursing staff perspectives. *J Pharm Pract Res* 2021;51(6):472–479. <https://doi.org/10.1002/jppr.1766>.
52. Vinterflod C, Gustafsson M, Mattsson S, Gallego G. Physicians' perspectives on clinical pharmacy services in northern Sweden: a qualitative study. *BMC Health Serv Res* 2018;18(1):35. <https://doi.org/10.1186/s12913-018-2841-3>.
53. Chevalier B, Neville HL, Thompson K, Nodwell L, MacNeil M. Health care professionals' opinions and expectations of clinical pharmacy services on a surgical ward. *Can J Hosp Pharm* 2016;69(6):439–448. <https://doi.org/10.4212/cjhp.v69i6.1606>.
54. International pPharmaceutical fFederation (FIP). Global pharmacy workforce intelligence: trends Report. Accessed April 6, 2023: <https://www.fip.org/file/1401> 2015.
55. Moreland RL, Zajonc RB. Exposure effects in person perception: familiarity, similarity, and attraction. *J Exp Soc Psychol* 1982;18(5):395–415.
56. Hurley E, Gleeson LL, Byrne S, Walsh E, Foley T, Dalton K. General practitioners' views of pharmacist services in general practice: a qualitative evidence synthesis. *Fam Pract* 2022;39(4):735–746. <https://doi.org/10.1093/fampra/cmab114>.
57. Supper I, Catala O, Lustman M, Chemla C, Bourgueil Y, Letrilliant L. Interprofessional collaboration in primary health care: a review of facilitators and barriers perceived by involved actors. *J Public Health (Oxf)* 2015;37(4):716–727. <https://doi.org/10.1093/pubmed/udu102>.
58. El-Awaisi A, Joseph S, El Hajj MS, Diack L. A comprehensive systematic review of pharmacy perspectives on interprofessional education and collaborative practice. *Res Soc Adm Pharm* 2018;14(10):863–882. <https://doi.org/10.1016/j.sapharm.2017.11.001>.
59. Glenton C, Carlsen B, Lewin S, et al. Applying GRADE-CERQual to qualitative evidence synthesis findings-paper 5: how to assess adequacy of data. *Implement Sci* 2018;13(1):14. <https://doi.org/10.1186/s13012-017-0692-7>.