

The background of the cover is a textured painting. The top half shows a sky with horizontal brushstrokes in shades of blue, purple, and grey. The bottom half shows a sea with various shades of blue and green. In the foreground, there are two dark, rocky islands with some yellow-green vegetation. White foam from waves is visible crashing against the base of the islands.

Development of a framework for nurses' role in interprofessional pharmaceutical care in Europe

**Thesis submitted for the degree of doctor of Medical Sciences
at the University of Antwerp to be defended by
Elyne DE BAETSELIER**

Antwerp, 2021

Supervisors:

Prof. dr. Tinne Dilles

Prof. dr. Bart Van Rompaey

PhD
'Rock bottom became the solid foundation on which I rebuilt my ~~life~~'

~ J.K. Rowling ~

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De ontwikkeling van een raamwerk voor de rol van verpleegkundigen in interprofessionele farmaceutische zorg in Europa

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List of abbreviations

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ADR	Adverse Drug Reaction
CP	Clinical Practice
COREQ	Consolidated Criteria for Reporting Qualitative Research
DeMoPhaC	Development of a Model (framework) for nurses' role in interprofessional Pharmaceutical Care
DI	Disagreement Index
DRP	Drug Related Problems
EANS	European Academy of Nursing Science
EFQM	European Foundation for Quality management
EQF	European Qualifications Framework
EUPRON	Europe – Pharmaceutical care – Role Of Nurses
FINE	European Federation of Nurse Educators
IOM	Institute Of Medicine
IPR	Inter-percentile Range
IPRAS	Interpercentile Range Adjusted for Symmetry
IPRCP	Interpercentile Range Central Point
ME	Medication Error
ME	Monitoring therapeutic / adverse Effects of medicines
MeSH	Medical Subject Headings
MMA	Monitoring Medication Adherence
MRC	Medical Research Council
NuPhaC	Nurse and Pharmaceutical Care
NUPHAC-EU	NUrse and PHArmaceutical Care EUrope
PC	Pharmaceutical Care
PEI	Providing patient Education and Information about medication
PM	Prescribing Medicines
PCNE	Pharmaceutical Care Network Europe
PRISMA-ScR	Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews
PRN	Pro Re Nata, 'if needed' medication
RAM	RAND/UCLA Appropriateness Method

List of abbreviations

STROBE	Strengthening the Reporting of Observational Studies Epidemiology
STTI	Sigma Theta Tau International honour society of nursing
SWOT	Strengths, Weaknesses, Opportunities and Threats
WHO	World Health Organization

Chapter 1



General introduction

General introduction

This general introduction provides the background information on which this doctoral study is built. The first section elaborates on important problems in pharmaceutical care from a 'problem-gap-hook' perspective. Secondly, the core concepts used in this thesis are explained. In the third section the rationale of the study is described, followed by the aims. Then, the study is situated in the overall DeMoPhaC project and the project management details are provided. This general introduction concludes with the outline of the thesis.

1. Role clarity for nurses in interprofessional collaboration in pharmaceutical care: problem – gap – hook

1.1. Problem 1: Medication errors due to collaboration issues

Interprofessional collaboration and communication play a crucial role in patient safety.¹⁻⁷ Research has documented the negative impact of collaboration problems on safe care.⁸⁻⁹ In fact, ineffective communication among team members is often a contributing factor to medication errors (ME).¹⁰⁻¹² These preventable events, that may lead to inappropriate medication use or patient harm, occur at unacceptable high rates in all healthcare settings. In Europe, according to the European Medicines Agency, estimates of ME rates in ambulatory care are 7.5% at prescription and 0.08% at dispensation, while in hospital care ME rates are estimated between 0.3% and 9.1% at prescription and between 1.7% and 2.1% at the dispensing stage.¹³ Systematic reviews about ME rates worldwide report wide ranges from 2% to 94% in community care contexts¹⁴ and 19% to 63% following discharge from hospital to community settings.¹⁵ Generally, it is assumed that about half of the ME will lead to patient harm.¹⁶ These harmful events contain a financial burden that should not be underestimated. Globally, the cost associated with ME has been estimated at €35 billion annually or almost 1% of total global health expenditure.¹⁷

1.2. Problem 2: Collaboration problems due to unclarity of nurses' role

Ineffective team communication and unclear definitions of team members' roles are two of the fundamental causes of ineffective collaboration.¹⁸⁻²⁰ Research has

shown that knowing about and valuing the skills and responsibilities of other team members and respecting each person's unique contribution to the work of the team can lead to more effective communication and collaboration in the context of medication safety.¹⁹

Nurses' roles are often a topic of discussion, even within the nursing profession itself.^{21 22} Preparing and administering medicines are basic and generally known nursing activities, allocated to nurses even before Florence Nightingale laid the foundation of professional nursing in the 19th century.²³ Less commonly known is that additional medication-related activities are also part of nurses' daily practice. Conflicting evidence, however, exists about nurses' activities in medication-related care, henceforth described as pharmaceutical care (PC).²⁴⁻²⁷ Discrepancies between and within countries are observed in what nurses are allowed to do, what they actually do and what they would be able to do.^{24 28 29} Additionally, nurses with different educational levels are often performing the same tasks in clinical practice.³⁰ Hence, it is not unreasonable that healthcare professionals, and likewise the public, are unable to distinguish between these nursing levels and associated responsibilities and tasks.

1.3. Problem 3: Missed care due to unclarity of nurses' role

Missed care is defined as care that is delayed, partially completed, or not completed at all.³¹ Its outcomes are poorer quality of patient care, less effective care, suboptimal patient satisfaction and nurses' job satisfaction, increased ME and organizational outcomes of increasing hospital length of stay and hospital readmission.³² A recent scoping review of Bagnasco et al. (2020) focused on the patient's perspective of missed nursing care. They found that the majority of patients' unmet care needs were: communication, self-management, autonomy and education, and emotional and psychological care.³³

Missed nursing care can be related to the lack of clarity about nurses' role. More to the point, the role of nurses must be clear to all other professionals, with whom they collaborate, but even more so to nurses themselves. In fact, if the majority of the nurses believe not to be responsible for a specific task, as a consequence, this task may be performed by nurses too incautiously or not performed at all. For

example, if nobody dwells on monitoring errors, they won't be noticed either, resulting in missed nursing care and undetected ME.

1.4. Gap

Due to limited research into what nurses' actually do or could do in PC and lacking knowledge about nurses', physicians' and pharmacists' opinions about (shared) responsibilities in PC, the role nurses can have in interprofessional PC is not defined. The lack of such insight is a critical gap in the literature, as well as in clinical practice and education. After all, to prevent missed care and promote interprofessional collaboration, team members should clearly know what to expect from each other in different healthcare settings and situations.

1.5. Hook

Therefore, to ensure proper collaboration between nurses, physicians and pharmacists in PC and consequently to improve the quality of PC and patient outcomes a clear description of nurses' role in PC is urgently needed. A framework describing this role in a variety of healthcare situations can enable professionals to openly discuss allocation of specific (shared) responsibilities and tasks. This awareness begs the ubiquitous question: if such a framework ambitions to improve patient safety, then what should it look like?

2. Core concepts and terminology within this doctoral study

2.1. Scope of practice ~ Role ~ Responsibilities ~ Tasks

Nurses' scope of practice is considered as the full range of roles, responsibilities and tasks that nurses are educated, competent and authorized to perform.³⁴

The role of a nurse is defined as the expected function and characteristic pattern of behaviour exhibited by a member of the nursing profession. Registered nurses, nurse midwives, nurse assistants (enrolled nurses), nurse practitioners, research nurses are examples of roles.³⁵ Nurses' role involves several responsibilities.

A responsibility for nurses is an obligation that they have in virtue of their role as a nurse. Their central responsibility is to function as the patient's health advocate

and to provide high quality of care, using sound professional judgement and taking into account the relevant legal and moral considerations. The other responsibilities of nurses derive from this central responsibility. Failing in their responsibilities, could result in disciplinary, civil, and criminal liability. Specific tasks may have to be performed in order to fulfill a responsibility.^{36 37} The determination of responsibilities and tasks in PC will be addressed in this doctoral thesis.

2.2. Multidisciplinary collaboration ~ Interprofessional collaboration

According to the World Health Organization (WHO) collaborative practice in healthcare occurs when multiple healthcare workers from different professional backgrounds provide comprehensive services by working with patients, their families, caregivers and communities to deliver the highest quality of care across settings.³⁸ While multidisciplinary collaboration brings disciplines together, interprofessional or interdisciplinary collaboration cuts across the disciplines and fosters the integration of ideas.³⁹

Interprofessional collaboration involves more than just different healthcare providers applying their unique skills and knowledge to the management of a patient. This kind of collaboration occurs when individuals have mutual respect for each other and each other's professions and are willing to participate in a cooperative atmosphere.^{40 41} In an interprofessional collaboration different professional groups have shared goals related to patient outcomes. They are working together on a common task or a joint project, to positively impact the delivery of care to patients. This involves regular negotiation and interaction between professionals, valuing the expertise and contributions that the various disciplines bring to patient care.^{42 43}

Multidisciplinary collaboration is more discipline-oriented, with all professionals working parallel. Their level of professional autonomy is high. Clear role definitions, specified tasks and hierarchical lines of authority are typical. Multidisciplinary team members create their own individual goals and treatment plans for the patient. The physician communicates with each of the other healthcare providers in the team, but there is little or no communication among the individual professionals. As a result there is little overlap between the team members and team discussions are rare.⁴⁴

2.3. Medicines management ~ Medicines optimisation ~ Pharmaceutical care

Medicines management is defined as the clinical, cost-effective and safe use of medicines to ensure patients get the maximum benefit from the medicines they need, while at the same time minimising potential harm.⁴⁵ Medicines management is an important enabler of medicines optimisation.

Medicines optimisation is a patient-focused approach to get the best from investment in and use of medicines. It requires a holistic approach, an enhanced level of patient-centred professionalism, and partnership between clinical professionals and their patient. A medicines optimisation approach requires extensive interprofessional team working. As such, healthcare professionals will need to work together to improve the quality of medicines use by individualizing care, monitoring outcomes more carefully, reviewing medicines more frequently and supporting patients when needed.⁴⁶

Both medicines management and medicines optimization are sometimes used to refer to (parts of) pharmaceutical care (PC).⁴⁷ In this doctoral thesis we embrace PC as the most comprehensive concept. PC was first defined in 1990 by Hepler and Strand as: the responsible provision of drug therapy for the purpose of achieving definite outcomes that improve a patient's quality of life. These outcomes include (1) cure of a disease, (2) elimination or reduction of a patient's symptomatology, (3) arresting or slowing of a disease process, or (4) preventing a disease or symptomatology.⁴⁸ Pharmaceutical care involves the process through which a pharmacist cooperates with a patient and other professionals in designing, implementing, and monitoring a therapeutic plan that will produce specific therapeutic outcomes for the patient. This in turn involves three major functions: (1) identifying potential and actual drug-related problems, (2) resolving actual drug-related problems, and (3) preventing potential drug-related problems.⁴⁸ In other words, the responsibilities of the PC practitioner are to ensure that all of the medications being taken by the patient are appropriate, effective and safe, and can be taken as intended.⁴⁹ In 2013, the Pharmaceutical Care Network Europe (PCNE) redefined the definition to 'the pharmacist's contribution to the care of individuals in order to optimise medicines use and improve health outcomes.'⁵⁰ This revised definition, however, was limited to the contribution of pharmacists, even though the

literature review that preceded the development of this PCNE definition demonstrated the involvement of pharmacists as well as other healthcare workers. (Figure 1.1) Consequently, in 2020, the Council of Europe disregarded the PCNE definition and again referred to the original authors, Hepler and Strand, emphasizing the interprofessional dimension of PC.⁵¹

Since it is broadly recognised that there is a need for interprofessional collaboration in PC,⁵¹⁻⁵⁵ in this doctoral study, we paraphrased PC, taking into account all healthcare professionals rather than considering PC as pharmacists-only care. This resulted in:

Pharmaceutical care is healthcare professionals' contribution to the care of individuals in order to optimise medicines use and improve health outcomes.

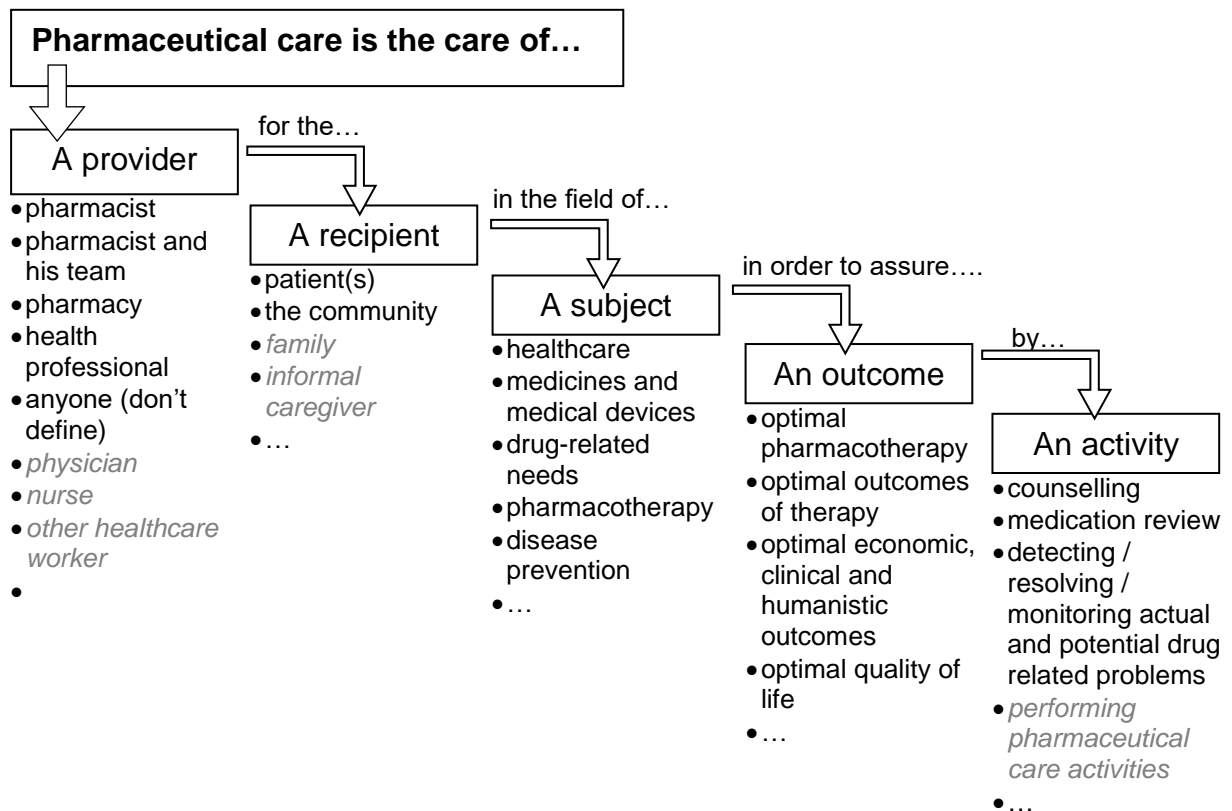


Figure 1.1. Standardised syntax for pharmaceutical care definitions, based on the literature review preceding the PCNE definition. (Source: Allemann et al, 2014)⁵⁰

For each domain, a non-limitative list of examples was given by the authors. For the purpose of this thesis, additional examples were added to the original syntax in *grey italic*.

Figure 1.2 visualises our view on the interprofessional and informal PC team to obtain best patient outcomes. This model will be the basis of our framework to be developed.

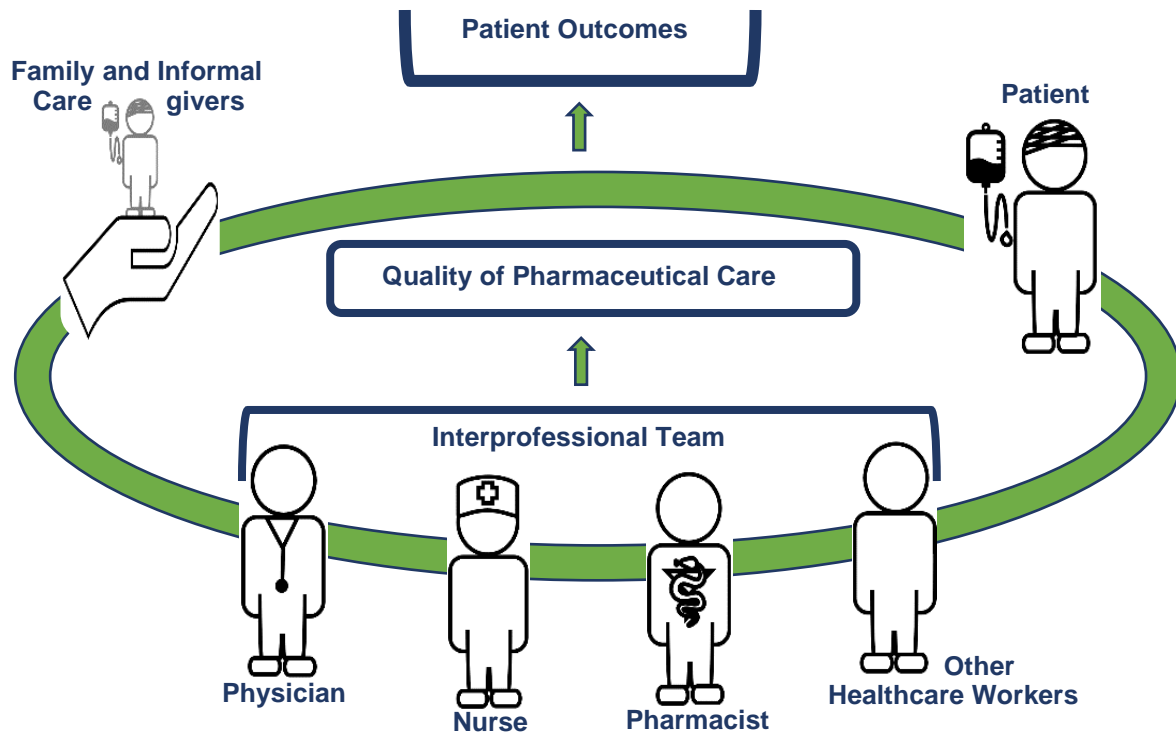


Figure 1.2. Interprofessional and informal pharmaceutical care team to obtain best patient outcomes

3. Rationale of this doctoral study

Healthcare is constantly changing. Many countries seek to improve healthcare delivery by reviewing the roles of health professionals, including nurses.⁵⁶ The evolution of nurses' scope of practice brings new levels of competency and latitude in the care of patients. To illustrate, in an increasing number of European countries nurses can independently prescribe medicines for selected patients, which was previously restricted to physicians only.²⁴

Clear delineation of roles is essential to guarantee effective interprofessional collaboration.⁵⁷ Quality of healthcare may be compromised if professionals do not fully appreciate nurses' role. After all, poorly defined roles can lead to missed care and conflicts in healthcare teams which negatively effects patient outcomes.⁵⁸

Additionally, distinct role descriptions are of crucial importance to facilitate labour mobility. International mobility of nurses in the European Union as well as worldwide is an increasing phenomenon. Hereby, several advantages have been described, including: a balanced supply and demand for health workforce; foreign-trained health professionals can fill service gaps and nurse shortages; increased cultural diversity; decreased average age to keep salary levels in check; and sending remittances to the less wealthy home countries.^{59 60} Transparency of (advanced) nursing roles can support policy makers and nurse managers to develop workforce planning policies and create adapted contexts for more barrier-free nurse labour mobility, taking into account feasibility, cost-effectiveness, care quality and patient outcomes.

Within Europe's single market, health professionals can practice in any other European free movement zone country. Considering the variation in both level of nurse education and practice in Europe, increasingly connected labour markets would benefit from delineating clear role descriptions, basic educational and practice requirements to allow for cross-country comparability.

Nurses' role in interprofessional PC is not transparent and varies between European countries. Similarly, in nurse education, a clear description of specific learning outcomes on PC is lacking. Given the potential risk to patient safety related to missed nursing care / PC, integrating these findings into nursing education is critical.³² Through focused educational programs, nurse students are being prepared to take up existing and new responsibilities in clinical practice. Education is an important opportunity for nurses to extend and accelerate acquisition of essential knowledge, skills and behaviours and in particular, to realise their roles and responsibilities related to care quality. This implies knowledge of roles to be firmly rooted in basic and lifelong education of nurses – and by extension of all healthcare professionals.

Despite several reforms on European nursing education, performed over the last two decades, attempting to harmonise curricula and degree structures, curricula on PC still vary a lot.⁶¹ The current match with the needs of the labour market and society is insufficient. Competency-based education can meet this shortcoming in nurse education.⁶² Nurse education is expected to prepare nurse students for

practice, equipped with both core discipline specific knowledge and skills, as well as the competencies central to safe and high quality PC. The lack of transparency and recognition, together with the variation between countries, in nursing practice and nurse education, has a major impact. Indeed, it hinders collaboration on different levels: interprofessional collaboration in clinical practice; international collaboration in research, education and innovation; and labour mobility of nurses. As a result patient safety is threatened, development and innovation are slowed down, and healthcare budgets are not used most efficiently.

Every day, millions of nurses worldwide contribute to the care of patients, almost all of whom are treated with medicines. So PC is ubiquitous. Consequently, the lack of a clear role description for nurses in PC is absolutely a huge problem.

In summary, there is an urgent need to develop a framework for nurses' role in interprofessional PC in Europe, looking beyond 'the obvious' and focusing on broader nursing roles. This framework could be used as a discussion frame in interprofessional healthcare teams. Additionally, such a framework could be used to develop an assessment to evaluate nurse competences in PC, as a guidance to evaluate nurse education and a tool for nurse educators.

4. Aim of this doctoral study

The general aim of this study was to investigate nurses' role in clinical practice in delivering PC from an interprofessional viewpoint throughout Europe, to develop and evaluate a consensual framework about the role of nurses in PC, and finally, to examine the competences nurses need to fulfill this role.

Specific research questions for this dissertation derived from the general aim:

4.1. Investigating the current role of nurses in PC

- What are the current PC practices of nurses in Europe and what are the experiences in interprofessional collaboration with nurses in PC, from the viewpoint of nurses, physicians and pharmacists?
- What are the existing PC responsibilities and tasks of nurses beyond preparations and administration of medication in the international literature?

4.2. Evaluating the role of nurses in PC

- What are the strengths and weaknesses of nurses' role in PC in Europe today? And what are the opportunities and threats for the future, according to pharmacists', physicians' and nurses'?
- To what extent do pharmacists, physicians and nurses consider PC related tasks, beyond preparation and administration of medicines, as nurses' responsibility in an ideal healthcare situation with best quality of interprofessional care and patient outcomes?

4.3. Defining competences of nurses in PC

- What competences do nurses need for tasks in interprofessional PC?

5. The DeMoPhaC project and project management

This doctoral study is part of the Erasmus+ and Consensus funded DeMoPhaC project. DeMoPhaC is an acronym for the **D**evelopment of a **M**odel for nurses' role in interprofessional **P**harmaceutical **C**are. The overall goal of the project aimed at creating a framework for nurses' role in PC, specific learning outcomes for PC in nurse education and an assessment to evaluate these learning outcomes in final year nursing students. Additionally DeMoPhaC aimed to build a long-term network to promote the quality of education, research, practice and policy in nurse PC.

The project has been performed from September 2018 to December 2021 in a European collaboration with 14 partner institutions from Belgium (University of Antwerp), the Czech Republic (Charles University), Germany (Martin Luther University Halle-Wittenberg), Greece (University of Peloponnese), Hungary (University of Pecs), Italy (ANASTE-Humanitas Foundation), the Netherlands (University of Applied Sciences Utrecht), the Republic of North Macedonia (St. Clement of Ohrid University of Bitola), Norway (Østfold University College), Portugal (Nursing School of Coimbra), Slovakia (Slovak Medical University), Slovenia (University of Primorska), Spain (University of Alicante), and the United Kingdom (Swansea University). The project coordination was performed by the research teams of the University of Antwerp and the University of Applied Sciences Utrecht.

Three associated partners supported the project. The Rho Chi at large Chapter of Sigma Theta Tau International Honour Society of Nursing (STTI), the European Academy of Nursing Science (EANS) and the European Federation of Nurse Educators (FINE) provided the external quality control of the DeMoPhaC project.

6. Outline of this doctoral thesis

This doctoral thesis is one strongly cohesive entity with a clear thread, focus and logic. From the start, we had a clear path in mind to carry out the different sub-studies. We were determined to close the gap that existed at the beginning of this research. Throughout the different chapters, we show how each study seamlessly connects to both the previous and the next, to finally - after 6 chapters - reach our main goal: to present a framework on the role of nurses in PC, and a framework on the competences nurses need to fulfill this role.

Subsequent to this general introduction, the results of our research are presented, addressing all research questions in the next chapters (chapter 2-6), based on articles published in international peer reviewed journals. The results are followed by a general discussion, practical implications, recommendations and a conclusion. Finally an English and Dutch summary are given.

Chapter 1 – General introduction

Chapter 2 - EUPRON: nurses' practice in interprofessional pharmaceutical care in Europe. A cross-sectional survey in 17 countries.

We describe nurses' practice and experiences on interprofessional collaboration with nurses in monitoring adverse and therapeutic effects of medication, monitoring medicines adherence, prescribing, and providing patient education and information about medication, from the viewpoint of nurses, physicians and pharmacists, in different European countries.

Chapter 3 - Perspectives of nurses' role in interprofessional pharmaceutical care across 14 European countries: a qualitative study in pharmacists, physicians and nurses

We explored nurses', physicians' and pharmacists' experiences and expectations about nurses' potential or ideal roles in PC, and related strengths, weaknesses, opportunities and threats through a qualitative descriptive research design with a phenomenological case study approach. Interviews in 14 European countries were performed to unravel healthcare workers' opinions.

Chapter 4 - Nurses' responsibilities and tasks in pharmaceutical care: a scoping review

In this chapter, previous findings from the quantitative EUPRON study (chapter 2) and the qualitative interview study (chapter 3) were compared with existing evidence, and its validity was investigated. A scoping review of research about nurses' role within PC was performed to corroborate the role described in the first two studies and to supplement the existing list with additional responsibilities and tasks.

Chapter 5 - The NUPHAC-EU framework about nurses' role in interprofessional pharmaceutical care: cross-sectional evaluation in Europe

In this chapter, we created a framework describing potential nursing tasks in PC, together with potential barriers and enablers of nurses performing these PC activities. After the development of the framework, the content was evaluated to investigate whether healthcare workers considered all PC tasks as nurses' full responsibility in order to obtain best quality of care, or that a certain level of supervision by physicians or pharmacists would be required. Also, the minimum level of nurse education expedient with the focus on care quality and patient outcomes was described.

Chapter 6 - Developing a competence framework for nurses in pharmaceutical care: a Delphi study

In this chapter, we described a scoping review that was performed to identify competences, followed by the five Delphi rounds to reach agreement with experts

about nurses' competences for tasks in interprofessional PC. We presented a competence framework to be used in educational programs to evaluate the integration of all PC related competences in the nursing curriculum or to redesign curricula in order to adequately address nurses' competences.

Chapter 7 – General discussion, practical implications, recommendations and conclusion

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Chapter 2

EUPRON - Nurses' practice in interprofessional pharmaceutical care in Europe. A cross-sectional survey in 17 countries

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Abstract

Objectives

Safe pharmaceutical care (PC) requires an interprofessional team approach, involving physicians, nurses and pharmacists. Nurses' roles however, are not always explicit and clear, complicating interprofessional collaboration. The aim of this study is to describe nurses' practice and interprofessional collaboration in PC, from the viewpoint of nurses, physicians and pharmacists.

Design

A cross-sectional survey.

Setting

The study was conducted in 17 European countries, each with their own health systems.

Participants

Pharmacists, physicians and nurses with an active role in PC were surveyed. Main outcome measures Nurses' involvement in PC, experiences of interprofessional collaboration and communication, and views on nurses' competences.

Results

A total of 4888 nurses, 974 physicians and 857 pharmacists from 17 European countries responded. Providing patient education and information (PEI), monitoring medicines adherence (MMA), monitoring adverse/therapeutic effects (ME) and prescribing medicines were considered integral to nursing practice by 78%, 73%, 69% and 15% of nurses respectively. Most respondents were convinced that quality of PC would be improved by increasing nurses' involvement in ME (95%), MMA (95%), PEI (91%) and prescribing (53%). Mean scores for the reported quality of collaboration between nurses and physicians, collaboration between nurses and pharmacists and interprofessional communication were respectively $<7/10$, $\leq 4/10$, $<6/10$ for all four aspects of PC.

Conclusions

ME, MMA, PEI and prescribing are part of nurses' activities, and most healthcare professionals felt their involvement should be extended. Collaboration between nurses and physicians on PC is limited and between nurses and pharmacists even more.

Strengths and limitations of this study

- First pan-European survey of pharmaceutical care by nurses with insight into the current European situation.
- The large sample size with respondents from three professional groups from seventeen European countries.
- Key elements of pharmaceutical care might be understood differently in different countries, due to differences in health systems across Europe, and collaborative development of a conceptual model and the questionnaire may not have overcome inconsistencies in interpretation.
- The sample was self-selected with an unknown response rate, which might have led to a distortion of the results due to only the most motivated professionals participating.
- The findings represent perceptions and are not validated against direct observations.

1. Introduction

In 1990 pharmaceutical care (PC) was defined as the process through which a pharmacist cooperates with a patient and other professionals in designing, implementing, and monitoring a therapeutic plan that will produce specific therapeutic outcomes for the patient. This in turn involves three major functions: (1) identifying potential and actual drug-related problems, (2) resolving actual drug-related problems, and (3) preventing potential drug-related problems.¹ In other words, the responsibilities of the PC practitioner are to ensure that all of the medications being taken by the patient are appropriate, effective, and safe, and can be taken as intended.² It is broadly recognised that there is a need for interprofessional collaboration in PC.³⁻⁴ Ensing, et al. (2015) corroborated this in their systematic review identifying components of pharmacist interventions that can improve clinical outcomes during care transitions. They concluded that collaborating with other healthcare professionals is crucial to increase the effectiveness of pharmacist interventions.⁵

Nurses are healthcare professionals with significant responsibilities in PC. Dilles, et al. (2010) indicated that nurses regularly engage in pharmaceutical practice, such as providing information, monitoring treatment adherence and recognising adverse drug reactions.⁶ Furthermore, many nurses are continuously in the immediate presence of patients, and therefore well-positioned to deliver PC.⁷⁻⁹ However, nurses experience a large number of barriers to safe PC related to medicines monitoring and interprofessional collaboration.⁶⁻¹⁰ Moreover, nurses' roles are not always explicit, distinct and clear to other professionals complicating interprofessional collaboration.⁶

PC requires an interprofessional team approach, involving physicians, nurses and pharmacists.¹¹ If nurses are able to raise concerns with physicians and pharmacists, this will help to reduce medication errors. Therefore, interprofessional interactions and open communication are essential for safe PC.¹¹⁻¹²

An international comparative study in 39 countries, of which 35 were European, indicated a large variation in nurses' roles. Clinical activities traditionally reserved for the medical profession were investigated. It was apparent that task shifting, where nurses, mostly with advanced training, take up advanced roles, such as prescribing medicines, was already implemented in 23 of 35 European countries, to

maximise workforce capacity.¹³ PC activities of nurses, such as patient education, support, adherence monitoring, and monitoring patients for potential adverse effects of medicines can be part of nursing practice throughout Europe. Evidence, however, is scarce. Also, in nurse education, a clear description of specific learning outcomes on PC appears to be absent in most European countries. Curricula covering PC vary considerably.^{5 13} Maier and Aiken (2016) state that developing minimum educational and practice standards may facilitate the comparability and recognition of advanced nursing roles across borders and in increasingly connected labour markets.¹³

To our knowledge, there is no research available describing nurses’ roles in clinical practice in delivering PC from an interprofessional viewpoint throughout Europe. The aim of this study is to describe nurses’ practice and experiences on interprofessional collaboration with nurses in PC, from the viewpoint of nurses, physicians and pharmacists, in different European countries. This study is abbreviated to EUPRON, an acronym for Europe, PC, roles of nurses.

2. Methods

2.1. Study design

In a quantitative, cross-sectional survey in seventeen different European countries, nurses, physicians and pharmacists were invited to complete an online structured questionnaire on nurses’ practice in selected components of interprofessional PC.

2.2. Participants and setting

Seventeen European countries participated in the study: Belgium, Czech Republic, England, Germany, Greece, Hungary, Italy, the Netherlands, Norway, Poland, Portugal, the Republic of North Macedonia, Slovakia, Slovenia, Spain, Sweden and Wales. Although England and Wales are both part of the United Kingdom, and not independent countries, they are mentioned separately because of their different healthcare systems.

Not all European countries participated because inclusion in the project depended on the intrinsic motivation of researchers to join and collaborate in the

project, since no funding resources were available at the start. In every country, local nurse researchers were contacted through international nurse associations. All nurse researchers collaborated in the project consortium by national recruitment of volunteer respondents and local data collection. Convenience sampling was used to select nurses, physicians and pharmacists, with an active role in PC for patients in a range of healthcare settings, such as hospitals, community care organizations, residential care settings and mental healthcare organizations. 'Active' was defined as currently working in clinical practice with patients.^{14 15} The term physician referred to all medical doctors, including surgeons, irrespective of specialty. Level 5 to 8 nurses of the European Qualification Framework¹⁶ (vocational, associate, bachelor, master or PhD nurses) were eligible, whereas professionals without registered nursing status or in training, and students were excluded.

2.3. Survey development

Based on literature, a conceptual model about nurses' practice in interprofessional PC was developed. (appendix 2.1) This conceptual model was validated (face validity) by the project consortium of researchers to ensure the fit with local context. Afterwards, based on the model, an English language questionnaire was developed by the consortium of international experts and evaluated and adjusted until consensus was reached. (see online article) Following questions on demographics, employment and education, four aspects of PC were addressed: monitoring adverse/therapeutic effects of medicines (ME), monitoring medicines adherence (MMA), prescribing and providing patient education and information about medicines (PEI). The perceived quality of collaboration between nurses and physicians and between nurses and pharmacists, the perceived quality of nurses' competences and the perceived quality of interprofessional communication on the different aspects of PC were rated with a score of 0-10 (0 = low quality, 10 = high quality). The four domains addressed, are part of PC, yet, other responsibilities and tasks could be defined within the concept of PC.^{1 2} The main content of the questionnaire was the same for nurses, physicians and pharmacists. However, while nurses were questioned about their own practice, physicians and pharmacists were questioned about nurses' practice. The questionnaire was translated into all languages of the participating countries by

voluntary and sworn translators. The nurse researchers were asked to check the translation in their own language, and the completion time. Finally, the instrument was piloted with the group of international researchers as to its applicability and comparability in different health system contexts.

2.4. Patient and public involvement

The study participants included pharmacists, physicians and nurses. Since the study focused on healthcare providers, patients and the public were not involved in this study.

2.5. Data collection

We aimed to reach a representative sample of nurses, physicians and pharmacists in each country. Between December 2017 and June 2018, institutions and organisations were asked to distribute the questionnaire and send reminders. Each partner looked for the optimum distribution strategy, depending on local possibilities (existing organisations and networks). A weblink to the questionnaire was sent by email to key stakeholders, professional associations, healthcare facilities, and private professional networks. Sampling efforts focused on nurses, pharmacists and physicians. Nursing faculties as well as interprofessional colleagues (Faculty of Medicine and Faculty of Pharmacy) initiated sampling. All contacts were additionally asked to forward the link to colleagues, eligible to participate. The weblink was placed on university websites, webpages of professional associations, and on social media. Each country received regular updates about the number of participants.

2.6. Data analysis

Data were analysed using IBM SPSS Statistics version 24.0®. A two-sided level of significance of 0.05 was used. Discontinuous data were described using frequency distributions; continuous data were described using a mean value and a standard deviation. Normality of the distribution was tested with the absolute values of the skewness and kurtosis because of the large sample size.¹⁷ All data were normally distributed. Differences in opinion by nurses, physicians and pharmacists

were explored. To evaluate the statistical significance of the differences between the three professional groups, chi squared for dichotomous variables, one-way ANOVA (Bonferroni post hoc test) for scale variables and Kruskal-Wallis for ordinal variables were used. Representativity of the sample size per country was shown by a ratio, calculated as: the number of respondents in each country divided by the approximate number of inhabitants in that country multiplied by 100,000.¹⁸ The number of inhabitants per country was chosen to represent the country size, since approximate numbers of nurses, physicians and pharmacists were not available for all countries.

2.7. Ethical considerations

The Ethics Committee for Social Sciences and Humanities of the University of Antwerp approved the study design. Depending on local regulations, in some countries additional approval from local organisations: Health Research Authority approval and Bournemouth University approval (England), Ethical Committee of School of Human Movement and Quality of Life of University of Peloponnese (Greece), Health Science Council - Scientific and Research Ethics Committee (Hungary), Bioethics Commission at the Medical University of Warsaw (Poland), Ethics Committee of the Nursing Sciences Research Unit of the Nursing School of Coimbra (Portugal), Integrated Research Application System ethical approval and Research & Development departments (Wales). All respondents received information on the purpose, design and execution of the study. Before the digital questionnaire could be started, all respondents had to indicate they had read the study information and consented to participate. Data were collected anonymously to ensure privacy.¹⁹

3. Results

3.1. Research population

A total of 6719 respondents participated, of whom 73% were nurses, 14% physicians and 13% pharmacists. Across the 17 countries, the number of respondents per 100,000 inhabitants varied from 0.1 to 36.4. Mean age was 42 years and 78% of the population was female. The majority of the respondents

worked in a hospital (61%) and worked together with one or more nurses and with one or more physicians. Collaboration with one or more pharmacists was reported by 90% of the pharmacists but only 39% of the nurses and 42% of the physicians. More than half of the respondents reported that interprofessional PC was encouraged by their employer's policies. Forty per cent of the nurses had a level 6 post (European Qualification Framework) and 48% had attended specific extra educational activities focusing on PC after obtaining their nursing qualification. More detailed population characteristics are presented in table 2.1.

Table 2.1. Population characteristics (n = 6719)

	All respondents (n = 6719)	Nurses (n = 4888)	Physicians (n = 974)	Pharmacists (n = 857)
DEMOGRAPHICAL DATA	n (%)	%	%	%
Country (respondents / 100,000 inhabitants[†], n)				
Slovenia (36.4)	753 (11.2)	11.5	16.7	3.0
Slovakia (16.6)	902 (13.4)	11.0	11.6	29.2
Norway (9.0)	479 (7.1)	6.2	6.8	12.6
Belgium (8.7)	992 (14.8)	11.8	23.3	22.1
Czech Republic (8.2)	868 (12.9)	15.1	8.4	5.5
Wales (6.5)	202 (3.0)	2.9	1.1	5.6
North Macedonia (6.5)	134 (2.0)	1.7	3.0	2.6
Hungary (3.8)	376 (5.6)	6.3	5.5	1.6
Sweden (2.5)	256 (3.8)	3.0	3.2	9.0
Greece (2.4)	256 (3.8)	4.6	2.6	0.6
Portugal (1.3)	130 (1.9)	2.3	1.4	0.7
The Netherlands (0.8)	134 (1.8)	2.2	1.1	0.2
Germany (0.7)	584 (8.7)	11.3	0.3	3.2
Italy (0.6)	341 (5.1)	4.7	10.8	0.5
United Kingdom (0.5)	336 (5.0)	5.0	2.2	8.5
Poland (0.4)	167 (2.5)	2.7	3.0	0.6
England (0.2)	34 (2.0)	2.0	1.0	2.9
Spain (0.1)	25 (0.4)	0.5	0.1	0.2
Gender (female)	5242 (78.2)	83.3	53.2	77.6
Age (years), mean (min-max)	42.0 (21-77)	41.8 (21-75)	45.1 (24-75)	39.5 (23-77)
JOB CHARACTERISTICS	%	%	%	%
Area of CP				
Hospital	61.1	66.5	67.6	30.1
Community or primary care	18.9	16.5	19.2	44.2
Residential care	7.3	9.5	5.8	1.4
Educational setting	0.1	0.4	0.3	0.0
Other	12.5	7.1	7.1	23.6
Work experience in healthcare (years), mean (SD)	18.0 (12.0)	11.8	12.8	11.5
Main patient population to take care for				
Children (0-17years)	7.3	7.2	7.7	<i>Pharmacists not questioned</i>
Adults (18-64years)	25.7	25.7	25.7	
Older persons (≥65years)	18.7	19.7	13.5	
More than one age group	48.3	47.4	53.0	
Domains/roles[‡]				
CP/direct patient care	100	100	100	100
Research	37.2	38.8	39.0	28.9
Management	61.4	68.5	38.2	52.4
Education	52.9	58.4	44.2	40.2
Working in CP (hours/week), mean (SD)	12.4	11.6	13.7	12.2

Table 2.1 (continued). Population characteristics (n = 6719)

	All respondents (n = 6719)	Nurses (n = 4888)	Physicians (n = 974)	Pharmacists (n = 857)
Number of medical co-workers in daily CP				
None	8.4	5.7	6.8	29.1
<5	58.8	63.9	46.9	41.3
5-10	21.1	20.7	27.1	16.0
>10	11.7	9.8	19.3	13.6
pharmacists available to discuss patients' MM	<i>Only nurses questioned</i>	59.5		
(strongly) agree		24.3		
(strongly) disagree		16.2		
Don't know				
EDUCATION	%	%	%	%
Highest educational level (EQF)				
Level 5	<i>Only nurses questioned</i>	33.4		
Level 6		40.4		
Level 7		22.8		
Level 8		3.3		
Time spend on non-mandatory extra education				
> 2days/year	77.0	74.1	89.0	80.1
1-2days/year	15.7	17.7	7.0	14.2
<1day/year	4.6	5.1	2.3	4.6
No time spent	2.7	3.2	1.7	1.0
Extra educational on PC since graduated	<i>(only for nurses)</i>	47.7		
Interprofessional MM is encouraged by employers' policies				
(Strongly) agree	58.8	56.2	58.0	76.0
(Strongly) disagree	25.3	27.8	21.9	13.5
Don't know	15.9	16.0	20.0	10.6

†The number of persons having their usual residence in a country on 1/1/2018. Number of inhabitants was chosen to represent the country size, since the approximate number of nurses, physicians and pharmacists was not available for all countries.¹⁸ ‡More than one answer possible. CP = clinical practice, EQF = European Qualifications Framework¹⁶, PC = pharmaceutical care.

3.2. Monitoring adverse/therapeutic effects of medicines

Almost 70% of the nurse respondents had been involved in ME in the last month, with a higher prevalence of ME as the level of education decreased (table 2.2). Across Europe, the proportion of respondents considering ME as part of nurses' roles, varied from 72% to 98% (appendix 2.2). More healthcare workers in non-ambulatory settings and professionals already collaborating with other professions were convinced of this (respectively, 90% vs 82%, $p < 0.001$, appendix 2.3, and 88% vs 55%, $p < 0.001$, appendix 2.4). Pharmacists were significantly less likely to recognise ME as part of nurses' roles ($p < 0.001$, table 2.3).

Almost all respondents (95%) were convinced of the positive impact of nurses' involvement in ME on the quality of PC (86%–98% across Europe) (appendix 2.5). Two-thirds of respondents believed that the involvement of nurses in ME should be extended (table 2.3).

Table 2.2. Nurses' self-reported prevalence of different aspects of pharmaceutical care (PC) and reported actions or opinions concerning PC, split up for the different educational levels

Monitoring adverse / therapeutic effects (ME)	% of all nurses	% of level 5 nurses (n=1570)	% of level 6 nurses (n=1897)	% of level 7 nurses (n=1072)	% of level 8 nurses (n=156)	p
Part of activities last month	69.1	74.2	70.8	61.2	52.6	<0.001
Actions after observing an adverse effect[†]						
Discussed with a physician	90.1	90.1	89.3	91.7	88.9	0.194
Discussed with a pharmacist	7.6	6.8	7.5	7.9	14.4	0.009
Discussed with a nurse	43.6	44.7	44.7	40.5	41.2	0.108
Discussed with the patient	39.1	40.2	39.3	37.0	39.2	0.438
Reported in the patient file	61.2	66.6	58.9	58.2	56.2	<0.001
Intervened on own initiative	28.4	29.9	24.5	32.8	30.1	<0.001
Nothing	0.1	0.2	0.1	0.1	0.0	0.821
Never observed an adverse effect	4.1	3.5	4.9	3.5	3.3	0.108
Monitoring medicines adherence (MMA)	%					
Part of activities last month	73.0	82.7	70.6	66.3	53.0	<0.001
Actions after observing non-adherence[†]						
Discussed with a physician	83.5	86.0	81.6	83.3	84.4	0.016
Discussed with a pharmacist	5.0	3.7	5.2	5.4	10.9	0.001
Discussed with a nurse	43.7	44.5	44.8	41.0	41.5	0.232
Discussed with the patient	58.5	61.8	56.0	58.6	55.8	0.014
Reported in patient file	60.4	68.0	56.4	57.8	53.1	<0.001
Intervened on own initiative	16.8	19.2	13.7	18.2	19.7	<0.001
Nothing	0.4	0.3	0.4	0.6	0.0	0.502
Never observed non-adherence	6.7	5.3	8.0	7.2	5.4	0.026
Prescribing medicines (PM)	%					
Part of activities last month	14.9	13.7	15.3	15.6	18.2	0.364
Actions after observing inappropriate prescribing by any professional[†]						
Discussed with a physician	78.2	81.5	73.4	81.6	78.9	<0.001
Discussed with a pharmacist	8.2	6.5	8.8	8.7	14.3	0.007
Discussed with a nurse	35.8	38.2	34.5	34.3	39.1	0.137
Discussed with the patient	16.9	18.6	15.1	17.3	18.0	0.091
Reported in the patient file	26.3	32.0	23.3	23.9	25.6	<0.001
Intervened on own initiative	13.8	17.2	10.8	14.2	15.8	<0.001
Nothing	0.3	0.2	0.3	0.2	0.8	0.586
Never noticed inappropriate PM	17.9	15.9	22.2	14.3	9.8	<0.001
Providing patient education and information about medicines (PEI)	%					
Part of activities last month	78.1	81.2	77.4	76.1	71.1	0.004
Nurse opinions concerning PEI[†]						
Pharmacists, physicians, nurses aware of PEI by each team member	20.1	16.1	21.6	23.6	17.3	0.021
Feeling qualified to PEI	36.6	34.8	37.5	36.4	46.2	0.379
Enough info of physician to PEI	39.0	21.9	20.7	14.1	11.5	0.008
Other professions would better PEI	20.0	16.4	12.4	12.3	9.6	0.116

[†] >1 answer possible; p calculated with chi² for the difference between educational levels, p<0.05 are in bold.

3.3. *Monitoring medicines adherence*

MMA was reported as part of nursing practice in the last month by 73% of nurses. In nurses with lower levels of education, MMA was significantly more a part of their activities than in nurses with higher educational levels (table 2.2). Pharmacists healthcare workers in ambulatory settings and professionals who did not collaborate with nurses were less likely to recognise MMA as part of nurses' roles (table 2.3, appendix 2.3 and appendix 2.4). In Hungary, 31% of the respondents considered MMA as part of nurses' role, while across the rest of Europe this varied from 82% to 98% (appendix 2.2). Almost all respondents (95%) were convinced of the positive impact of nurses' involvement in MMA on the quality of PC (89%–100% across Europe) (appendix 2.5). According to 65% of respondents, the involvement of nurses in MMA should be extended. However, nurses were less convinced (63%) of the need to extend their involvement than physicians (70%) and pharmacists (71%) ($p < 0.001$) (table 2.3).

3.4. *Prescribing medicines*

Nurse prescribing was the aspect of PC least likely to be reported as part of nursing practice in the last month (15%; with a range across Europe from 7% to 30%) (figure 2.1, table 2.2). No difference in educational level existed. Almost one-third of the nurses stated prescribing was a part of their role, which was significantly more than physicians' ($p < 0.001$) and pharmacists' ($p < 0.001$) (table 2.3). Professionals working in primary or community care and professionals collaborating with nurses were more likely to evaluate prescribing as part of nurses' roles (respectively 32% vs 27%, $p = 0.008$, appendix 2.3 and 28% vs 13%, $p < 0.001$, appendix 2.4). Across Europe, the proportion of respondents acknowledging prescribing as part of nurses' roles differed: from 11% in Germany to 52% in Wales and 81% in The Republic of North Macedonia ($p < 0.001$) (appendix 2.2). However, at the time of data collection only England, The Netherlands, Poland, Sweden and Wales had legislation in place for non-medical prescribing, usually restricted to specialised nurses and/ or certain medicines. More nurses (60%) were convinced of the positive impact of nurse involvement in prescribing medicines on the quality of PC than physicians (39%) or pharmacists (29%) ($p < 0.001$). Across Europe, between 35% and 75% of respondents felt that nurse prescribing had a positive

impact on care quality (appendix 2.5). More than half of all nurses thought their involvement in prescribing should be extended, which was significantly higher than physicians (29%, $p<0.001$) and pharmacists (23%, $p<0.001$) (table 2.3).

Table 2.3. Nurse involvement in four aspects of pharmaceutical care from the viewpoint of nurses, physicians and pharmacists

	Nurses' viewpoint (n=4888)	Physicians' viewpoint (n=974)	Pharmacists' viewpoint (n=857)	Overall viewpoint (n=6719)
Monitoring adverse/therapeutic effects (ME)†	%	%	%	%
Part of nurses' role	93.0	73.0	62.9	81.2
Convinced of positive impact of nurse involvement on PC	95.9	92.6	88.0	94.5
Involvement of nurses in ME should:				
Be extended	68.2	69.5	69.2	68.5
Remain the same	29.9	28.2	24.8	29.0
Be restricted	1.9	2.3	6.0	2.4
Monitoring medicines adherence (MMA)†	%	%	%	%
Part of nurses' role	94.7	84.0	75.8	85.2
Convinced of positive impact of nurse involvement on PC	95.7	93.6	90.5	94.8
Involvement of nurses in MMA should:				
Be extended	63.4	69.6	71.2	65.2
Remain the same	35.2	28.8	24.8	33.0
Be restricted	1.4	1.6	4.0	1.8
Prescribing medicines (PM)†	%	%	%	%
Part of nurses' role	30.3	22.1	21.3	23.1
Convinced of positive impact of nurse involvement on PC	60.1	38.9	29.3	53.3
Involvement of nurses in PM should:				
Be extended	54.6	28.9	22.8	46.9
Remain the same	32.2	49.4	37.9	35.6
Be restricted	13.2	21.7	39.3	17.4
Providing patient education/information about medicines (PEI)†	%	%	%	%
Part of nurses' role	86.3	68.2	64.5	76.7
Convinced of positive impact of nurse involvement on PC	93.3	85.1	80.2	90.6
Involvement of nurses in PEI should be:				
Extended	68.5	63.8	58.9	66.7
Remain the same	28.9	30.9	29.8	29.3
Restricted	2.6	5.3	11.3	4.0

†Viewpoint of nurses, physicians, pharmacists was significantly different ($p<0.001$) for all variables except for 'involvement of nurses in ME should be extended/remain the same/be restricted' ($p=0.775$). p-value was calculated with chi squared test for 'part of nurses' role' and 'convinced of positive impact' and Kruskal-Wallis test for 'nurse involvement should be extended/remain the same/be restricted'.

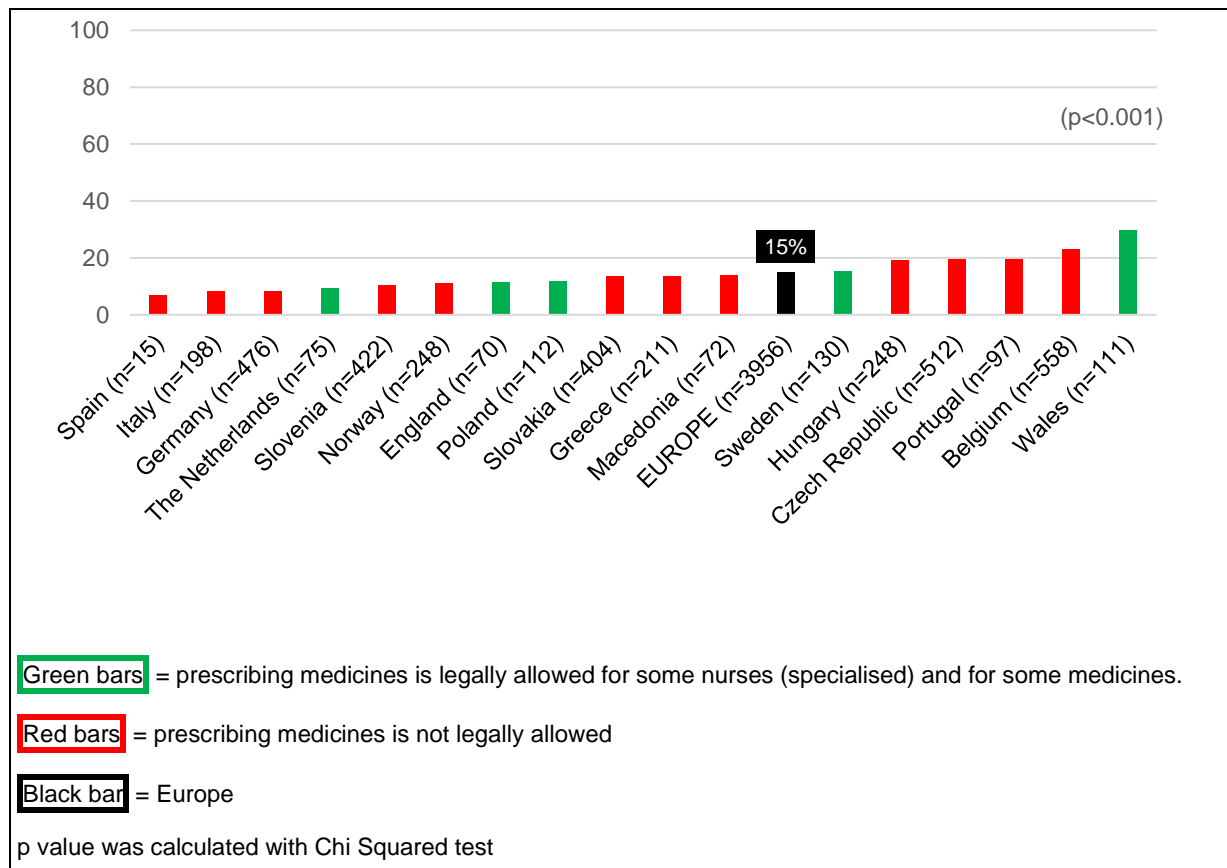


Figure 2.1. Percentages of nurses stating that prescribing medicines was part of their activities last month, by country and across Europe as a whole.

3.5. Providing patient education and information about medicines

More than three-quarters of the nurses reported PEI as part of their practice in the last month, with more PEI activities as the level of education decreased (table 2.2). Across Europe, the proportion of respondents that acknowledged PEI as part of nurses' roles, varied from 55% to 93% (appendix 2.2). Pharmacists and professionals who did not collaborate with nurses were significantly less likely to consider PEI as part of nurses' roles ($p<0.001$). Almost all respondents (91%) were convinced of the positive impact of nurse involvement in PEI on the quality of PC (table 2.3). This ranged from 81% to 100% across Europe (appendix 2.5). Two-thirds of the respondents believed that the involvement of nurses in PEI should be extended (table 2.3).

3.6. Quality of interprofessional collaboration, interprofessional communication and nurses' competences in PC

The mean reported perceived quality of collaboration between nurses and physicians on ME, MMA, prescribing and PEI varied from 5.9/10 to 6.6/10. Between nurses and pharmacists scores were lower (3.6/10–4/10). Professionals who already collaborated interprofessionally, rated the quality of collaboration more highly than non-collaborating professionals (appendix 2.4). These 'collaborating' professionals were also more likely to consider ME, MMA, prescribing and PEI as part of nurses' roles and to acknowledge the positive impact of nurse involvement in PC. Detailed comparisons can be found in appendix 2.4. Nurses rated their own competence on a self-rating scale more highly (4.8/10–7.1/10) than did physicians (4.0/10–6.3/10) and pharmacists (3.7/10–5.2/10) (figure 2.2). The scores for the reported quality of interprofessional communication varied from 5.0/10 to 5.7/10. Here, pharmacists gave a significantly lower score (4.3/10–4.5/10) than nurses (5.1–5.9/10) and physicians (4.9/10–5.7/10) (figure 2.3). More detailed scores across Europe are presented in appendices 2.6–2.9.

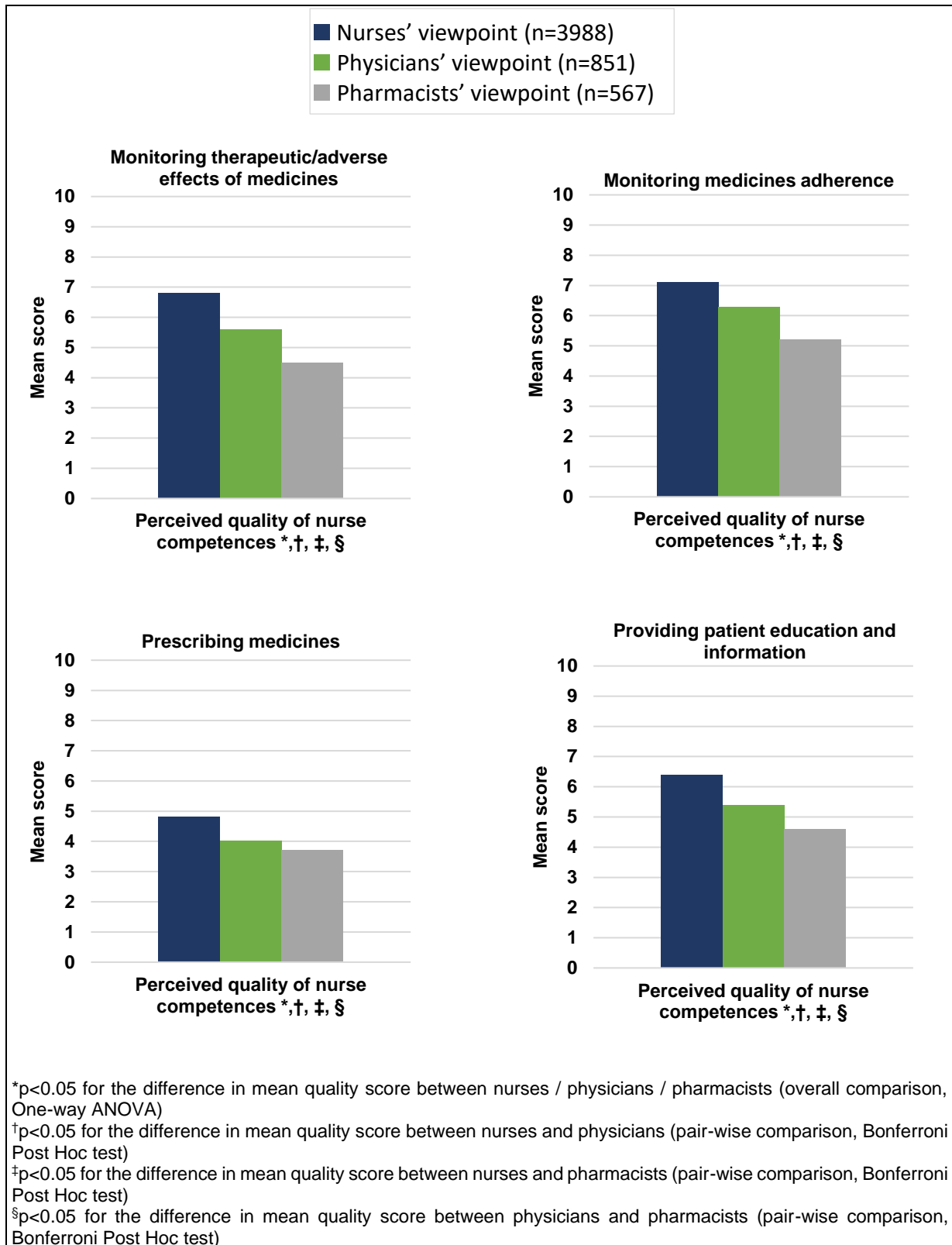


Figure 2.2. Mean scores (on 10) for the reported self-perceived quality of nurse competences in pharmaceutical care (split up for four aspects), from the viewpoint of nurses, physicians and pharmacists (n=5406)

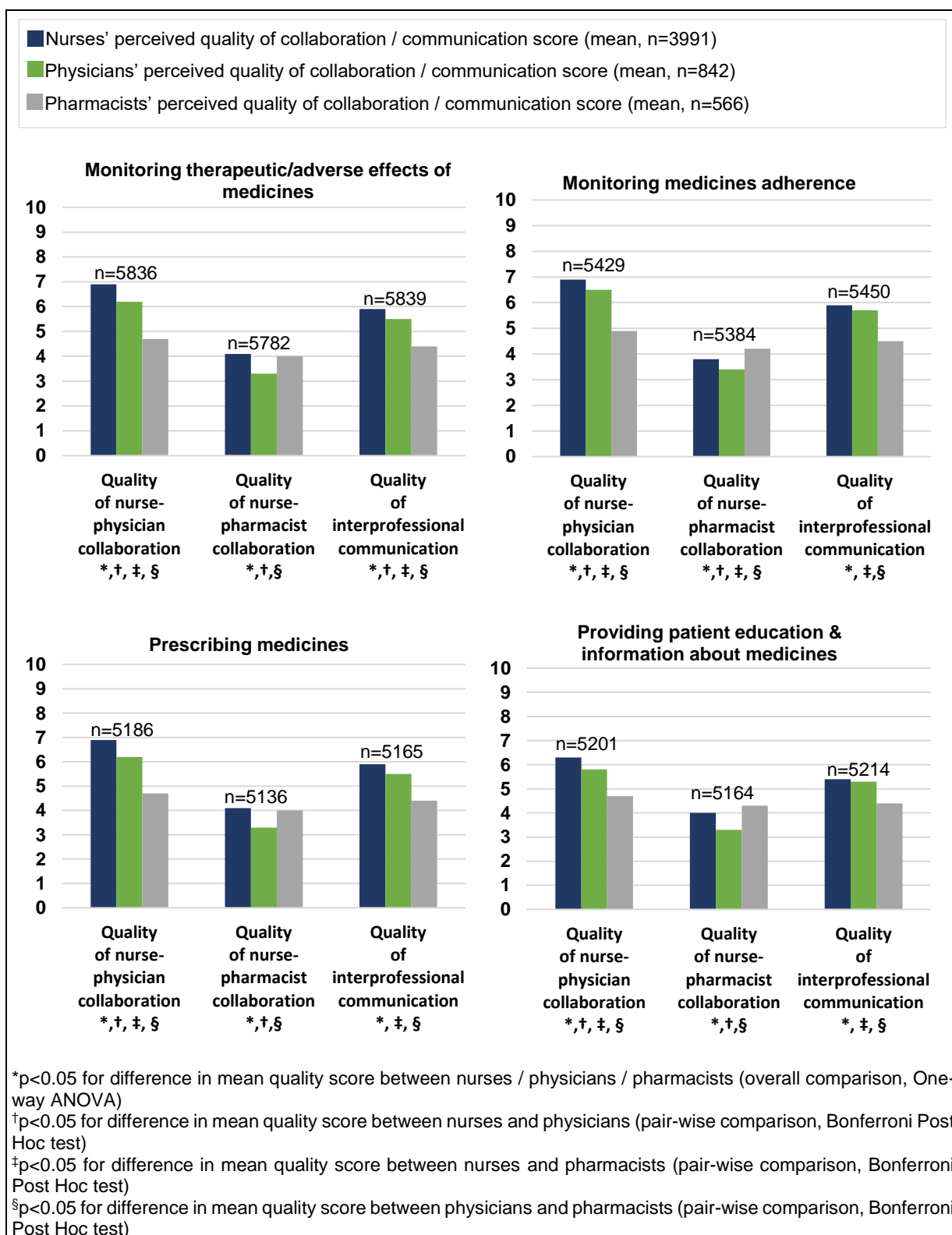


Figure 2.3. Score (on 10) for the reported self-perceived quality of collaboration between nurses and physicians, collaboration between nurses and pharmacists and interprofessional communication in pharmaceutical care (split up for four aspects), from the viewpoint of nurses, physicians and pharmacists (n=5399)

4. Discussion

The EUPRON data clearly describe nurses' routine clinical practice in PC. Although some variation is apparent, the differences between the 17 countries in practice, competence, collaboration and communication in PC are not as large as expected.

We investigated four different PC activities. Most nurses were actively involved in ME, PEI and MMA the last month, particularly the nurses with lower educational attainment. Nearly all nurses, physicians and pharmacists believed nurse involvement positively impacted on the quality of PC. Also, most nurses, physicians and pharmacists were convinced ME, PEI and MMA are part of nurses' role. Moreover, an extension of nurses' roles in ME, PEI, MMA was proposed by two-thirds of respondents. However, scores were suboptimal in all four different aspects of PC for the quality of: nurses' competences, collaboration of nurses with physicians or pharmacists and interprofessional communication.

The lowest ratings for collaboration related to nurse-pharmacist working. This may reflect the observation that pharmacists were the least frequently mentioned co-workers in clinical practice, and this lack of familiarity might have influenced pharmacists' perceptions of nurses' practice. After all, it is more difficult to understand another professionals' role, when not working directly with them. The literature on nurse-pharmacist collaborations is contradictory. A study in Pakistan found poor collaboration between nurses and pharmacists: 24% of the nurse study population (n=220) never or rarely interacted with a pharmacist.²⁰ A Chinese study found positive attitudes towards nurse-pharmacist collaboration, even though there was still room for improvement and American research showed nurse-pharmacist collaboration was efficient and cost-effective, which improved patient safety.^{21 22} In Europe, there is little recent research on nurse-pharmacist collaboration. A UK study reported limited contact between community pharmacists and nurse prescribers, in contrast to the reported frequency of contact with other healthcare professionals. Yet, there are positive views on pharmacist-nurse team-working.²³ A recent review by Celio et al in European as well as non-European countries concluded pharmacist-nurse medication adherence-enhancing interventions are rare and often in the nascent phase.²⁴

Our findings on nurse prescribing were surprising: prevalence was much higher than expected, based on the legislation in the participating countries. Only The Netherlands, Poland, Sweden and the UK legally permitted nurse prescribing at the time of data collection.¹³ However, in all other countries some nurses indicated having prescribed the last month. In addition, one-quarter of the nurses, physicians and pharmacists believed prescribing was part of nurses' role, with up to 81% in The Republic of North Macedonia, where nurse prescribing is not legally allowed. After discussing these results within the research consortium, the experts concluded the term 'prescribing' might have been interpreted by respondents as selecting and applying medicinal products for wound care. Another possibility is that prescribing was not legally allowed, yet performed by nurses in an informal, unofficial way. Maier and Aiken described how prescriptive authority by nurses can vary from no authority to a limited or a broad range of activities officially authorised.¹³ In some countries, nurses are allowed to prescribe a wide range of medicines within certain specialties. Levels of independence range from fully independent to various forms of physician oversight, depending on types of medicines and country-specific governance structures. The study of Maier and Aiken in 39 countries, of which 35 European, indicated task shifting from physicians to nurses, for example, prescribing by nurses, has become common in many countries.¹³

This study showed lower educated nurses were more likely to monitor patients for adverse/therapeutic effects and medication adherence and provided more patient education/information. Our results partly correspond to a previous study of Dilles et al on nurses' practice in PC and association with educational level (diploma vs bachelor nurse). There, more diploma nurses observed non-adherence, yet more bachelor nurses observed adverse drug reactions. No differences for providing patient education/information were shown.⁶

The results in this study showed nurses are willing to extend their involvement in all areas of PC. This suggests nurses believe PC is the responsibility of teams in which they are included. While nurses favoured an expansion of their involvement in prescribing, this was not supported by pharmacists. On the contrary, 39% were in favour of restricting nurses' involvement.

Although most nurses were performing several activities of PC, and consequently taking responsibility in parts of PC, our findings show nurses' competences in PC were reported as rather low. The lack of clarity in nurses' roles in PC can contribute to nurses not receiving sufficient training in different aspects of PC. A clear definition of roles however, is a fundamental prerequisite for effective education and collaboration among nurses, physicians and pharmacists, for delivering safe care to patients and meeting patients' needs.²⁴ Effective team communication and better training in interprofessional collaboration is needed to tackle adverse patient events.^{25–31} Therefore, nurse education curricula as well as the curricula of all other disciplines need to address these weaknesses.³²

4.1. Strengths and limitations

This study is unique because of its large sample size and diversity, consisting of respondents of three professional groups from 7 European countries. To our knowledge, this is the first pan-European survey of PC by nurses. Despite the limited number of participants at the national level, the overall data provided interesting first insight in the current European situation.

This internet survey had limitations. The inclusion or exclusion of countries and respondents was determined by whether they agreed or declined to participate in the study. This self-selected sample with an unknown response rate might have led to a distortion of the results due to only the most motivated professionals participating. Also, the sample favoured more educated computer-literate professionals, due to use of internet recruitment. Another limitation that needs to be taken into account when interpreting the results is the differences in health systems across Europe. Despite the conceptual model and international collaboration in the questionnaire development, key elements of PC might be understood differently, as discussed for the term 'prescribing'. Finally, we acknowledge that our findings represent perceptions and are not validated against direct observations or correlated with any outcomes.

4.2. Implications and recommendations for practice and research

Because of the descriptive nature of this survey, few associations were explored. Differences exist, for example, in area of clinical practice or educational attainment.

Further research, zooming in on possible associations, is needed to highlight these differences and identify areas of greatest need.

The EUPRON data demonstrated that throughout Europe, nurses' contribution to interprofessional PC is not transparent and differs between countries, in both law and practice. The lack of transparency and recognition, combined with international variation, in both nursing practice and education, can hinder collaboration on different levels: quality of interprofessional communication and collaboration in daily clinical practice; transnational collaboration in research, education and innovation across Europe and labour mobility of nursing students and nurses. Further research is needed to explore whether the level of education and practice variation is associated with variation in patient outcomes, particularly in terms of medication errors, the prevalence of adverse effects and hospitalisation for adverse effects.

In EUPRON, we decided to use a quantitative study design to investigate the current clinical practice of nurse in PC. Insights in the strengths and weaknesses of nurses' practice today, and in the opportunities and threats for the future cannot be extracted out of the EUPRON data. An in-depth qualitative study in all partner countries, interviewing nurses, physicians and pharmacists, would create a strengths, weaknesses, opportunities and threats (SWOT) analysis on nurses' roles in interprofessional PC in the different countries, and in Europe as a whole. This would allow learning about good practice, and the prerequisites for patient safety, which can then form the basis for development of a model for nurses' roles in interprofessional PC. Subsequently, this model could be a framework for interprofessional collaboration in clinical practice, education, transnational collaboration in research in Europe and labour mobility of nurses and nursing students.

5. Conclusion

Monitoring adverse/therapeutic effects of medicines, monitoring medicines adherence, prescribing medicines and providing patient education and information about medicines are part of the activities of nurses in clinical practice. Healthcare professionals felt that nurse involvement should be extended. The quality of collaboration between nurses and physicians on pharmaceutical care is limited and between nurses and pharmacists even more so.

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Contributors

EDB, BVR, NED, CS, TD contributed to the design of the study. EDB, BVR, LMB, MB, BC-P, ADS, NED, MIF, IF, VAG, JH, AKH, MI, SJ, IK, SK, PK, GL, ML-C, VL, AM, GM, AO, HP, MP, DP, CS, ST, EZ, TD contributed to the data collection. EDB conducted the data analysis. All authors contributed to the interpretation of the data, and the preparation and refinement of the final manuscript.

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Ethical approval

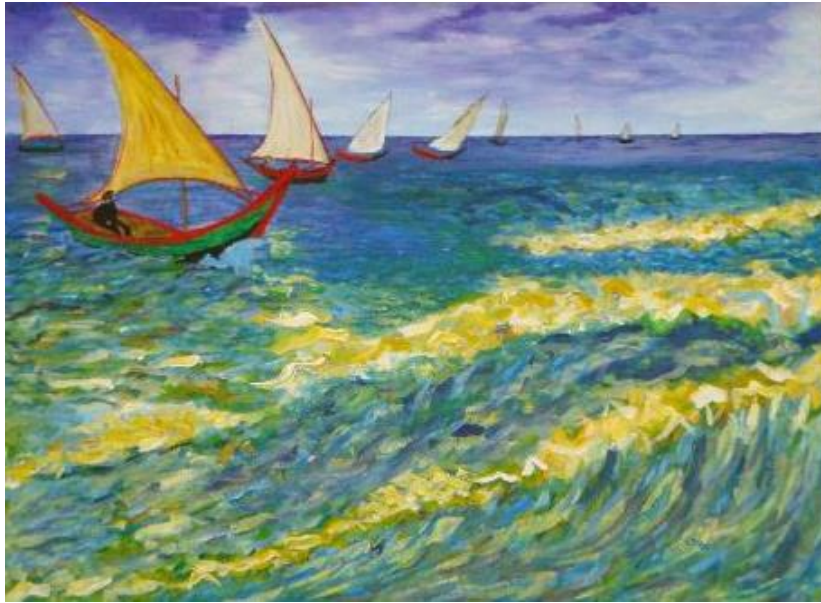
The Ethics Committee for Social Sciences and Humanities of the University of Antwerp approved the study design. Depending on local regulations, in some countries additional approval from local organisations: Health Research Authority approval and Bournemouth University approval (England), Ethical Committee of School of Human Movement and Quality of Life of University of Peloponnese (Greece), Health Science Council—Scientific and Research Ethics Committee (Hungary), Bioethics Commission at the Medical University of Warsaw (Poland), Ethics Committee of the Nursing Sciences Research Unit of the Nursing School of Coimbra (Portugal), Integrated Research Application System ethical approval and Research & Development departments (Wales).

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Chapter 3

Perspectives of nurses' role in interprofessional pharmaceutical care across 14 European countries: a qualitative study in pharmacists, physicians and nurses

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Abstract

Objectives

To understand healthcare professionals' experiences and perceptions of nurses' potential or ideal roles in pharmaceutical care (PC).

Design

Qualitative study conducted through semi-structured in-depth interviews.

Setting

Between December 2018 and October 2019, interviews were conducted with healthcare professionals of 14 European countries in four healthcare settings: hospitals, community care, mental health and long-term residential care.

Participants

In each country, pharmacists, physicians and nurses in each of the four settings were interviewed. Participants were selected on the basis that they were key informants with broad knowledge and experience of PC.

Data collection and analysis

All interviews were conducted face to face. Each country conducted an initial thematic analysis. Consensus was reached through a face-to-face discussion of all 14 national leads.

Results

340 interviews were completed. Several tasks were described within four potential nursing responsibilities, that came up as the analysis themes, being: 1) monitoring therapeutic/adverse effects of medicines, 2) monitoring medicines adherence, 3) decision making on medicines, including prescribing 4) providing patient education/information. Nurses' autonomy varied across Europe, from none to limited to a few tasks and emergencies to a broad range of tasks and responsibilities. Intended level of autonomy depended on medicine types and level of education. Some changes are needed before nursing roles can be optimised and implemented in practice. Lack of time, shortage of nurses, absence of legal frameworks and limited education and knowledge are main threats to European nurses actualising their ideal role in PC.

Conclusions

European nurses have an active role in PC. Respondents reported positive impacts on care quality and patient outcomes when nurses assumed PC

responsibilities. Healthcare professionals expect nurses to report observations and assessments. This key patient information should be shared and addressed by the interprofessional team. The study evidences the need of a unique and consensus-based PC framework across Europe.

1. Introduction

Effective team communication and clear definitions of roles are two of the fundamental prerequisites for effective collaboration among nurses, physicians and pharmacists to deliver high quality care and better meet patients' needs^{1, 2}. Unclear role boundaries hinder collaboration on different levels: quality of interprofessional communication and collaboration in daily clinical practice; transnational collaboration in research, education and innovation; and labor mobility of nurses¹⁻⁴. A clear description of roles in pharmaceutical care (PC) and medicines optimisation, however, is not always available^{2, 5-7}. In this study PC is defined as '*Healthcare professionals' contribution to the care of individuals in order to optimize medicines use and improve health outcomes*'. This definition is based on the definition of the Pharmaceutical Care Network Europe (PCNE)⁸, which, however, was limited to the contribution of pharmacists, as well as the original definition of Hepler and Strand in 1990⁹. After all, the need for interprofessional collaboration in PC is broadly recognised^{3, 10-14}.

Large variations in nurses' roles exist, as was demonstrated in a cross-country comparative study in 39 countries. In two third of the countries, nurses took up advanced roles from physicians, but the extent varied. A trend towards expanding nurses' scope of-practice in primary care was evolving⁴. The large variation in nurses' roles was corroborated in the EUPRON-study investigating nurses' current clinical practices in interprofessional pharmaceutical care (PC). This showed that monitoring medicines effects, monitoring medicines adherence, prescribing medicines and providing patient education/information about medicines are already part of nurses' clinical practice, and nurses' contribution to PC differs between countries, in both law and practice¹³.

Nurses' scope of practice is considered as the full range of roles, responsibilities and tasks that nurses are educated, competent and authorized to perform¹⁵. Within this scope of practice, a framework for nurses' ideal roles in interprofessional PC would allow insights into current and potential roles in PC, and facilitate discussions in clinical practice, education, research, international comparisons, policy-making and legislation. Additionally, this framework could be used to develop an assessment to evaluate nurse competences in PC, as a guidance to evaluate nurse education, as a tool for nurse educators, for benchmarking and nurse labour

mobility. To date, we have not identified such a framework in the published literature. To develop a robust framework, adapted to the needs of clinical practice, insights in the preferences of the most important stakeholders (nurses, physicians and pharmacists) are necessary. Exploring those preferences, requires in-depth qualitative research.

This study is the second part of the DeMoPhaC project, an international Erasmus+ collaboration to investigate nurses' role in interprofessional PC in 14 countries. Within this project several large-scale quantitative and qualitative studies are being undertaken with healthcare workers and nursing students. The overall aim of the project is the Development of a Model for nurses' role in interprofessional Pharmaceutical Care in Europe and the development of an assessment to evaluate nursing curricula and final year nursing students' competences in PC. The first part of the project focused on the current clinical practice of nurses in PC without insights into strengths, weaknesses, opportunities and threats from nurses' involvement in PC¹³. In-depth qualitative research through case studies can close this gap. Therefore, we aimed to perform a qualitative study, to understand pharmacists', physicians' and nurses' experiences and perceptions of nurses' potential or ideal roles in PC.

By considering the 'potential or ideal roles', we aimed to investigate nurses' responsibilities and tasks within—but also beyond—nurses' current legal scope of practice, taking into account all necessary contextual factors.

2. Methods

2.1. Study design

This study was conducted and reported according to the Consolidated Criteria for Reporting Qualitative Research (COREQ)¹⁶.

We explored nurses', physicians' and pharmacists' expectations about nurses' role in PC, and related strengths, weaknesses, opportunities and threats through a qualitative descriptive research design with a phenomenological case study approach. Case study as a research method has been widely used for preliminary and exploratory stages of research.^{17–19} Multiple case studies allow cross-case comparisons and the identification of themes across cases. A phenomenological

approach using in-depth semi-structured interviews within the case studies support high quality data collection²⁰⁻²². Phenomenology is well suited for exploring perspectives of healthcare professionals²³. This research approach was chosen as an appropriate way to describe the essence of the phenomenon “nurses’ role in interprofessional PC”, by exploring it from the perspective of those who have experienced it, namely pharmacists, physicians and nurses themselves. Interviewing this study population enables studying and understanding healthcare professionals’ lived experiences in interprofessional PC. Only by understanding their personal experiences and perceptions of nurses’ responsibilities and tasks, and interprofessional collaboration and communication, we will be able to provide detailed examination of the current strengths and weaknesses, together with the future opportunities and threats from nurses’ involvement in PC²³.

2.2. Setting

The study took place in 14 European countries: Belgium, Czech Republic, Germany, Greece, Hungary, Italy, the Republic of North Macedonia, the Netherlands, Norway, Portugal, Slovakia, Slovenia, Spain and the United Kingdom (England and Wales). In each country in-depth interviews were conducted in four different settings: hospitals, community care, long-term residential care, and mental health care.

2.3. Participants

‘Key informant’ pharmacists, physicians and nurses were purposively sample²⁴. They could only be selected on the condition that they were named as expert in PC by at least two other healthcare professionals, with local knowledge of PC, and insights into the nature of problems and possible solutions. This allowed us to get information about nurses’ roles in interprofessional PC and to understand the motivations and beliefs of a large number of healthcare professionals with diverse backgrounds and opinions. Representatives of professional associations for nurses, physicians and pharmacists, and healthcare providers in different healthcare institutions were asked to identify key informants. Researchers contacted the persons identified as potential participants by email or telephone, informed them about the study, and about being named as a key informant on nurses’ role in

interprofessional PC. If they agreed with being able to serve as a key informant, written information was provided to fully inform the potential participants about the study details.

We aimed for at least two interviews per profession ($n = 3$) per healthcare setting ($n = 4$), per country ($n = 14$), resulting in 24 in-depth face-to-face interviews per country. These numbers were aimed for in order to compile a sample with perspectives as diverse as possible. Data saturation was reached in each participating country. There were no restrictions as to gender or age. No reimbursement was provided for participation. Exact numbers of those approached and declining were not registered in all countries.

2.4. Interview guide development

An interview guide (see online article) was developed in English based on literature and the results of a previous quantitative study about nurses' practices in interprofessional PC (Fig 3.1, step 1)¹³. During a meeting with all European partners, the interview guide was adjusted until consensus was reached (Fig 3.1, step 2).

To ensure conformity across twelve languages, the concept of PC was described at the beginning of the interview: "healthcare professionals' contribution to the care of individuals in order to optimize medicines use and improve health outcomes". This description was derived from the Pharmaceutical Care Network Europe definition of 2013, taking into account the interprofessional aspect of PC^{8, 14}.

Responsibilities and tasks were defined based on the literature, together with discussions with an expert in health law, liability law and ethics and an expert in legal philosophy and ethics: *"The role of nurses involves several responsibilities. A responsibility for nurses is an obligation that they have by virtue of their role as a nurse. Their central responsibility is to be the patient's health advocate and to provide high quality care, using sound professional judgement and taking into account the relevant legal and moral considerations. The other responsibilities of nurses derive from this central responsibility. Nurses can be made to answer for failing in their responsibilities, which could result in disciplinary, civil, and criminal liability. Specific tasks may have to be performed in order to fulfill a responsibility."*^{25,26}.

The interview guide consisted of four main topics.

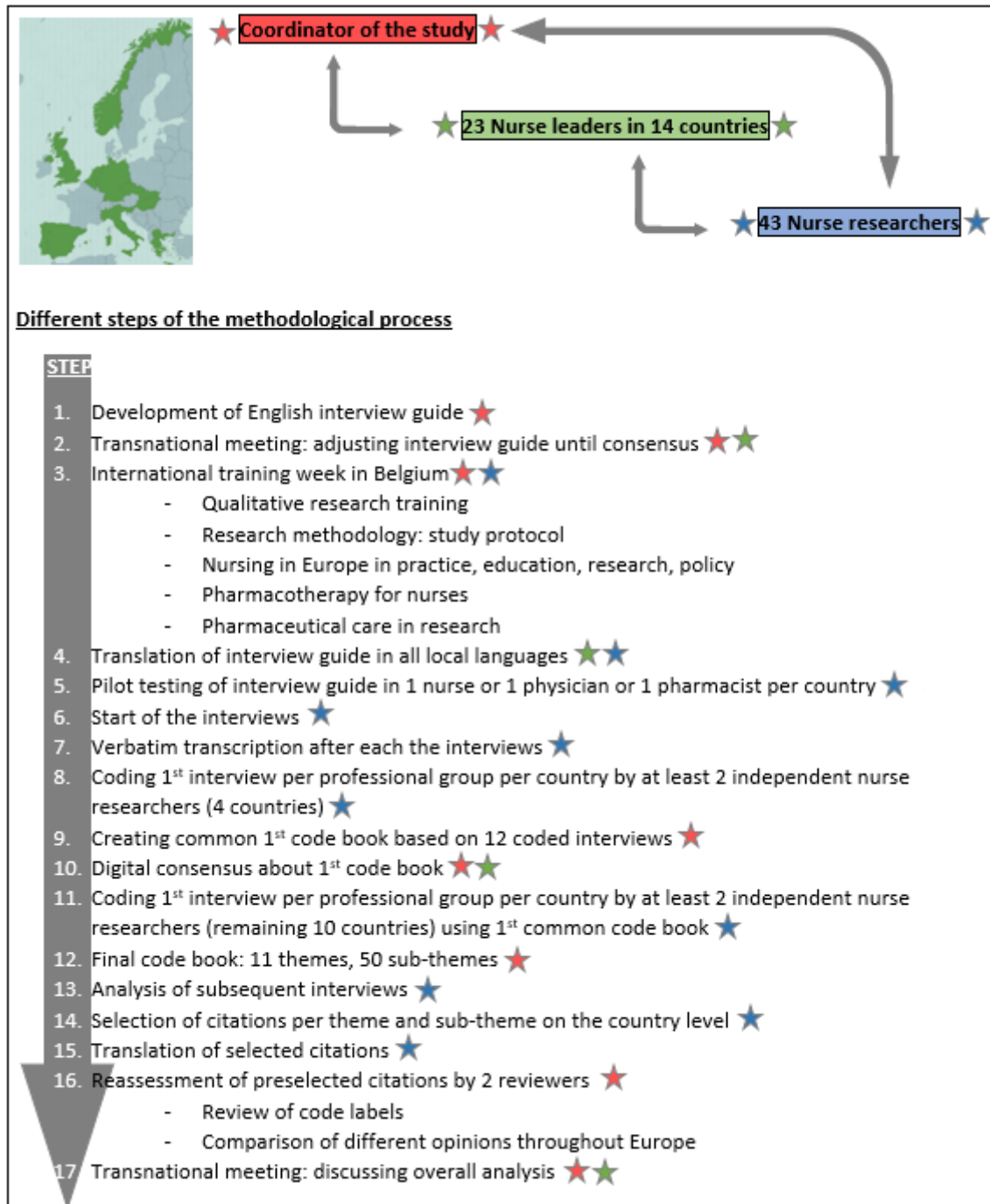


Figure 3.1. International approach to increase methodological quality

Topic 1: Responsibilities

Respondents were asked what responsibilities would be part of the ideal role of nurses in PC and what these responsibilities would imply. Preparation and administration of medicines by nurses was considered as an obvious part of PC and therefore outside the study's scope. After open reflections, four responsibilities were presented: 1) monitoring and following-up of therapeutic and adverse effects of

medicines; 2) monitoring and following-up medicines adherence; 3) decision making on medicines use, including prescribing medicines, excluding preparation and administration; 4) providing patient education and information about medicines. Respondents were asked what they would like to change, add, or remove. This structuring ensured uniformity across 14 countries and 12 languages.

Topic 2: Tasks

Specific tasks within the previously defined responsibilities were elicited. A similar strategy as above, with open and then more guided reflections, was used. The predefined tasks for reflection were: 1) detecting clinical change, healthcare problems or assessing patient needs; 2) registration; 3) interprofessional communication (including reporting, alerting and discussion); 4) patient communication; 5) intervention in emergency cases; 6) follow-up; 7) self-care support; 8) 'dependent' nurse prescribing; 9) 'independent' nurse prescribing; 10) reporting medication errors and safety issues.

Topic 3: Interprofessional team working

Ideal communication and collaboration between pharmacists, physicians and nurses, when aiming for high quality PC and predefined interactions were suggested: 1) nurses reporting observations to physicians and pharmacists; 2) physicians providing information and instruction to nurses; 3) pharmacists giving advice to nurses.

Topic 4: SWOT analysis

Finally, respondents were asked to reflect on strengths, weaknesses, opportunities and threats (SWOT) of nurses' current and ideal roles.

2.5. Data collection

Nurse researchers in each country were trained in qualitative research and in-depth interviewing during a joint one-week training program at University of Antwerp in November 2019 (Fig 3.1, step 3). When agreed, the interview guide was translated into all national languages and pilot tested in each country by at least one pharmacist, physician and nurse (Fig 3.1, step 4–5). The test interviews were not included in the data analysis. No significant adjustments were made after the pilot interviews. Between December 2018 and October 2019 interviews were conducted by two to four interviewers per country (Fig 3.1, step 6). Participants were mostly

interviewed at their workplace, or another location, such as participant's home or the researcher's workplace. Regardless of location, confidentiality was maintained. Only the interviewer and the interviewee were present during the interview. Interviews lasted from 30 to 90 minutes, and were audio recorded. Field notes were taken. No interviews were repeated. Audio recordings were transcribed *verbatim* by the interviewer or a professional transcriber (Fig 3.1, step 7). They were not returned to participants for member checking.

2.6. Data analysis

The qualitative analysis started after the first interview²⁷. The transcripts were coded by labelling lines of text in order to group and compare similar or related data segments. To create an international code book for data analysis, 12 interviews were fully translated into English and coded by the local researchers from 4 countries (one pharmacist, one physician, one nurse per country) (Fig 3.1, step 8). The English codes were then collected to create a common first code book, to be used as a guide for analysing subsequent interviews (Fig 3.1, step 9). Consensus was achieved within the consortium, and the next 30 interviews were analysed (Fig 3.1, step 10–11). Extra codes and themes could be added if new content arose. The final code book consisted of 11 themes, combined with 49 sub-themes, addressing nurses' roles and the related SWOT analysis (Appendix 3.1; Fig 3.1, step 12).

To improve the confirmability of the study, every first interview per professional group per country was analysed by two researchers^{28–30}. In that way, at least three interviews per country (one nurse, one physician, one pharmacist) were analysed by two researchers. All other transcripts and coding were at least checked by a colleague. After the data were analysed at national level, by coding the transcripts, researchers in each country selected quotations for each theme and sub-theme (Fig 3.1, step 14). To store the quotations, add labels and arrange the data, Microsoft Excel tables were created. To accomplish an overall view on the data, the preselected citations were reviewed by two researchers (first and second author) to reassess the code labels for accuracy and to compare the different opinions throughout Europe. All assumptions were taken into account, regardless the number of times they occurred (Fig 3.1, step 16). The national data per country, as well as the overall international data, were presented at an international meeting with all

partners to discuss the completeness and interpretation of the results per country, and achieve international consensus (Fig 3.1, step 17).

3. Results

The characteristics of the 340 healthcare professionals interviewed are presented in Table 3.1: 113 pharmacists, 111 physicians and 116 nurses, employed in hospital care (45%), community care (26%), residential care (14%), mental healthcare (9%), and other settings, such as a (10%). Healthcare professionals involved were equally distributed across participating countries. Most respondents worked in clinical practice (80%) and spent an estimated mean of 29 ± 15.1 hours/week on PC.

In response to questions about the ideal role of nurses in clinical practice, the four main responsibilities, developed in previous work, remained substantially unchanged. Within each responsibility, several tasks and contextual factors were reported. Opinions differed regarding expectations of nurses. An overview of all nurse responsibilities and tasks in interprofessional PC reported by pharmacists, physicians and nurses is given in Table 3.2.

3.1. Responsibility 1: Monitoring therapeutic and adverse effects of medicines

Some respondents considered monitoring patients for the benefits and harms of medicines administered as part of basic nursing care, whereas others disagreed.

"I think pharmacists are better placed to report about unwanted effects, since we are committed to report on pharmacovigilance. Pharmaceutical care is pharmacists' work, and nobody else's."

(Pharmacist-05, Slovenia)

"The clinical evaluation and follow-up is something nurses currently do on a daily basis and which is often the trigger of alarm to physicians. It is already part of nurses' skills and it is being done well."

(Physician-01, Portugal)

Within monitoring, nurses' tasks were defined as medication anamnesis, detecting clinical change and healthcare problems and assessing patient needs. Early recognition of signals and linking with medicines was seen as vital to patients' safety. Reporting observations to the team (physician and pharmacist) and to

Table 3.1. Population characteristics.

	n (%)	
Country		
Belgium	28 (8.2)	
Czech Republic	29 (8.5)	
Germany	22 (6.5)	
Greece	24 (7.1)	
Hungary	21 (6.2)	
Italy	24 (7.1)	
The Netherlands	24 (7.1)	
Norway	24 (7.1)	
Portugal	24 (7.1)	
Republic of North Macedonia	24 (7.1)	
Slovakia	24 (7.1)	
Slovenia	24 (7.1)	
Spain	24 (7.1)	
United Kingdom	24 (7.1)	
Profession		
Pharmacist	113 (33.2)	
Physician	111 (32.6)	
Nurse	116 (34.1)	
Gender		
Female	206 (60.6)	
Male	134 (39.4)	
Other	0 (0)	
Healthcare setting*		
Hospital care	154 (45.3)	
Community care	88 (25.9)	
Residential care	46 (13.5)	
Mental healthcare	29 (8.5)	
Other / no specific healthcare setting**	35 (10.3)	
Main field*		
Clinical practice	272 (80.0)	
Policy	67 (19.7)	
Education	41 (12.1)	
Research	28 (8.2)	
Politics	10 (2.9)	
	Mean (SD)	Median (min-max)
Age (years)	45.9 (10.6)	46.0 (24-76)
Expertise in main field (years)	19.1 (10.7)	18 (2-48)
Work related to pharmaceutical care (hours/week)	28.3 (15.3)	30 (1-105)

* Total is different from 100% because more than one answer was possible ** academic setting, education, research, politics, national health services, individual practice (not community care) or not specified.

patients or their informal caregivers and family, as well as registration and follow-up of medicines' desirable and undesirable effects were recognized as nurses' tasks. Follow-up was suggested as either a nursing or shared responsibility or solely a medical task.

"Pharmacists won't notice side effects, only one person will—it's the nurse."

(Pharmacist-20, Hungary)

"Nurses don't only distribute medicines like a trained monkey. They are able to realize that somehow a problem could arise and preventive interventions might be necessary."

(Nurse-04, Germany)

To monitor therapeutic and adverse effects of medicines, respondents perceived a certain level of knowledge about medication to be needed, and therefore high quality nurse education must be provided. In addition, some felt clear legal frameworks, policies and regulations, allocating nurses clear roles in monitoring, are necessary.

Table 3.2. Existing or potential nurse responsibilities and tasks in interprofessional pharmaceutical care (beyond medication preparation and administration)

Responsibilities	Tasks
1. Monitoring therapeutic and adverse effects of medicines	a. Detecting, addressing, reporting clinical change and healthcare problems
2. Monitoring medicines adherence	b. Assessing patients' needs
3. Decision making on medicines use, including (de)prescribing, medication reconciliation and medication review	c. Identifying, reporting and addressing drug related problems and safety issues
4. Providing patient education and information about medicines	d. Follow-up assessments of patients
	e. Intervention in emergencies
	f. Documentation in patient records
	g. Communication with patient, informal caregiver and family
	h. Selfcare support and therapeutics education
	i. Interprofessional communication, including reporting, advising, informing, alerting and discussing
	j. Communication within the nursing team
	k. Supervising and coaching new healthcare workers and less qualified team members

3.2. Responsibility 2: Monitoring medicines adherence

Many respondents considered adherence monitoring to be a clear and obvious aspect of nurses' roles, while some were convinced that this was a physician-only responsibility or even the sole responsibility of the patient.

"Monitoring and following-up medication adherence, this is probably clear. This is an area which is the least controversial, I see no problem in it."

(Nurse-12, Czech Republic)

Within monitoring medication adherence, one important nursing task was to detect and alert the interprofessional team of any non-adherence. Nurses may also

motivate patients to adhere to their prescribed regimen. Motivational interviewing of patients with targeted open questions would identify reasons of non-adherence, determine patients' needs, and support self-care.

"When the nurse is with the patient, she realizes whether the pill is too big for the patient and he would prefer to take two smaller ones twice a day."

(Pharmacist-02, Italy)

Prerequisites of adherence monitoring by nurses included: clear guidelines about the responsibilities of nurses, pharmacists and physicians in monitoring adherence within a legal framework; open, blame-free culture; open dialogue between pharmacists, physicians and nurses; appropriate nurse training in PC; and a manageable workload, resulting in time to care and explore issues with patients.

3.3. Responsibility 3: Decision making on medicines use, including (de)prescribing, medication reconciliation and medication review

A wide variation in opinions was reported, with more positive views in countries with existing nurse prescribing. Differences in opinion were not confined to any one profession. A small number of respondents considered nurses already possessed the required competences, and advocated nurse-prescribing for a wide range of medicines, usually within their specialist fields.

"Doctors, especially in hospitals, got used to giving their stamps to the head nurse to write prescriptions."

(Pharmacist-01, Greece)

"We have an internal deal with the nurses on my ward, that they are allowed to give some medicines to patients on their own, under specific circumstances and specific medicines that we agreed on."

(Physician-06, Slovenia)

Others favoured nurse prescribing, but only after extra training and under specific conditions, e.g. emergencies, low risk medicines (often those that can be purchased without a prescription) or confined to nurses with high levels of nursing education. A further group would never—under any circumstances—give nurses a role in decision making or prescribing. They considered this responsibility to be too

complex and a medical responsibility, in which collaboration with nurses was not desirable.

"Experiences with nurse prescribing in other countries are not of that kind, that we need to be scared of it."
(Pharmacist-02, Belgium)

"It scares me. . . it is probably just my feeling. . . I cannot imagine nurse prescribing."
(Pharmacist-10, Czech Republic)

Respondents considering decision making on medicines to be a part of nurses' ideal roles described possible tasks within this responsibility: nurses could decide on the route, formulation and brand; add or deprescribe treatments; adjust and titrate doses; prepare prescriptions (to be validated by a physician); and prescribe repeat prescriptions. Respondents predominantly reflected on the selection of products, the level of autonomy and the level of emergency: local and low-risk medicines from a limited list were preferred to systemic and high-risk medicines; supervision by physicians or pharmacists and shared responsibility were favoured above full autonomy for nurses; and life-threatening emergencies warranted increased autonomy. Others felt that more complex thinking is required in these situations, arguing against more responsibility for nurses. There were calls for flexible practice guidelines. Knowledge was mentioned as a crucial prerequisite for decision-making in PC. As an initial step, more pharmacology is needed in pre- and post-registration nurse education. Level 6 (Bachelor) nurses³¹, nurse specialists and nurse practitioners were suggested as having the minimum level of education to prescribe.

"Nurse prescriptions should be very limited. I would understand nurse prescribing, but only in very specific restricted situations."
(Pharmacist-03, Spain)

"What responsibilities would be part of the ideal role of a nurse in interprofessional pharmaceutical care? In my ambulatory practice I think nurses can prescribe 'repeating prescriptions' within control consultations. I think nurses can decide about routine medicines, within a certain spectrum, within their specialization in the field." (Physician-22, Slovakia)

"Nurses could have autonomy on the renewal of chronic therapies, previously prescribed by a doctor."
(Nurse-10, Italy)

"Nurses have the right to give emergency therapy when the patient's life is endangered, e.g. in case of major bleeding."

(Nurse-02, Republic of North-Macedonia)

"I would increase the level of knowledge, because if we don't have the proper level of knowledge, we can't prove to doctors and pharmacists that we are competent to prescribe and right now they don't trust us enough to prescribe."

(Nurse-07, Slovenia)

3.4. Responsibility 4: Providing patient education and information about medicines

Some respondents were convinced that responsibilities for educating and informing patients were the professional territory of physicians or pharmacists, while others believed these responsibilities should be shared with nurses. Opinions were based on the very limited content in pharmacotherapeutics in nurse education.

"Patient education about medicines would be better done by a pharmacist, they go to school for 5 years and learn everything about medicines, while nurses have only one course in school."

(Pharmacist-01, Slovenia)

With improved education, nurses could: explain medical diagnoses; inform patients and their caregivers about short- and long-term advantages and disadvantages of their medicines; support self-care; counsel patients at discharge; encourage and empower patients to take their medicines.

"A nurse has a responsibility to the patient to keep the patient fully informed about what has been prescribed, the risks associated, side effects associated and benefits likewise."

(Physician-04, UK)

"I think patient education and providing information is already done, it is common that nurses educate patients. We can discuss about the quality and the way, but I think, the role of nurses should be enhanced here."

(Nurse-12, Czech Republic)

"Nurses should provide patient education and information on drugs, because doctors are too complicated for patients."

(Nurse-02, Slovakia)

3.5. Interactions between nurses, physicians and pharmacists in an ideal interprofessional collaboration

Interprofessional communication, including reporting, advising, informing, alerting and discussing was considered of major importance in interprofessional PC. Collaboration, coaching and supervising within the nursing team was also reported as important.

"Multidisciplinary communication works, nurses are irreplaceable, they ensure that information and documentation is effectively passed between team members."

(Nurse-03, Slovakia)

"Three-dimensional communication is missing. Clinical pharmacists have been collaborating mainly with physicians, discussion with nurses is missing."

(Physician-10, Czech Republic)

Contextual factors allowed nurses to have a role in interprofessional collaboration, e.g. confidence in nurses' knowledge, self-confidence of nurses, an open blame-free culture, clear roles and responsibilities, availability of team members, involvement of nurses in PC team meetings, absence of hierarchic attitudes, and equality between professionals. Written communication was recommended to ensure proper communication.

"The working atmosphere is crucial. This must ensure openness and honesty and give room for clear feedback to each other."

(Physician-08, the Netherlands)

"I don't know who my nurses are in my two local surgeries. It would be nice to know their names, I don't think that's the nurses' fault I think it's the way we get used to working."

(Pharmacist-24, UK)

3.6. Strengths, weaknesses, opportunities and threats of nurses' role in interprofessional PC

Strengths

The proximity of nurses to patients was a strength of nurses' contribution to PC. Nurses spend a lot of time with patients and these frequent contacts could facilitate

screening for symptoms, monitoring adherence, making decisions and informing or educating patients and their informal caregivers.

“The nurse regularly visits the patient and therefore is the first in line to recognize adverse effects of medicines and to act upon them. Physicians don’t spend as much time near the patients’ beds, so, they don’t always see the effect of medicines, compared to a nurse on a ward, who walks in the patient’s room for about 10 times a day.”

(Physician-23, the Netherlands)

Nurses were seen as well-positioned to take up responsibilities in interprofessional PC. They have key information to share, which can trigger interventions by themselves or other team members, in order to optimize medication use and improve health outcomes. Nurses’ reinforcement of physicians’ words to patients is important in their role in patient education.

“I, as a pharmacist, I am a real expert in medication. The GP is an expert in pathology. But nurses, they are ‘the eyes’ because they SEE patients, they can report to other professionals. Without you, nurses, the healthcare sector is dead. Without you, we are nothing!”

(Pharmacist-05, Belgium)

Weaknesses

Firstly, the absence of a legal framework for nurse’s roles in PC was evident in several countries. Some professionals reported absence of diagnostic mindsets, PC competences and poor education. Inadequate education promoted a lack of confidence in nurses from some pharmacists, physicians and nurses. Open dialogue with adequate interaction between nurses, pharmacists and physicians seemed to be missing. Although respondents believed that there was more communication than in the past, some hierarchical attitudes persisted.

“There must be an open dialogue, without throwing remarks, such as ‘I am a professional, I am first, you are last.’ An open dialogue to be able to say ‘Hey guys, who can deal with this part?’ It’s a puzzle. A brainstorming session to create clear abilities and job descriptions.”

(Pharmacist-01, Greece)

Opportunities

Further, opportunities for nurses' roles in an ideal interprofessional PC were identified. Each professional looking at the patient from his/her own perspective makes the involvement of multiple professionals of added value. Nurse consultations to monitor medicines effects and adherence, and care coordination by nurses were suggested as facilitators of PC. This would align complementary knowledge of team members, and reduce contradictory messages from different professionals.

"I could not imagine independent prescribing, because of interactions between body systems. A nurse alone cannot order pharmaceuticals, but a team is involved. Each team member has its own perspective; putting knowledge together will lead to much better results."

(Nurse-11, Hungary)

"Multidisciplinary teams are the ones who do all the work. It is never a one man's success. Nurses have the capacity to lead, gather and organize multidisciplinary collaborations for the patient's benefit."

(Nurse-02, Greece)

Nurses taking up more responsibilities in PC could have a positive impact on care quality and patient outcomes: an increase of professional support for patients (including in areas where few physicians are available e.g. rural or post-industrial areas), a substitute for physicians' input, reduction of waiting times and stress for patients, and, in case of nurse prescribing, a facilitation of prescription changes in emergencies.

"I completely agree that making decisions on medicines would take some weight off doctors shoulders"

(Physician-04, Slovenia)

"The benefits of interprofessional co-operation with nurses, pharmacists and physicians are rapid response, patient satisfaction and quality of care."

(Nurse-02, Republic of North-Macedonia)

In addition, shared digital patient files, interprofessional ward rounds and integrating interprofessional collaboration and communication into education of all professionals would be great opportunities for the future.

“Training with all the professionals is needed, we finish our degree without connecting directly to the other professionals and that is not what we see in the practice.”

(Nurse-02, Spain)

Threats

However, lack of time (to care), shortage of nurses and limited financial compensation for the time spent in PC roles, in combination with the current high burden of nursing responsibilities threaten the realisation of nurses’ ideal roles in PC.

“I don’t understand why things should change, nurses want to prescribe and they don’t even have time to do what they are already competent to do. . .”

(Pharmacist-01, Slovenia)

“Those who bear more responsibility should also receive more money, which is not yet the case in today’s collective agreements.”

(Nurse-06, Germany)

Finally, the absence of a legal framework for nurses’ roles and some physicians or pharmacists worrying about “their territory” in PC must be addressed.

“Interactions should be more lubricated and should be encouraged and I think they should be even legislated because it seems that nobody does anything if it is not an obligation... in order to boost public health...but a diagram needs to be made for people understood how it works.. so it will be better to be legislated...”

(Pharmacist-06, Portugal)

“The barriers are quite clear, professional conflicts have always been there. Every time one tries to get into a subject to another profession then they put up a stop that “this is my area of responsibility, you shouldn’t have anything to do with”.”

(Nurse-01, Norway)

“My experience is that hospital nurses think they are like physicians and I don’t like it. They are also elevated to us as pharmacists, while the role of both our professions is very important. Everybody is better in different area and nobody is the subordinate.”

(Pharmacist-02, Slovakia)

4. Discussion

Four main responsibilities for nurses in PC were evaluated. Many different tasks were described as part of nurses' ideal practice, yet many professionals were ambivalent over their implementation.

The extent of nursing autonomy depended on type of medicine and country-specific governance structures, and varied from no authority to authority and responsibility for broad ranges of activities. Not every nurse would be capable of performing every task in every situation. Several contextual factors should be taken into account while translating nurses' ideal roles in PC into clinical practice. Important prerequisites which were also already discussed in the literature were: sufficient education^{32,33}, knowledge (more pharmacology and pharmacotherapeutics)^{34,35}, an interprofessional collaborative approach,^{1,36} confidence in nurses^{37,38}, an open blame-free culture with clarity of team composition and roles^{39,40}, equality between professionals⁴¹, adjusted legislation⁴², readiness of professionals and patients to allow nurses to have responsibilities in PC⁴³, and a manageable workload leaving "time to care"^{44, 45}. Lack of time, shortage of nurses, absent legal frameworks and limited education and knowledge were described as main threats. However, a positive impact on care quality and patient outcomes was associated with nurses taking up responsibilities in PC. Nurses' observations and assessments could convey key patient information to the interprofessional team, as was also shown in previous research.⁴⁶

Fourteen countries were included in the study. Despite all of these being in Europe, it cannot be assumed that the education of nurses in each of these countries is uniform. A systematic review of nurse education in European presented differences on both level and duration of education³³. Two thirds of all nursing education programs are offered at the higher education level, while one third is offered at diploma-level. The duration of full-time nursing education programs varies from two to four years, with the majority (58%) lasting for three years. Also, different education pathways lead to the same level of nursing qualification in some countries and specialist qualifications are offered at both undergraduate and graduate degrees³³. Although the participants in this study raised the issue of the need for sufficient education before nurses could have a role in pharmaceutical care, experiences on the specific differences between the levels of education in each

country were not addressed in the interviews. Only for nurse prescribing did some respondents formulate minimum conditions in terms of educational level. Further research investigating differences in nursing responsibilities between levels of nurse education can offer significant added value to the development of a framework for level-specific roles of nurses in interprofessional PC. Nurses' roles have expanded in Europe over the last decade. An international comparative analysis of reforms of nurse prescribing concluded that 13 European countries already had legislation on nurse prescribing, eight since 2010. The extent of prescribing rights ranged from nearly all medicines within nurses' specialisations to a limited set of medicines. All countries had regulatory and minimum educational requirements in place to ensure patient safety; the majority required some form of physician oversight⁴⁷. Our study included four countries with legal prescribing rights for some nurses or some products at the time of data collection: the Netherlands, Norway, Spain and the United Kingdom. Different participant perspectives, however, were not related to country or any one profession.

Regardless of whether or not nurses are able to prescribe, they can have a pivotal role in initiating and supporting deprescribing^{48, 49}. However, nurses' roles in providing patient information about deprescribing are not always well considered, but nurses may be as effective as physicians at discussing medicines discontinuation with patients⁵⁰. When nurses are aware of the medicines that are most appropriate for deprescribing, for example antipsychotics for behaviour disturbance, they can monitor these patients to ascertain the benefits no longer outweigh the harms^{48, 49}.

We consciously chose to start the interviews with a definition of PC. This strategy has both advantages and disadvantages. Predefining PC ensured uniformity across 14 countries and 12 languages. On the other hand, we were unable to extract the participants' conceptualizations of the definition. However, we did encourage open reflections about the interpretation of role fulfilment within PC. The phenomenological approach of this study incorporates the supposition that there may be multiple truths or realities as perceived by multiple participants^{51, 52}. Additionally, the conceptualization of PC responsibilities may differ between healthcare professionals, as was already investigated for the concept of 'medication monitoring'⁵³. Monitoring from a nursing perspective is a dynamic, ongoing, day-to-

day activity, while pharmacists and physicians typically associate monitoring with structured medication reviews and an intermittent, planned activity⁵³. In our study, we were unable to explore any differences in how the concepts or themes were conceptualised by participants. Nevertheless, we described many ambiguous opinions on PC responsibilities and tasks, and participants elaborated on a broad range of subthemes that needed to be specified in order to define nurses' role in PC.

4.1. Strengths and limitations

To our knowledge, this is the first pan-European qualitative interview study about PC by nurses. The quality of the research can be demonstrated based on the qualitative research quality criteria of Lincoln and Guba²⁸. Firstly, triangulation of sources and analyst triangulation indicate *credibility*. Secondly, the extensive focus on the PC context of the participants resulting in thick descriptions will facilitate *transferability* of the study findings. Thirdly, the *dependability* is confirmed by investigator triangulation: coding of the first interviews by multiple researchers within one country, plus a non-country specific reassessment of the code labels linked to preselected citations by a team of researchers.

The *confirmability* of this research could only be partially achieved. Researchers from all countries were trained in qualitative research, in-depth interviewing, and 'bracketing' their own beliefs about nurses' role in PC during a joint one-week training program. However, since interviewers and respondents often shared work environments, contextual intersecting relationships between the participants and the researchers cannot be ignored. As we wanted to avoid the profession of the researchers influencing the responses from physicians, pharmacists, and other nurses, interviewers were asked not to inform interviewees about their profession unless directly questioned⁵⁴.

Another limitation is the absence of structured integration of the field notes, that have been made during the process of transcribing, critical reflecting and coding. Therefore, the researchers might have missed important non-verbal indicators, such as participants' body language and tone of voice.

The selected participants were 'key informant' experts in PC, who knew best what was happening in PC in clinical practice. However, findings cannot be generalised

to more junior clinicians or managerial staff. No reimbursement was provided for participation, leading to occasional refusal to participate. Exact numbers of those declining to participate were not registered, leading to an unknown selection bias. Despite the limited number of participants per professional group at national level, no new themes were generated in the last interviews reviewed, suggesting sufficient information power⁵⁵. Socio-cultural influences, mainly in terms of attitudes towards other professions might affect perspectives related to interprofessional collaboration, as was demonstrated in several studies^{43, 56}. In this research, no information was sought on cultural and/or ethnic identities of respondents. We wished to avoid sensitive questions and any possibility that respondents might be identified by local readers. Diversity should be taken into account in future research.

4.2. Implications for clinical practice and future research

Our results offer opportunities to create a framework for discussion in clinical practice, collaboration in research, and labour mobility. Nurses, pharmacists and physicians should openly discuss allocation of specific responsibilities and tasks. Our list of responsibilities and tasks is not exhaustive. Medication safety management⁵⁷, care coordination⁵⁸, overseeing patient medication self-management^{59, 60}, assessing patients' competences⁶¹, coaching and training patients⁶², discharge planning⁶³ and interprofessional referrals⁶⁴ are additional nursing responsibilities and tasks identified in the literature. A scoping review of research about PC by nurses would be useful to confirm the completeness of the role described or supplement with additional responsibilities and tasks. Further research should also address the differences in nurses' roles within different levels of nurse education.

Exploring nurses' ideal role in PC is not intended to remove responsibilities from other professional groups. On the contrary, the benefits of interprofessional collaboration and communication between pharmacists, physicians and nurses and its major impact on care quality and patient outcomes have already been amply demonstrated^{48, 49, 65–69}. Yet, healthcare systems are historically hierarchical in nature with physicians regularly assuming leadership positions and decision-making roles. Frustrations, lack of confidence, lack of organization and structural hierarchies hinder interprofessional relationships and communication⁴¹. Power imbalance

between professions is an important factor in nurses' professional roles when discussing PC and its formalisation. To address this source of conflict, it may be helpful for team members to discuss and agree roles and responsibilities⁴⁰. Increasing the awareness of all team members' potential roles would allow pharmacists, nurses and physicians to benefit from teamwork⁶⁵. Also, educators hesitate to address the reality of hierarchies in healthcare⁷⁰.

The training of healthcare professionals remains largely single discipline, which may reduce the ability to collaborate interprofessionally⁷¹. Therefore, we call for more interprofessional education, as well as rigorous research on interprofessional PC to tackle the remaining barriers.

5. Conclusion

Nurses have an active role in monitoring patients for the impact of their medicines, monitoring adherence, making decisions on medicines, and providing patient education and information. Different tasks within these responsibilities have been described, although contextual, knowledge and training factors have to be considered before nurses can perform this ideal role. Lack of time, shortage of nurses, an absent legal framework and limited education and knowledge were the main threats for nurses' roles in PC. Nevertheless, a positive impact on care quality and patient outcomes was associated with nurses taking up responsibilities in PC. Nurses' observations and assessments could lead to key information about patients being shared and addressed by the interprofessional team. The outcomes of this study evidence the need for a consensus-based PC framework across Europe.

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Contributors

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Ethical approval

The Ethics Committee for Social Sciences and Humanities of the University of Antwerp approved the study design (reference SHW_19_30). Depending on local regulations in Slovenia, the UK and Portugal, additional approval was obtained from the Medical Ethics Committee of the Republic of Slovenia (reference 0120-516/2018/6), Health and Care Research Wales (reference 19/HCRW/00) and the Ethics Committee of the Escola Superior de Enfermagem in Coimbra (reference 543/12-2018). National regulations and laws applying to the other countries didn't require additional permits or approvals. All respondents received information on the purpose, design and execution of the study. Written informed consent was given by all study participants.

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Chapter 4

Nurses' responsibilities and tasks in pharmaceutical care: a scoping review

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Abstract

Aim

To provide an overview of responsibilities and tasks of nurses in pharmaceutical care.

Design

Scoping review.

Methods

Two databases were systematically searched (MEDLINE and Scopus) for recent original research papers concerning nurses' responsibilities and tasks in pharmaceutical care. Existing responsibilities and tasks beyond preparation and administration of medication were collected and synthesized. This main study outcome was extracted from titles and abstracts only. Results were reported in accordance with PRISMA-ScR guidelines.

Results

Of the 3,805 titles and abstracts reviewed, 453 abstracts were included. A total of seven responsibilities were identified: (a) management of therapeutic and adverse effects of medication, (b) management of medication adherence, (c) management of patient medication self-management, (d) management of patient education and information about medication, (e) prescription management, (f) medication safety management and (g) (transition of) care coordination. Within these responsibilities, all tasks performed by nurses were described.

1. Introduction

Effective team communication and clear definitions of roles are two of the fundamental prerequisites for effective collaboration.¹⁻³ Unclear role descriptions hinder the quality of interprofessional communication and collaboration in daily clinical practice, international collaboration in research, education and innovation, and labour mobility of healthcare professionals.²⁻⁶ In pharmaceutical care (PC), defined as 'the process through which a pharmacist co-operates with a patient and other professionals in designing, implementing and monitoring a therapeutic plan that will produce specific therapeutic outcomes for the patient'^{7, 8}, a clear description of nurses' responsibilities is often lacking.^{5,9-13} Historically, nurses are responsible for the preparation and administration of medicines under physicians' supervision. However, nurses' responsibilities have expanded over the last decades, with task shifting from physicians to nurses.⁶

2. Background

In 2017, the World Health Organisation (WHO) has invited its member states to increase medication safety. Their 'Global Patient Safety Challenge on Medication Safety' aimed to reduce avoidable patient harm resulting from medication errors by 50% within 5 years. Only high prioritization of medication safety within healthcare systems globally will make this goal achievable.¹⁴ PC can have a considerable impact on medication safety and patient outcomes. Positive effects on the number of medication errors and adverse drug reactions, increased patient treatment perception and a decrease of unplanned hospital admissions have been shown in previous research.¹⁵⁻¹⁹ Nurses are considered as essential to the promotion of patient safety. They assess risks to safety and take appropriate action to manage those, putting the best interests, needs and preferences of people first.^{10, 20} Nurses often appear to be the last barricade between patients and medication errors, because they are well-positioned to identify drug-related problems and minimize unnecessary drug-related patient harm.^{18, 21-26} They play a central but also a complex role in the medication monitoring processes.²⁷ Physicians and pharmacists expect nurses to share observations and assessments of key patient information to be addressed in the interprofessional team.²⁸ In a previous study, 4888 European

nurses indicated monitoring therapeutic and adverse effects of medicines, monitoring medicines adherence, prescribing medicines and providing patient education and information about medicines are part of their clinical practice activities.¹¹ A subsequent large-scale interview study was able to confirm this active role in PC.²⁹ Moreover, within nurses' responsibilities several tasks were described, depending on the context, knowledge and training of the nurse: detecting clinical change and healthcare problems; assessing patients' needs; registration; multidisciplinary communication (including reporting, alerting and discussion); communication with patients; intervention in emergency cases; follow-up; self-care support; 'dependent' and 'independent' nurse prescribing; and reporting medication errors and safety issues.²⁹ Although the list of responsibilities and tasks was not exhaustive, both studies offer opportunities to create a framework for discussion in clinical practice, collaboration in research, and labour mobility. Nurses, pharmacists and physicians should openly discuss allocation of specific (shared) responsibilities and tasks. Full recognition of healthcare professionals' roles will further improve research investment into nurses' roles in interprofessional PC and enable the achievement of the WHO's patient safety agenda.

To develop a consensual framework about nurses' role in PC, previous findings should be compared with existing evidence, and the validity should be investigated. A scoping review of research about nurses' role within PC is needed to corroborate this role or to supplement the existing list with additional responsibilities and tasks. After all, internationally different nurse responsibilities may exist. Consequently, the aim of this study was to provide an overview of existing responsibilities and tasks of nurses in PC in international literature beyond preparation and administration of medication.

3. Methods

3.1. *Study design*

A scoping review methodology was used.³⁰⁻³² The review was drafted using the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR)³³. As the aim was to identify responsibilities and

tasks described, results of the studies included were not used or reported. Quality appraisal of the studies was irrelevant to the aim and therefore not applied.

3.2. Search strategy and eligibility criteria

Two electronic databases were searched with a team of 10 nurse researchers, including all authors: MEDLINE (PubMed) and Scopus. Since nurses' roles and responsibilities are continuously evolving, the inclusion date of publication was limited to 5 years in order to reduce the chance of including dated research on nursing practice.³⁴⁻³⁶ Also, the time between study completion and publication lasts on average two years, thus further prolonging the papers' age was not considered as appropriate.³⁷ For MEDLINE the publication date was limited to five years and for Scopus from 2016 to July 2020. The exact search strategy for both databases is shown in table 4.1. The initial search strategy was drafted for MEDLINE, and adapted for Scopus. All authors agreed on the search strategy. A combination of Medical Subject Headings (MeSH-terms) or free text terms related to PC and the search term 'nurse' in title or abstract was used. After the last search on July 16th 2020, the final search results were exported to EndNote X9®, and duplicates were removed.

Subsequently, papers were screened for title and abstract. Original research published in the last five years in English, French, Dutch or German was eligible. To be included, abstracts were required to clearly report a nurse responsibility or task related to PC, pharmacotherapy, medicines optimization, or medication management in clinical practice. Research papers about illegal drug use, deliberate self-harm, suicide in psychiatry or nurse activities not related to direct patient care were excluded. Studies limited to preparation and administration of medication were not accepted for inclusion. These basic and generally known nursing tasks have been performed by nurses even before Florence Nightingale laid the foundation of professional nursing in the 19th century, and hence were not a topic of discussion.³⁸ To enable including a large number of studies, only abstracts were considered. The presumption of the researchers was that if an article had a fundamental opinion about nurse responsibilities or tasks, this should at least have been stated in the abstract. Nurses' responsibilities and tasks are often not the main focus of an article.

Table 4.1: Detailed database search strategy

Database	Search strategy
MEDLINE	((((("pharmaceutical care") OR ("pharmacotherapy") OR ("drug monitoring") OR ("medication review") OR ("medication reconciliation") OR ("medicines optimization") OR ("medication therapy management") OR ("Drug Utilization Review"[Mesh]) OR ("medication monitoring") OR (Medication Errors[Mesh]) OR ("drug-related problem*") OR ("adverse drug reaction*") OR ("adverse drug event*") OR ("Pharmaceutical Preparations/adverse effects"[Mesh])) OR (((education) OR (prescribing) OR (adherence) OR (self-management) OR (self-care) OR (safety) OR ("nurses' role") OR ("Quality Assurance, Health Care"[Mesh]) OR ("Program Evaluation"[Mesh]) OR ("Safety Management"[Mesh]) OR ("patient safety")) AND ((medication[Title/Abstract]) OR (drug[Title/Abstract]) OR (medicines[Title/Abstract]))) AND ((nurse*[Title/Abstract]) OR (nursing[MeSH])))) NOT (((("pharmaceutical care") OR ("pharmacotherapy") OR ("drug monitoring") OR ("medication review") OR ("medication reconciliation") OR ("medicines optimization") OR ("medication therapy management") OR ("Drug Utilization Review"[Mesh]) OR ("medication monitoring") OR (Medication Errors[Mesh]) OR ("drug-related problem*") OR ("adverse drug reaction*") OR ("adverse drug event*") OR ("Pharmaceutical Preparations/adverse effects"[Mesh])) OR (((education) OR (prescribing) OR (adherence) OR (self-management) OR (self-care) OR (safety) OR ("nurses' role") OR ("Quality Assurance, Health Care"[Mesh]) OR ("Program Evaluation"[Mesh]) OR ("Safety Management"[Mesh]) OR ("patient safety")) AND ((medication[Title/Abstract]) OR (drug[Title/Abstract]) OR (medicines[Title/Abstract]))) AND ((nurse*[Title/Abstract]) OR (nursing[MeSH])))) AND Review[ptyp] AND "last 5 years"[PDat])
Scopus	((((("pharmaceutical care") OR (pharmacotherapy) OR ("drug monitoring") OR ("medication review") OR ("medication reconciliation") OR ("medicines optimization") OR ("medication therapy management") OR ("medication monitoring") OR ("drug-related problem*") OR ("adverse drug reaction*") OR ("adverse drug event*")) OR (((education) OR (prescribing) OR (adherence) OR (self-management) OR (self-care) OR (safety) OR ("nurses' role") OR ("patient safety")) AND ((TITLE(medication)) OR (TITLE(drug)) OR (TITLE(medicines)))) AND ((TITLE(nurse*)) AND (EXCLUDE (DOCTYPE,"re")) AND (LIMIT-TO (PUBYEAR,2020) OR LIMIT-TO (PUBYEAR,2019) OR LIMIT-TO (PUBYEAR,2018) OR LIMIT-TO (PUBYEAR,2017) OR LIMIT-TO (PUBYEAR,2016))

Very often, in improvement projects, nurses' role is described in just a few sentences. It is not feasible to find, select and read all scientific articles in which nurse responsibilities and tasks about pharmaceutical care have been reported somewhere in the text. However, in projects where nurses have been assigned essential responsibilities or tasks, a reference to the nursing profession in title or abstract is very likely. Hence, for this review, all necessary data could be extracted from title or abstract. This approach was also used in a recent scoping review of Rinchuse and Greene (2018).³⁹ Figure 4.1 shows the selection process and results in a flow diagram according to the PRISMA reporting guidelines.³³

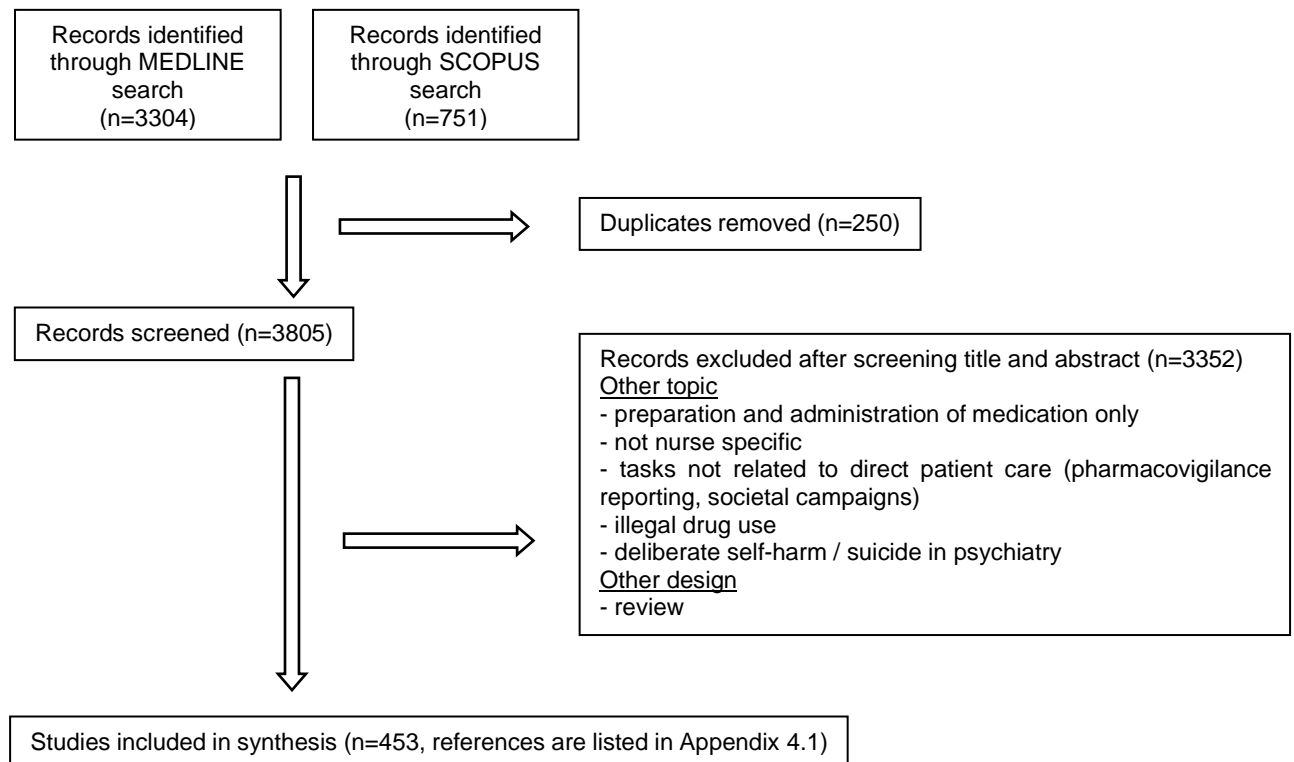


Figure 4.1. Selection of sources of evidence

3.3. Data extraction and synthesis

Data of included studies were extracted by all team members independently using a structured data extraction matrix and checked by the first author as part of quality assurance. Any disagreements were resolved by consensus or by discussion within the team. General characteristics were recorded: design, country, setting, patient population, level of nurse education, outcomes, whether or not published in a nursing journal and by nurse researchers. For each paper, nurse responsibilities in PC as well as nurses' tasks within these responsibilities were extracted. Responsibilities and tasks were defined based on literature, together with discussions with an expert in health law, liability law and ethics and a legal philosopher which was also an ethicist: 'The role of nurses involves several responsibilities. A responsibility for nurses is an obligation that they have in virtue of their role as a nurse. Their central responsibility is to be the patient's health advocate and to provide high quality of care, using sound professional judgement and taking into account the relevant legal and moral considerations. The other responsibilities of nurses derive from this central responsibility. Nurses can be made to answer for failing in their responsibilities, which could result in disciplinary, civil, and criminal

liability. Specific tasks may have to be performed in order to fulfill a responsibility.^{40, 41}

Responsibilities and tasks were extracted from title or abstract, whereas for the extraction of general article characteristics also full texts were considered. Primary study results were not extracted from the papers because of the lack of added value in providing an overview of nurse responsibilities and tasks in PC. For the same reason, a critical appraisal of the study quality was not carried out either.

3.4. Data analysis

All PC-related nursing roles beyond administration and preparation of medication, described in recent literature, were taken into account, regardless of the frequency of their reporting. Equal or similar nurse activities were described in different ways across studies. To provide a manageable overview, comparable and similar activities were clustered, and the most inclusive terminology was chosen. In Appendix 4.2, examples of similar tasks have been presented in order to enhance reliability and verifiability of the data analysis.

4. Results

4.1. Study selection

After duplicates were removed, a total of 3805 citations were identified from the electronic database searches. Based on title and abstract, 3352 were excluded. The remaining 453 studies were considered eligible for this review and hence were included. References are listed in Appendix 4.1.

4.2. Study characteristics

A summary of relevant study characteristics is presented in table 4.2. Besides, individual study characteristics can be found in Appendix 4.1. Studies from all continents and with a large variety of qualitative and quantitative study designs were reviewed. Patient populations and healthcare settings varied widely, and different nurse categories were described, although most articles did not specify nurses' specialisation or level of education. In 19% of the studies nurse researchers were

involved in the research team and 38% of the studies were published in nursing journals.

Table 4.2. Characteristics of included papers (n=453)

Study characteristics	Number of studies, % (n)
Continent	
Africa	4.2 (19)
Asia	14.6 (66)
Australia	9.5 (43)
Europe	33.3 (151)
North America	36.4 (165)
South America	1.6 (7)
More than one continent	0.4 (2)
Study design	
Quantitative	
Observational	46.8 (212)
Interventional	27.2 (123)
Qualitative	17.4 (79)
Multimethod	8.6 (39)
Patient population, specified by:	
Disease	
Physical disease or characteristic	34.0 (154)
Mental disease or characteristic	4.4 (20)
Social characteristic (<i>eg. income, insurance</i>)	2.2 (10)
Therapy	
Medication related (<i>eg. opioids, antibiotics</i>)	13.0 (59)
Non-medication related (<i>eg. surgery, end of life care</i>)	3.6 (16)
Other	
Age (<i>eg. elderly, children</i>)	8.4 (38)
Residence (<i>eg. hospital, home</i>)	9.9 (45)
No patients involved or not specified	24.5 (111)
Healthcare setting	
Hospital	51.6 (234)
Primary/community healthcare	24.9 (113)
Residential healthcare	5.5 (25)
Mental healthcare	1.8 (8)
Outpatient setting	7.1 (32)
More than one care setting (<i>eg. transitional care</i>)	0.7 (3)
Educational setting	1.3 (6)
Not specified or unclear	7.1 (32)
Nurse category, if specified†	
(Advanced) nurse practitioner	32.2 (64)
Registered nurse	25.1 (50)
Specialised nurse (<i>eg. oncology, ER, nurse-midwives</i>)	24.6 (49)
Independent nurse prescriber	7.5 (15)
(Clinical) nurse specialist	7.0 (14)
Advanced Practice Nurse	5.5 (11)
Other (<i>nurse case manager, physician assistant, licenced practical nurse, graduate nurse, diploma nurse, students</i>)	9.0 (18)
Nurse researchers involved	
Yes	26.3 (119)
No	18.8 (85)
Unknown	54.9 (249)
Published in a nursing journal (yes)	37.5 (170)

4.3. Nurses' responsibilities and tasks in pharmaceutical care

More than 100 aspects of PC by nurses (Appendix 4.2) were extracted from the included abstracts, compiled into 28 tasks and subsequently clustered into seven main nurse responsibilities. Some tasks were part of one specific responsibility, yet most tasks could be categorised as part of several responsibilities. Below we described responsibility-specific tasks for each of the seven nurse responsibilities. Table 4.3 provides a complete overview of the responsibilities and tasks extracted from recent literature.

Table 4.3. Overview of nurses' responsibilities and tasks in pharmaceutical care

	7 responsibilities [†] of nurses within pharmaceutical care						
	1	2	3	4	5	6	7
Tasks of nurses within pharmaceutical care							
Observation, monitoring medication effects							
Medication anamnesis							
Assessing patients' competences							
Assessing and addressing patients'/family's needs							
Recognising & preventing risks/complications/DRPs							
Identifying, assessing, reporting & addressing contra-indications/DRPs							
Documentation, registration in patient files							
Communication with patient/family, including discussion & advice							
Inter/intraprofessional communication, including reporting, advising, informing, alerting and discussing							
Evidence-based practice							
Decision making							
Inter/intraprofessional referrals							
(Selfcare) support, empowerment							
Therapeutic education (counselling, coaching, training patient/family)							
Antimicrobial stewardship							
Motivational interviewing							
Initiation of medication (reactive/proactive)							
Determination and adaptation of type/dosage of medication							
Decision on continuation/cessation of medication							
PRN (pro re nata, 'if needed' medication)/standing prescription order							
Medication reconciliation (anamnesis, medication histories, ...)							
Medication review							
Intervention in case of emergency							
Follow-up of patients and medication regimens							
Discharge planning, transition of care planning							
Collegial mentoring							

[†]The 7 responsibilities are: 1) Management of therapeutic & adverse effects of medication; 2) Management of medication adherence; 3) Management of patient medication self-management; 4) Management of patient education and information; 5) Prescription management; 6) Medication safety management; 7) Care/transition of care coordination

□ a light grey cell means the task (row) was reported to be performed in order to fulfill the responsibility (column)

■ a dark grey cell means the task (row) was not reported as a part of the responsibility (column)

Management of therapeutic and adverse effects of medication

Structured medication monitoring was carried out by nurses in charge of supervising patients. This consisted of medication anamnesis, observing, monitoring and assessing therapeutic and side effects of medication, for example by monitoring vital signs. Nurses collected information and evaluated patients' clinical status and needs, which was documented and registered in patients' files, as well as communicated to the team (physician and pharmacist), the patient or his informal caregiver and family. Early identification of drug related problems (DRPs) and intensive monitoring of adverse drug reactions (ADRs) by nurses were reported. In order to prevent DRPs, assessments and follow-up of medication regimens were done. Nurse-led phone calls and nurse consultations were a frequently used way of follow-up.

Management of medication adherence

Nurses assessed medication adherence and its hindering factors. Through in-depth assessing, followed by planning of medication regimens, patients could be encouraged to take their medicines correctly. Support and promotion to adhere to medication schedules were part of nurses' tasks for which motivational interviewing techniques were used. Several studies described nurse interventions to improve and follow-up adherence, among others: providing dispensing services, adherence counselling, telemonitoring, web-based interventions, and nurse-led telephone calls. Furthermore, nurses had an important warning function: when observing non-adherence, they contacted other healthcare disciplines to report their findings and to collaborate to prevent non-adherence related ADRs.

Management of patient medication self-management

Several tasks for nurses in medication self-management have been described. Nurses assessed patients' self-administration competences, assisted self-administration and empowered patients to self-manage their medicines. Regular visits by nurses as well as web-based/e-health interventions contributed to support self-care and medication self-management. Both patients and informal caregivers were coached and trained by nurses. Collaboration with other professionals was indispensable.

Management of patient education and information

Nurses were described as healthcare professionals responsible for facilitating and filtering information for patients, family and informal caregivers. After assessing patients' needs, a diverse range of evidence-based information, education, counselling and training strategies led to a better understanding of medication regimens and possible effects and improved medication adherence. Antimicrobial stewardship, in terms of educating patients to stem antibiotic overuse, and nurse educational programs about proper and safe medication disposal were also mentioned. From observation over recording to follow-up, nurses communicated and collaborated intensively with physicians and pharmacists.

Prescription management

Independently prescribing of medicines was done by certain nurses in some countries, though this was not a generally reported task of nurses. Besides the autonomous initiation of medicines during a nurse consultation, a range of tasks with a large variation in autonomy was described. Nurses monitored indications to prescribe, evaluated contra-indications and assessed patient's and family's preferences. They created accurate, up-to-date medication lists in preparation of medication reconciliation, highlighted discrepancies in medicines and initiated multidisciplinary medication reviews to be carried out together with physicians and pharmacists. Medical prescriptions were continued, optimised (eg. by adjusting routes, dosage or type of drug) or discontinued. Management of standing renewal prescription orders and PRN (*pro re nata*, 'if needed') medication were also described as nursing tasks within prescription management. Throughout the total prescription process, nurses communicated with patients, physicians, pharmacists and other nurses. If necessary, patients were referred to medical prescribers. Lastly, antimicrobial stewardship, in terms of educating and persuading prescribers to stem antibiotic overuse, was reported as a possible nursing task.

Medication safety management

Different studies mentioned a key role for nurses in detecting potentially harmful medications or combinations of medications. Further tasks in optimizing and improving patient safety were assessment of DRPs and drug risks-benefits, (early)

identification and report of ADRs and monitoring high risk medicines. Nurses – often referred to as patients' advocates – were also responsible for preventing ADRs, promoting safe medication use and safekeeping.

(Transition of) care coordination

Within one healthcare setting or between two or more settings, nurses took up the coordination of care. To ensure the continuity of PC, nurses had to exchange medication related information. Interprofessional communication about observations, discharge planning and follow-up were part of nurses' job content. Nurses assessed patients' needs, educated patients and their informal caregivers before discharge and performed follow-up of patients after discharge. During the transition of care nurses had a role in identifying medication discrepancies and preparing discharge summaries.

5. Discussion

In this scoping review, we identified 453 studies published between 2016 and 2020 addressing nurses' responsibilities and tasks in PC across various healthcare settings. Our findings gave us the opportunity to map existing responsibilities and tasks of nurses in PC. A total of seven responsibilities were synthesized: 1) management of therapeutic and adverse effects of medication, 2) management of medication adherence, 3) management of patient medication self-management, 4) management of patient education and information about medication, 5) prescription management, 6) medication safety management, and 7) (transition of) care coordination. Also, specific tasks to be performed in order to fulfill these responsibilities were reported. Nurses' responsibilities in PC, however, are not strictly defined self-contained entities with unique tasks, yet, more an entangled, interwoven continuum of tasks with many of these tasks being part of more than one responsibility. In this way, the responsibility of care coordination is apparently covered by the other six responsibilities. However, discharge planning, an essential task within care coordination, cannot be attributed to the other responsibilities, which demonstrates the need to specify care coordination as a separate responsibility.

Also, the responsibility of medication safety management is a bit an odd one out, since ensuring safety has to be done within each of the other responsibilities.

Therefore, the question can be raised whether safety management has to be seen as a separate responsibility or a part of all the other ones. To emphasize the importance of safe PC, we have chosen for a separate mentioning.

Obviously, not every nurse would be capable of performing every task in every situation. Many contextual factors should be taken into account. A recent study in 340 nurses, physicians and pharmacists listed some of the prerequisites to allow nurses' to take up responsibilities in PC: educational level, laws and legislation, an interprofessional collaborative approach, confidence in nurses, an open blame-free culture with clarity of team composition and roles, equality between professionals, readiness of professionals and patients to allow nurses having responsibilities in PC, and a manageable workload leaving "time to care".²⁹ The aim of our study was not to provide a ready-made description of the responsibilities of any nurse, anywhere in the world, yet to present a broad overview of possible responsibilities and tasks. As a result, this review gives important insights in the extensiveness of nurses' activities. These activities extended far beyond the generally known preparation and administration of medication, suggesting nurses playing an important part in PC with a major impact on care quality.

When comparing basic characteristics as geographical spread and study design between the studies, included in this review, and other nursing research with and without specific focus on nurses' responsibilities in PC, no significant differences are found. To illustrate, numbers from the Scimago institution rankings show similarity for overall publications in nursing areas between 2016 and 2019 with most publications in North America (32%) and Europe (29%), followed by Asia (18%), South America (10%), Australia (8%), and Africa (2%).⁴² A recent systematic review on European nursing research publications corroborates that observational studies are most represented (42%) in nursing literature.⁴³

5.1. Implications for nursing research, clinical practice and education

Nurses can contribute to effectiveness, safety and efficiency in PC.⁴⁴ Uncertainty about nurses' role in interprofessional PC, however, can lead to nurses not or insufficiently taking up responsibility to perform PC tasks by nurses, but also to nurses performing tasks for which they are not educated. This current practice is a threat for interprofessional collaboration, care quality and patient outcomes.

Recognition of nurses' roles will enhance transparency about nurses' contribution to interprofessional PC and promote collaboration in research and policy making.⁴⁵ The knowledge, gained in this study, about the extent of nurses' capabilities in different countries and healthcare settings, with distinct contexts and educational levels will contribute to cross-country comparability and labour mobility of nurses. This was also suggested in previous international research.^{6, 46, 47} Furthermore, successful examples of high-educated nurses with advanced nursing roles can inspire countries with lower educated nurses or less extensive nursing roles. This in turn can lead to an extension of task shifting and changes of professional boundaries between nurses and medical staff all over the world. Moreover, countries with already existing role extensions, yet without legal framework, can be persuaded to adapt current laws and regulations to existing clinical practice.

Our results offer opportunities to create a framework for nurses' role in PC, to be used for discussion in clinical practice, collaboration in research, and labour mobility. Increasing the awareness of team members' (potential) roles can allow pharmacists, nurses and physicians to benefit from teamwork.⁴⁸ Additionally, such a framework could be used to develop an assessment to evaluate nurse competences in PC, as a guidance to evaluate nurse education and a tool for nurse educators.

Further research should investigate differences in nurses' responsibilities and tasks between different levels of education.

5.2. Strengths and limitations

Our review has some limitations. To enable including a large number of studies, only abstracts were considered. Therefore, some of the excluded studies might also have mentioned certain responsibilities or tasks in their full text, yet without focusing on them. Despite the risk of having missed some responsibilities and tasks, the list we have been able to create, is of important added value to what was already known. Also, to make our review more feasible, we only used two databases and exclusively included primary research (no reviews) with a clear mentioning of nurses' responsibilities or tasks in title or abstract.

An important strength of our review is the reporting quality. Through our approach, methodological rigor and transparency could be achieved.^{30, 33, 49, 50} Our systematic approach and reproducible method add to the important value of this study in PC.

6. Conclusion

We examined recent international literature related to PC by nurses and gave an overview of the variety within nurses' responsibilities and tasks in PC. Main areas of responsibility were management of therapeutic and adverse effects of medication, medication adherence, patient medication self-management, patient education and information about medication, prescribing, medication safety, and (transition of) care coordination. The extensiveness of nurses' activities showed nurses are key persons in PC for patients, suggesting them having a major impact on care quality. This scoping review will promote the development of a framework for nurses' role in interprofessional PC, to be used for discussion in clinical practice, collaboration in research and labour mobility of nurses. Future research should investigate differences in nurses' responsibilities and tasks between different levels of nurse education.

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Contributors

EDB, TD, HF, FH, LM, and BVR: Conceptualization, methodology, and investigation. TD, HF, FH, LM, and BVR: Validation and writing –review and editing. EDB, TD and BVR: Data curation and funding acquisition. EDB: Writing –original draft preparation and formal analysis. TD and BVR: Supervision. All authors have read and agreed to the published version of the manuscript.

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Ethical approval

Ethical approval nor patient consent was required for this scoping review.

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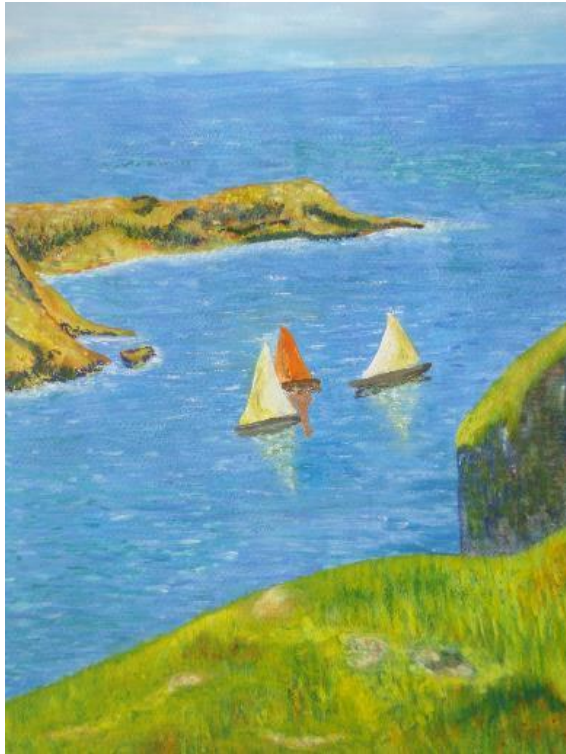
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Chapter 5



The NUPHAC-EU framework about nurses' role in interprofessional pharmaceutical care: cross-sectional evaluation in Europe

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Abstract

Clear role descriptions promote the quality of interprofessional collaboration. Currently, it is unclear to what extent healthcare professionals consider pharmaceutical care (PC) activities to be nurses' responsibility in order to obtain best care quality. This study aimed to create and evaluate a framework describing potential nursing tasks in PC and to investigate nurses' level of responsibility. A framework of PC tasks and contextual factors was developed based on literature review and previous DeMoPhaC project results. Tasks and context were cross-sectionally evaluated using an online survey in 14 European countries. A total of 923 nurses, 240 physicians and 199 pharmacists responded. The majority would consider nurses responsible for tasks within: medication self-management (86–97%), patient education (85–96%), medication safety (83–95%), monitoring adherence (82–97%), care coordination (82–95%), and drug monitoring (78–96%). The most prevalent level of responsibility was 'with shared responsibility'. Prescription management tasks were considered to be nurses' responsibility by 48–81% of the professionals. All contextual factors were indicated as being relevant for nurses' role in PC by at least 74% of the participants. No task nor contextual factor was removed from the framework after evaluation. This framework can be used to enable healthcare professionals to openly discuss allocation of specific (shared) responsibilities and tasks.

1. Introduction

Patient safety is an important global health concern. More than twenty years after the publication of the Institute of Medicine's report *To Err is Human*, serious efforts have been undertaken to decrease the number of medication errors.^{1–6} In 2017, the World Health Organization's (WHO) third 'Global Patient Safety Challenge on Medication Safety' invited WHO Member States to prioritize medication safety at the national level. The Challenge aimed to make improvements at each stage of the medication process, including prescribing, dispensing, administering, monitoring and use. The target was to reduce severe, avoidable harm resulting from errors or unsafe practices due to weaknesses in health systems by 50% by 2022. The success of this Challenge will depend on the high prioritization of medication safety within healthcare systems globally.⁷

Several studies corroborated that pharmaceutical care (PC) can have a serious impact on medication safety and patient-reported outcomes.^{8–11} In the randomized trial of Dürr et al. (2021), the intervention group received an intensified clinical pharmacological / pharmaceutical care, which included medication management and structured patient counselling. Considerable positive effects on the amount of medication errors, patient treatment perception, and severe side effects were shown.⁶

One of the opportunities to improve PC and medication safety is strengthening interprofessional collaboration in PC.^{12–17} Research suggests that an interprofessional team approach, involving pharmacists, physicians and nurses, has the potential to improve team drug-therapy decision-making, continuity of care and patient safety.¹⁸ A review by Donovan et al. (2018) substantiated that a robust body of data supports improvement in patient outcomes when care is provided by an interprofessional team.¹⁹ This interprofessional team approach can enable nurses to raise concerns with physicians and pharmacists, which can contribute to medication error reduction.^{20,21} Furthermore, collaboration problems, such as imbalances of authority, professional boundary friction and limited understanding of others' roles and responsibilities threaten patient safety.^{22,23} If role clarity is missing in a team, then effective interprofessional collaboration cannot be guaranteed.²⁴ After all, poorly defined roles can lead to conflicts in healthcare teams, which negatively affects patient care and patient outcomes.²⁵ Nowadays, a clear role

description of all professionals involved in PC is not always available.^{21,26,27} In particular, nurses' roles are not always explicit, distinct and clear to other professionals, complicating interprofessional collaboration.^{28–31} According to the National Interprofessional Competency Framework of the Canadian Interprofessional Health Collaborative physicians, pharmacists and nurses must understand not only their own roles but also those of other practitioners in the team.³² The need for a transparent framework describing nurses' roles in PC is therefore indispensable and urgently needed.

The European Commission funded DeMoPhaC project (DEvelopment of a Model for nurses' role in interprofessional PHArmaceutical Care in Europe) investigates the role of nurses' in interprofessional PC in 14 European countries. Within this project several large-scale quantitative and qualitative studies are being undertaken with healthcare professionals and nursing students. The overall aim of the project is the development of a framework for nurses' role in interprofessional PC and the development of an assessment to evaluate nursing curricula and nursing students' competences in PC. The project started in December 2017. The first part focused on the current clinical practice of nurses. This cross-sectional study showed that monitoring medicines effects, monitoring medicines adherence, nurse prescribing and providing patient education are part of the activities of nurses in clinical practice. Moreover, healthcare professionals felt that nurse involvement should be extended.³³ The second DeMoPhaC study was a qualitative interview study. Healthcare professionals confirmed the positive impact on care quality and patient outcomes when nurses assumed PC responsibilities. The study evidenced the need for a unique and consensus-based PC framework across Europe.³⁴ In the subsequent scoping review of international literature related to PC by nurses, an overview was given of the variety within nurses' responsibilities and tasks in PC. Main areas of responsibility were management of therapeutic and adverse effects of medication, medication adherence, patient medication self-management, patient education and information about medication, prescribing, medication safety, and (transition of) care coordination. The extensiveness of nurses' activities showed nurses to be key persons in PC for patients.³⁵ Only domains beyond preparation and administration of medication were taken into account. Preparation and administration of medication are basic and generally known activities being

performed by nurses even before Florence Nightingale laid the foundation of professional nursing in the 19th century, and hence are not a topic of discussion.³⁶

Because the scoping review showed nurses can be active in several additional PC domains beyond those initially investigated in the DeMoPhaC project, it is unclear whether healthcare professionals would consider all PC tasks to be nurses' full responsibility in obtaining best quality of care, or a certain level of supervision by physicians or pharmacists would be required. Additionally, the minimum level of nurse education necessary to perform certain PC tasks has not yet been investigated.

The results of the first three DeMoPhaC studies offer the opportunity to create a framework for nurses' responsibilities and tasks in PC, together with potential barriers or enablers of nurses performing these PC activities. After the development of such a framework, the content should be evaluated. Therefore, the aim of this study is to create and evaluate a framework describing potential tasks for nurses in PC and to evaluate to what extent physicians, pharmacists and nurses from 14 European countries consider PC-related tasks beyond preparation and administration of medicines to be nurses' responsibility in an ideal healthcare situation with best quality of interprofessional care and patient outcomes.

2. Materials and methods

2.1. *Study design*

This observational, descriptive research has a quantitative, cross-sectional study design. The collection of cross-sectional data at a certain point in time allowed us to gather a considerable amount of information from a large pool of participants. The study is reported according to the 'Strengthening the Reporting of Observational Studies in Epidemiology' (STROBE) Statement.³⁷ (Supplementary file, see online article). In an international setting, nurses, physicians and pharmacists were invited to complete an online structured questionnaire on nurses' tasks within seven pharmaceutical care domains.

2.2. Participants and setting

The study took place in 14 European countries: Belgium, Czech Republic, Germany, Greece, Hungary, Italy, Norway, Portugal, Slovakia, Slovenia, Spain, The Netherlands, the Republic of North Macedonia, and the United Kingdom (Wales and England). The countries were selected in an earlier phase of the overarching DeMoPhaC project of which this study is part.

We included nurses, physicians and pharmacists employed in clinical practice (community care, residential care, hospital care and mental healthcare), education, research, and policy making. Professionals in training and students were excluded.

The estimated sample size to obtain a representative framework of nurses' role in Europe was calculated with the single population proportion formula³⁸ The final sample size was 752, assuming a 50% proportion of risk perception (as this would yield the maximum sample size), a 5% margin of error, and 1.96 as the standard score value for a 95% confidence level.

2.3. Framework and survey development

In this study, PC is defined as *the contribution of 'Healthcare professionals to the care of individuals in order to optimize medicines use and improve health outcomes*. This definition is based on a combination of the definition of the Pharmaceutical Care Network Europe (PCNE) and the original definition of Hepler and Strand in 1990.^{39,40} The PCNE definition limits PC to the contribution of pharmacists. Because of the broadly recognized need for interprofessional collaboration in PC, and in line with the original definition of Hepler and Strand, the definition used in this study was extended to all healthcare professionals.^{20,33,41,42}

The results of the previous quantitative cross-sectional study³³ and the qualitative interview study³⁴ in European nurses, physicians and pharmacists, followed by the scoping review³⁵ of the literature, resulted in an overview of seven PC domains, 26 tasks for nurses and 20 contextual factors, which were potential barriers or enablers for nurses taking up tasks in PC (Table 5.1). Based on this overview, a framework, called the NUPHAC-EU framework (Nurse and Pharmaceutical Care Europe), was created.

Table 5.1. Overview of 26 potential tasks within 7 pharmaceutical care (PC) domains, and 20 contextual factors, for nurses in interprofessional PC, extracted from previous DeMoPhaC studies^{14, 34, 35}. Colours indicate whether the task was part of a PC domain (green) or not (red).

TASKS		Domain 1*	Domain 2*	Domain 3*	Domain 4*	Domain 5*	Domain 6*	Domain 7*
Task 1	Observation, documentation, registration, reporting	Green	Green	Green	Green	Green	Green	Green
Task 2	Assessing patients' competences	Green	Green	Green	Green	Green	Green	Green
Task 3	Assessing & addressing patient/family needs	Green	Green	Green	Green	Green	Green	Green
Task 4	Recognising & preventing risks/complications/drug related problems	Green	Green	Green	Red	Green	Green	Green
Task 5	Identifying, reporting, addressing contra-indications/drug related problems	Green	Green	Green	Red	Green	Green	Green
Task 6	Follow-up	Green	Green	Green	Green	Green	Green	Green
Task 7	Evidence based practice	Green	Green	Green	Green	Green	Green	Green
Task 8	Decision making	Green	Green	Green	Green	Green	Green	Green
Task 9	Communication/discussion with patient/family	Green	Green	Green	Green	Green	Green	Green
Task 10	Detection of non-adherence, drug abuse/misuse	Red	Green	Red	Red	Red	Red	Red
Task 11	Motivational interviewing	Red	Green	Green	Green	Red	Red	Red
Task 12	Inter/intraprofessional referrals	Green	Green	Green	Green	Green	Green	Green
Task 13	Facilitation of medication management	Green	Green	Green	Green	Green	Green	Green
Task 14	Self-care support & education of patients	Green	Green	Green	Green	Red	Green	Green
Task 15	Advice (to patient or other healthcare professional)	Green	Green	Green	Green	Green	Green	Green
Task 16	Determination of type/dosage	Red	Red	Red	Red	Green	Red	Red
Task 17	Initiation of medication (reactive/proactive)	Red	Red	Red	Red	Green	Red	Red
Task 18	Adaptation of dose, dose titration	Red	Red	Red	Red	Green	Red	Red
Task 19	Decision on continuation/cessation of medication	Red	Red	Red	Red	Green	Red	Red
Task 20	PRN/standing prescription renewal order	Red	Red	Red	Red	Green	Red	Red
Task 21	Medication reconciliation	Red	Red	Red	Red	Green	Red	Red
Task 22	Medication review	Red	Red	Red	Red	Green	Red	Red
Task 23	Intervention in case of emergency	Red	Red	Red	Red	Green	Green	Red
Task 24	Discharge planning, transition of care planning	Red	Red	Red	Red	Red	Red	Green
Task 25	Transitional care communication, inter/intraprofessional collaboration / communication including reporting, advising, informing, alerting, discussing	Green	Green	Green	Green	Green	Green	Green
Task 26	Mentoring colleagues	Green	Green	Green	Green	Green	Green	Green
CONTEXTUAL FACTORS								
Level of emergency		Adequate nurse to patient ratio						
Level of nurse education		Shared digital / electronic patient files and records						
Quality of nurse education		Legal framework in a country						
Interprofessional education		(self-)confidence in nurses						
Adequate reimbursement		Readiness of healthcare professionals and patients						
Clarity of interprofessional team members' role		Healthcare setting						
Availability of interprofessional team members		Ethical context (e.g. norms, values, ...)						
Workload/time to care		Political context						
Collaborative approach between nurses, pharmacists & physicians		Epidemiological context (e.g. demographics, patient needs, professional needs, ...)						

* Domain 1 - Management of therapeutic and adverse effects of medicines; Domain 2 - Management of medicines adherence; Domain 3 - Management of patient medication self-management; Domain 4 - Management of patient education and information; Domain 5 - Prescription management; Domain 6 - Medication safety management; Domain 7 - (Transition of) care coordination

To evaluate the content of this framework, an English-language questionnaire was developed by the Belgian researchers in this study (EDB, BVR, TD) and validated (face validity) by the consortium of international experts involved in the DeMoPhaC project. Consequently, the questionnaire was adjusted until consensus was reached (Supplementary file, see online article).

The survey consisted of three main parts. In the first part eight multiple choice questions defined demographics, employment and education.

The second part consisted of seven matrices with questions about the level of responsibility for nurses performing tasks within each of the seven PC domains (respectively 15, 17, 16, 14, 22, 16 and 16 tasks, Table 5.1). Respondents were instructed to envision the ideal situation to obtain the best quality of interprofessional care and patient outcomes. This part of the questionnaire was different for two groups of participants, depending on their ability to distinguish between nurse responsibilities based on nurses' education level. The first group confirmed being able to make this distinction. They were asked to indicate for each of the four European levels of nurse education (level 5–8)⁴³ whether each task should be a nursing task and, if so, whether this should be under supervision, with shared responsibility, or fully autonomous. Respondents unable to distinguish between levels of education were asked to indicate the level of responsibility (not allowed, under supervision, with shared responsibility or fully autonomous) for nurses in general. For 'Prescription management', two extra questions were presented: (1) the extent to which nurses should be allowed to prescribe medicines in order to obtain best quality of care and patient outcomes, and (2) the necessary restrictions to optimize nurse prescribing in an ideal interprofessional healthcare situation. For the first extra question respondents were asked to consider an ideal situation, which could be different from the current situation. The answering options were: no prescribing, dependent prescribing and independent prescribing. Dependent or supplementary prescribers were defined as 'prescribers who's prescribing is based on clinical management plans, which are put in place for individual patients and relate only to the patient named in the plan. Plans are compiled and signed by both the independent medical prescriber (doctor or dentist), and the supplementary (non-medical) prescriber. They must be agreed by the patient or carer'.⁴⁴ Independent prescribers were defined as 'practitioners responsible and accountable for the

assessment of patients with previously undiagnosed or diagnosed conditions and for decisions about the clinical management required, including prescribing'.⁴⁵ For the second extra question, respondents had the possibility of selecting multiple answers from a list of eight predefined restrictions: no restrictions; only a restricted list of medicines; only in a specific context, pathology/specialization; only after specific training; only long-term chronic medicines; only low risk medicines; prescription-only medicines only; only in emergency; and only within an individual patient clinical management plan. Other restrictions could be described in a free text field.

The third part consisted of 20 questions about contextual factors being barriers or enablers for nurses' roles in interprofessional PC. Respondents had to indicate the factors of their current healthcare context on a scale from -5 (great barrier), through 0 (no influence on nurses' responsibilities or tasks), to +5 (great enabler).

The questionnaire was translated into all languages of the participating countries by the specific co-authors. In two countries (Belgium and Italy) the instrument was pilot tested as to its applicability by all three professional groups.

2.4. Data collection

The weblink to the questionnaire was emailed to key stakeholders, professional associations, healthcare facilities and professional networks of the researchers in all countries. Nursing faculties as well as interprofessional colleges (Medicine faculties and Pharmacy faculties) initiated data collection. The weblink was placed on university websites, webpages of professional associations and on social media. Each country received monthly updates about the number of participants.

We aimed to reach a representative sample of nurses, physicians and pharmacists in each country. The length of the questionnaire, however, hindered many potential participants from completing the survey. Moreover, our data collection period (December 2019–August 2020) coincided with the start of the Covid-19 pandemic, resulting in less accessibility to healthcare professionals to take part. Therefore, in March 2020, after two months of data collection, we decided to decrease the number of questions showed to each respondent. Especially the second part of the questionnaire was shown to be too time consuming, when all tasks within all PC domains and all levels of nurse education were considered.

Hence, we switched to a shorter survey with all questions of parts 1 and 3, and with only four of the seven matrices presented in part 2. For each participant, the online survey program made a random selection of four PC domains to be shown. This resulted in a significant reduction in the time required to complete all questions, while still allowing each domain to be sufficiently studied.

2.5. Data analysis

Respondents who ended the survey during or immediately after the first part of the questionnaire (demographics, employment, education) were excluded from the data analysis because they did not provide data relevant to the research question. Data were analysed using IBM SPSS Statistics v27.0 (IBM Corp., Armonk, NY, United States). A two-sided level of significance of 0.05 was used. The main outcome variable was the level of responsibility in PC tasks (not allowed, under supervision, with shared responsibility or fully autonomous) that would be assigned to nurses in an ideal situation with best quality of interprofessional care and patient outcomes, from the perspective of physicians, pharmacists and nurses themselves. Discontinuous data were described using frequency distributions; continuous data were described using a mean value, a minimum and a maximum. To evaluate the statistical significance of the differences between the three professional groups or between the 14 countries, 2 test for nominal variables, and Kruskal–Wallis test for ordinal variables were used. Before Kruskal–Wallis tests were executed, a power analysis using G*power (Universität Düsseldorf, Düsseldorf, Germany) was performed to determine the minimum number of cases in each country.⁴⁶ According to the F-test ANOVA for fixed effects with an a priori medium effect size of 0.25, an alfa of 0.05, and a power of 0.8, at least 28 respondents per group were needed. Consequently, if a country had less than 28 responses, it was not included in the calculation of the p-value.

To clearly visualise as much data as possible, two types of matrices were created. In the first matrix type, each cell shows: (1) the percentage of respondents thinking a certain task could be a nursing task within a certain PC domain and performed by a nurse with a certain level of nurse education, and (2) the colour of that cell indicating the mode of the level of responsibility (red for ‘not allowed’, orange for ‘to be performed under supervision’, yellow for ‘to be performed with shared

responsibility' or green for 'to be performed with full autonomy'). In the second matrix type, the same colouring scheme was used. Each cell shows the percentage of respondents considering a certain task to be a nursing task within a certain country, without distinguishing between the seven PC domains. To achieve this, the PC domains were restructured in two ways: either all seven domains were clustered, or a cluster of six PC domains without 'prescription management' was considered.

Data analysis on restructured data resulted in apparently increased sample sizes per country, yet these numbers did not refer to unique respondents, but to clustered data of multiple PC domains per respondent.

To evaluate which tasks had to be either included or excluded from the final framework, we chose a 60% cut-off. In other words, we considered a PC task to be excluded from the framework if indicated as 'not allowed for nurses' by at least 40% of the respondents in each country. If a task was evaluated as to be excluded in some, but not all countries, it remained in the framework. After all, the performance of each nursing task in clinical practice will have to be considered in combination with all contextual factors, including country-specific prerequisites.

3. Results

3.1. The NUPHAC-EU framework for nurses' role in interprofessional pharmaceutical care in Europe

Taking into account the results of a previous quantitative cross-sectional study³³ and a qualitative interview study³⁴ in European nurses, physicians and pharmacists, followed by a scoping review of the literature,³⁵ together with the responses in the current cross-sectional evaluation, we developed a framework for nurses' role in interprofessional pharmaceutical care in Europe (Figure 5.1). The framework consists of several parts. On top of this, the patient and his network are presented. Together with the patient, the family and the informal caregivers, the interprofessional team, consisting of physicians, nurses, pharmacists and other healthcare professionals, communicates and collaborates in order to obtain the best quality of care and patient outcomes. In the middle of the framework, seven PC domains, beyond medication preparation and administration, and 26 tasks of nurses within these domains, are listed. On the

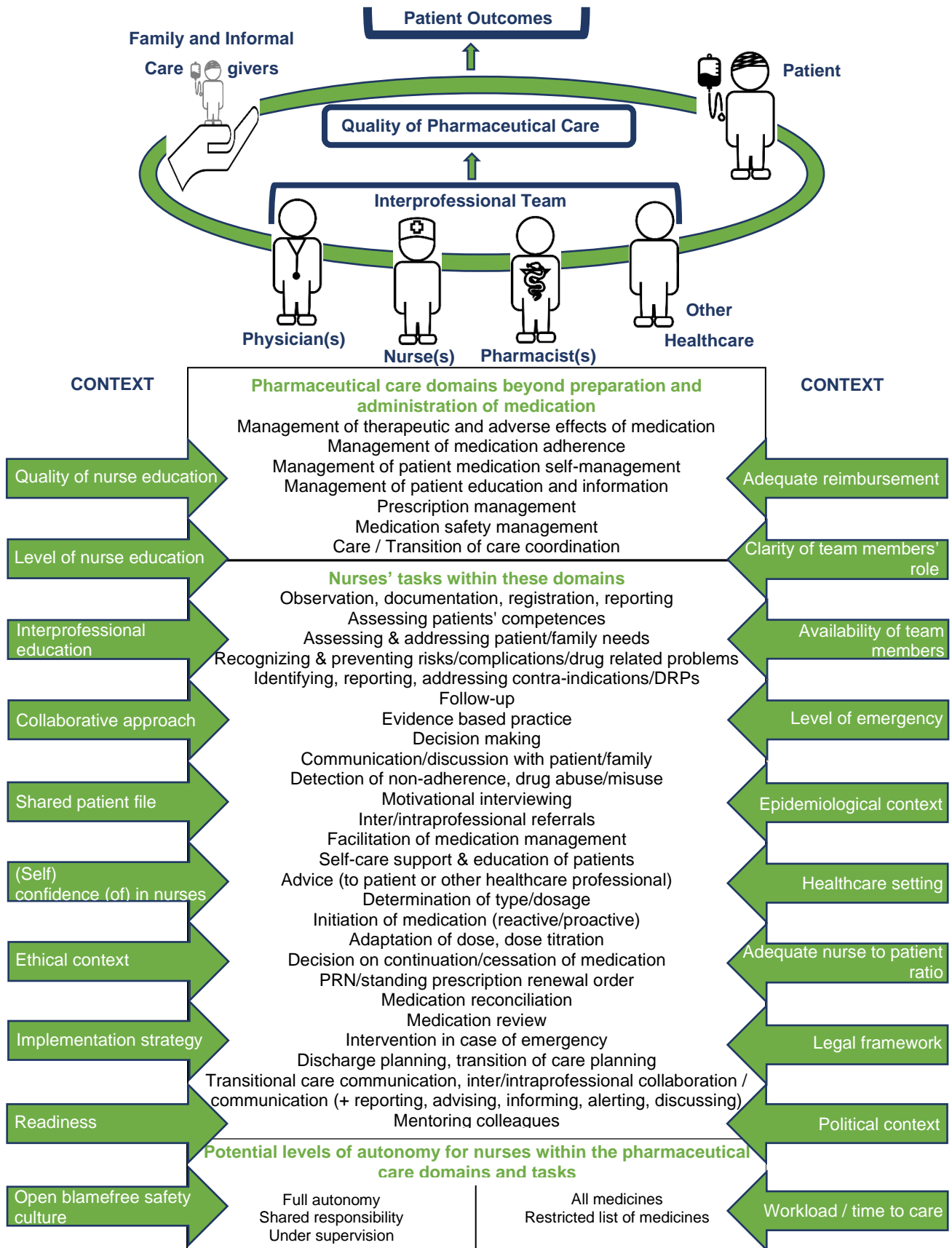


Figure 5.1. The NUPHAC-EU framework for **NURses'** role in interprofessional **PHArmaceutical Care** in **Europe**

bottom, potential levels of autonomy within the PC domains and tasks are shown, ranging from performing tasks under supervision, through shared responsibility, to full autonomy, and being responsible for a more or less restricted list of medicines. Finally, on the left and right side, twenty contextual factors are defined, being potential barriers or enablers of nurses' tasks in interprofessional PC.

3.2. Research population to evaluate the NUPHAC-EU framework

A total of 1385 respondents participated, of whom 68% were nurses, 17% physicians and 15% pharmacists. The majority (86%) of the respondents were employed in seven of the 14 countries: Slovakia, Belgium, Italy, Slovenia, Czech Republic, Spain and Greece. Mean age was 41 years, and 73% of the population was female. Mean years of work experience in healthcare was 18 years, three quarters of the healthcare professionals were employed in a hospital, and 83% had an active role in clinical practice. More detailed population characteristics are presented in Table 5.2.

3.3. Healthcare professionals' opinions about the level of nurse responsibility for nurses performing tasks in interprofessional pharmaceutical care

In the second part of the data collection, the respondents were presented a random selection of four out of seven PC domains, resulting in smaller samples for domain-specific questions. Questions about domains 1 to 7 were answered by respectively 731, 796, 726, 731, 669, 738, and 711 respondents.

Levels of nurse responsibility for European nurses

Looking at healthcare professionals' opinions without distinguishing between countries or levels of nurse education, we found that, in an ideal situation, in order to obtain best quality of care and patient outcomes, the majority of the respondents would consider all but four PC tasks to be nurses' responsibility. These four non-considered tasks were specific for the domain 'prescription management': determining type or dosage of medicines, initiating medication, adapting of dose and dose titration and deciding on continuation or cessation of medication.

Table 5.2. Population characteristics (n = 1385)

	All (n = 1385)	Nurses (n = 923)	Physicians (n = 240)	Pharmacists (n = 199)
DEMOGRAPHICAL DATA	% of total (n)	%	%	%
Country				
Slovakia	18.8 (261)	9.8	35.8	40.7
Belgium	18.2 (252)	15.2	29.2	19.1
Italy	13.4 (186)	15.4	16.3	2.0
Slovenia	11.0 (153)	13.1	1.7	13.1
Czech Republic	9.3 (129)	11.6	3.3	4.5
Spain	8.4 (117)	10.7	4.6	3.0
Greece	7.6 (105)	9.8	2.9	3.5
United Kingdom (Wales + England)	3.1 (43)	3.7	1.3	2.5
Republic of North Macedonia	3.0 (41)	3.6	1.7	1.5
Portugal	1.8 (25)	1.7	1.3	3.0
The Netherlands	1.6 (22)	1.3	0.8	3.5
Germany	1.5 (21)	1.2	1.3	2.5
Norway	1.4 (20)	2.1	-	0.5
Hungary	0.7 (10)	1.0	-	0.5
Gender				
Female	73.0 (992)	80.2	50.0	66.8
Male	26.8 (364)	19.4	50.0	33.2
Other	0.1 (1)	0.1	-	-
Prefer not to say	0.1 (2)	0.2	-	-
Age (years), mean (min-max)	40.8 (18-71)	40.5 (18-71)	42.9 (25-69)	38.7 (23-68)
JOB CHARACTERISTICS				
Work experience in HC (years), mean (min-max)	17.5 (0.3-60)	18.0 (0.5-60)	17.1 (0.5-47)	15.7 (0.3-45)
Work experience in HC (setting) †				
Hospital care	74.7 (985)	76.9	81.1	56.7
Community or primary care	26.6 (351)	22.5	20.2	52.9
Residential care	17.1 (225)	21.2	12.6	2.7
Mental healthcare	8.0 (106)	10.0	3.8	4.3
Current employment †				
Clinical practice	83.2 (1078)	81.7	85.8	86.7
Education	23.5 (304)	26.8	18.8	14.4
Research	12.1 (157)	9.6	22.6	10.8
Policy making	10.5 (136)	10.7	11.7	8.2
EDUCATIONAL CHARACTERISTICS				
Highest level of nursing education (EQF)				
Level 5		24.9		
Level 6	Only nurses	42.1		
Level 7	questioned	26.6		
Level 8		6.4		

† More than one answer possible. HC = healthcare. EQF = European Qualifications Framework ⁶³

For these tasks, 52.4%, 50.5%, 51.6%, and 51.3% of the respondents, respectively, did not consider them to be nurses' responsibility. Nevertheless, almost half of the respondents did consider these tasks as possible nursing tasks; hence, all 26 predefined tasks were included into the NUPHAC-EU framework.

Percentages of respondents not considering PC tasks to be nurses' responsibility ranged from 3.6% to 21.7% for tasks within management of therapeutic and adverse effects, from 3.0% to 18.2% for tasks within management of medicines adherence, from 3.1% to 14.2% for tasks within management of patient medication self-management, from 3.7% to 14.9% for tasks within management of patient education

and information, from 18.9% to 52.4% for tasks within prescription management, from 4.6% to 16.5% for tasks within medication safety management, and from 5.2% to 18.0% for tasks within transition of care coordination.

For the majority of the tasks, 'shared responsibility' between nurses and other healthcare professionals was seen as the most appropriate level of responsibility. Detailed percentages of the level of responsibility per task (under supervision, with shared responsibility or fully autonomous) are presented in Figure 5.2 and Supplementary Table S1 (available in online article). Furthermore, opinions on whether or not nurses should perform PC tasks differed significantly between physicians, pharmacists and nurses for almost all tasks ($p < 0.001$, Appendix 5.1).

The ideal level of nurse prescribing

More than one-fifth of the nurses considered 'independent nurse prescribing' as the ideal level of nurse prescribing, compared to only 1% of the physicians and 4% of the pharmacists. To obtain best quality of care and patient outcomes, most physicians (55%) and pharmacists (58%) believed that nurses should not prescribe, while the majority of the nurses (51%) thought 'dependent prescribing' would be the ideal level of nurse prescribing ($p < 0.001$, Table 5.3). Healthcare professionals' opinions also differed between countries, as shown in Figure 5.3 ($p < 0.001$). The country with the most proponents of 'no nurse prescribing' was Slovakia (63%), whereas in the UK (Wales and England), the most 'independent nurse' prescribers were considered (41%).

If nurse prescribing—whether or not (in)dependent—were to be considered, several restrictions would be needed in order to optimize prescribing: only after specific training (61%), only a restricted list of medicines (54%), only in a specific context or pathology/specialisation (43%), only within an individual patient clinical management plan (36%), only low risk medicines (31%), only long-term chronic medicines (30%), only in emergency (23%), prescription-only medicines only (19%). Still, 7% of the respondents thought there were no restrictions needed. (Appendix 5.2, Figure 5.4)

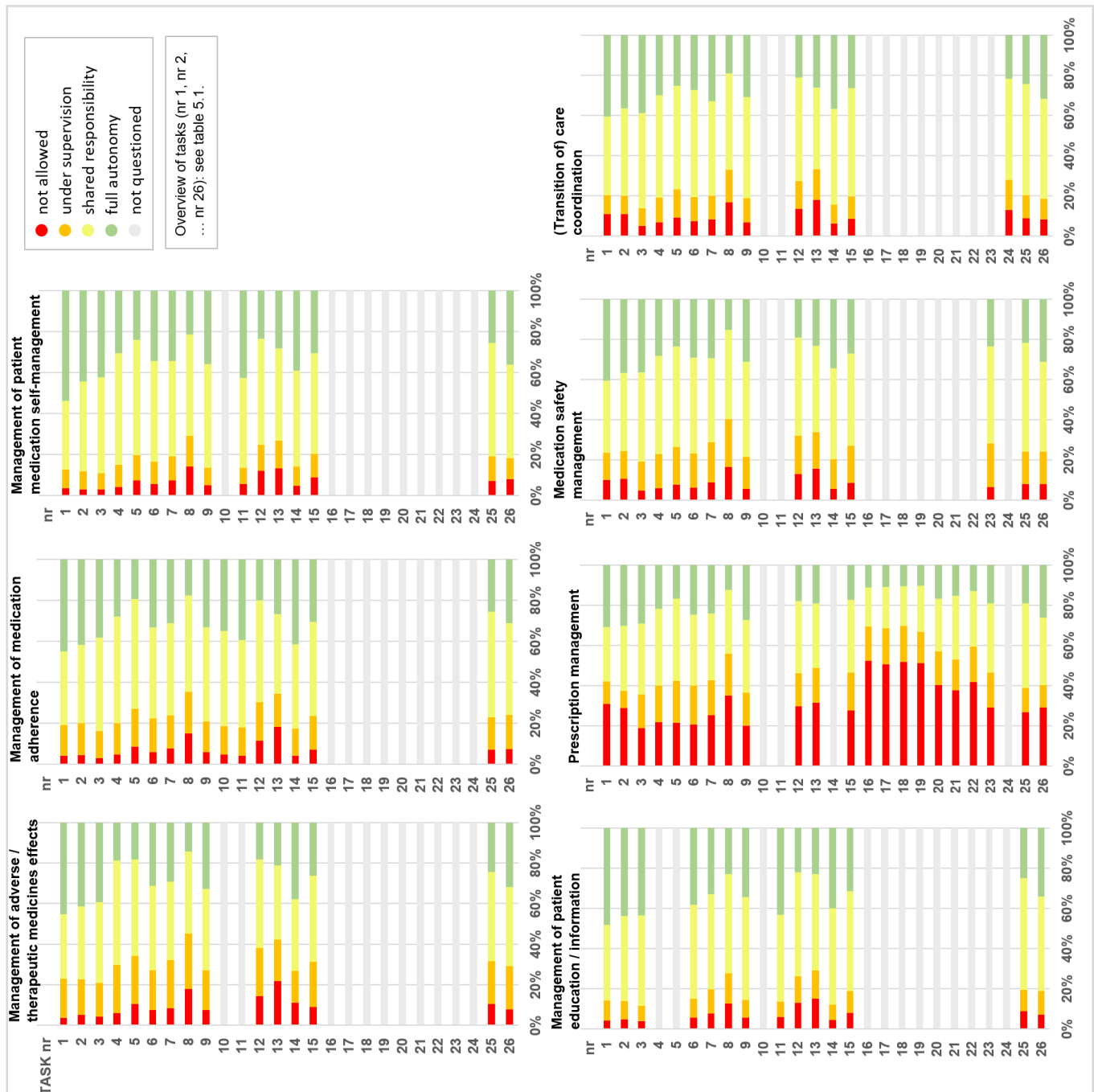


Figure 5.2. Healthcare professionals' opinions about the level of nurse responsibility in seven pharmaceutical care domains (n=1385)

Table 5.3. Physicians', pharmacists' and nurses' opinions about the extent to what nurses should be allowed to prescribe medicines, in order to obtain best care quality and patient outcomes (= ideal situation, which can be different from current situation).

Level of nurse prescribing	All %(n)	Physicians %(n)	Pharmacists %(n)	Nurses %(n)	p - value
No nurse prescribing	36.1 (330)	54.6 (83)	58.1 (68)	27.7 (176)	<0.001
Dependent nurse prescribing	47.9 (437)	44.1 (67)	37.6 (44)	51.0 (324)	
Independent nurse prescribing	16.0 (146)	1.3 (2)	4.3 (5)	21.3 (135)	

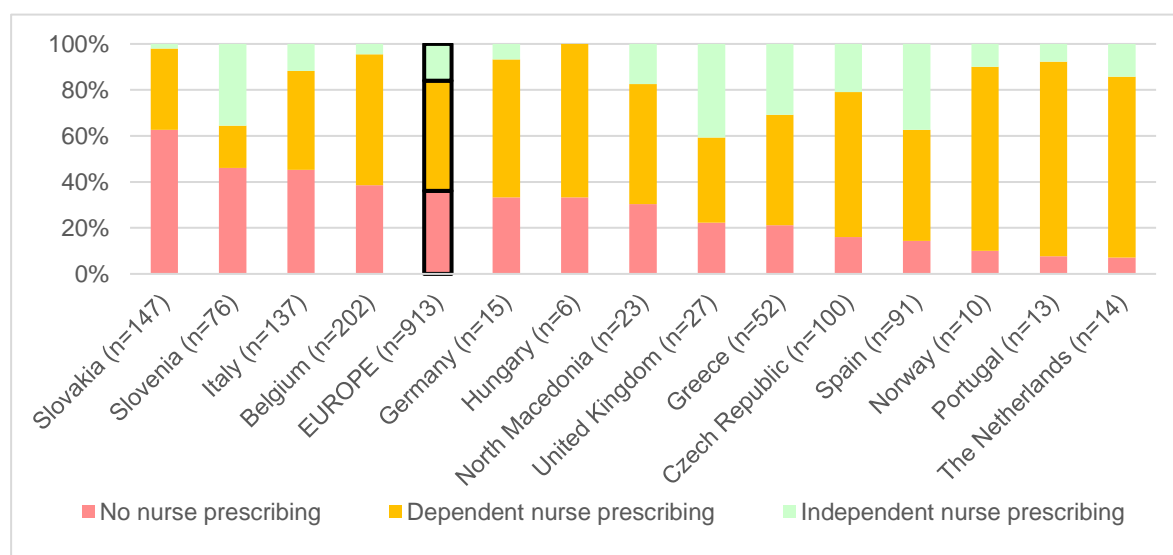


Figure 5.3. Healthcare providers' opinion on the level of nurse prescribing authorization in order to obtain best quality of care and patient outcomes in 14 countries (n=913; p<0.001)

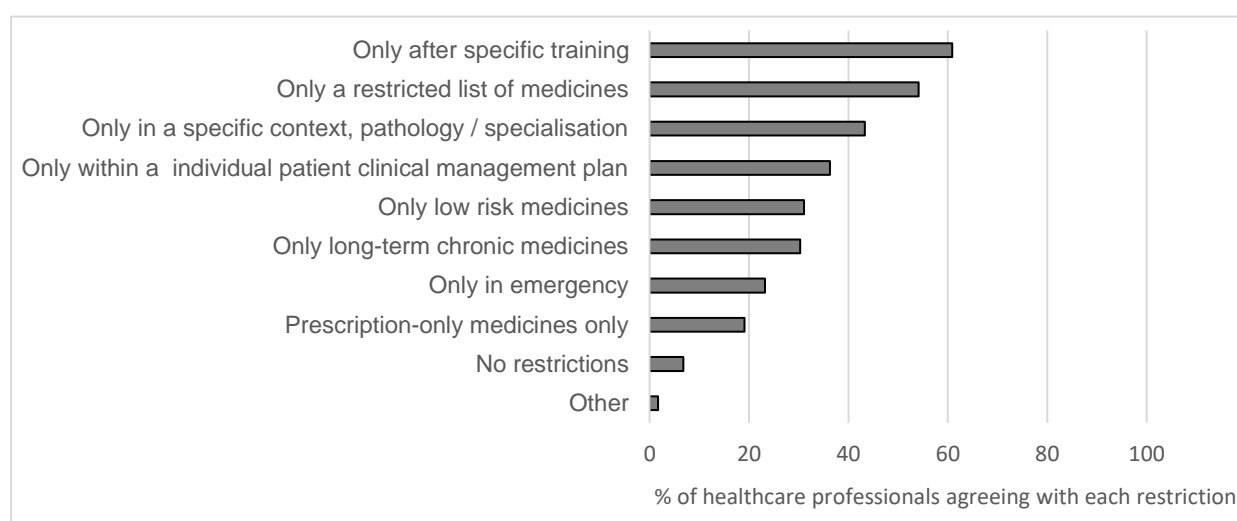


Figure 5.4. Restrictions to optimise nurse prescribing in an ideal interprofessional healthcare situation (n = 537)

3.4. Contextual factors of nurses' role in current interprofessional PC

Twenty potential barriers or enablers of nurses' role in interprofessional PC were presented to the participants. Factors were rated both as barriers and as enablers, median scores ranged from 0 (no influence) to +3 (enabler), and means ranged from -0.2 to +1.9. The highest mean scores were seen for 'quality of nurse education',

‘level of nurse education’, ‘interprofessional education’, and ‘collaborative approach between nurses, physicians and pharmacists’ (respectively 1.9, 1.8, 1.6, and 1.5). Figure 5.5 shows all factors were indicated as barriers or enablers of nurses’ role by at least three quarters of the respondents. Therefore, none of these predefined factors were removed as contextual factors from the NUPHAC-EU framework. Two potential influencing factors were investigated in more detail: the country and nurses’ educational level.

Differences in levels of nurse responsibility between countries

Opinions of healthcare professionals about the level of responsibility that nurses should have in an ideal situation differed between countries ($p < 0.001$ for all PC tasks). In countries reaching the minimum sample size for all questions, ranges of percentages of respondents considering PC tasks to be nursing tasks were 31–96% (Belgium), 52–96% (Czech Republic), 63–97% (Greece), 75–99% (Italy), 10–99% (Slovakia), 49–92% (Slovenia), and 59–94% (Spain). The lowest percentages were seen for seven tasks (tasks 16–22) that were specific to one single responsibility: prescription management (Table 5.4). All percentages of healthcare professionals considering PC tasks to be nursing tasks were increased when ‘prescription management’ was not taken into account (Appendix 5.3), indicating lower levels of responsibility were assigned to tasks within prescription management. Tasks within prescription management were considered to be nurses’ tasks by 31–80% (Belgium), 51–82% (Czech Republic), 63–91% (Greece), 75–93% (Italy), 10–66% (Slovakia), 49–85% (Slovenia), and 59–90% (Spain) (Appendix 5.4).















In Greece and Italy, all 22 PC tasks were considered to be nurses’ tasks by at least 60% of the respondents. In the Czech Republic (three tasks), Spain (one task), Belgium (five tasks), Slovenia (six tasks) and Slovakia (seven tasks), more than 40% of the respondents did not consider a part of the tasks to be nurses’ tasks in order to obtain best quality of care and patient outcomes. The latter tasks were all defined as being part of prescription management only (Table 5.5).

Because no task was indicated as being ‘not allowed for nurses’ by at least 40% of the respondents in each country, no tasks were excluded from the NUPHAC-EU framework after the evaluation.










Figure 5.5. Bar charts for the percentage of respondents considering 20 contextual factors as barriers or enablers of nurse' role in interprofessional pharmaceutical care, supplemented with boxplots for the scores on a 10-point scale from -5 (great barrier) to +5 (great enabler) (n=1005)

Table 5.4. Percentages of healthcare professionals considering 26 tasks in seven^s pharmaceutical care domains as nurses' tasks in order to obtain best quality of care and patient outcomes, split up for 14 countries

	 Belgium (n=622)	 Czech Republic (n=199)	 Germany (n=56)	 Greece (n=193)	 Hungary (n=29)	 Italy (n=595)	 The Netherlands (n=52)	 North Macedonia (n=52)	 Norway (n=72)	 Portugal (n=80)	 Slovakia (n=603)	 Slovenia (n=350)	 Spain (n=295)	 UK (n=118)	p - value
T1	94.7	91.5	89.9	96.3	74.2	96.3	97.5	87.3	98.4	98.8	73.4	91.8	92.2	94.7	<0.001
T2	93.8	94.0	86.2	95.9	75.9	96.6	100	86.5	98.4	98.8	76.5	92.0	91.5	92.5	<0.001
T3	93.4	94.1	90.8	95.2	75.9	98.1	96.9	82.0	100	98.8	93.6	90.9	93.7	93.9	<0.001
T4	90.0	91.4	94.6	95.9		97.3	98.0	79.3	100	98.6	88.6	90.3	91.8	96.1	<0.001
T5	82.8	89.2	92.7	95.4		96.2	84.2	70.5	100	98.6	88.7	87.6	89.1	92.2	<0.001
T6	86.3	90.3	92.1	96.9		94.1	96.4	88.1	100	97.5	96.0	88.0	90.3	94.9	<0.001
T7	80.7	88.9	87.5	95.0	75.0	95.1	96.2	77.9	94.5	97.4	92.5	86.5	90.3	94.5	<0.001
T8	66.9	90.9	65.0	86.3		91.4	88.9	60.2	89.1	94.9	81.4	84.5	81.9	88.4	<0.001
T9	89.1	93.4	85.9	91.9	67.9	96.4	97.0	85.7	100	98.8	93.4	89.1	89.6	97.3	<0.001
T10	96.1	90.9		97.9		98.5					96.6	89.2	94.1		<0.001
T11	95.6	94.7	96.6	91.5		97.6	96.8	78.9	100	100	98.6	89.5	91.6	90.7	<0.001
T12	72.6	87.7	58.5	92.3		94.5	89.8	68.4	90.9	98.8	84.9	86.0	85.2	89.8	<0.001
T13	74.8	87.1	87.5	91.7		95.8	96.9	79.3	98.3	98.8	62.5	82.7	82.8	80.0	<0.001
T14	93.1	95.9	98.0	96.6	76.9	97.2	100	93.4	100	100	92.8	88.1	93.2	96.0	<0.001
T15	83.4	89.4	88.7	95.5	75.0	93.5	98.4	79.5	100	98.7	90.7	85.4	87.2	88.6	<0.001
T16	30.7	53.3		72.1		78.0					11.1	51.4	65.6		<0.001
T17	37.7	55.8		68.9		77.1					12.5	51.4	65.1		<0.001
T18	39.7	52.3		66.7		76.6					11.1	52.1	58.7		<0.001
T19	39.4	60.5		62.8		75.4					10.2	50.0	66.7		<0.001
T20	79.0	61.1		76.2		79.8					14.0	49.3	67.7		<0.001
T21	75.4	75.7		76.2		82.0					21.5	53.4	75.0		<0.001
T22	56.6	61.5		67.4		77.3					13.3	76.3	82.1		<0.001
T23	84.4	79.5	71.4	93.0		94.8			77.8	95.2	60.7	86.1	88.9	93.0	<0.001
T24	81.6	80.0		97.6		94.2					88.3	78.8	82.8		<0.001
T25	83.9	90.3	88.7	93.4		95.0	98.0	83.9	98.3	100	86.3	87.3	90.2	94.9	<0.001
T26	87.7	88.6	91.4	94.8	75.0	92.6	96.1	80.0	100	98.7	86.9	87.1	87.8	95.1	<0.001

Overview of tasks (T1, T2, ...T26): see table 1.^s 7 domains: 1) therapeutic and adverse effects of medicines; 2) medicines adherence; 3) patient medication self-management; 4) patient education and information; 5) prescription management; 6) medication safety; 7) care coordination. The colours indicate the level of responsibility that was most prevalent for each task (=mode) per country: green = full autonomy; yellow = shared responsibility; orange = under supervision; red = not allowed. Blank cells: no percentage presented because of insufficient valid responses for this task in this country (n<28). p calculated with Kruskal-Wallis test for the difference in level of responsibility between countries. Only countries with ≥28 responses were taken into account. * n = mean number of valid responses. Numbers differ from respondents per country since tasks were part of several PC domains and hence shown multiple times.

Table 5.5. Presentation of 26 tasks within seven^{\$} pharmaceutical care domains considered as nurses' tasks in order to obtain best quality of care and patient outcomes, by at least 60% of the respondents, split up for 7 countries

	 Belgium (n=622*)	 Czech Republic (n=199*)	 Greece (n=193*)	 Italy (n=595*)	 Slovakia (n=603*)	 Slovenia (n=350*)	 Spain (n=295*)	p-value
T1	94.7	91.5	96.3	96.3	73.4	91.8	92.2	<0.001
T2	93.8	94.0	95.9	96.6	76.5	92.0	91.5	<0.001
T3	93.4	94.1	95.2	98.1	93.6	90.9	93.7	<0.001
T4	90.0	91.4	95.9	97.3	88.6	90.3	91.8	<0.001
T5	82.8	89.2	95.4	96.2	88.7	87.6	89.1	<0.001
T6	86.3	90.3	96.9	94.1	96.0	88.0	90.3	<0.001
T7	80.7	88.9	95.0	95.1	92.5	86.5	90.3	<0.001
T8	66.9	90.9	86.3	91.4	81.4	84.5	81.9	<0.001
T9	89.1	93.4	91.9	96.4	93.4	89.1	89.6	<0.001
T10	96.1	90.9	97.9	98.5	96.6	89.2	94.1	<0.001
T11	95.6	94.7	91.5	97.6	98.6	89.5	91.6	<0.001
T12	72.6	87.7	92.3	94.5	84.9	86.0	85.2	<0.001
T13	74.8	87.1	91.7	95.8	62.5	82.7	82.8	<0.001
T14	93.1	95.9	96.6	97.2	92.8	88.1	93.2	<0.001
T15	83.4	89.4	95.5	93.5	90.7	85.4	87.2	<0.001
T16	30.7	53.3	72.1	78.0	11.1	51.4	65.6	<0.001
T17	37.7	55.8	68.9	77.1	12.5	51.4	65.1	<0.001
T18	39.7	52.3	66.7	76.6	11.1	52.1	58.7	<0.001
T19	39.4	60.5	62.8	75.4	10.2	50.0	66.7	<0.001
T20	79.0	61.1	76.2	79.8	14.0	49.3	67.7	<0.001
T21	75.4	75.7	76.2	82.0	21.5	53.4	75.0	<0.001
T22	56.6	61.5	67.4	77.3	13.3	76.3	82.1	<0.001
T23	84.4	79.5	93.0	94.8	60.7	86.1	88.9	<0.001
T24	81.6	80.0	97.6	94.2	88.3	78.8	82.8	<0.001
T25	83.9	90.3	93.4	95.0	86.3	87.3	90.2	<0.001
T26	87.7	88.6	94.8	92.6	86.9	87.1	87.8	<0.001

Overview of tasks (T1... T26) and seven^{\$} pharmaceutical care domains: see table 1. Green cells indicate the task was considered as nurses' task by $\geq 60\%$ of respondents (exact % in cells); red cells indicate the task was not considered as nurses' task by $>40\%$ of respondents (exact % in cells); p calculated with Chi² tests for the difference in opinion (whether or not nurses' task) between countries. *n = mean number of valid responses. Numbers differ from respondents per country since tasks were part of several PC domains and hence shown multiple times.

Levels of nurse responsibility for European nurses of different educational levels

Slightly more than half of the respondents indicated that they were able to make a distinction between nurse responsibilities based on nurses' educational level (53%), where significantly more nurses (62%) were able to distinguish this item compared to physicians (35%) and pharmacists (28%) ($p < 0.001$).

Within this subsample of healthcare professionals, being able to differentiate between levels of nurse education, most respondents indicated that all PC tasks within all PC domains could be performed by nurses of all educational levels. Between 80% and 100% of the respondents considered that PC tasks could be performed by level 5 nurses. These percentages increased for level 6 nurses (89–100%), level 7 nurses (96–100%) and level 8 nurses (98–100%).

Most tasks were considered to be able to be performed fully autonomously by level 8 nurses, and preferably with shared responsibility by level 5, 6, 7 nurses. Detailed percentages of the level of autonomy per task, per PC domain and per level of nurse education are presented in Supplementary Table S1 (available in online article) and Appendix 5.5.

4. Discussion

A framework for nurses' role aiming for the best quality of interprofessional PC and patient outcomes in an ideal healthcare situation was developed. This NUPHAC-EU framework consists of the patient and his personal and professional network, seven PC domains, and 26 tasks within these domains. These tasks could be performed by nurses with varying levels of autonomy, depending on a range of contextual factors. The majority of the healthcare professionals would consider nurses responsible for tasks within six of the seven domains proposed. Within the domain of prescription management, more respondents were reluctant to allow nurses to take up responsibilities. Overall, physicians, pharmacists and nurses considered a shared responsibility level to be the most appropriate level of autonomy for nurses in PC.

When interpreting the results of this study, it is of major importance to recognize that more than half of the participants were nurses. The comparisons between professional groups showed nurses entrusted with higher levels of responsibility to

perform PC tasks. This might have distorted our results in favour of nurses' more positive opinions regarding their own roles and their opinion about the most appropriate level of autonomy in PC. Despite the higher representation of nurses in this sample, we are convinced of the great value of the NUPHAC-EU framework, which aimed to offer healthcare professionals a discussion tool in a wide range of interprofessional PC situations. The level of nurse responsibility for a certain task in a certain healthcare situation can be different between and within countries, depending on the contextual factors. Because of this, no tasks were removed from the framework, even though they were considered to be irrelevant by the majority of professionals in one or more countries. After all, in other countries with other contexts, the same tasks did meet all prerequisites to be allowed for nurses. This underlines the importance of interpreting the framework as a whole, when openly discussing the allocation of specific (shared) responsibilities and tasks.

Most of the comparisons between the opinions of pharmacists, physicians and nurses showed fewer pharmacists would consider nurses taking up responsibilities in PC. This was also seen in the EUPRON study, where the perceived quality of nurses' competences in PC was rated the lowest by pharmacists, and hence they were less convinced of the positive impact of nurse involvement on PC.³³ Compared to daily collaborations between physicians and nurses, contacts between pharmacists and nurses in healthcare settings are less frequent or even rare.^{47–49} This lack of familiarity between pharmacists and nurses might explain the higher percentages of pharmacists considering PC tasks not to be suitable for nurses. After all, it is more difficult to understand another professional's role, when not working directly together with them. Additionally, the fact that PC was described by pharmacists as a pharmacist-only responsibility for decades may have negatively influenced pharmacists' opinions in this study, explicitly defining the role of nurses in PC.^{8,9} It should be stressed that the development of a model for nurses' role in PC is in no way an intention to take away responsibilities from other professional groups. In contrast, the NUPHAC-EU model is meant to enable interprofessional collaboration by means of greater role transparency, which has been demonstrated to positively effect care quality and patient outcomes.^{50–55}

Aiken et al. (2003) showed that educational differences in nurses are related to patient outcomes. Surgical patients experienced lower mortality and failure-to-

rescue rates in hospitals with higher proportions of nurses educated at the baccalaureate level (=level 6 of EQF) or higher. They suggested that recruiting and retaining bachelor degree nurses could lead to substantial improvements in quality of care.⁵⁶ These results can be extended to the opinions about nurses' responsibilities in our sample of healthcare professionals. As the level of nurse education increased, more professionals considered PC tasks to be nursing tasks with higher levels of autonomy. Our results, however, cannot be generalised to the opinions of all professional groups, since fewer physicians and pharmacists were able to make a distinction between responsibilities based on nurse educational levels. As already discussed, this might have biased our results.

For tasks within prescription management, more hesitancy regarding nurse involvement was seen. This is not a surprising result, given these nursing tasks were traditionally associated with the medical profession only.⁵⁷ However, this situation has been changing in recent decades, with an increasing number of countries legally allowing nurses to prescribe certain medications, either dependently or independently.⁵⁸ Despite this relatively recent task shifting between physicians and nurses, studies showed the benefits of nurses taking part in prescription management. Nurse prescribing can improve patient outcomes, such as blood pressure,^{59,60} cholesterol levels,⁶¹ HbA1C levels,^{60,62} medication adherence,^{63,64} and patients' quality of life⁶⁵. Nurse prescribing can also enhance patient safety and satisfaction.^{62,63} and improve care continuity.⁶³ Next to better patient outcomes, increased job satisfaction for nurses^{64,66} and higher cost-effectiveness of healthcare services because of reduced inappropriate service use^{66,67} are also linked to nurse prescribing. We therefore call for a more accepting attitude from healthcare professionals towards nurses prescribing medicines within certain boundaries.

4.1. Implications for clinical practice, research, education, and policy

Nurses, as key personnel in healthcare delivery, play a critical role in patient care, and more specifically, in PC. To establish appropriate interprofessional relationships, it is necessary to provide a framework that allows the building of trust, co-operation and communication.⁶⁸ Our NUPHAC-EU framework will increase the awareness of nurses' (potential) roles, which will allow pharmacists, nurses and physicians to benefit from teamwork.¹⁸ In further research, expert consensus should

be sought regarding necessary PC knowledge, skills, and attitudes for nurses. An overview of nurse competencies based on the NUPHAC-EU framework will enable the development of an assessment to evaluate nurse competences in PC, as guidance for evaluating nurse education, and as a tool for nurse educators. The assessment could also be a tool in the strategy of lifelong learning among nurses in clinical practice.

Currently, the training of healthcare professionals remains largely a single discipline, which may reduce the ability to collaborate interprofessionally.⁶⁹ Therefore, more interprofessional education should be organized, as well as rigorous research on interprofessional PC to tackle the remaining barriers. The enablers and barriers presented in the NUPHAC-EU framework can help policy makers and nurse managers to gain insights into the prerequisites for nurses' role in PC. This can support them in developing workforce planning policies and creating adapted contexts for more barrier-free nurse labour mobility, taking into account feasibility, cost-effectiveness, care quality and patient outcomes. After all, the international mobility of nurses is an increasing phenomenon in the EU, as well as worldwide, and several advantages have been described: balanced supply and demand for the health workforce; foreign-trained health professionals can fill service gaps and nurse shortages; increased cultural diversity; decreased average age to keep salary levels in check; and sending remittances to the less wealthy home countries.^{70,71}

4.2. Strengths and limitations of the study

This study has significant strengths. The NUPHAC-EU framework was developed based on the results of two large-scale quantitative and qualitative studies and a scoping review of the literature, followed by a stakeholders' evaluation. This resulted in a framework adapted to the needs of clinical practice, with insights into the preferences of the interprofessional team in which nurses collaborate on a daily basis. The framework offers opportunities for discussion in clinical practice, collaboration in research, nurse education and labour mobility of nurses and nursing students. To our knowledge, never before have nurses' responsibilities in 26 PC-related tasks been distinguished between four EQF levels.

Despite the limited number of participants at the national level in some countries, the overall sample size was satisfactory and provided interesting insights into the extent to which European healthcare professionals consider PC-related tasks to be nurses' responsibility in an ideal healthcare situation with the best quality of interprofessional care and patient outcomes.

This internet survey had limitations. The inclusion or exclusion of countries and respondents was determined by whether they were included in the overarching Erasmus + project. Additionally, this self-selected sample with an unknown response rate might have led to a distortion of the results due to only the most motivated professionals participating. The enormous workload of healthcare professionals at the time of the COVID-19 pandemic forced many clinicians to neglect activities such as completing scientific surveys. The sample also favoured more educated, computer-literate professionals, because of the Internet recruitment. In seven countries, i.e., Germany, Hungary, The Netherlands, the Republic of North Macedonia, Norway, Portugal and the UK, there were low response rates. Therefore, our findings may not be as applicable in these parts of Europe. Finally, as with all self-reports, we cannot discount acquiescence response bias.⁷² The views of 1385 professionals are important, yet we have to assume that some might have been biased by socially desirable responding.

5. Conclusions

This study aimed to evaluate to what extent physicians, pharmacists and nurses from 14 European countries considered PC-related tasks beyond preparation and administration of medicines to be nurses' responsibility in an ideal healthcare situation with the best quality of interprofessional care and patient outcomes. The developed NUPHAC-EU framework consisted of the patient and his personal and professional network, seven PC domains, and 26 tasks within these domains, which could be performed by nurses with varying levels of autonomy, depending on a range of contextual factors. The majority of healthcare professionals would consider nurses to be responsible for tasks within six of the seven domains proposed. Within the domain of prescription management, more respondents were reluctant to allow nurses to take up responsibilities. Overall, physicians, pharmacists and nurses

considered a shared responsibility level as the most appropriate level of autonomy for nurses in PC.

This framework enables healthcare professionals to openly discuss allocation of specific (shared) responsibilities and tasks.

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Ethical approval

This study was conducted according to the guidelines of the Declaration of Helsinki. Researchers from the University of Antwerp (Belgium) received overall approval from the Ethics Committee for Social Sciences and Humanities (reference SHW_19_30). Depending on local regulations in some countries additional approval was obtained: the Nursing School of Coimbra (Portugal) received approval from the Ethics Committee of the Nursing Sciences Research Unit (reference P640_01-2020), the Slovak Medical University from the Ethics Committee of the Slovak Medical University (reference 10/2019), the University of Primorska from the National Medical Ethics Committee of the Republic of Slovenia (Reference 0120-516/2018/6; 21 January 2019), Bournemouth University from HRA in England (IRAS project number 239960), institutional approval in England and approval from the participating NHS healthcare trusts in England, Swansea University from the College of Human and Health Sciences (CHHS) Ethics Committee in Wales (reference 190120), and letters of 'no objection' from the UHBs in Wales. National regulations and laws applying to the other countries did not require additional permits or approvals.

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Chapter 6

Developing a competence framework for nurses in pharmaceutical care: A Delphi study

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Abstract

Background

Nurses play an important role in PC. They are involved in: detecting clinical change; communicating/discussing pharmacotherapy with patients, their advocates, and other healthcare professionals; proposing and implementing medication-related interventions; and ensuring follow-up of patients and medication regimens. To date, a framework of nurses' competences on knowledge, skills, and attitudes as to interprofessional PC tasks is missing.

Objectives

To reach agreement with experts about nurses' competences for tasks in interprofessional PC.

Methods

A two-phase study starting with a scoping review followed by five Delphi rounds was performed. Competences extracted from the literature were assessed on relevance by an expert panel, using the RAND/UCLA method. The experts (n = 22) involved were healthcare professionals, nurse researchers, and educators from 14 European countries with a specific interest in nurses' roles in interprofessional PC. Descriptive statistics supported the data analysis.

Results

The expert panel reached consensus on the relevance of 60 competences for 22 nursing tasks. Forty-one competences were related to 15 generic nursing tasks and 33 competences were related to seven specific nursing tasks.

1. Background

Nurses are healthcare professionals who play an important role in interprofessional pharmaceutical care (PC). PC has been defined by Hepler and Strand as 'the responsible provision of drug therapy for the purpose of achieving definite outcomes that improve a patient's quality of life'.¹ (Hepler and Strand, 1989). The focus on interprofessional communication and collaboration by nurses, pharmacists, pharmacy (technicians), and physicians has been acknowledged as key to optimising this aspect of care.^{2,3} In Europe, these healthcare professionals manage several tasks such as prescribing, dispensing, delivering, administering medication, providing patient education, and monitoring and evaluating the effectiveness and efficacy of the medicine, sometimes with distinct and sometimes with overlapping roles.⁴⁻⁷ In other words, within PC, multiple professions have responsibilities; however, within this study the focus will be on nurses. In order to emphasize that PC is a responsibility of several professions, and to avoid ignoring other professions beyond nursing, the term 'nurses' roles in interprofessional PC' is used hereafter. Nurses' roles in interprofessional PC has been studied previously. De Baetselier et al. (2020) divided nurses' roles into distinct responsibilities such as: providing patient education and information, monitoring medication adherence, adverse and therapeutic effects; and prescribing medicines.⁸ Nurses' roles in PC are expected to contribute to improved medication use and patient outcomes.⁹⁻¹¹ In Europe, nurses' responsibilities depend on their educational level and national policies. In order to undertake interprofessional PC, nurses must be well educated. Education is an ongoing process focused on competence development, starting during nurse education and continuing in practice settings. A competence can be defined as 'a coherent cluster of knowledge, skills, and attitudes which can be utilized in real performance contexts'.¹² Today, in Europe, a distinct and clear framework of nurse competences related to tasks in interprofessional PC is missing. This hinders adequate education and labour mobility of nurses in Europe, which could impact quality of care. In our study, a competence framework for nurses' competences in tasks in interprofessional PC will be developed. This study is part of the European DeMoPhaC project (Development of a Model for nurses' roles in interprofessional Pharmaceutical Care), an international collaboration to investigate nurses' roles in 14 countries. The framework (Nurse and Pharmaceutical Care –

European Union [NuPhaC-EU] framework) with nurses' roles in interprofessional PC is in development. The framework shows the ideal nursing roles and creates the opportunity to translate them into nurse education curricula. Accordingly, a competence framework is needed to focus on the expected roles and establish competence-oriented educational programs, fitted to the expectations of the labour market.

The aim of this study is to reach agreement with experts about nurses' competences for tasks in interprofessional PC.

2. Methods

2.1. Design

A two-phase study was performed to develop the competence framework, consisting of (1) searching for and creating an overview of relevant nurse competences regarding interprofessional PC by a scoping review and (2) a Delphi study consisting of five rounds with experts to reach agreement about nurses' competences (as developed in phase 1) for tasks in interprofessional PC by using the RAND/UCLA Appropriateness Method (RAM).¹³⁻¹⁵ The steps are illustrated in Figure 6.1 and are explained below.

2.2. The competence framework

In the competence framework, nurses' competences were assigned to nurses' tasks relating to their responsibilities in interprofessional PC as described in the NuPhaC-EU framework. The framework indicates seven responsibilities for nurses in PC (beyond preparation and administration of prescribed medicines) including: 1) management of therapeutic and adverse effects of medicines, 2) management of medication adherence, 3) management of medication self-management, 4) management of patient education and information, 5) prescription management, 6) patient safety management, and 7) (transitional) care coordination. For each of the responsibilities, several tasks were formulated, including for example: detecting clinical change, healthcare problems or assessing patient needs; communicating/discussing with patients and/or patient advocates; intervention in emergencies; inter-disciplinary communication; ensuring follow-up of patients in

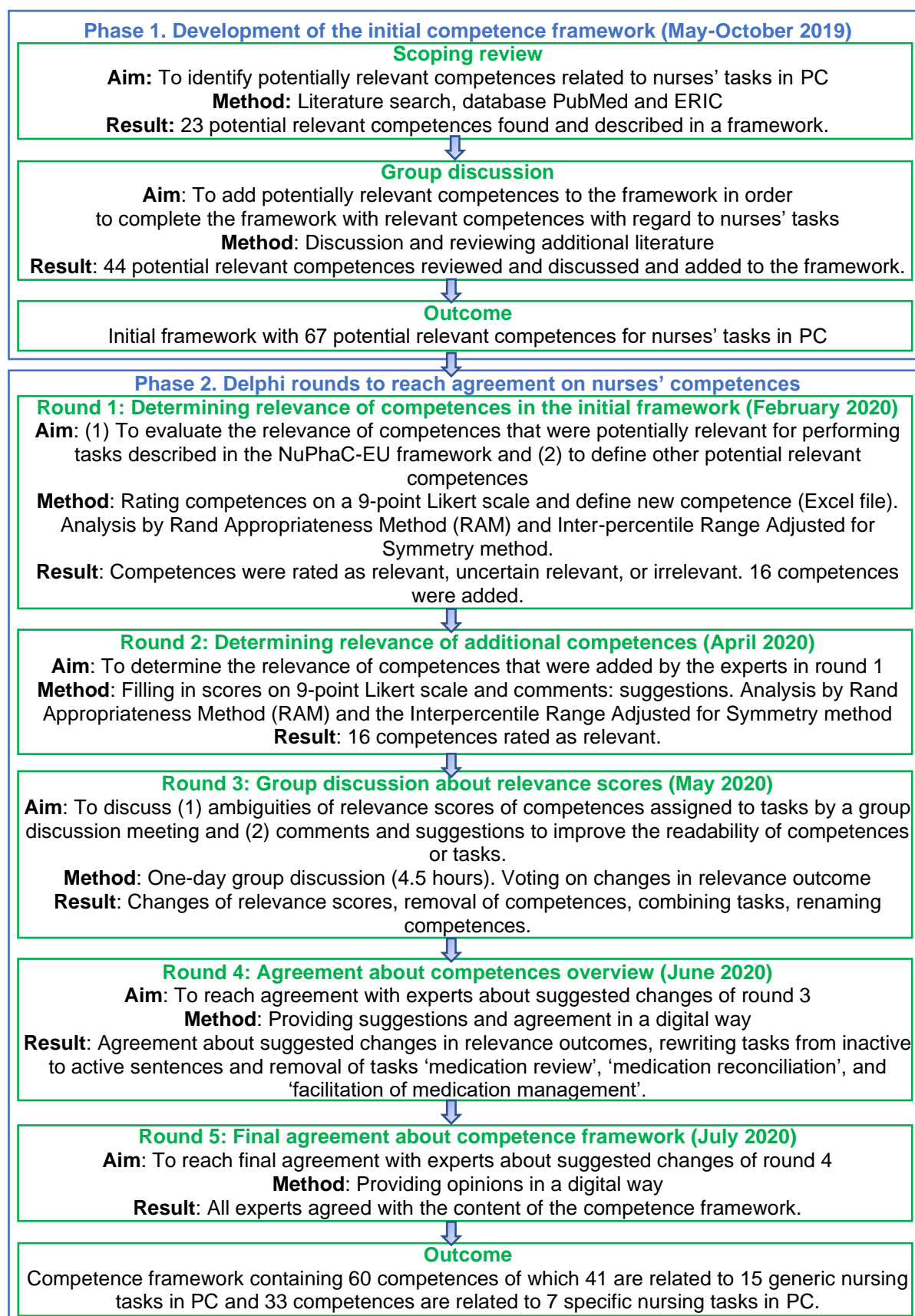


Figure 6.1. Study design of the development of competence framework for nurses in interprofessional pharmaceutical care (PC).

relation to their medication regimens; and (in)dependent or supplementary nurse prescribing.⁸ No competences regarding preparation and administration of prescribed medicines were included in the competence framework, since the NuPhaC-EU framework focuses on advanced roles in interprofessional PC. Competences were not linked to educational levels. Today, not all nurse educational levels are available in all countries and assignment of tasks to certain levels may not be comparable. Therefore, it was impossible to make a distinction in competences required by each education level.

2.3. Phase one: scoping review

A scoping review was performed to identify competences (May–October 2019). This review was guided by the methodological framework for scoping studies.¹⁶ Competences were identified through searching the relevant literature in the databases PubMed and Education Resources Information Center (ERIC). A mix of Medical Subject Headings (MeSH-terms) and free text terms of the following key concepts was used for the search strategy: education, training, nursing, nurses, (professional/clinical) competence, responsibility, knowledge, skill, attitude, collaboration, cooperation, treatment adherence/compliance, pharmacotherapeutic, drug (prescription), medication, adherence, safety, process, and management (Appendix 6.1). Article types included were: (systematic) reviews, longitudinal studies, randomized controlled trials and cohort studies. Studies were selected if published between 2000 and 2020 and written in Dutch or English. Articles were first screened by title and abstract for relevance, followed by reading the full text by three researchers (ND, CS, JV) independently. Afterwards the researchers discussed the title and abstract of the non-selected articles. If the title and abstract contained potential relevant key words about nurses' competences, the article was included. In addition, key journals were hand searched. The researchers read one third of the selected articles each.

The search identified 396 articles. After title and abstract screening, 312 were removed, since they contained no references to nursing competences. In total, 84 articles met the criteria for full paper review. After reading the full text, another 16 articles were excluded. In the remaining 68 articles, a total of 23 competences,

beyond preparation and administration of prescribed medicines, were found (Appendix 6.2).

The selection process and results are reported in a flow diagram according to the PRISMA reporting guidelines (Figure 6.2).¹⁷

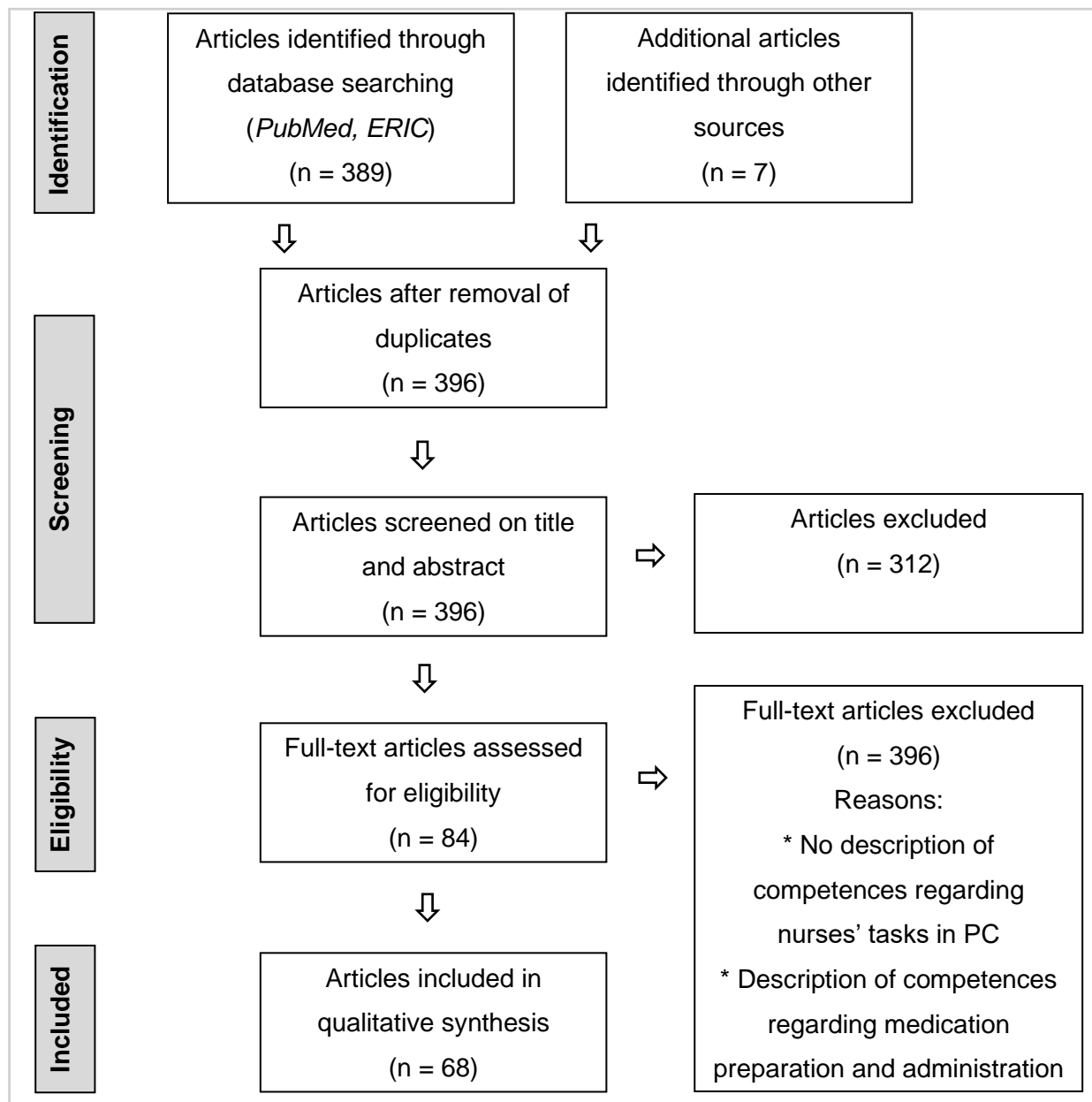


Figure 6.2. Flow diagram of selection process of scoping review on nurses' competences for interprofessional pharmaceutical care.

Competences were extracted from the articles and were categorised as knowledge, skill, or attitude (Appendix 6.2). Subsequently, the researchers (ND, CS) and an education specialist (BV) held a discussion about the completeness of the competences. The literature seemed to be limited to competences for all tasks in the NuPhaC-EU framework and the framework was too limited to start the Delphi study. Therefore, 44 expected relevant competences based on nursing competence related literature were added (Appendix 6.3).¹⁸⁻²¹ Subsequently, the researchers (ND, CS, BV) assigned the competences to tasks in the NuPhaC-EU framework and reported them in an Excel file, which was the basis of the competence framework used for the Delphi study (see online article). In the framework, tasks in the NuPhaC-EU framework, together with related competences, were described. For each task, respondents marked whether or not the competence was expected to be relevant (green coloured cells indicated potentially relevant, according to the literature, and red that the competence was potentially irrelevant). In the Delphi rounds the relevancy of all coloured cells was discussed.

2.4. Phase two: Delphi study

Expert panel

In this Delphi study the 20 nurse leaders of the 14 participating countries of the DeMoPhaC project (Belgium, Czech Republic, Germany, Greece, Hungary, Italy, North-Macedonia, the Netherlands, Norway Portugal, Slovenia, Slovakia, Spain, and United Kingdom [Wales]) could participate. The nurse leader could decide to participate or to ask one representative peer (with the same expertise). It was anticipated that about 20 professionals with a position in nurse education (for example as a teacher) and/or in clinical practice would constitute a representative group. All experts had participated in previous DeMoPhaC project studies. Because of the likely homogeneity of the professionals, a sample size of 15–30 respondents per panel was considered sufficient for the study's aim.²² Two nurse leaders opted for collaboration with a peer. They discussed this with the coordinators of the study (NED, EDB, TD, BVR, and CS), who agreed because the proposed peers met the inclusion criteria (expertise) of a panel member.

Experts were informed via an information letter and consented to participate before the start of the first Delphi round.

The Delphi study consisted of different phases of data collection and data analysis following an iterative process.²³ In total, five Delphi rounds were performed to reach consensus with experts on the relevant competences for nurses in interprofessional PC.

All documents and discussions in the Delphi rounds were held in English. Rounds one, two, four, and five were performed by completing an Excel file, while round three involved an online group discussion. When more than one expert participated in a country, one jointly completed Excel file was used.

This Delphi study was a modified version of a classic Delphi study.^{23,24} More specifically, a face-to-face meeting with the experts was planned besides the sequential rounds with the Excel files. This was done to obtain experts' opinions on the relevance of competences, to discuss scores, to investigate areas of disagreement, and to gain more in-depth insights from the experts.

Round one: determining relevance of competences in the initial framework

The aim of the first round was to: (1) evaluate the relevance of competences defined in the first phase of this study and (2) to define other potentially relevant competences, followed by assigning them to tasks (February 2020). For this round, an Excel file with the content of phase one was presented to the experts (see online article). The experts were asked to determine relevance for each competence on a 9-point Likert scale (1 = strongly disagree, 9 = strongly agree) as described in the RAND/UCLA Appropriateness Method.¹³⁻¹⁵ Additionally, the experts were asked which knowledge, skill, and/or attitude was missing in the framework and should be considered in the next Delphi round. The Excel file also contained background information about the study objective, user instructions, and questions regarding demographic characteristics (i.e. age, gender, country, and professional status).

Results were analysed using the RAM and the Inter-percentile Range Adjusted for Symmetry method. First, for each outcome (score of 1–9 of each competence linked to a task) a group median was calculated to determine the degree of relevance. The disagreement index (DI) was calculated to determine the level of agreement. As described in the RAM, the DI is the ratio between the Inter-percentile Range (IPR) and the IPR Adjusted for Symmetry, which has been calculated following the equation in Appendix 6.4.¹³ A DI <1 indicates agreement, with a score

closer to zero indicating a stronger agreement. A median of 1–3 with agreement ($DI < 1$) indicates that the competence is not relevant, a group median of 4–6 with agreement ($DI < 1$) and medians with disagreement ($DI \geq 1$) indicate that the relevance of the competence is uncertain, and any median of 7–9 with agreement ($DI < 1$) indicates that the competence is relevant.¹³

Competences that were rated as relevant, were included in the final framework. Scores were analysed using SPSS version 25 (IBM Corporation, Armonk, NY, USA). Competences rated as relevant were presented with a green coloured cell in the competence framework, competences rated as irrelevant were presented with a red coloured cell, and competences rated as uncertain were presented with an orange colour to be discussed in round three. Descriptive analysis was performed to analyse demographic characteristics.

Round two: determining relevance of additional competences

The second round started from the results of the first round, aiming to determine the relevance of competences that were added by the experts. Experts received an Excel file with the results of round one and the added competences. For each of the competences the same Likert-scale for relevance was used as in round one (April 2020). In addition, the experts had the opportunity to provide suggestions to improve the readability of the competence framework, such as resolving confusion in the wording. The analysis was as in round one. This resulted in an Excel file with one worksheet containing all competences assigned to tasks. For each competence the colour of the cell indicated the relevance score (green = relevant, orange = uncertainly relevant, and red = irrelevant).

Round three: group discussion about relevance scores

The results of the second round showed that a group discussion was desirable to address ambiguous interpretations of competences or tasks. During the third round, preliminary results and discrepancies were presented to discuss (1) ambiguities in relevance scores, (2) to discuss competences with missing relevance scores, and (3) comments and suggestions to improve the readability of competences or tasks.

A one-day group discussion in which experts should physically meet was proposed, however, due to COVID-19 pandemic (May 2020), a digital group discussion of 4.5 h was chosen. Before the meeting, the experts received the relevance outcomes of round one and two. They were asked to prepare questions on any ambiguities before the discussion. During the online meeting, experts had the opportunity to discuss individual views on ambiguities orally or through a chat function. The discussion for each competence ended in a voting round to determine if the relevance score needed to be changed or not. Researcher ND functioned as the chair of the meeting and TD functioned as a moderator. The group discussion was video recorded and in addition notes were taken. Notes and the video record were used to analyse the discussions and adjust relevance as discussed. Some suggested changes were related to multiple competences assigned to a certain task (e.g. motivational interviewing). Based on the discussion, all other scores were reviewed once more by the researchers (ND; CS) to find potentially ambiguous scores and to suggest any changes in scores or wording of competences, with explanations. The group discussion was also meant to discuss suggested changes to improve the readability of the framework. However, because of shortage of time, comments and suggestions of three experts (round 2) for improvement of readability could not be discussed, resulting in email responses concerning the improvements.

Round four: agreement about competence overview

The fourth round (June 2020) aimed to reach agreement concerning changes the experts had disagreed in the previous Delphi round. The experts received the Excel file that was created after the analysis of round three. The experts could indicate any disagreements and their reasons in a comment field for each cell.

Round five: final agreement about competence framework

The fifth round (July 2020) aimed to reach final agreement with experts about suggested changes of round four. The experts were asked to indicate whether they agreed on the changes of round four (yes or no).

3. Results

3.1. Demographic characteristics

Demographic characteristics of the experts are presented in Table 6.1. In total, the same 22 experts participated in all rounds of the Delphi study except for round three, in which 18 experts participated (4 had other commitments that day).

Table 6.1. General characteristics of the experts (n = 22).

	n (%)
Gender, female	15 (68)
Age (years), median (IQR)	46 (41-56)
Country	
Belgium	3
Czech Republic	1
Germany	1
Greece	2
Hungary	1
Italy	2
North-Macedonia	1
The Netherlands	1
Norway	2
Portugal	1
Slovakia	2
Slovenia	2
Spain	2
United Kingdom (Wales)	1
Professional status ^a	
Working in clinical practice	
Nurse	5 (23)
Medical doctor	3 (14)
Researcher (PhD student, post-doc, [assistant] professor)	21 (96)
Working in nurse educational program	
Teacher	12 (55)
Director	3 (14)

IQR = Interquartile range

^aParticipants could indicate more than one professional status.

3.2. Round one: determine relevance of competences of the initial framework

The relevance outcomes (the median scores and the disagreement index scores) of competences and the additionally formulated competences are presented in a spreadsheet, available in the online article. In total, 16 competences were added and assigned to tasks.

3.3. Round two: determine relevance of additional competences

In the second round, the 16 added competences of the first round were rated as relevant (spreadsheet available in online article). Three experts gave comments and suggestions to improve readability of competences and/or tasks.

3.4. Round three: group discussion about relevance scores

The discussion resulted in voting rounds in which experts voted unanimously if relevance outcomes of several competences needed to be changed (from relevant to irrelevant or vice versa) and if competences with missing relevance scores should be considered as relevant or irrelevant. Furthermore, 22 tasks were divided into 7 specific nursing tasks and 15 general nursing tasks in interprofessional PC, three tasks were combined into one and renamed, one task was split up in two tasks, seven times two or more competences were combined, 18 competences were renamed, and five duplications of competences were checked and removed. The changes of this Delphi round are presented in Appendix 6.5.

3.5. Round four: agreement about competence overview

In the fourth round, the experts indicated whether they agreed or not with the suggested changes that resulted from round three. Six outcomes were changed (from relevant to irrelevant or vice versa) in the specific nursing tasks and five were changed in the general nursing tasks. Also, tasks were reformulated from passive to active voice sentences and three tasks were removed (i.e. 'medication review', 'medication reconciliation', and 'facilitation of medication management'). These tasks were removed because they were considered as processes containing several tasks, which were already included in the framework. Three competences that were related to these tasks only, were removed and another 15 competences were renamed. The changes of round four are presented in Appendix 6.6.

3.6. Round five: final agreement about competence framework

All experts agreed with the content of the competence framework, containing a total of 60 competences. Forty-one of the 60 competences were related to 15

[illegible]

Table 6.2a. (continued) Competence framework: generic nursing tasks and related competences

Generic nursing tasks related to interprofessional pharmaceutical care																
Discharge planning																
Intervening in emergency																
Motivational interviewing																
Advising patients and/or other healthcare professionals																
Ensuring transitional care communication, inter/ intraprofessional communication																
Collegial mentoring																
Ensuring inter/ intraprofessional referrals																
Ensuring follow-up																
Applying evidence based practice																
Communicating/ discussing with patients																
Decision making																
Assessing patients' competences																
Assessing, addressing patients' needs																
Documenting																
Observing																
<div> <div>Relevant</div> <div>Uncertain relevant</div> <div>Not relevant</div> </div> <div> SKILLS, the nurse... Is able to observe and recognize therapeutic effects and drug-related problems Is able to observe patients' level of competences Is able to observe patients' level of competences Is able to communicate and discuss drug-related problems, referrals, changes in the medication therapy to patients/patient advocates/healthcare professionals clearly Is able to recognize the needs and preferences in self-care of the patient and/or patient advocates Is able to empower and involve the patient and/or patient advocates Is able to act according to patients' level of competences Is able to delegate medication tasks to patients/patient advocates/healthcare professionals Is able to supervise colleagues and to provide ongoing feedback and is able to accept feedback from colleagues Is able to promote critical self-reflection Is able to apply clinical reasoning Is able to apply shared-decision making Is able to apply motivational interviewing techniques Is able to recognize the level of emergency Is able to document observations and potential risks Is able to function effectively taking into account the different cultural backgrounds to work appropriately with patients (advocates) and healthcare providers from different cultural backgrounds </div>																

Table 6.2a. (continued) Competence framework: generic nursing tasks and related competences

Generic nursing tasks related to interprofessional pharmaceutical care							
Discharge planning							
Intervening in emergency							
Motivational interviewing							
Advising patients and/or other healthcare professionals							
Ensuring transitional care communication, inter/ intraprofessional communication							
Collegial mentoring							
Ensuring inter/ intraprofessional referrals							
Ensuring follow-up							
Applying evidence based practice							
Communicating/ discussing with patients							
Decision making							
Assessing patients' competences							
Assessing, addressing patients' needs							
Documenting							
Observing							
<div> <div>Relevant</div> <div>Not relevant</div> </div> <div>ATTITUDE, the nurse...</div> <div>Has self-confidence to perform a task</div> <div>Takes the responsibility and a proactive attitude to perform a task in order to improve patients' medication therapy</div> <div>Is able to respond to and respect patients' preferences</div> <div>Takes the opportunity to mentor colleagues</div> <div>Takes responsibility to document clinical change</div> <div>Is able to collaborate inter/intraprofessionally, is aware of own shortcomings, identifies situations where interdisciplinary consultation is needed and recognizes chances to share expertise with other healthcare professionals</div> <div>Takes the responsibility to jointly clarify relevant reasoning processes and construct common meaning through dialogical discourse with patients (advocates) and healthcare professionals</div>							

Table 6.2b. Competence framework: specific nursing tasks and related competences

Specific nursing tasks related to interprofessional pharmaceutical care																			
Proposing or taking a decision on continuation and/or cessation of medication (=deprescribing)																			
Determining type/dosage/route																			
Adapting doses (incl. dose titration) within the range prescribed by a prescriber																			
Prescribing/administering PRN (pro re nata, 'if needed' medication) and/or ensuring a standing prescription renewal order																			
Initiation of medication (reactive/proactive)																			
Recognising, addressing and preventing DRPs																			
Recognising, addressing and preventing DRPs																			
KNOWLEDGE, the nurse... <div> <div>Relevant</div> <div>Uncertain relevant</div> <div>Not relevant</div> </div>	Has knowledge of anatomy, physiology, pharmacokinetics and pharmacodynamics																		
	Is familiar with protocols and able to act according to protocols																		
	Has knowledge of national laws and legislation																		
	Has knowledge of potential causes of drug-related problems																		
	Has knowledge of interventions that aim to prevent DRPs and to support self-care																		
	Knows the role of each healthcare professional in case of discussion of treatment choices/changes																		
	Is familiar with which healthcare professional should be contacted in case of discussion of treatment choices/changes																		
	Has knowledge of educational interventions																		
	Knows how to receive the best possible medication history and current medication regimen																		
	Has knowledge of the nurse independent/dependent prescribers' formulary																		
	Has knowledge of (electronic) drug references and or prescribing software																		
	Has basic theoretical knowledge of relevant social sciences and knows how to apply that knowledge in order to improve self-care																		
	Has knowledge of ethics																		
	Has knowledge how to seek for medication-related information effectively to address DRPs																		
	Understands the importance of sharing knowledge and medication-related information																		

Table 6.2b. (continued) Competence framework: specific nursing tasks and related competences

Specific nursing tasks related to interprofessional pharmaceutical care													
Proposing or taking a decision on continuation and/or cessation of medication (=deprescribing)													
Determining type/dosage/route													
Adapting doses (incl. dose titration) within the range prescribed by a prescriber													
Prescribing/administering PRN (pro re nata, 'if needed' medication) and/or ensuring a standing prescription renewal order													
Initiation of medication (reactive/proactive)													
Recognising, addressing and preventing DRPs													
Recognising, addressing and preventing DRPs													
SKILLS, the nurse... <div>Relevant</div> <div>Uncertain relevant</div> <div>Not relevant</div>	Is able to observe and recognize therapeutic effects and drug-related problems												
	Is able to propose and implement interventions that aim to prevent drug-related problems												
	Is able to apply interventions to optimize self-care												
	Is able to interview patients about the use of prescription medications and over-the-counter medications												
	Is able to obtain timely, accurate, and thorough medication histories												
	Is able to propose appropriate changes in the medication therapy												
	Is able to recognize the needs and preferences in self-care of the patient and/or patient advocates												
	Is able to empower and involve the patient and/or patient advocates												
	Is able to delegate medication tasks to patients/patient advocates/healthcare professionals												
	Is able to undertake safe storage, transportation and disposal of medicines for/with patients and/or patient advocates												
	Is able to (de)prescribe medication of the nurse (in)dependent prescribers' formulary												
	Has (technology) skills to work with (electronic) drug references and or prescribing software												
	Is able to seek for medication-related information effectively to address DRPs												
	Is able to order medication for/with patients and/or patient advocates												
	Is able to function effectively taking into account the different cultural backgrounds, to work appropriately with patients (advocates) and healthcare providers from different cultural backgrounds												

Table 6.2b. (continued) Competence framework: specific nursing tasks and related competences

Specific nursing tasks related to interprofessional pharmaceutical care				
Proposing or taking a decision on continuation and/or cessation of medication (=deprescribing)				
Determining type/dosage/route				
Adapting doses (incl. dose titration) within the range prescribed by a prescriber				
Prescribing/administering PRN (pro re nata, 'if needed' medication) and/or ensuring a standing prescription renewal order				
Initiation of medication (reactive/proactive)				
Recognising, addressing and preventing DRPs				
Recognising, addressing and preventing DRPs				
<div> <div>Relevant</div> <div>Not relevant</div> </div> <div>ATTITUDE, the nurse...</div>	Has self-confidence to perform a task			
	Takes the responsibility and a proactive attitude to perform a task in order to improve patients' medication therapy			
	Is able to respond to and respect patients' preferences			
	Is able to verify patients' understanding of education/information			

4. Discussion

This study resulted in a competence framework containing skills, knowledge, and attitudes designated for nurses to perform tasks in interprofessional PC. The framework fits nursing tasks in current clinical practice and can be used for competency-based education of nurses and nursing students. The competences were derived from existing literature combined with knowledge and expertise of international experts in the field of nursing and interprofessional PC. To our knowledge, such a framework has not been published.

In the first phase of this study, we concluded that literature about PC related nursing knowledge and attitudes fitting to our previously defined nursing tasks was scarce. On the one hand, existing research about nursing knowledge was mainly about drug prescribing,²⁵⁻²⁸ patient education,²⁹⁻³² and shared decision making.^{25,33-35} On the other hand, literature regarding PC related attitudes was limited to 'adequate and consistent attitude based on knowledge'^{26,36} and 'confidence in own decision making'.²⁵ In our opinion attitudes regarding interprofessional collaboration with other health care professionals and attitudes to patients (e.g. respectfulness and responsiveness to patients' needs) were missing. These attitudes are essential in nursing care.^{37,38} A possible explanation for absence of these essential attitudes in our scoping review could be that research about such universal attitudes has been linked to nursing care in general, but not specifically to nurses' roles in interprofessional PC. Therefore, our search strategy did not detect these competences.

We believe that the online discussion meeting was important in our study and increased the reliability of the framework's content and its applicability for educational purposes. Discussion meetings are advised for Delphi studies,³⁹ but are not structural applied. In 63% (49 out of 78) of the Delphi studies in healthcare reviewed, panel members met.⁴⁰ To illustrate the value of our online discussion meeting, the performance of the task 'motivational interviewing' also concerns the performance of the task 'patient communication'. As a consequence, the competences needed for patient communication are relevant for motivational interviewing as well. To develop a clear competence overview, however, only competences with a direct link to a task were rated as relevant. Without the discussion meeting, we would not have been able to detect some unnecessary

competence-task links. Furthermore, the discussion resulted in the removal of all 'leadership' competences. Confusion and misinterpretation were presumed because leadership could be understood in different ways. In fact, leadership can be (mis)interpreted as the management process of planning, organizing, managing, and controlling within teams and organizations.⁴¹ This was not the meaning we intended within our competence framework. By leadership competences, we meant the attitudes which promote and encourage learning and create collaborative and facilitative environments inside an organization.⁴² This meaning is related to nurses being patients' advocates. Patient advocacy involves taking the responsibility and a proactive attitude to perform task to improve patients' medication therapy.⁴³ This competence, however, already existed in the framework (attitudes) and hence, leadership competence was not included.

4.1. Implications for education, policy, and future research

Our competence framework can be used in educational programs to evaluate whether all PC related competences are integrated in nursing curricula or to redesign curricula so that the nurses' competences will be adequately addressed. Our framework was not split into the different nurse educational levels of the European Qualification Framework (EQF), because of differences in national legislation. Therefore, we advise nurse educators, using our competence framework, to only teach competences that fit with the legally allowed nursing tasks in their country. This can be challenging, knowing that several tasks (e.g. 'recognising and preventing DRPs' or 'self-care support and therapeutic education') can be performed by nurses of different levels. There is little evidence as to the impact of education programmes on patient outcomes⁴⁴, and work is needed to map competencies to outcomes in practice. Therefore, nursing curricula should describe learning outcomes, which can exactly determine at what level of complexity nurses should master each competence, and how these will relate to patient care.

We want to address the need for universal agreement on interprofessional PC competences, for both equal and different levels of the EQF. Currently, there is no universal agreement regarding the tasks nurses should be able to perform, either between countries or within the different educational levels of the EQF.¹⁸ This hinders labour mobility of nurses between countries. To illustrate, a study in 13

European countries showed independent nurse prescribing is a task performed by nurses in 8/13 countries: Cyprus, Estonia, Ireland, the Netherlands, Norway, Spain, Sweden and the UK. In two of those countries, the Netherlands and Norway, not all level 6 nurses are allowed to prescribe, but nurse specialists are.⁴⁵

A universal agreement could create the opportunity to develop comparable nursing curricula per educational level throughout Europe. As a result, all European nursing students would be taught the same competences, facilitating international labour mobility. Comparisons between and within levels of education will enable national and international benchmarking between nurses and nursing schools. The content of educational programs differs significantly, even within countries, as was shown by Sulosaari et al. (2014b), in relation to the content of medication education in Finnish Bachelor nursing programs.⁴⁶

Further research is needed regarding assessment of nursing students' competences that can measure the readiness of students for clinical practice. In a recent European study in 6719 nurses, physicians, and pharmacists the quality of nurse competences in interprofessional PC was rated suboptimal (6.9/10)⁸, leaving a hiatus in care.⁴⁷ Developing minimum educational and practice standards might facilitate the comparability and recognition of advanced nursing roles across borders and in increasingly connected labour markets.⁴⁸

4.2. Limitations and strengths

Some limitations have to be acknowledged. Due to the COVID-19 pandemic, a one-day face-to-face group discussion was replaced by a digital discussion meeting of 4.5 hour. The virtual distance may have reduced the spontaneous sharing of opinions. Due to the digital environment, the combination of chairing/moderating the discussing, observing non-verbal communication and managing the chat function was difficult. Nevertheless, we believe the different voting rounds gave the experts sufficient space to share their thoughts. The experts were identified from their publications and international research profiles and they collaborated in previous studies of the DeMoPhaC project. Their willingness to participate also leaves the findings vulnerable to self-selection bias. Further work is needed to confirm the findings' transferability into educational and clinical practice.

The digital Delphi meeting has several advantages compared to the traditional non digital Delphi meetings.³⁸ For this study, the digital Delphi meeting provided the opportunity to continue the research during the COVID-19 pandemic in order to finalize the Delphi rounds.

A strength of our Delphi study was the involvement of a relevant international expert panel with important experience in clinical practice or nurse education. Their expertise allowed in-depth reflection on the relevance of nurse competences in interprofessional PC across Europe, which assured the generalizability of the results. The study provides useful insights in nursing competences related to tasks in interprofessional PC.

5. Conclusions

After five Delphi rounds concerning nurses' competences needed for the performance of essential tasks in interprofessional PC, 22 experts reached consensus on the relevance of 60 competences within 22 nursing tasks. Forty-one competences were related to 15 generic tasks and 33 competences were related to seven specific tasks. The study resulted in a competence framework that can be used in competency-based education to prepare nursing students for clinical practice. Assessment strategies to measure students' readiness for processing competences relating to interprofessional PC in clinical practice are needed. Future research should focus on embedding these competences in nursing curricula and how they impact patient outcomes.

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Contributors

ND, EDB: Conceptualization, Methodology, Formal analysis, Investigation, Writing - Original Draft, Visualization, Project administration, Funding acquisition.

T BVR, CS: Conceptualization, Methodology, Writing - Review & Editing, Supervision, Project administration, Funding acquisition, Final approval of the version to be submitted.

LB, IF, VG, JH, AKH, SJ, ZK, IK, PK, GL, ML-C, AM, HP, MP, DP, FT, ST: Methodology, Writing - Review & Editing, Final approval of the version to be submitted.

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Ethical approval

This study was approved by the ethical review board of the University of Applied Sciences Utrecht, the Netherlands (reference number 102_000_2019). The ethical review board concluded that the study procedure was in compliance with all ethical requirements.

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Chapter 7



General discussion,
practice implications,
recommendations and conclusion



Discussion

Healthcare professionals' scopes of practice, including nurses' practices, are evolving, bringing new levels of competency and latitude in patient care. To improve healthcare delivery, researchers and policy-makers are reconsidering nurses' roles.¹ This is necessary, since clarity of roles is essential to guarantee quality of patient care, effective care, patient satisfaction, nurses' job satisfaction, and effective interprofessional collaboration.^{2 3}

The overall aim of this doctoral study was to bridge the gap in clinical practice, education and research. A role description for nurses in pharmaceutical care (PC) was lacking on both national (Belgium) and international (Europe) levels resulting in missed care. This gap was a huge shortcoming in nurses' daily care of patients, who are almost all taking medicines. As such, an urgent need existed to investigate nurses' role in clinical practice in delivering pharmaceutical care (PC) from an interprofessional viewpoint throughout Europe, to assess this role by developing and evaluating a consensual framework about the role of nurses in PC, and finally, to define the required competences to fulfil this role.

1. Main findings

The research accomplished in this doctoral project provides a solution to the significant problems associated with the lack of a clear role description for nurses in PC. Beforehand, healthcare professionals, nurse educators and researchers continually collided with the barrier of a missing framework for nurses' role in PC. Neither literature, nor colloquy with professionals in the field could provide clear answers on questions about tasks and responsibilities of nurses in PC or about inherent competences. In contrast, the findings of the various sub-studies, have led to an evidence-based framework. This will motivate stakeholders to seize the opportunities to move towards more interprofessional, integrated, evidence-based PC, together and with a shared focus on what is best for the patient.

In general, the presented studies provided insight into current and potential responsibilities and tasks of nurses in PC, barriers and enablers related to the performance of these activities, and an overview of competences needed by nurses to take up the described role.

In order to evaluate the routine clinical practice situation from different professional viewpoints, a large-scaled cross-sectional study was performed in three main stakeholder groups, closely involved in nurse PC. In total, 6719 healthcare workers participated in this exploratory study. The results (**chapter 2**) suggested that most nurses were actively involved in monitoring therapeutic and adverse effects of medication, providing patient education and information about medication, and monitoring medication adherence. A considerable part of the nurse respondents prescribed medicines the month preceding our survey, even in countries where nurse prescribing was not (yet) legally allowed at the time of the study. Nearly all nurses, physicians and pharmacists believed nurse involvement has a positive impact on the quality of PC. Also, most nurses, physicians and pharmacists were convinced that monitoring medicines effects, providing patient education and adherence monitoring are part of nurses' role. Moreover, an extension of nurses' roles in these PC domains was proposed by two-thirds of respondents. However, quality of nurses' competences, collaboration between nurses and physicians or pharmacists and interprofessional communication were rated as suboptimal. Given the link between interprofessional communication and patient safety, scores about communication on PC were alarmingly low.

In **chapter 3** the four PC responsibilities from the first study were scrutinized through interviews with 340 European physicians, pharmacists and nurses. Different tasks were described as part of nurses' ideal practice, yet many professionals were ambivalent about their implementation. Tasks within the responsibility 'decision making on medicines use, including (de)prescribing' showed most variation in opinions. For tasks in all four PC responsibilities, nurses' autonomy varied across Europe: from none to limited to a few tasks and emergencies to a broad range of tasks and responsibilities. Indeed, not every nurse could be expected to be capable of performing every task in every situation. Intended level of autonomy depended on medicine types and level of education. Several contextual factors (e.g. country-specific governance structures) should be taken into account, when translating nurses' ideal roles in PC into clinical practice. Additionally, some changes will be needed before nursing roles can be optimised and implemented in practice. Lack of time, shortage of nurses, absence of legal frameworks and limited education and knowledge are main threats to European nurses actualising their ideal role in PC.

However, from their experience, healthcare providers reported a positive impact on care quality and patient outcomes was associated with nurses taking up responsibilities in PC. Moreover, nurses' observations and assessments could convey key patient information to the interprofessional team.

A scoping review of 453 internationally published studies, described in **chapter 4**, supplemented the role of nurses, as defined in the cross-sectional and interview study, with additional responsibilities and tasks. A total of seven PC responsibilities were formulated: (1) management of therapeutic and adverse effects of medication, (2) management of medication adherence, (3) management of patient medication self-management, (4) management of patient education and information about medication, (5) prescription management, (6) medication safety management and (7) (transition of) care coordination. Also, specific tasks to be performed in order to fulfill these responsibilities were described.

The results of the previously described studies offered the opportunity to create a framework for nurses' role in PC. The findings in **chapter 5** showed that no task, nor contextual factor had to be removed from the framework after the evaluation by 1362 key stakeholders, i.e. nurses, physicians and pharmacists. The majority of the healthcare professionals would consider nurses responsible for tasks within all PC domains except for nurse prescribing. Within the domain of prescription management more respondents were reluctant to allow nurses to take up responsibilities. Overall, a shared responsibility level was reported as the most appropriate level of autonomy for nurses in PC.

Finally, in **chapter 6**, a two-phase study, starting with a scoping review of 68 articles and followed by five Delphi rounds consulting 22 experts, resulted in a competence framework with 60 competences needed for the performance of 22 essential nursing tasks in interprofessional PC. Forty-one competences were related to 15 generic nursing tasks and 33 competences were related to seven more specific nursing tasks.

2. Terminology: model versus framework

At the start of the umbrella project, of which this doctoral study was a part, an acronym was created for the project: DeMoPhaC, which stands for the Development of a *Model* for nurses' role in Pharmaceutical Care. The term 'model' was used

during the first cross-sectional study, because, at that time, we assumed a model, rather than a framework, would be developed.

The concepts of ‘framework’ and ‘model’ sometimes overlap, and models are referred to – even by their authors – as frameworks and vice versa. There is an inconsistent use of the terms in academia. Although the terms are used interchangeably, a *framework* refers generally to a descriptive way of thinking, organising or approaching an area, e.g. the area of PC. It is a rather general approach of a topic, that contains a - not completely detailed - structure with relevant concepts for the realization of a defined goal, e.g. clarifying and defining nurses’ tasks and responsibilities in PC. A framework provides the theoretical understanding that guides the creation of models. Many frameworks comprise one or more models.⁴

A *model* tends to be more prescriptive, specific and with a narrow scope. A model is developed from or within a framework. It is more focused, already describing parameters of the phenomenon and its relationships. The schematic form is the presentation of an existing or future state or situation, often in a simplified way.⁴ According to the above definitions, the concept of a framework better suited the criteria of the final outcome of this study and therefore, this terminology was used from chapter 3 onwards.

3. Strengths and limitations of this international doctoral project

3.1. *Strengths*

This doctoral study has contributed to the national and international body of knowledge regarding the development of an evidence-based framework for nurses’ role in interprofessional PC. The NUPHAC-EU framework is based on the opinions of a large sample of healthcare professionals and relevant literature. The acquired knowledge resulted from large scaled studies in at least 14 European countries and a broad range of healthcare settings. The decision for the development of a comprehensive framework was a deliberate choice, in order to ensure its broad applicability in diverse healthcare settings and contexts. Local, national contexts were respected thanks to the critical reflections on the development of all documents, document translations and data collection by healthcare professionals and researchers residing and working in the respective countries. To our

knowledge, these are the first pan-European quantitative and qualitative studies about PC by nurses, resulting in a framework adapted to the needs of clinical practice, with insights in preferences of the interprofessional team where nurses collaborate on a daily basis. Based on the content of the NUPHAC-EU framework we were able to develop a competence framework to be used in competency-based education to prepare nursing students for their role in interprofessional PC in clinical practice.

A specific strength of this project was the involvement of diverse stakeholder groups. Earlier research investigated PC more focusing on the perspective of one healthcare professional group: pharmacists.⁵ In contrast, we have conducted interprofessional research, giving pharmacists, as well as physicians and nurses the opportunity to reflect on PC responsibilities and tasks.

Another strength was the triangulation of methods to gain more in-depth information from the clinical field. Hereto, two cross-sectional studies (chapter 2 and chapter 5), a qualitative interview study (chapter 3), two scoping reviews (chapter 4 and 6) and a Delphi study (chapter 6) were performed. All studies have been reported according to internationally accepted reporting guidelines, developed for the respective study designs we used: Strengthening the Reporting of Observational Studies in Epidemiology (STROBE)⁶ for the two cross-sectional studies, Consolidated Criteria for Reporting Qualitative Research (COREQ)⁷ for the interview study, Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR)⁸ for the scoping review in chapter 4, the methodological framework for scoping studies of Aksey and O'Malley (2002)⁹ for the scoping review in chapter 6, and finally the RAND/UCLA Appropriateness Method¹⁰ for the Delphi study. Furthermore, our systematic and international approach of the subsequent studies and the reproducible methods add to the methodological strength of this doctoral study.

Due to the lack of validated measurement tools for investigating nurses' role in interprofessional PC, structured questionnaires in the different studies were developed. All were (face) validated by the DeMoPhaC research consortium. We acknowledge face validity is not the strongest validation technique, yet, the consortium was composed of 23 experts in nursing research, ensuring sufficiently reviewed and consensus-based instruments.

3.2. *Limitations*

A first limitation that has to be acknowledged is the generalisability in European healthcare. All healthcare workers, sampled in the studies presented in this doctoral research, were employed in 14 (or for the EUPRON-study in 17) European countries. This implies that, strictly speaking, only conclusions can be drawn about nurses' role in the involved countries. However, by comparing our findings with the available international literature, we broadened our scope. Verifying our results for completeness, allowed to go beyond the vision of professionals in the countries included. Furthermore, although we reached large sample sizes (more than 8000 participants in the two quantitative studies and 340 in the qualitative interview study), these samples still remained small to extremely small at the country-level. When considering subsamples (e.g. professional groups, healthcare settings), similar imbalances can be detected. More specifically, both physicians and pharmacists were underrepresented as compared to the nursing profession in the cross-sectional studies (ratio 1:5 in the EUPRON study and 1:4 in the framework study). This is, however, not incongruous since nurses belong to the largest group of health workforce. Numbers of 2015, show that there were about three nurses per physician across OECD countries, with about half of the countries reporting between two to four nurses per physician.¹¹ Likewise, the opinions of the different healthcare settings were not equally pictured, with an underrepresentation of community care, residential care and mental healthcare compared to hospital care. However, when comparing EU-numbers of hospital beds per 100.000 persons (461/100.000¹²) with beds or units in mental healthcare (77/100.000¹³), residential care (370/100.000¹⁴) and community care (61/100.000¹⁵), this purported underrepresentation is a reflection of the reality in clinical practice. In order to develop a framework for interprofessional PC, applicable in all healthcare situations, it is of major importance that all stakeholders are sufficiently, and preferably in an equivalent way, involved in the evaluation. After all, besides aiming at generating a role description that is transparent for all healthcare workers, this role should also be accepted by all these professionals. The current data does allow to conclude with sufficient certainty that our NUPHAC-EU frame has been approved by a representable part of all healthcare workers.

Our sampling strategies have some limitations. The cross-sectional parts of this study have self-selected samples with an unknown response rate, which might have caused a distortion of the results due to participation of only the most motivated professionals. In the interview study, exact numbers of those declining to participate were not registered either, leading to an unknown selection bias. We also have to acknowledge that our findings represent perceptions and are not validated against direct observations or correlated with any outcomes. Therefore, as with all self-reports, we cannot guarantee that some of the 8444 professionals may have responded with socially desirable answers. We, however, minimized this bias by performing anonymous data collection in the cross-sectional studies and pseudonymisation of personal data in the interview study.

4. Experiences from the international DeMoPhaC project

This doctoral study was part of an international Erasmus+ partnership project in 14 European countries. This partnership is a transnational cooperation projects designed to develop and share innovative practices and promote cooperation, peer learning, and exchanges of experiences in the field of education, training and youth.¹⁶ Thanks to the Erasmus+ funding we were able to collaborate with an amazing diverse and experienced research group. On the other hand, because of the agreements accompanying this support, the earlier described general aims were not the only ones to deal with. In an Erasmus+ strategic partnership a strong student involvement is essential. A group of 43 European nurse students were included as student researchers. Two 5-day intensive study programs were organised to prepare this group for collaboration in the project. Frequent joint student calls were established, next to individual coaching or mentoring on request. A substantial part of the data in this doctoral project was collected with the help of the 43 nurse students, supervised by the national research groups, and coordinated by the Antwerp University team. We would like to stress that data collection didn't always go as fast or smoothly as planned. As a coordinator and researcher in Belgium, the Belgian sample size could be actively increased, yet, for the comparisons with other countries we largely depended on the efforts in the partner countries. Sometimes frustrating, but mostly rich, interesting and unique experiences were encountered.

Most importantly, in addition to developing and expanding coordination skills, robust partnerships were created, that could be of great benefit for future research.

In summary, coordinating such a diverse group of nurse researchers was a challenging side-line, parallel to this doctoral project.

5. Practical implications and recommendations

Based on the results from this doctoral thesis, we will address the following questions: (1) What are the practical implications and recommendations for clinical practice, nurse education, future research and policy-making? (2) What are the perspectives for the NUPHAC-EU framework and the PC competence framework? In the next paragraphs we elaborate on a range of possibilities to be considered.

5.1. *For clinical practice*

Healthcare systems are historically hierarchical in nature with physicians regularly assuming leadership positions and decision-making roles. Frustrations, lack of confidence, lack of organization and structural hierarchies hinder interprofessional relationships and communication.¹⁷ Our research showed that power imbalance between professions could have a negative impact on discussions about nurses' professional role in PC and its formalisation. To address this source of conflict, it may be helpful for team members to discuss and agree on roles and responsibilities.¹⁸ Increasing the awareness of all team members' (potential) roles will be beneficial for the teamwork of pharmacists, nurses and physicians.¹⁹ In addition, role clarity for nurses themselves can positively impact missed nursing care, which has been shown to be associated with higher job satisfaction of nurses.

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With the actual development and validation of the NuPhaC-EU framework our work is not at his endpoint. The next step is to implement the framework in clinical practice. We aim for a sustainable instrument, embedded in daily nursing practice, to frequently fall back on and support discussions about nurses' role between nurses and all other healthcare workers they collaborate with in PC. A suggestion for the implementation of the NuPhaC-EU framework is described below under 3) practical implications and recommendations for further research.

Furthermore, the patient and his informal network, are perhaps the most important party in clinical practice to be affected by this research. By investigating the role of nurses' in PC, we aimed to provide a useful framework for nurses and other healthcare workers in order to reduce missed care and to achieve more effective and qualitative care.² Also, better collaboration between physicians, pharmacists and nurses could be achieved by using our frame. Interprofessional collaboration and communication have been shown to play a crucial role in patient safety.^{19 23-28} In this way, our research will also have a positive impact, albeit indirectly, on the patient. (Figure 7.1)

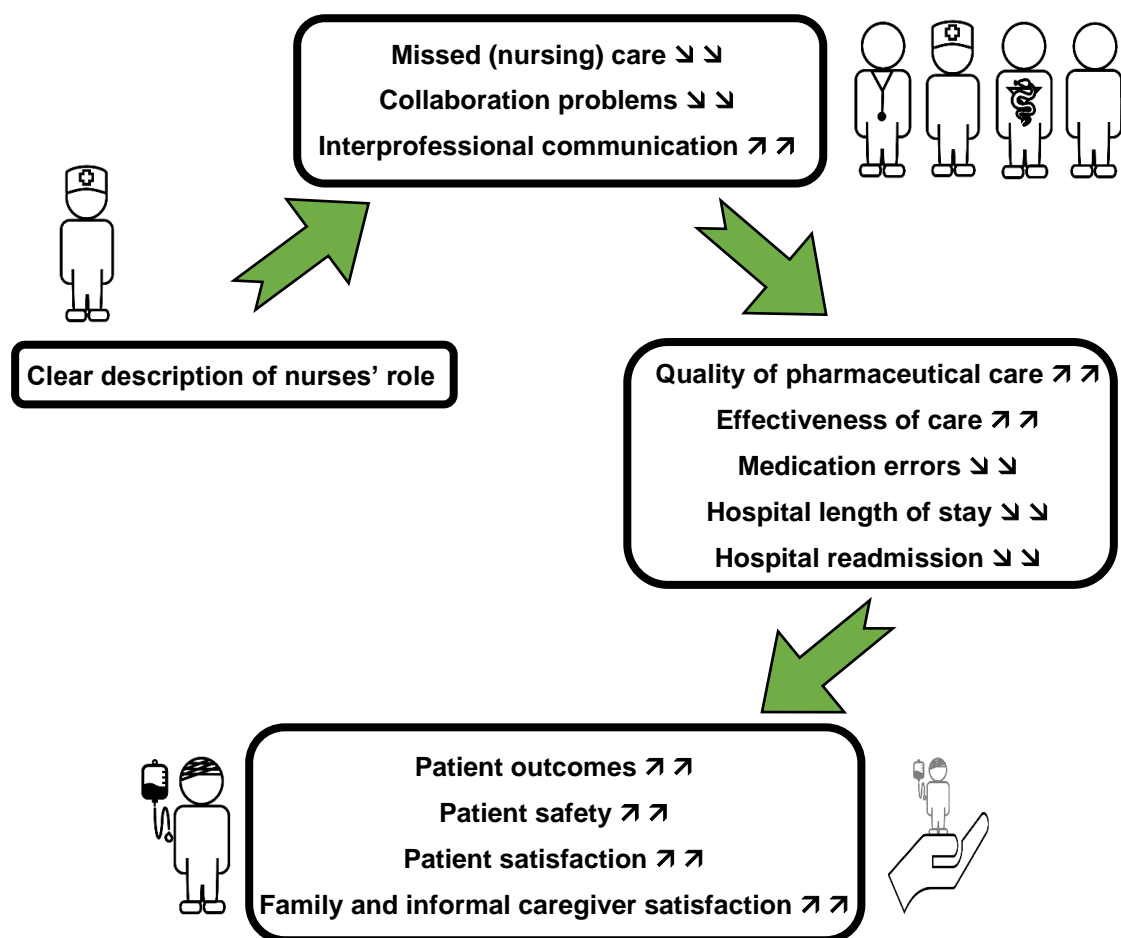


Figure 7.1 Visualisation of the indirect positive impact of a 'clear description of nurses' role' on the patient and his informal network

The quality of pharmaceutical care is closely linked to patient satisfaction.^{29 30} Other core PC related patient outcomes that can benefit from our research are: drug-related hospital (re)admissions, drug overuse, drug underuse, medication

appropriateness, clinically significant drug-drug interactions, health-related quality of life, pain relief, adverse drug reactions, falls, medication regimen complexity, mortality, and medication side effects.^{31 32} To meet the WHO third 'Global Patient Safety Challenge on Medication Safety', a focus on these patient outcomes is required.³³

5.2. For nurse education and interprofessional education

To perform PC related tasks, nurses need specific competences, consisting of knowledge, skills and attitudes.³⁴ Unless nurses' role in PC is fully recognised, nurse educational programs cannot sufficiently prepare nurse students for their role in clinical practice. Mapping the competences related to PC that are presently taught to nursing students can lead to a better estimation of the extent to which current nurse curricula prepare students to perform PC. The validated competence framework, that was developed in our Delphi study, can be used to gain insight in the presence and content of PC related courses in nurse educational programs. Comparisons within and across countries can be made.

Previous research demonstrated that nursing students' pharmacological knowledge and calculation skills are limited. Also, students did not perceive themselves able to deliver safe PC in practice.³⁵ Comparing EQF levels (European Qualifications Framework)³⁶, more specific level 5 and 6 students, showed level 5 students scored significantly lower (57%) than level 6 students (61%). Current research about minimum levels of education to perform PC is scarce. In chapter 5 we described that the majority of our sample allowed nurses of all educational levels to perform all PC tasks proposed. At least 80% of the healthcare professionals believed level 5 nurses were sufficiently competent. Although, percentages did increase as higher levels of nurse education were considered. When reviewing research beyond PC, more evidence is available. This experimental evidence is in contrast to the observational findings in our work (chapter 5), since we did not find clear differences in opinions about levels of responsibility for lower and higher educated nurses. Indeed, in other studies, nurse education is suggested to have a significant influence on patient outcomes, such as in-hospital mortality.³⁷ A study in 300 hospitals spread over nine European countries calculated that every 10%

increase in the number of level 6 nurses (Bachelor's degree) is associated with a 7% decrease in the likelihood of an inpatient dying within 30 days of admission.³⁸ Haegdorens et al (2019) corroborated this effect of the level of nurse education on patient mortality in their longitudinal multicentre study in Belgium.³⁹ They put forward that the proportion of highly educated nurses has a significant impact on patient safety and subsequently mortality.

Ten years ago, the Institute Of Medicine's (IOM) report 'The Future of Nursing' was released. At that time 50% of the nursing workforce held a level 6 degree. The report recommended that the proportion of level 6 nurses should increase to 80% by 2020 to provide safe care.⁴⁰ Unfortunately, recent figures show that this goal is still far from being achieved in all countries (e.g. a mean proportion of 59% level 6 nurses in Belgian hospitals³⁹). Although the IOM recommendation was written for safe care in general, and not for PC in specific, we believe their advice is equally applicable on PC. The more highly educated nurses are employed, the better PC related outcomes may be expected.

Our call for higher-educated nurses does not mean lower-educated nurses cannot have a place in modern healthcare environments. In contrast, with current shortages of nurses, the contribution of nurses of all educational levels is essential. However, the efficient use of available nurses is paramount. The NUPHAC-EU framework can provide guidance on how to further concretize job differentiation based on educational level.

We suggest that, the readiness to perform PC related tasks within seven PC domains should be estimated in all aspiring nurses, regardless of their educational level, before they enter the 'real clinical practice world'. An assessment covering knowledge, attitude and skills questions related to the broad range of PC tasks we defined can evaluate students' PC preparedness. Hence, such an evaluation for final year nursing students, based on our PC competence framework, should be developed. After all, last year students are expected to be sufficiently prepared to function as qualified nurses in PC practice in their near future. Of course, nurses will need to update their PC competences regularly during their career and continued professional development will be indispensable to renew and update their knowledge, skills and attitudes. The proposed student assessment will be a guidance to evaluate nurse education, a tool for nurse educators, benchmarking

and nurse labour mobility. Its implementation for nursing students of different EQF levels will allow benchmarking between the EQF levels, both within and between countries. Most importantly, it will allow to detect mismatches between competences required in the labour market and those resulting from current nurse educational programs. If it turns out that certain (lower) levels of nurses are insufficiently prepared to take up responsibilities in PC, as already suggested by certain studies for overall patient care⁴⁰⁻⁴³, they should not be given full responsibility about PC for patients. The gaps and mismatches in their competences should be addressed first.

Since we also aimed to investigate nurses' role in an interprofessional context, our recommendations are not restricted to nurse education only. Also interprofessional education can benefit from the NUPHAC-EU framework. Until now, the training of healthcare professionals remains largely confined to a single discipline, which may hamper the ability to collaborate interprofessionally⁴⁴. Shared interprofessional courses for different types of healthcare students in topics such as PC could allow students to experience opportunities for collaboration, with shared goals and action plans for better patient safety.⁴⁵ Therefore, we urge for more interprofessional education to tackle the collaboration barriers. Our framework represents an excellent tool to initiate discussions in interprofessional courses with medical, nursing and pharmacist students and to strengthen educational preparation.

5.3. For nursing research

This research contributes to the already existing body of knowledge about PC by nurses. National and international experts collaborate on and strengthen research, practice, policy-making and education on medication management and PC in nursing.⁴⁶ Nowadays, nurses are insufficiently represented in PC related debates with more 'powerful' professional groups, such as physicians and pharmacists. Consequently the interest of nurses as a professional group is not always appreciated or even ignored, despite their importance in PC. The growing number of academic nurses can facilitate the integration of nurses in these debates. We therefore suggest that higher educated or academic nurses and nurse researchers, involved in or informed about our PC research, will advocate the

nursing profession in future PC debates on different levels: national, European and worldwide. Firstly, professional bodies in different countries can play a role as national contact points for sharing national research about PC. Secondly, the European Federation of Nurses Associations (EFN), which represents more than one million nurses over 36 national nurses associations at European level, would be a valuable partner to promote research about nurses' role in PC.⁴⁷ Additionally, the International Council of Nurses (ICN), a federation of more than 130 national nurse associations, representing the more than 20 million nurses worldwide should be approached and informed about our research.⁴⁸ Due to a better role definition in this doctoral study, improved recognition of nurses' responsibilities by other professional groups can be achieved. Subsequently, this role appreciation can make it more logical to invite nurses to discuss PC related themes.

Strengthening interprofessional collaboration in PC can be one of the opportunities to improve PC and medication safety.⁴⁹⁻⁵⁴ However, more evidence on the effects of nurses' contribution to interprofessional PC is needed. Hence, interprofessional research, as a strong fundament for interprofessional practice, should be performed. The DeMoPhaC project has contributed to strengthening the Nurse and Pharmaceutical Care (NuPhaC) network.⁴⁶ Besides serving to the enhancement of collaboration, the exchange of initiatives and the dissemination of research information, this network also provides a point of contact for other professional groups to identify nurse representatives engaged in research and policy-making on PC.⁵⁵ Through future research collaborations, involving more European countries, increased capacity and efficiency in the professionalisation of nursing in interprofessional PC are expected to occur.

We have to be vigilant that this doctoral research will effectively add value to clinical practice and that it doesn't end on a beautiful bookshelf of an equally beautiful bookcase. As stated by Richards and Borglin (2018) in their opinion paper "Shitty nursing' – the new normal?", more fundamental nursing care research is needed to really impact patient care.⁵⁶ However, before being able to plan experimental research that can impact patient outcomes, such as patient safety and patient satisfaction, fundamental clarity about nurses' role (by means of the NuPhaC-EU framework) and the necessary competences to be able to perform this

role (by means of the PC competence framework) was indispensable. Indeed, first and foremost knowledge about the responsibilities, tasks and competences of nurses in PC was needed. Now that we have provided this essential evidence, we can invest in intervention studies.

Two frameworks have been developed in this doctoral study. As a result, future research will be two-fold. On the one hand, studies will have to demonstrate that our defined role of nurses will effectively lead to decreased missed care, medication errors, near misses, hospital admissions, hospital length of stay, interprofessional collaboration problems and improved patient safety, patient satisfaction, quality of PC and effectiveness of care. On the other hand, the impact of nurse competences on patient outcomes needs to be experimentally investigated.

Future of the NuPhaC-EU framework and the PC competence framework

To ensure that both the NuPhaC-EU framework and the PC competence assessment for nursing students can be applied sustainably in respectively clinical practice and nursing education, the development-evaluation-implementation process has to be carefully conducted. To guide this process, we suggest to use the Medical Research Council (MRC) framework⁵⁷, a guidance on the development, evaluation and implementation of complex interventions to improve health (Figure 7.2).

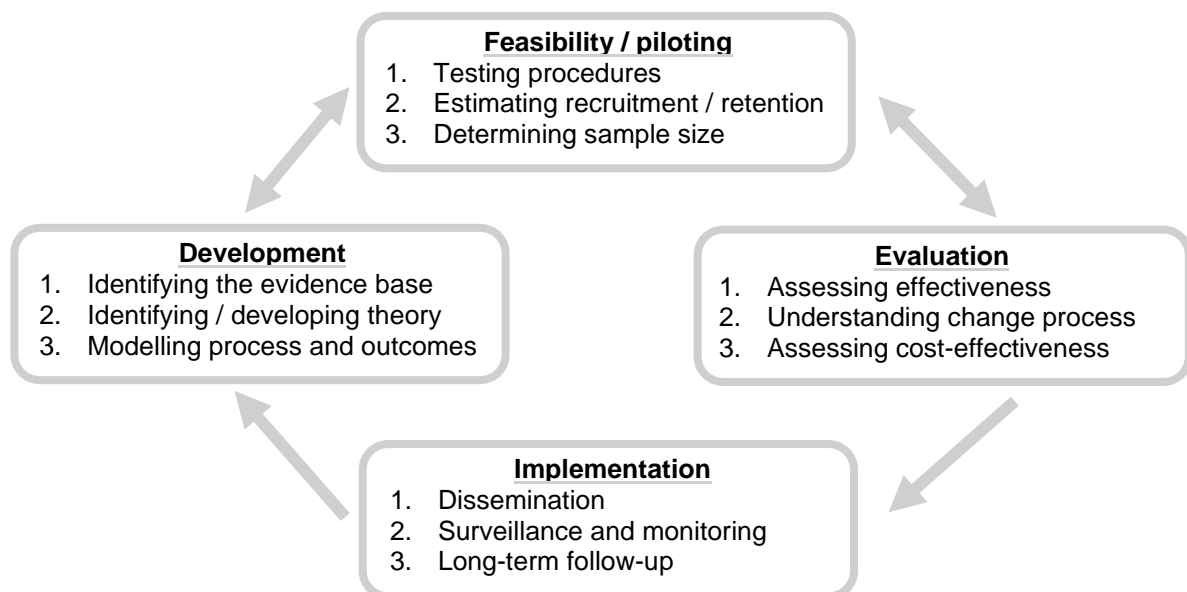


Figure 7.2 Key elements of the development and evaluation process according to the new Medical Research Council (MRC) guidance⁵⁷

a) The PC competence framework

Assessment strategies to measure nurse students' readiness for processing competences related to interprofessional PC in clinical practice have to be embedded in nursing curricula. When assessing these students, it is important not to lump all levels of education together. As already stressed before, there are indications that lower levels of nurse education are associated with lower levels of care quality and patient safety.^{38 39} Additional research is needed to corroborate or disprove these findings for PC competences. By implementing the suggested assessment strategies in students of different EQF levels, these comparisons will be possible. Based on the PC competence framework, an evaluation for final year nursing students should be developed. The assessment development must be accompanied by robust content validation by a team of experts in education or in PC, followed by a feasibility study in nursing students of each of the different EQF levels (level 4, 5, 6, 7 nurse students). Following evaluation of the effectiveness of the assessment and making the according necessary adjustments, the PC competence assessment should be implemented in last year nursing curricula in Europe. Hereby, long term follow-up will be needed.

In the longer term, the thoroughly validated and sustainably implemented student assessment could be also extrapolated to nurses in clinical practice.

b) The NuPhaC-EU framework

Future research should guide the implementation of the NuPhaC-EU framework in interprofessional healthcare teams and consequently evaluate the willingness of healthcare providers to use this frame as a discussion framework.

To make this recommendation more concrete, figure 7.3 provides a flowchart for the implementation of the framework in a specific healthcare setting of a specific country (e.g. a nursing home in Belgium). This guideline, however, can be used in all settings and countries. Depending on the setting, measurement scales, other than those suggested, have to be used.

A pre-post intervention study without control group is advised. Firstly, the outcomes related to clear role descriptions in interprofessional PC have to be quantitatively measured: missed nursing care, quality of care, patient satisfaction, nurse job satisfaction, medication errors and near misses, hospital (re) admissions

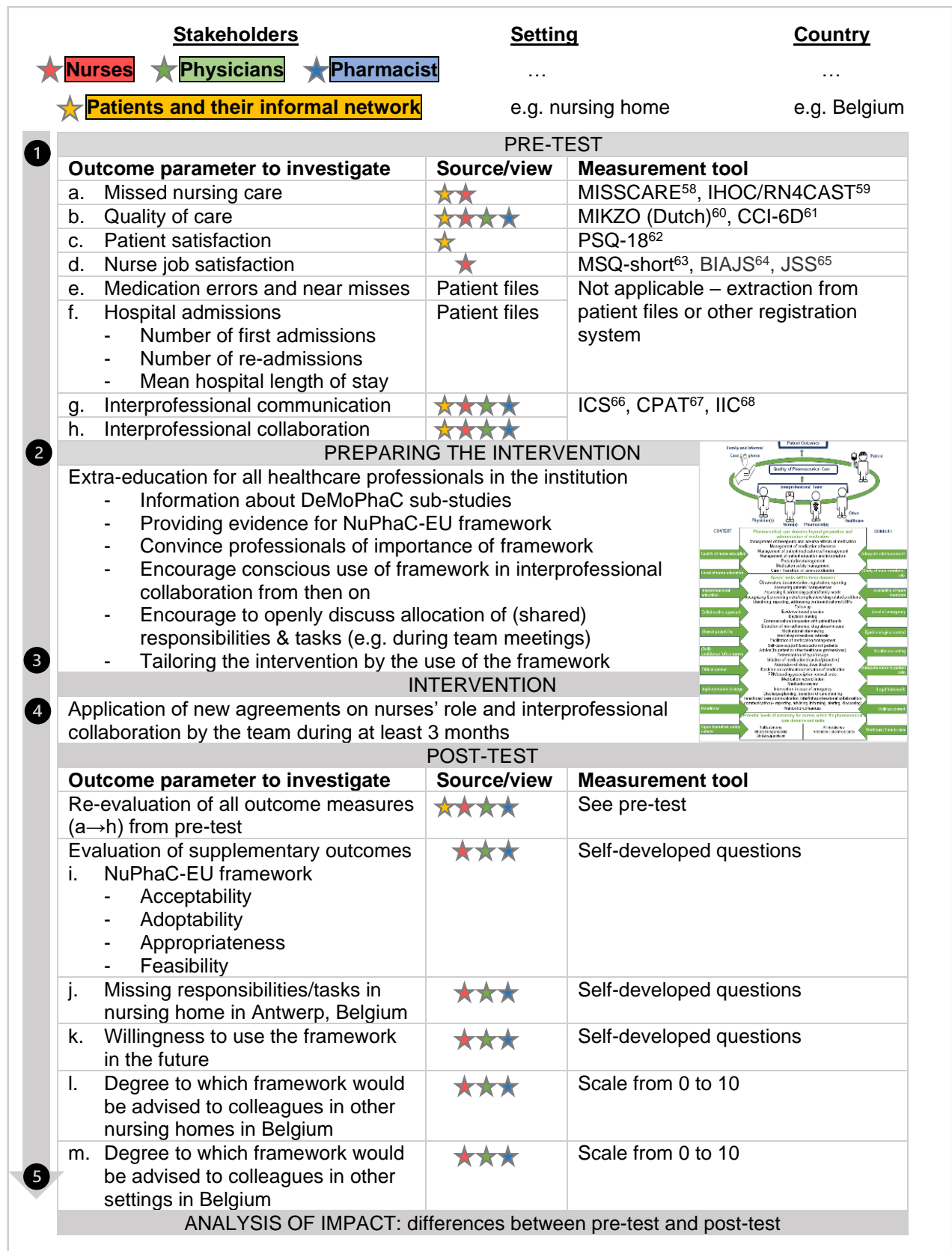


Figure 7.3. Flowchart of suggested steps to guide the implementation of the NuPhaC-EU framework in clinical practice

and hospital length of stay, and interprofessional communication and collaboration. Several validated measuring tools are suggested to evaluate these outcomes, yet our list is not exhaustive. Before implementing the use of the NuPhaC-EU framework in clinical practice, trained researchers have to inform the nurses, physicians and pharmacists of the selected team(s) about the framework and the evidence that has led to its development. The team needs to be encouraged to openly discuss the allocation of (shared) responsibilities and tasks, e.g. during team meetings. The framework can support these interprofessional discussions. Based on the framework current and future roles must be discussed, and collaboration agreements need to be made. Then, new arrangements will have to be implemented. After a period of about three months, in which the team will collaborate as newly agreed, a post-test should be performed. The agreements will have to be evaluated and if necessary, adjusted. Also, the outcomes from the pre-test will be re-evaluated. Additionally the acceptability, adoptability, appropriateness and feasibility of the framework will be questioned. Finally the extent to which the framework would be used in the future and advised to colleagues in other institutions or settings will be questioned.

In this doctoral research, the opinion of the patient was not included. However, our indirect aim is to improve *patient* outcomes in PC. In other words, the patient is an important stakeholder, who may not be neglected.⁶⁹ To really impact care and not to fall in the trap of “Research waste 2”, as described by De Geest et al (2020), all potential stakeholders should be approached, including patients.⁷⁰ So far, we have described nurses’ role from the perspective of the interprofessional team. In order to include the perspective of the patient, we recommend to assess patients, during both pre-test and post-test, for all outcomes that apply to them, i.e. missed care, quality of care, patient satisfaction, and interprofessional collaboration and communication. Patients will not directly participate in the intervention, yet they will be informed about the study and the framework.

Additionally, a potential long-term benefit of involving patients and informal caregivers may be that clarity and transparency about nurses’ role in PC for the patient, and by extension for the general public, may lead to a better appreciation of their role, beyond ‘the obvious’ preparing and administering medication. This may promote the interest and appreciation of the nursing profession. In addition, this may

also trigger the interest of (young) people in becoming a nurse. As such, one of the main barriers identified in the interview study, namely the shortage of nurses, may also be reduced in time.

5.4. For policy-makers

Healthcare budgets are under pressure in most European countries.^{71 72} Savings result in major changes in healthcare practice, such as ever-shortening hospital stays, which are in turn very challenging for the healthcare workers and patients.⁷³ Nurses are known to be less expensive to healthcare systems⁷⁴⁻⁷⁶ and their profession is often positioned lower in society compared to physicians and pharmacists.⁷⁷ Acknowledging nurses' (shared) responsibilities in PC will be beneficial to stimulate the representation of nurses in PC related debates and policy-making. Till now, nurses are too often considered as of insufficient value in this regard. To maximize the recognition of nurses' role and competences in PC, nurses should be included in policy and decision-making.

The successful implementation of our evidence-based NUPHAC-EU framework will not only lead to a stronger team approach and interprofessional collaboration in clinical practice, research and education, but also in policy-making. Our framework transparently describes nurses' roles, which can aid policy-makers and nurse managers to develop workforce planning policies and create adapted contexts for more barrier-free nurse labour mobility, taking into account feasibility, cost-effectiveness, care quality and patient outcomes.

PC is a complex process involving several management and treatment decisions. Policies are developed to assist health professionals to safely manage medications and standardise practice. However, variance exists in PC policies across organisations and countries, which raises concerns regarding consistency in governance and PC related practice.⁷⁸ Lack of practice standardisation and lack of interjurisdictional concordance should be addressed to increase coherence. Discrepancy in expectations between healthcare services may lead to confusion about nurses' role among health professionals moving from one healthcare service to another, within or between countries. Above all, this can lead to increased risk of missed care and medication errors.⁷⁸

This discussion elaborated on a range of practical implications and recommendations. In brief, the future of the NUPHAC-EU framework and PC competence framework will depend on its evidence based implementation in nurse education, interprofessional education and clinical practice. The implementation will take time and significant costs will have to be considered. However, when initiating a cost-benefit analysis, one should always keep in mind that the return of safe healthcare with better patient outcomes, is actually priceless. Therefore, we recommend European governments to provide healthcare systems, as well as educational institutions with incentives for the implementation of our suggested framework(s). We strongly advise to use funding from the European Union's health programme or research funding on health and wellbeing, such as the EU's Horizon 2020 programme, rather than funding by tax dollars, collected from employers and the public.⁷⁹

To conclude, the most important implications and recommendations for the NuPhaC-EU framework and the PC competence framework are summarised in table 7.1.

Table 7.1. Summary of specific points of action for clinical practice, education, research and policy-making

<p style="text-align: center;">Clinical practice</p> <ul style="list-style-type: none"> - Select setting to implement the NuPhaC-EU framework - Inform all stakeholders about framework in selected institution(s) - Encourage healthcare professionals to use the framework in team meetings during minimum 3 months - Start discussions based on the framework - Evaluate patient related outcomes before and after the implementation 	<p style="text-align: center;">Nurse education and interprofessional education</p> <ul style="list-style-type: none"> - Map PC related competences presently taught to nursing students - Develop assessment tool for final year nursing students + content validation - Assess nurse students' readiness to perform PC - Implement PC assessment in nurse curricula - Increase number of interprofessional PC courses for different types of healthcare students - Initiate PC discussions in interprofessional courses - Contact educational advisory boards (per country, e.g. VLHORA for Belgium) to present research and ask for support to sustainably implement assessment.
<p style="text-align: center;">Nursing research</p> <ul style="list-style-type: none"> - Test PC competence assessment through feasibility study in nursing students - Implement NuPhaC-EU framework in different settings/contexts through experimental pre-post intervention study 	<p style="text-align: center;">Policy-making</p> <ul style="list-style-type: none"> - Stimulate nurse representatives to be present in PC related debates and policy-making (supported by NuPhaC-EU framework) - Stimulate European governments to provide incentives for the implementation of both frameworks - Contact European Foundation for Quality management (EFQM) to stress the importance of this research

Conclusion

The lack of insights in nurses' roles in pharmaceutical care (PC) was a critical gap in literature, clinical practice and education. Therefore, in this thesis, we aimed to investigate nurses' role in delivering PC from an interprofessional viewpoint throughout Europe, to develop and evaluate a consensual framework about the role of nurses in PC, and finally, to examine the competences nurses need to fulfil this role.

Based on the results of a quantitative and qualitative observational study supplemented with a literature review, we developed a framework, termed the NUPHAC-EU framework, describing nurses' role in PC. This framework was evaluated by nurses, physicians and pharmacists in Europe and consists of two main parts. The first part is the visualisation of the patient and his personal and professional network. The second part defines a list of 26 tasks of nurses within seven PC domains, together with possible levels of autonomy (under supervision, shared responsibility, full autonomy) and all relevant contextual factors, that can be barriers or enablers when implementing nurses' role into clinical practice. The seven identified PC domains beyond preparation and administration of medication are: 1) Management of therapeutic and adverse effects of medication, 2) Management of medication adherence, 3) Management of patient medication self-management, 4) Management of patient education and information, 5) Prescription management, 6) Medication safety management, 7) Care / Transition of care coordination. The extensiveness of nurses' activities shows nurses are key persons in PC for patients, suggesting them having a major impact on care quality. The majority of the healthcare professionals would consider nurses to be responsible for tasks within six of the seven PC domains proposed. Within the domain of prescription management, more respondents were reluctant to allow nurses to take up responsibilities. Overall, physicians, pharmacists and nurses considered a shared responsibility level as the most appropriate level of autonomy for nurses in PC.

This framework can enable healthcare professionals to openly discuss allocation of specific (shared) responsibilities and tasks. A range of suggestions for the future use of our NUPHAC-EU framework in education, clinical practice research and policy-making was given.

Furthermore, following the development of the NUPHAC-EU framework, Delphi consensus was reached about the relevance of 66 competences nurses need to have in order to perform PC related tasks. The developed competence framework can be used in competency-based education to prepare nursing students for clinical practice.

We hope that this dissertation can convince and motivate healthcare providers, nurse educators, researchers and policy-makers to seize the opportunities to move towards more interprofessional, integrated, evidence-based PC, together and with a shared focus on what is best for the patient.

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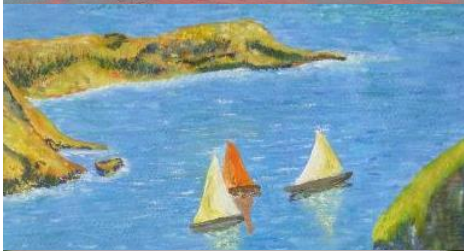
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Summary

Summary

To prevent missed care and promote interprofessional collaboration, team members should clearly know what to expect from each other in different healthcare settings and situations. Missing role transparency and recognition, in nursing practice and nurse education, has a direct or indirect impact on the quality of patient care, the effectiveness of care, patient satisfaction, nurses' job satisfaction, medication errors, hospital length of stay and hospital readmission rates. Furthermore, unclear nursing roles hinder collaboration on different levels: interprofessional collaboration in clinical practice; international collaboration in research, education and innovation; and labour mobility of nurses. As a result patient safety is threatened, development and innovation are slowed down, and healthcare budgets are not used most efficiently.

Limited research has been performed into what nurses' actually do or could do in interprofessional pharmaceutical care (PC). Additionally, knowledge about nurses', physicians' and pharmacists' opinions on (shared) responsibilities in PC is lacking. The lack of such insight is a critical gap in the literature, as well as in clinical practice and education. Therefore, there is an urgent need to develop a framework for nurses' role in interprofessional PC in Europe.

The aim of this study was to investigate nurses' role in clinical practice in delivering PC, to develop and evaluate a consensual framework about this role, and finally, to examine the competences nurses need to fulfill this role.

Our first cross-sectional study in 4888 nurses, 974 physicians and 857 pharmacists investigated nurses' current practice in PC. The results showed that 'providing patient education and information', 'monitoring medicines adherence', 'monitoring adverse/therapeutic effects' and 'prescribing medicines' were part of nurses' activities. Most health professionals felt the involvement of nurses should be extended because this would improve PC quality.

These first findings were explored in more depth through interviews with 340 physicians, pharmacists and nurses. We unravelled many potential nursing tasks in PC. Although ambivalence about their implementation existed – most of all in case of prescription activities – an active role of nurses in PC was evident. Respondents reported positive impacts on care quality and patient outcomes when nurses assumed PC responsibilities. Most importantly, however, is the need for nuancing.

Context will determine nurses' autonomy level, ranging from no authority to limited authority to being responsible of a few tasks and emergencies to a broad range of tasks and responsibilities. Education, team characteristics, country-specific governance structures, and medicines types should be taken into account when translating nurses' ideal roles in PC into clinical practice. Lack of time, shortage of nurses, absence of legal frameworks and limited education and knowledge were identified as main threats to European nurses actualising their ideal role in PC.

A scoping review of literature was performed to corroborate the evidence we described and to supplement the existing list with additional responsibilities and tasks. A total of seven responsibilities were identified: 1) management of therapeutic and adverse medicines effects, 2) management of medication adherence, 3) management of patient medication self-management, 4) management of patient education/information about medication, 5) prescription management, 6) medication safety management, and 7) care coordination. The extensiveness of nurses' activities within these seven domains (26 tasks were described) showed nurses are key persons in PC, once more suggesting they have a major impact on care quality.

This scoping review promoted the development of a framework, the NUPHAC-EU framework, describing potential nursing tasks in PC, together with potential barriers and enablers of nurses performing these PC activities. After the development of the framework, the content was evaluated by 923 nurses, 240 physicians and 199 pharmacists. The validated framework consisted of the patient and his personal and professional network, the seven previously mentioned PC domains, 26 tasks within these domains, varying levels of autonomy, and 20 contextual factors. The evaluation showed that 'shared responsibility' was the most preferred level of responsibility. The tasks included in the framework are: 1) observation, documentation, registration, reporting; 2) assessing patients' competences; 3) assessing & addressing patient/family needs; 4) recognizing and preventing risks/complications/drug related problems (DRP); 5) identifying, reporting, addressing contra-indications/DRP; 6) follow-up; 7) evidence-based practice; 8) decision making; 9) communication/discussion with patient/family; 10) detection of non-adherence, drug abuse/misuse; 11) motivational interviewing; 12) inter/intraprofessional referrals; 13) facilitation of medication management, 14) self-care support and education of patients; 15) advice to patient or other healthcare

professional; 16) determination of type/dosage; 17) initiation of medication; 18) adaptation of dose, dose titration; 19) decision on continuation/cessation of medication; 20) PRN/standing prescription renewal order; 21) medication reconciliation; 22) medication review; 23) intervention in case of emergency; 24) discharge planning, transition of care planning; 25) transitional care communication, inter/intraprofessional collaboration/communication, including reporting, advising, informing, alerting, discussing; and 26) mentoring colleagues.

Based on the NUPHAC-EU framework, a two-phase study, starting with a scoping review followed by five Delphi rounds, was performed to reach agreement about nurses' competences necessary for the previously defined tasks. Competences extracted from the literature were assessed on relevance by an expert panel. These experts built consensus on the relevance of 60 competences for 22 nursing tasks this dissertation offers healthcare providers, nurse educators, researchers and policy-makers the opportunities to move towards more interprofessional, integrated, evidence-based PC, together and with a shared focus on what is best for the patient. This resulted in a competence framework to be used in competency-based education to evaluate the integration of all PC related competences in nurse curricula or to redesign educational programmes in order to adequately prepare nurse students for clinical practice.

The future of the NUPHAC-EU framework and PC competence framework will depend on its evidence-based implementation in nurse education, interprofessional education and clinical practice. This dissertation offered healthcare providers, nurse educators, researchers and policy-makers the opportunities to move towards more interprofessional, integrated, evidence-based PC, together and with a shared focus on what is best for the patient.

Samenvatting

Om te voorkomen dat noodzakelijk zorg toch niet zou plaatsvinden en om interprofessionele samenwerking te bevorderen, moeten teamleden duidelijk weten wat ze van elkaar kunnen verwachten. Dit geldt in alle zorgomgevingen en situaties. Ontbrekende roltransparantie en -erkenning in de verpleegkundige praktijk en in onderwijs, heeft een directe of indirecte invloed op de zorgkwaliteit, effectiviteit van zorg, patiënttevredenheid, jobtevredenheid van verpleegkundigen, medicatiefouten, duur van ziekenhuisverblijf en het aantal (her)opnames in het ziekenhuis. Bovendien belemmeren onduidelijke verpleegkundige rollen de samenwerking op verschillende niveaus: interprofessionele samenwerking in de klinische praktijk; internationale samenwerking op vlak van onderzoek, onderwijs en innovatie; en arbeidsmobiliteit van verpleegkundigen. Hierdoor komt patiëntveiligheid in het gedrang, worden ontwikkeling en innovatie afgeremd en worden zorgbudgetten niet op de meest efficiënte manier gebruikt.

Slechts weinig onderzoek is voor handen over wat verpleegkundigen precies doen of zouden kunnen doen in interprofessionele farmaceutische zorg (FZ). Daarnaast ontbreekt kennis over de opvattingen van verpleegkundigen, artsen en apothekers betreft (gedeelde) verantwoordelijkheden in FZ. Het gebrek aan dergelijk inzicht is een fundamenteel hiaat in de literatuur, evenals in de klinische praktijk en het onderwijs. Daarom is er dringend nood aan de ontwikkeling van een kader voor de rol van verpleegkundigen in interprofessionele FZ in Europa.

Het doel van deze studie was om de rol van verpleegkundigen bij het leveren van FZ te onderzoeken, om vervolgens een discussiekader over deze rol te ontwikkelen en te evalueren en om tenslotte de competenties te onderzoeken die verpleegkundigen nodig hebben om deze rol te vervullen.

In een eerste studie bij 4888 verpleegkundigen, 974 artsen en 857 apothekers onderzochten we de huidige praktijk van verpleegkundigen in FZ. De resultaten toonden aan dat 'geven van patiënteducatie en -informatie over geneesmiddelen', 'waken over medicatietrouw', 'waken over bijwerkingen/therapeutische effecten van geneesmiddelen' en 'voorschrijven van geneesmiddelen' deel uitmaakten van frequente activiteiten van verpleegkundigen. De meeste gezondheidswerkers vonden dat de betrokkenheid van verpleegkundigen in FZ moest worden uitgebreid. De kwaliteit van FZ zou hierdoor namelijk verbeteren.

Deze eerste bevindingen werden verder uitgediept aan de hand van 340 interviews met artsen, apothekers en verpleegkundigen. Meerdere verpleegkundige FZ-taken kwamen naar voor. Ondanks ambivalentie over de implementatie ervan - vooral op vlak van voorschrijfactiviteiten – kregen verpleegkundigen een actieve rol in FZ toebedeeld. Respondenten meldden een positief effect op kwaliteit van zorg en patiëntuitkomsten wanneer verpleegkundigen FZ-verantwoordelijkheden op zich namen. Enige nuancering is hierbij echter van belang. De mate van verpleegkundige autonomie wordt namelijk bepaald door de context. Dit kan gaan van geen autoriteit over beperkte autoriteit of verantwoordelijkheid voor enkele taken en noodgevallen tot een breed scala aan taken en verantwoordelijkheden. Bij het vertalen van de ideale rol van verpleegkundigen in FZ naar de klinische praktijk moet rekening worden gehouden met opleiding, teamkenmerken, landspecifieke regelgeving en de soorten geneesmiddelen waarvoor de verpleegkundige verantwoordelijk wordt gesteld. Gebrek aan tijd, een tekort aan verpleegkundigen, het ontbreken van wettelijke kaders en beperkte opleiding en kennis werden geïdentificeerd als belangrijkste bedreigingen voor Europese verpleegkundigen om hun ideale rol in FZ te realiseren.

Vervolgens werd een literatuurstudie ('scoping review') uitgevoerd om de reeds beschreven bevindingen af te toetsen aan de literatuur en de bestaande lijst met verantwoordelijkheden en taken zo nodig aan te vullen. In totaal werden zeven verantwoordelijkheden geïdentificeerd: 1) management van therapeutische en neveneffecten van geneesmiddelen, 2) management van medicatietrouw, 3) management van medicatie-zelfmanagement door patiënten, 4) management van patiënteducatie/informatie over geneesmiddelen, 5) voorschrijfmanagement, 6) management van medicatieveiligheid en 7) zorgcoördinatie. De uitgebreidheid van verpleegkundige activiteiten - 26 taken werden beschreven binnen deze zeven domeinen – toonde aan dat verpleegkundigen sleutelfiguren zijn in FZ, wat eens te meer de grote impact suggereert van deze beroepsgroep op de kwaliteit van zorg.

Deze scoping review ondersteunde de ontwikkeling van een discussiekader, het NUPHAC-EU-kader, waarin potentiële verpleegkundige FZ-taken worden beschreven, samen met mogelijke barrières en bevorderende factoren om deze activiteiten uit te voeren. Na de ontwikkeling van het kader werd de inhoud geëvalueerd door 923 verpleegkundigen, 240 artsen en 199 apothekers. Het

gevalideerde raamwerk bestond uit de patiënt en zijn persoonlijke en professionele netwerk, de zeven eerder genoemde FZ-domeinen, 26 taken binnen deze domeinen, variërende autonomieniveaus, en 20 contextuele factoren. Uit de evaluatie bleek dat 'gedeelde verantwoordelijkheid' het meest geprefereerde niveau van verantwoordelijkheid was. De in het raamwerk opgenomen taken zijn: 1) observatie, documentatie, registratie, rapportage; 2) beoordelen van patiëntcompetenties; 3) beoordelen & aanpakken van noden van patiënt/familie; 4) herkennen en preventie van risico's, complicaties en medicatiefouten; 5) identificeren, rapporteren, aanpakken van contra-indicaties/medicatiegerelateerde problemen; 6) follow-up; 7) evidence-based praktijkvoering; 8) besluitvorming; 9) communicatie/bespreking met patiënt/familie; 10) signaleren van medicatie-ontrouw; 11) motiverende gespreksvoering; 12) inter-/intraprofessionele verwijzing; 13) faciliteren van medicatiebeheer, 14) zelfzorgondersteuning en -educatie van patiënten; 15) advies aan patiënt of zorgverlener; 16) bepaling van type/dosering van medicatie; 17) opstarten van medicatie; 18) dosisaanpassing, dosistitratie; 19) beslissing over voortzetting/stopzetting van medicatie; 20) beslissen om 'zo nodig' medicatie te geven, staande orders op te volgen 21) kritisch beoordelen van medicatieschema('s) en detecteren van tegenstrijdigheden; 22) medicatiereview (kritisch beoordelen en - indien nodig - aanpassen van een medicatieschema) ; 23) interventie in noodgevallen; 24) ontslagplanning, planning van de transitie van zorg; 25) transmurale zorgcommunicatie, inter-/intraprofessionele samenwerking, waaronder rapporteren, adviseren, informeren, alarmeren, bespreken en 26) mentorschap over collega's.

Op basis van het NUPHAC-EU-kader werd een laatste onderzoek uitgevoerd, bestaande uit een literatuurstudie en vijf Delphi-rondes, om overeenstemming te bereiken over de competenties van verpleegkundigen, nodig voor de eerder gedefinieerde taken. De relevantie van de - uit de literatuur - geëxtraheerde competenties werd door een expertpanel beoordeeld. Deze experts bereikten consensus over de relevantie van 60 competenties voor 22 verpleegkundige taken. Dit resulteerde in een competentiekader dat gebruikt kan worden in competentiegericht onderwijs om de integratie van alle FZ-gerelateerde competenties in verpleegkundige curricula te evalueren of om

onderwijsprogramma's te herontwerpen opdat verpleegkundestudenten adequaat voorbereid zijn op de klinische praktijk.

De toekomst van het NUPHAC-EU-kader en het FZ-competentiekader zal afhangen van de evidence-based implementatie ervan in het verpleegkundig onderwijs, interprofessioneel onderwijs en de klinische praktijk. Dit proefschrift biedt zorgverleners, docenten in verpleegkundig onderwijs, onderzoekers en beleidsmakers de handvaten om samen, en met een gedeelde focus op wat het beste is voor de patiënt, toe te werken naar meer interprofessionele, geïntegreerde, evidence-based FZ.

Appendices

Appendix 2.1

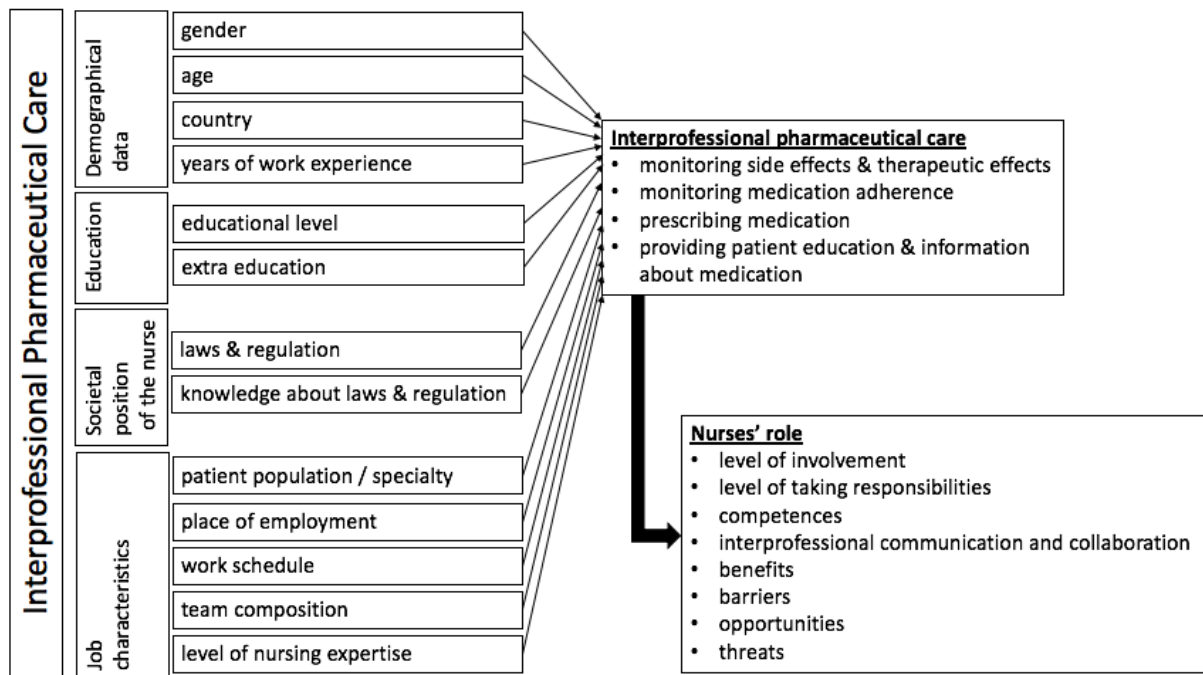


Figure. Conceptual framework for the development of the questionnaire to investigate nurses' practices in interprofessional pharmaceutical care in Europe

Appendix 2.2

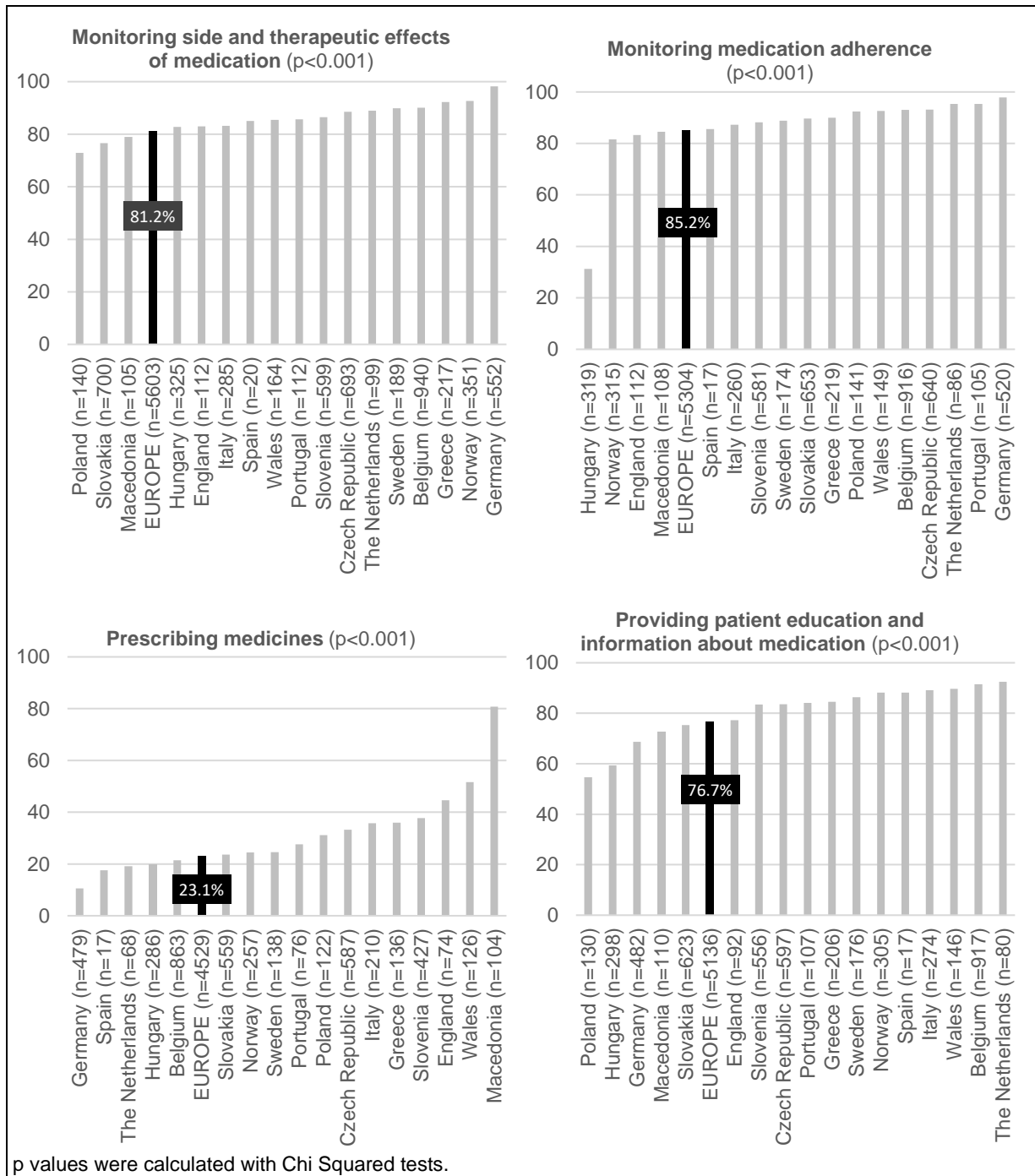


Figure. Percentages of participants (nurses, doctors and pharmacists), stating that four different aspects of pharmaceutical care are part of nurses' roles in their daily clinical practice, by country and across Europe as a whole.

Appendix 2.3

Table. Nurse involvement in four aspects of pharmaceutical care from the viewpoint of healthcare workers in ambulatory care settings (community or primary care) versus non-ambulatory settings (hospital or residential care)

	Ambulatory healthcare workers (n=1357)	Non-ambulatory healthcare workers (n=4661)	p
<u>Monitoring adverse/therapeutic effects (ME)</u>	%	%	
Part of nurses' role	82.1	89.6	<0.001
Convinced of positive impact of nurse involvement on PC	93.4	95.8	0.001
Involvement of nurses in ME should:			0.009
Be extended	72.1	67.9	
Remain the same	25.4	30.1	
Be restricted	2.5	2.0	
<u>Monitoring medicines adherence (MMA)</u>	%	%	
Part of nurses' role	88.2	92.9	<0.001
Convinced of positive impact of nurse involvement on PC	95.6	95.7	0.942
Involvement of nurses in MMA should:			<0.001
Be extended	70.1	64.1	
Remain the same	28.5	34.5	
Be restricted	1.4	1.4	
<u>Prescribing medicines</u>	%	%	
Part of nurses' role	31.6	27.1	0.008
Convinced of positive impact of nurse involvement on PC	51.0	54.9	0.022
Involvement of nurses in prescribing should be:			<0.001
Extended	43.5	49.2	
Remain the same	35.2	36.3	
Restricted	21.3	14.5	
<u>Providing patient education/information about medicines (PEI)</u>	%	%	
Part of nurses' role	82.4	81.0	0.330
Convinced of positive impact of nurse involvement on PC	92.1	90.8	0.205
Involvement of nurses in PEI should be:			0.205
Extended	68.8	66.7	
Remain the same	27.6	29.7	
Restricted	3.6	3.6	

p-values were calculated with chi squared test for 'part of nurses' role' and 'convinced of positive impact' and Kruskal-Wallis test for 'nurse involvement should be extended/remain the same/be restricted'.

Appendix 2.4

Table. Differences in viewpoints about nurses' role and interprofessional collaboration (nurse-physician and nurse-pharmacist) in four aspects of pharmaceutical care between professionals who collaborate and who don't collaborate with nurses in daily clinical practice.

	Collaborating professionals	Non-collaborating professionals	p
Monitoring adverse/therapeutic effects (ME)			
Part of nurses' role (%) *	88.2	54.5	<0.001
Convinced of positive impact of nurse involvement on PC (%) *	95.0	83.9	<0.001
Involvement of nurses in ME should: (%) *			0.500
Be extended	68.3	72.0	
Remain the same	29.5	21.1	
Be restricted	2.2	6.9	
Score/10 for physician-nurse-collaboration quality (mean, SD) **	6.73 (2.3)	5.14 (2.6)	<0.001
Score/10 pharmacist-nurse-collaboration quality (mean, SD) ***	5.15 (2.8)	3.0 (3.0)	<0.001
Monitoring medicines adherence (MMA)			
Part of nurses' role (%) *	91.9	74.8	<0.001
Convinced of positive impact of nurse involvement on PC (%) *	95.2	88.1	<0.001
Involvement of nurses in MMA should: (%) *			0.026
Be extended	64.7	73.7	
Remain the same	33.3	20.7	
Be restricted	1.7	5.6	
Score/10 for physician-nurse-collaboration quality (mean, SD) **	6.8 (2.4)	5.5 (2.5)	<0.001
Score/10 pharmacist-nurse-collaboration quality (mean, SD) ***	4.8 (2.9)	3.0 (3.0)	<0.001
Prescribing medicines			
Part of nurses' role (%) *	28.2	13.4	<0.001
Convinced of positive impact of nurse involvement on PC (%) *	54.7	25.2	<0.001
Involvement of nurses in prescribing should be: (%) *			<0.001
Extended	48.4	19.8	
Remain the same	35.4	41.0	
Restricted	16.2	39.2	
Score/10 for physician-nurse-collaboration quality (mean, SD) **	6.0 (2.9)	5.1 (2.9)	<0.001
Score/10 pharmacist-nurse-collaboration quality (mean, SD) ***	4.6 (3.1)	2.8 (3.1)	<0.001
Providing patient education/information about medicines (PEI)			
Part of nurses' role (%) *	82.1	60.5	<0.001
Convinced of positive impact of nurse involvement on PC (%) *	91.0	82.5	<0.001
Involvement of nurses in PEI should be: (%) *			0.004
Extended	67.0	59.5	
Remain the same	29.4	29.5	
Restricted	3.6	11.0	
Score/10 for physician-nurse-collaboration quality (mean, SD) **	6.2 (2.5)	4.8 (2.7)	<0.001
Score/10 pharmacist-nurse-collaboration quality (mean, SD) ***	4.9 (2.8)	3.1 (3.1)	<0.001

p-values were calculated with chi squared test for 'part of nurses' role' and 'convinced of positive impact', Kruskal-Wallis test for 'nurse involvement should be extended/remain the same/be restricted and Independent T-test for collaboration scores.

*'Collaborating professionals' = pharmacists/physicians with nurse co-workers in daily clinical practice + all nurses (n=6222). 'Non-collaborating professionals': all others (n=276).

***'Collaborating professionals' = nurses with physician co-workers in daily clinical practice + physicians with nurse co-workers in daily clinical practice + pharmacists with both nurses and physicians in daily clinical practice (n=5643). 'Non-collaborating professionals': all others (n=561).

****'Collaborating professionals' = nurses with pharmacist co-workers in daily clinical practice + pharmacists with nurse co-workers in daily clinical practice + physicians with both nurses and pharmacists in daily clinical practice (n=2537). 'Non-collaborating professionals': all others (n=3502).

Appendix 2.5

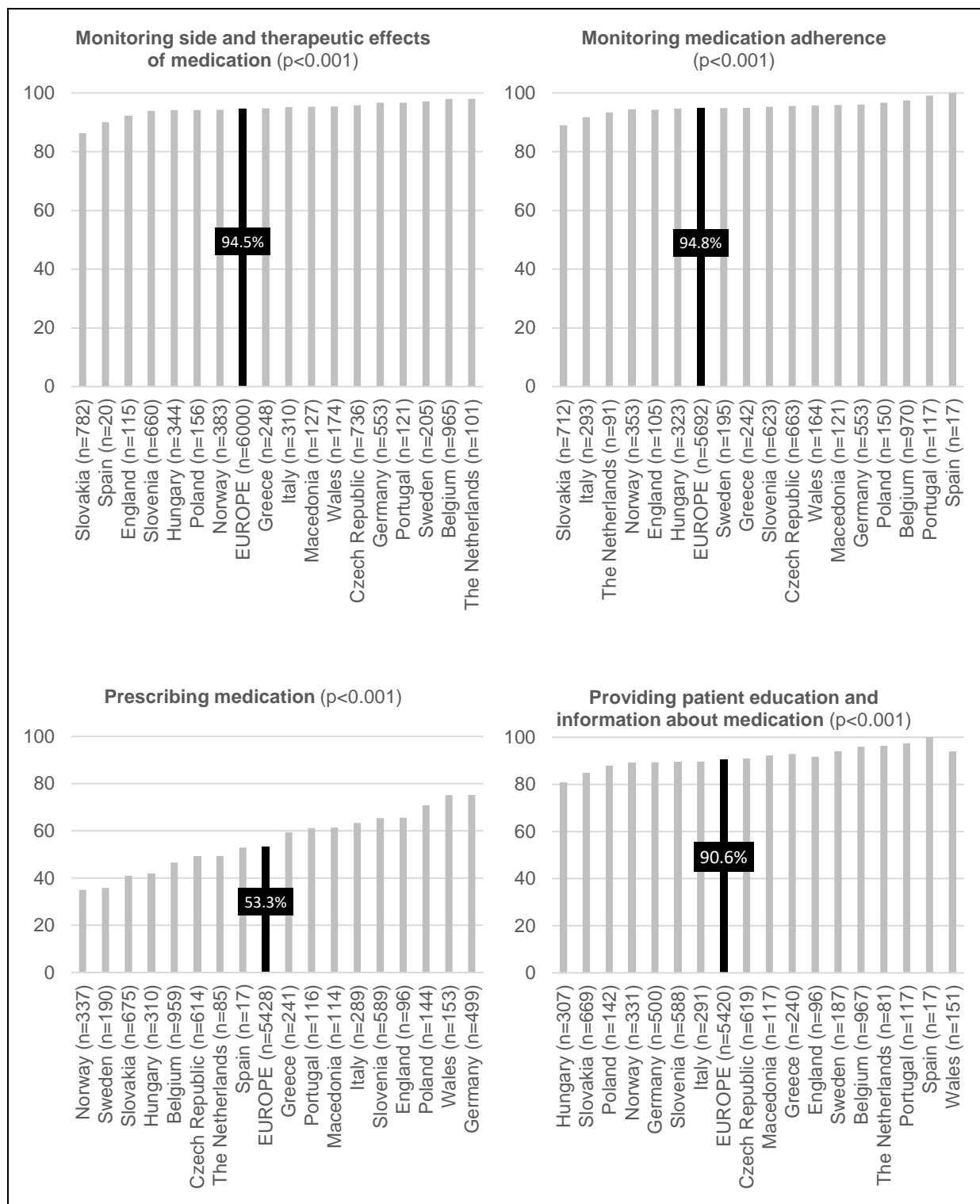


Figure. Percentages of participants (nurses, doctors and pharmacists), stating that nurses involved in four different aspects of pharmaceutical care have or would have a positive impact on the quality of pharmaceutical care, by country and across Europe as a whole.

Appendix 2.6

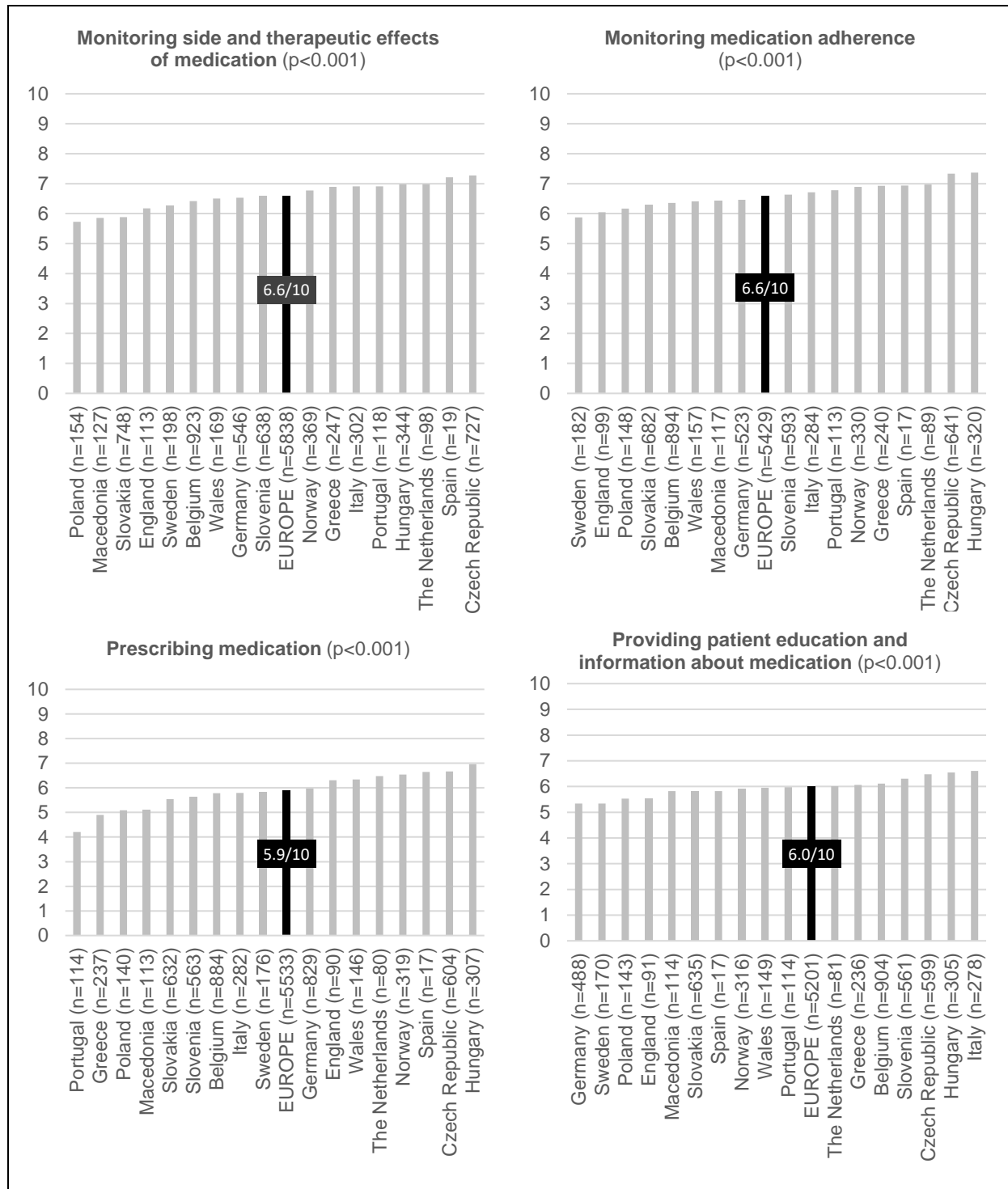


Figure. Score on 10 for the reported quality of collaboration between nurses and doctors in four different aspects of pharmaceutical care, from the viewpoint of nurses, doctors and pharmacists, by country and across Europe as a whole.

Appendix 2.7

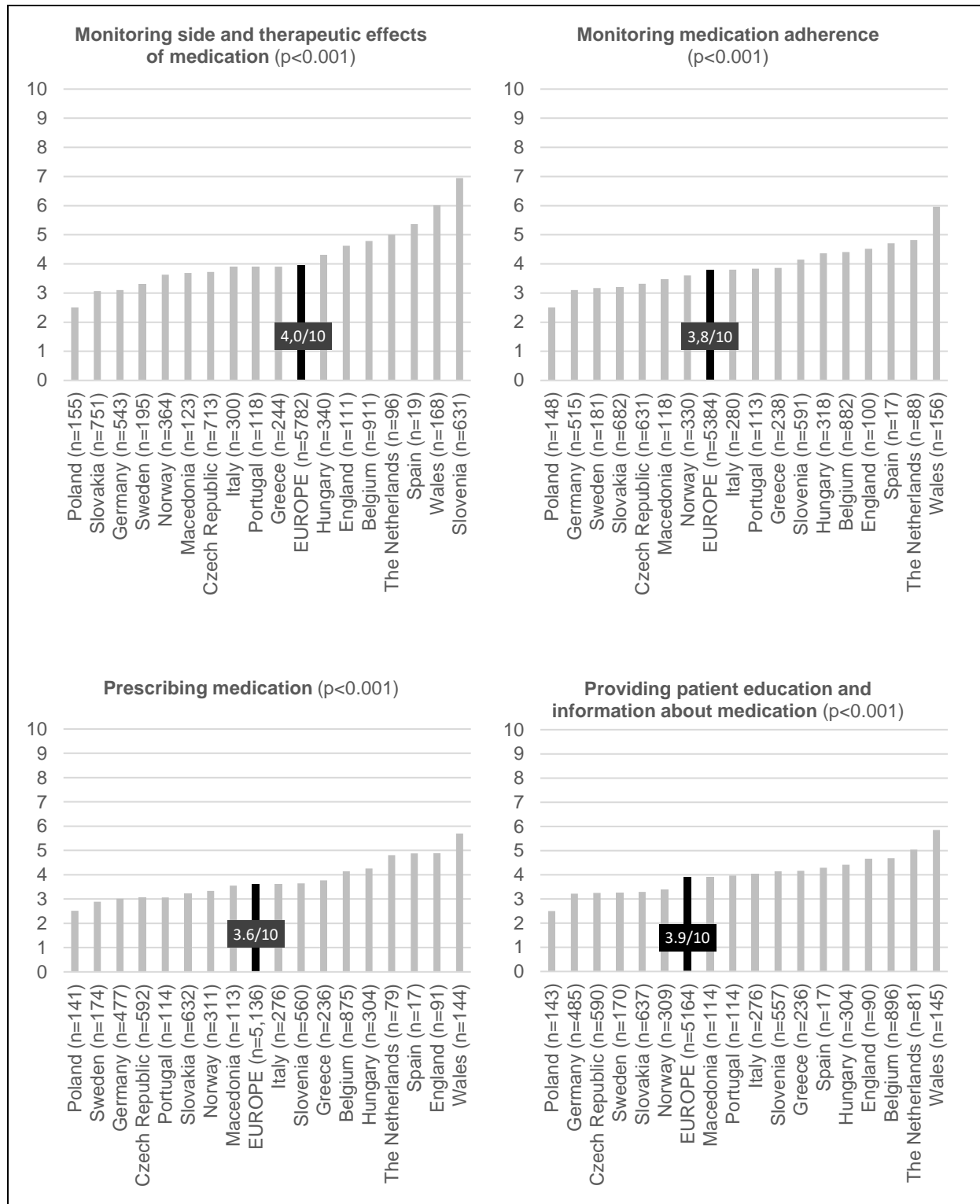


Figure. Score on 10 for the reported quality of collaboration between nurses and pharmacists in four different aspects of pharmaceutical care, from the viewpoint of nurses, doctors and pharmacists, by country and across Europe as a whole.

Appendix 2.8

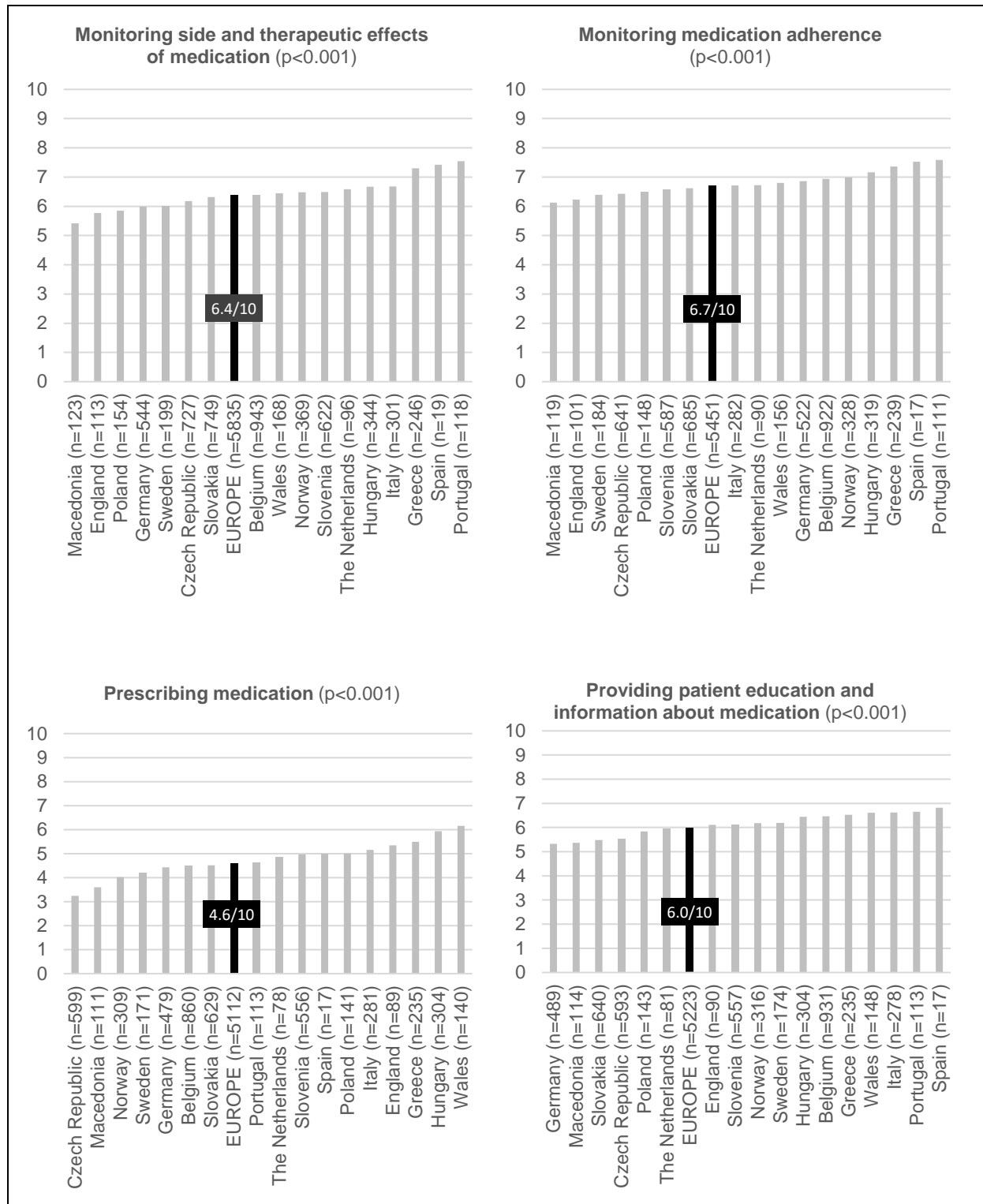


Figure. Score on 10 for the reported quality of nurses' competences in four different aspects of pharmaceutical care, from the viewpoint of nurses, doctors and pharmacists, by country and across Europe as a whole.

Appendix 2.9

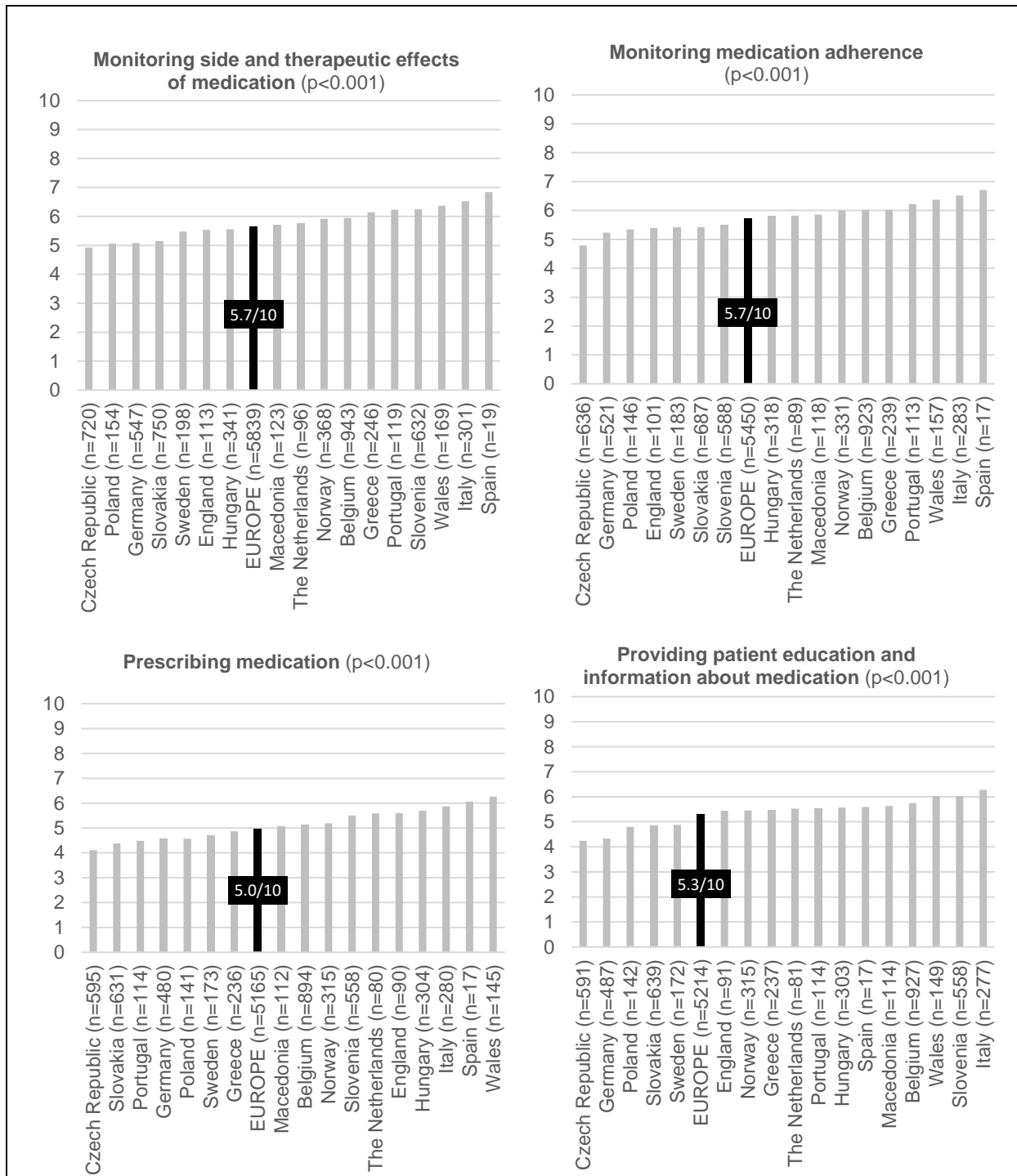


Figure. Score on 10 for the reported quality of interprofessional communication on four different aspects of pharmaceutical care, from the viewpoint of nurses, doctors and pharmacists, by country and across Europe as a whole.

Appendix 3.1

Table. Code book of the interview study.

Themes	Code	
drug monitoring	M01	
monitoring adherence	M02	
prescribing medicines	M03	
patient education	M04	
PC in general, not specified	M05	
interprofessional collaboration	M06	
pharmaceutical model implementation	M07	
strenghts nurses' role in interprofessional PC	M08	
weaknesses of nurses' role in interprofessional PC	M09	
opportunities of nurses' role in interprofessional PC	M10	
threats of nurses' role in interprofessional PC	M11	
Sub-themes	Code	Short description / clarification of the sub-theme
active involvement in research	S001	Clinical research for highly educated nurses
added value of nurse	S002	Characteristics of nurses and nursing which make the contribution of nurses of added value to the contributions of other professionals in PC
administrative tasks	S003	Administrative tasks of nurses in PC
availability of professionals	S004	Professionals available for other professionals or for patients
care coordination	S005	The coordination of different steps in the care for patients. Interprofessional PC is one system, like a chain.
collaboration between professions	S006	Collaboration between nurse-physician, nurse-pharmacist, pharmacist-physician, nurse-nurse. Interprofessional collaboration.
communication with patient/ informal caregiver	S007	Communication with patient/ informal caregiver
communication with professionals	S008	Mono-disciplinary or multidisciplinary communication, nurses questioning physicians, physicians questioning nurses, communication with individuals or with the entire staff. Written or oral communication.
competences	S009	Nurses' competences in different situations, concerning different tasks/responsibilities, resistance against certain competences. Competences, including knowledge, attitudes, skills and abilities
confidence	S010	Trust in/from other professionals, trust of patients in health care professionals
current nursing practice in PC	S011	Common practice for nurses, tasks that they are already performing currently
decision-making	S012	Making decisions about PC related topic
definition of PC	S013	Definition of PC
detecting clinical change / healthcare problems / assessing patient needs	S014	Detecting clinical change / healthcare problems / assessing patient needs
differentiation in function between different levels of nursing	S015	According to different levels of education. E.g. Specialised nurses.
equality - hierarchy	S016	Nurses are equal to physicians and pharmacists in interprofessional collaboration/communication versus there exists a hierarchy between the professions
(financial) rewards and recognition system	S017	Wages of nurses relative to their responsibilities. Recognition of their competences. Acknowledge nurse qualifications.
follow-up	S018	Follow-up adverse/therapeutic effects, follow-up of clinical change/patient status
independent nurse consultation	S019	Nurses can be consulted independently from a physician.

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intervention in case of emergency	S020	Nurse interventions in case of emergency
laws and regulations	S021	Legal framework
necessity of change in interprofessional PC	S022	Is changing the current situation necessary? Urgent or not.
nurse advise to other professional	S023	A nurse giving advice to other health professionals
nurse close to patient	S024	Availability of nurses for patients, their (constant) presence on the floor, leading to the nurses having more information about the patient.
nurse education	S025	Level of nurse education - extending or adjusting nurse education to allow nurses being involved in different aspects of PC - vocational education, extra education, mandatory (or not) education
nurse receiving advise from other professional	S026	Nurse receiving advise from other professional
patient characteristics	S027	Patient characteristics can influence the involvement of nurses in PC
patient needs	S028	Needs and expectations of patients and informal caregivers
patient safety	S029	(Improving) patient outcomes, safe PC. Safety of current nurse involvement or increase of nurse involvement. Risks, medication errors and safety issues.
pharmacists' role	S030	Not the aim of this study, but pharmacists' role can also be mentioned in the interviews.
physicians' role	S031	Not the aim of this study, but physicians' role can also be mentioned in the interviews.
prerequisites	S032	Requirements, conditions, necessities for nurse involvement in PC, prerequisites for the model to be implemented
quality of care	S033	The levels of excellence which characterize the health service or health care provided based on accepted standards of quality
registration	S034	Registration and documentation in patient records
reporting	S035	Reporting to other professionals
representation of physician in case of absence	S036	A nurse represents a physician in case of absence or in case of awaiting a physician
responsibility	S037	Responsibilities of nurses in PC, being responsible for a task or for a person
self-care support	S038	A nurse supporting self-care of patients is a task of nurses in PC
sense of responsibility	S039	Nurses feeling responsible towards PC, patients, ...
setting of employment	S040	In which setting are nurses employed
shortage of nurses	S041	Shortage of nurses in different health care settings and in health care in general
supervision	S042	Supervision of newly admitted, supervision of students
culture	S043	Ward culture of hospital department
ICT support	S044	PC, using technology, software, web applications, patient platforms, ...
nurses' role	S045	Nurses' role in interprofessional PC
patient's freedom of choice	S046	Freedom of choice when selecting healthcare professionals
therapy reconciliation	S047	The process of ensuring that two sets of medication therapy (eg. Medication list at home versus in hospital) are in agreement
turn-over	S048	Intention to leave and turn-over of nurses
workload	S049	Nurses' workload and patients per nurse ratio, time to care

Code S001 to S042 were the codes of the 1st code book, code S043 to S049 were added to the final code book.

Appendix 4.1

Table: Article characteristics of included papers with presentation of nurse responsibilities in pharmaceutical care mentioned in the article abstracts

Coding article characteristic																	
Continent		Study design		Healthcare setting		Patient population		Nurse category									
Africa	1	Quantitative		Hospital	1	Physical disease/characteristic	1	Not specified		1							
Asia	2	observational	1	Primary/community healthcare	2	Mental disease/characteristic	2	(Advanced) nurse practitioner		2							
Australia	3	interventional	2	Residential healthcare	3	Social characteristic	3	Registered nurse		3							
Europe	4	Qualitative	3	Mental healthcare	4	Medication related	4	Specialised nurse		4							
N-America	5	Multimethod	4	Outpatient setting	5	Non-medication related	5	Independent nurse prescriber		5							
S-America	6			More than one care setting	6	Age	6	(Clinical) nurse specialist		6							
More than one continent	7			Educational setting	7	Residence	7	Advanced Practice Nurse		7							
				Not specified or unclear	8	Not specified	8	Other		8							
	Reference					Nurse responsibility in pharmaceutical care						Article characteristic					
	Grey cells = responsibility present in article abstract					Management of therapeutic / adverse effects of medication	Management of medication adherence	Management of patient medication self-management	Management of patient education and information	Prescription management	patient safety management	Transitional care coordination	Continent	Study design	Patient population	Healthcare setting	Nurse category
1	Abbas S et al. Knowledge, attitudes, and practices of bedside nursing staff regarding antibiotic stewardship: A cross-sectional study. Am J Infect Control 2019;47(3):230-33												5	1	8	1	1
2	Abdullah N et al. Effect of patient characteristics on medication adherence among patients with type 2 diabetes mellitus: a cross-sectional survey. Contemp Nurse 2019;55(1):27-37.												2	1	1	1	1
3	Adenuga B et al. Optimizing spontaneous adverse drug reaction reporting in public healthcare setting in Namibia. Basic Clin Pharmacol Toxicol 2020;126(3):247-53.												1	4	7	2	1
4	Aerts L et al. Why deprescribing antipsychotics in older people with dementia in long-term care is not always successful: Insights from the HALT study. Int J Geriatr Psychiatry 2019;34(11):1572-81.												3	1	2	3	1
5	Afzal Z et al. Evaluation of a Pharmacist and Nurse Practitioner Smoking Cessation Program. J Pharm Pract 2017;30(4):406-11.												5	2	5	2	2

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6	Ailabouni N et al. Do Residents Need All Their Medications? A Cross-Sectional Survey of RNs' Views on Deprescribing and the Role of Clinical Pharmacists. <i>J Gerontol Nurs</i> 2017;43(10):13-20.								3	1	6	3	3
7	Al Qadire M, Alkhalaileh M. Jordanian oncology nurses' knowledge of managing chemotherapy-induced nausea and vomiting. <i>Br J Nurs</i> 2018;27(10):S4-s12.								2	1	4	1	4
8	Al Rabayah A et al. Assessing knowledge, attitude, and practices of health-care providers toward pharmacovigilance and adverse drug reaction reporting at a comprehensive cancer center in Jordan. <i>Perspect Clin Res</i> 2019;10(3):115-20.								2	1	1	5	1
9	Al Shemeili S et al. An exploration of health professionals' experiences of medicines management in elderly, hospitalised patients in Abu Dhabi. <i>Int J Clin Pharm</i> 2016;38(1):107-18.								2	4	6	1	1
10	Alexander D, Schnell M. Just what the nurse practitioner ordered: Independent prescriptive authority and population mental health. <i>Journal of Health Economics</i> 2019;66:145-62								5	1	8	8	2
11	Alharbi W et al. Exploring healthcare professionals' perceptions of medication errors in an adult oncology department in Saudi Arabia: A qualitative study. <i>Saudi Pharm J</i> 2019;27(2):176-81.								2	3	1	1	1
12	Ali MD et al. Knowledge, Practice and Attitudes Toward Pharmacovigilance and Adverse Drug Reactions Reporting Process Among Health Care Providers in Dammam, Saudi Arabia. <i>Curr Drug Saf</i> 2018;13(1):21-25.								2	1	8	1	1
13	Almandil N. Healthcare professionals' awareness and knowledge of adverse drug reactions and pharmacovigilance. <i>Saudi Med J</i> 2016;37(12):1359-64.								2	1	8	1	1
14	Almaskari A et al. Patients' and Nurses' Perceptions of Post-Coronary Artery Bypass Graft Learning Needs in Two Omani Hospitals. <i>Sultan Qaboos Univ Med J</i> 2019;19(2):e122-e28.								2	1	5	1	1
15	Alomari A et al. Effectiveness of Clinical Nurses' interventions in reducing medication errors in a paediatric ward. <i>Journal of Clinical Nursing</i> 2020								3	2	6	1	3
16	Alomari A et al. Pediatric Nurses' Perceptions of Medication Safety and Medication Error: A Mixed Methods Study. <i>Compr Child Adolesc Nurs</i> 2018;41(2):94-110.								3	4	6	1	3
17	Alqubaisi M et al. Quantifying behavioural determinants relating to health professional reporting of medication errors: a cross-sectional survey using the Theoretical Domains Framework. <i>Eur J Clin Pharmacol</i> 2016;72(11):1401-11.								2	1	8	1	1
18	Alsulami S et al. Knowledge, attitude and practice on medication error reporting among health practitioners in a tertiary care setting in Saudi Arabia. <i>Saudi Med J</i> 2019;40(3):246-51.								2	1	8	1	1
19	Alton S et al. Medication adherence in a nurse practitioner managed clinic for indigent patients. <i>J Am Assoc Nurse Pract</i> 2015;27(8):433-40.								5	1	3	2	2
20	Andersen L et al. A pilot study of a nurse-delivered cognitive behavioral therapy intervention (Ziphamandla) for adherence and depression in HIV in South Africa. <i>Journal of Health Psychology</i> 2018;23(6):776-87.								1	2	4	2	1
21	Anderson P et al. Nurse-led school-based clinics for rheumatic fever prevention and skin infection management: evaluation of Mana Kidz programme in Counties Manukau. <i>N Z Med J</i> 2016;129(1428):37-46.								3	2	6	2	3
22	Anderson R, Ferguson R. A nurse practitioner-led medication reconciliation process to reduce hospital readmissions from a skilled nursing facility. <i>Journal of the American Association of Nurse Practitioners</i> 2020;32(2):160-67.								5	2	8	3	2
23	Andersson Å et al. Factors contributing to serious adverse events in nursing homes. <i>J Clin Nurs</i> 2018;27(1-2):e354-e62.								4	1	7	3	3, 8
24	Andrilla C, Jones K, Patterson D. Prescribing Practices of Nurse Practitioners and Physician Assistants Waivered to Prescribe Buprenorphine and the Barriers They Experience Prescribing Buprenorphine. <i>Journal of Rural Health</i> 2020;36(2):187-95.								5	1	4	1	2, 8

25	Ankem K, Cho S, Simpson D. Nurses' perceptions and problems in the usability of a medication safety app. <i>Inform Health Soc Care</i> 2019;44(1):48-69.							5	2	8	7	8
26	Anrys P et al. Collaborative approach to Optimise MEdication use for Older people in Nursing homes (COME-ON): study protocol of a cluster controlled trial. <i>Implement Sci</i> 2016;11:35.							4	2	7	3	1
27	Apor E et al. Prechemotherapy Education: Reducing Patient Anxiety Through Nurse-Led Teaching Sessions <i>Clin J Oncol Nurs</i> 2018;22(1):76-82.							5	1	1	1	4
28	Aruda M et al. Evolving role of pediatric nurse practitioners. <i>J Am Assoc Nurse Pract</i> 2016;28(2):68-74.							5	1	6	2	2, 4
29	Aryani F et al. Chronic care model in primary care: can it improve health-related quality of life? <i>Integr Pharm Res Pract</i> 2016;5:11-17.							2	2	1	2	1
30	Asmirajanti M et al. Nursing care activities based on documentation. <i>BMC Nurs</i> 2019;18(Suppl 1):32.							2	1	7	1	1
31	Atinyagrika Adugbire B, Aziato L. Surgical patients' perspectives on nurses' education on post-operative care and follow up in Northern Ghana. <i>BMC Nurs</i> 2018;17:29.							1	3	1	1	1
32	Auty S et al. Buprenorphine waiver uptake among nurse practitioners and physician assistants: The role of existing waived prescriber supply. <i>Journal of Substance Abuse Treatment</i> 2020;115							5	1	4	1	2, 8
33	Bader F et al. Nurse-led education for heart failure patients in developing countries. <i>Br J Nurs</i> 2018;27(12):690-96.							2	2	1	1	1
34	Baldwin A, Rodriguez E. Improving Patient Safety With Error Identification in Chemotherapy Orders by Verification Nurses. <i>Clin J Oncol Nurs</i> 2016;20(1):59-65.							5	1	4	5	4
35	Baltzell K et al. "We were afraid of the lion that has roared next to us"; community response to reactive focal mass drug administration for malaria in Eswatini (formerly Swaziland). <i>Malar J</i> 2019;18(1):238.							1	3	4	2	1
36	Baniqued M et al. Social support from nurses and non-adherence with directly observed therapy (DOTS) maintenance phase among patients with tuberculosis in Metro Manila, Philippines. <i>Public Health Nurs</i> 2020;37(3):339-46.							2	1	1	2	1
37	Barja-Martínez E et al. Adherence to inhaled therapy in the outpatient setting. <i>Enferm Clin</i> 2019;29(1):34-38.							4	1	1	5	4
38	Bartlett Ellis R et al. Patient Perceptions of Provider and Hospital Factors Associated With New Medication Communication. <i>West J Nurs Res</i> 2016;38(9):1139-54. doi: 10.1177/0193945916645097 [published Online First: 2016/04/24]							5	1	7	1	1
39	Bartlett J, Kinsey J. Large-group, asynchronous, interprofessional simulation: Identifying roles and improving communication with student pharmacists and student nurses. <i>Curr Pharm Teach Learn</i> 2020;12(6):763-70.							5	2	8	7	8
40	Barton A et al. Clinical Inertia in a Randomized Trial of Telemedicine-Based Chronic Disease Management: Lessons Learned. <i>Telemed J E Health</i> 2018;24(10):742-48.							5	2	1	2	1
41	Bartosiewicz A, Januszewicz P. Readiness of Polish Nurses for Prescribing and the Level of Professional Burnout. <i>Int J Environ Res Public Health</i> 2018;16(1)							4	1	8	6	4
42	Bartosiewicz A, Różański A. Nurse Prescribing-Readiness of Polish Nurses to Take on New Competencies-A Cross-Sectional Study. <i>Healthcare (Basel)</i> 2019;7(4)							4	1	8	2	1
43	Basile L et al. Incident analysis occurrence related to potentially dangerous medicines distributed in teaching hospital. <i>Rev Gaucha Enferm</i> 2019;40(spe):e20180220.							6	1	8	1	1
44	Baumann S, Greif N. The use of PRNs medications with hospitalized older adults. <i>Geriatr Nurs</i> 2017;38(6):596-98.							2	3	6	1	1

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45	Bayraktar-Ekincioglu A, Kucuk E. The differences in the assessments of side effects at an oncology outpatient clinic. <i>Int J Clin Pharm</i> 2018;40(2):386-93.								2	1	1	5	1
46	Becker W et al. Evaluation of an Integrated, Multidisciplinary Program to Address Unsafe Use of Opioids Prescribed for Pain. <i>Pain Med</i> 2018;19(7):1419-24.								5	2	4	2	7
47	Been-Dahmen J et al. Evaluating the feasibility of a nurse-led self-management support intervention for kidney transplant recipients: a pilot study. <i>BMC Nephrol</i> 2019;20(1):143.								4	2	5	5	2
48	Begum F et al. Antipsychotic medication side effects knowledge amongst registered mental health nurses in England: A national survey. <i>Journal of Psychiatric and Mental Health Nursing</i> 2020								4	1	4	4	3, 4
49	Bennett M et al. Self-management toolkit and delivery strategy for end-of-life pain: the mixed-methods feasibility study. <i>Health Technol Assess</i> 2017;21(76):1-292.								4	4	4	2	6
50	Berry D et al. Imbedding Interdisciplinary Diabetes Group Visits Into a Community-Based Medical Setting. <i>Diabetes Educ</i> 2016;42(1):96-107.								5	2	3	2	2
51	Bessa A et al. Prospective Randomized Trial Investigating the Influence of Pharmaceutical Care on the Intra-Individual Variability of Tacrolimus Concentrations Early After Kidney Transplant. <i>Ther Drug Monit</i> 2016;38(4):447-55.								6	2	5	8	1
52	Best J et al. The Impact of Scripted Pain Education on Patient Satisfaction in Outpatient Abdominal Surgery Patients. <i>J Perianesth Nurs</i> 2018;33(4):453-60.								5	2	5	5	1
53	Billington J et al. Evaluation of a Nurse-Led Educational Telephone Intervention to Support Self-Management of Patients With Chronic Obstructive Pulmonary Disease: A Randomized Feasibility Study. <i>Copd</i> 2015;12(4):395-403.								4	2	5	2	1
54	Bingham J et al. The Discharge Companion Program: An Interprofessional Collaboration in Transitional Care Model Delivery. <i>Pharmacy (Basel)</i> 2019;7(2)								5	1	6	1	4
55	Binkowska-Bury M et al. Nurse prescribing in Poland: Opinions expressed by primary care doctors, nurses, and patients. <i>Medicine (Baltimore)</i> 2016;95(33):e4506								4	1	8	2	1
56	Black A et al. A comparison between independent nurse prescribing and patient group directions in the safety and appropriateness of medication provision in United Kingdom sexual health services: A mixed methods study. <i>International Journal of Nursing Studies</i> 2020;								4	4	1	5	1
57	Blackstone S et al. 'I believe high blood pressure can kill me:' using the PEN-3 Cultural Model to understand patients' perceptions of an intervention to control hypertension in Ghana. <i>Ethn Health</i> 2019;24(3):257-70.								1	3	1	2	1
58	Bogolubova S, Padayachee N, Schellack N. Knowledge, attitudes and practices of nurses and pharmacists towards adverse drug reaction reporting in the South African private hospital sector. <i>Health SA</i> 2018;23:1064.								1	1	8	1	3
59	Bonaudo M et al. Medication discrepancies across multiple care transitions: A retrospective longitudinal cohort study in Italy. <i>PLoS One</i> 2018;13(1):e0191028.								4	1	8	1	1
60	Bourne R et al. Reliability of clinical impact grading by healthcare professionals of common prescribing error and optimisation cases in critical care patients. <i>Int J Qual Health Care</i> 2017;29(2):250-55.								4	1	8	1	1
61	Bowen J et al. Nurses' attitudes and behaviors on patient medication education. <i>Pharm Pract (Granada)</i> 2017;15(2):930.								5	1	8	1	1
62	Bower R et al. A qualitative, exploratory study of nurses' decision-making when interrupted during medication administration within the Paediatric Intensive Care Unit. <i>Intensive Crit Care Nurs</i> 2018;44:11-17.								4	3	7	1	4
63	Bowman C et al. Comparison of Medication History Accuracy Between Nurses and Pharmacy Personnel. <i>J Pharm Pract</i> 2019;32(1):62-67.								5	1	8	1	1

64	Bradley K et al. Alcohol-Related Nurse Care Management in Primary Care: A Randomized Clinical Trial. <i>JAMA Intern Med</i> 2018;178(5):613-21.							5	2	2	2	8
65	Brett J et al. Adjuvant endocrine therapy after breast cancer: a qualitative study of factors associated with adherence. <i>Patient Prefer Adherence</i> 2018;12:291-300							4	3	1	2	4
66	Broom J et al. How do hospital respiratory clinicians perceive antimicrobial stewardship (AMS)? A qualitative study highlighting barriers to AMS in respiratory medicine. <i>J Hosp Infect</i> 2017;96(4):316-22.							3	3	8	1	1
67	Bucknall T et al. Nurses' decision-making, practices and perceptions of patient involvement in medication administration in an acute hospital setting. <i>Journal of Advanced Nursing</i> 2019;75(6):1316-27.							3	3	8	1	1
68	Bui J et al. Senior nurses' perspectives on the transfer of opioid substitution treatment clients from clinics to community pharmacy. <i>Drug Alcohol Rev</i> 2015;34(5):495-98.							3	3	8	1	1
69	Bull E et al. Developing nurse medication safety training in a health partnership in Mozambique using behavioural science. <i>Global Health</i> 2017;13(1):45.							1	4	8	1	1
70	Byrne C, Sierra H, Tolhurst R. Does a checklist reduce the number of errors made in nurse-assembled discharge prescriptions? <i>Br J Nurs</i> 2017;26(8):464-67.							4	1	8	1	1
71	Campling N et al. Self-management support at the end of life: Patients', carers' and professionals' perspectives on managing medicines. <i>Int J Nurs Stud</i> 2017;76:45-54.							4	3	5	1	4
72	Cantey J, Vora N, Sunkara M. Prevalence, Characteristics, and Perception of Nursery Antibiotic Stewardship Coverage in the United States. <i>J Pediatric Infect Dis Soc</i> 2017;6(3):e30-e35.							5	4	6	1	1
73	Carlos Patiag M, Farrar Highfield M. RN Evaluation of Errorless Methods in Teaching Discharge Medications to Cognitively Challenged Patients. <i>Rehabil Nurs</i> 2017;42(6):312-18.							5	1	2	1	3
74	Carpenter D et al. Using Tailored Videos to Teach Inhaler Technique to Children With Asthma: Results From a School Nurse-Led Pilot Study. <i>J Pediatr Nurs</i> 2016;31(4):380-9.							5	2	1	2	1
75	Carter E et al. Exploring the nurses' role in antibiotic stewardship: A multisite qualitative study of nurses and infection preventionists. <i>American Journal of Infection Control</i> 2018;46(5):492-97.							5	3	6	1	1
76	Carter E et al. Clinical Nurse Preparation and Partnership in Antibiotic Stewardship Programs: National Survey Findings Are a Call to Action for Nurse Leaders. <i>J Nurs Adm</i> 2019;49(12):591-95.							5	1	8	1	1
77	Casey M et al. "Providing a complete episode of care": A survey of registered nurse and registered midwife prescribing behaviours and practices. <i>J Clin Nurs</i> 2020;29(1-2):152-62.							4	1	8	1	3
78	Castilho E et al. Potential drug-drug interactions and polypharmacy in institutionalized elderly patients in a public hospital in Brazil. <i>J Psychiatr Ment Health Nurs</i> 2018;25(1):3-13.							6	1	6	1	1
79	Castro-Sánchez E et al. Nurse roles in antimicrobial stewardship: Lessons from public sectors models of acute care service delivery in the United Kingdom. <i>Antimicrobial Resistance and Infection Control</i> 2019;8(1)							4	1	8	1	1
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449	Zarzeka A et al. Nurse prescribing: Attitudes of medical doctors towards expanding professional competencies of nurses and midwives. <i>J Pak Med Assoc</i> 2019;69(8):1199-204.								4	1	8	1	1
450	Zarzeka A et al. Nurse prescribing. Knowledge and attitudes of Polish nurses in the eve of extending their professional competences: cross-sectional study. <i>Acta Pol Pharm</i> 2017;74(3):1031-38.								4	1	8	8	6
451	Zeng D et al. Attitudinal Barriers to Pain Management and Associated Factors Among Cancer Patients in Mainland China: Implications for Cancer Education. <i>J Cancer Educ</i> 2020;35(2):284-91.								2	1	1	8	1
452	Zimmer A et al. Optimizing treatment initiation: Effects of a patient education program about fingolimod treatment on knowledge, self-efficacy and patient satisfaction. <i>Mult Scler Relat Disord</i> 2015;4(5):444-50.								4	2	1	1	1
453	Zimmermann A et al. The implementation process of nurse prescribing in Poland—A descriptive study. <i>International Journal of Environmental Research and Public Health</i> 2020;17(7)								4	1	8	8	1

Appendix 4.2

Table: Overview of nurses' tasks in pharmaceutical care, with clustering of similar and comparable tasks described in recent literature

Observation, monitoring medication effects
Observations of effects and side effects
Observing and recording patients for taking each dose
Observing adherence
Adherence monitoring
Monitoring side effects
Medication monitoring
Monitoring of the individual and his medication
Intensive monitoring of ADR
Drug monitoring
Structured monitoring
Evaluation of individual patient's responses to treatment
Evaluate clinical status for effects
Evidence based patient monitoring for adverse treatment effects
Monitoring parameters
Supervision of patients
Telephone monitoring
Assessing patients' competences
Assessing self-administration competences
Assessing patient competency
Assessing patient's management of adverse effects
Assessing compliance and factors hindering compliance
Assessing medication adherence
Detecting lack of adherence
Reviewing patients' compliance
Assessing and addressing patients' / family's needs
Assessing patients' needs
Assessing patients' preferences
Clarifying patients' expectations
Patient needs assessment
Assessing the compliance and factors hindering the implementation
Assessing adherence motivation
Evaluation of clinical status for indications
Assessing and managing therapeutic effects
Symptom management
Identification of medication goals
Ensuring patients receive optimal therapy
Recognising & preventing risks / complications / DRPs
Preventing complications
Preventing medication related problems
Preventing ADRs
Preventing medication errors
Risk prevention
Abuse/misuse prevention
(Early) identifying, detecting potential ADRs and interactions
Identifying potential medication absorption issues
Identifying potentially harmful medicines or medication combinations
Providing patients with information on the safekeeping and proper disposal of medicines
Promoting safe medication use
Improving medication error awareness
Improving processes for medication administration
Ensuring medication safety
Identifying, assessing, reporting & addressing contra-indications / DRPs
Identification of medication side effects
Notifying medication incidents
Detecting lack of adherence
Recognising complications
Assessing DRPs
DRP screening
Assessing side effects
Evaluating contra-indications

Assessing ADRs
 Analysing all medication errors
 Assessing medication safety
 Reporting medication errors
 Reporting medication administration errors
 (Spontaneous) reporting of ADRs
 Reporting DRPs
 Management of adverse events
 (Early) identification of medication-related problems
 Management of medication side effects
 Managing ADRs
 Judging drug-risk-benefit
 Risk assessment
 Clinical judgement

Documentation, registration in patient files

Documenting nursing care
 Documentation of medication rounds
 Documentation in patient records

Communication with patient / family, including discussion & advice

Communication about medication with patient and family
 Discussing aberrancies during medication monitoring
 Providing advice about medication
 Providing medication management advice
 Providing (telephone) advice
 Advising patients to take their medicines as prescribed
 Communication and collaboration between nurse-patient
 Discussing with family

Inter / intraprofessional communication, including reporting, advising, informing, alerting and discussing

Interprofessional communication
 Interprofessional dialogue
 Interprofessional discussions
 Pharmacist-nurse communication
 Physician-nurse communication
 Intraprofessional communication (nurse-nurse)
 Discussing with prescribers
 Interprofessional collaboration
 Reporting DRPs
 Advising on administration route
 Informing other professionals

Evidence based practice

EBP
 Research
 Evidence based care
 Evidence based patient monitoring
 Evidence based education

Decision making

(Clinical) decision making
 Deciding on medication dose
 Deciding to administer medication
 Clinical reasoning
 Decision making on medication safety management

Inter / intraprofessional referrals

Referring for treatment if needed
 Interprofessional referrals
 Intraprofessional referrals

(Selfcare) support, empowerment

Supporting self-care management
 Supporting self-management
 Supporting self-care
 Improving self-care
 Supporting patients and family members
 Medication support home visits
 Supporting medication management
 Supporting patients to take their medication as prescribed
 Supporting medication adherence
 Supporting self-care management
 Supportive care on medication adherence

Encouraging patients to take medication
 Reinforcing medication adherence
 Improving medication adherence
 Enhancing medication adherence
 Promoting medication adherence
 Promoting medication management
 Empowering patients to self-manage their disease
 Empowering medication self-management
 Patient empowerment
 Strengthening patient involvement
 Strengthening patient/family engagement
 Motivating patients

Therapeutic education (counselling, coaching, training patient / family)

Informing patient & family on medication management
 Providing patient and family information
 Educating patient & family on medication management
 Giving therapeutic education
 Giving evidence based education
 Teaching patient & family
 Coaching patient & family
 Training patient & family
 Counselling patients on medication management
 Providing adherence counselling
 (Follow-up) counselling
 Facilitating/framing/filtering medication information for patients
 Examples of therapeutic education:
 - pharmacodynamic nurse consultation
 - nurse (telephone) consultation
 - nurse-led patient educational programs
 - support and consultation programs to family members
 - abortion counselling
 - pre-discharge education and training
 - educating patients on: safekeeping and proper disposal of medication, drug administration, self-management, management of adverse effects, medication adherence, treatment schedule, medication regimen, treatment related anxiety

Antimicrobial stewardship

Antibiotic stewardship
 Antimicrobial stewardship
 Ensuring optimal use of antimicrobials
 Ensuring optimal prescribing of antimicrobials

Motivational interviewing

Motivational interviewing
 Motivational adherence counselling
 Assessing adherence motivation
 Assessing medication adherence
 Promoting medication adherence
 Reinforcing medication adherence
 Improving medication adherence
 Enhancing medication adherence

Initiation of medication (reactive/proactive)

(Electronic) prescribing
 Nurse prescribing
 Non-medical prescribing
 Independent nurse prescribing
 Prescribing controlled substances
 Autonomous prescribing
 Issuing prescriptions
 Medication initiation
 Medication abortion provision
 Medical assistance in dying

Determination and adaptation of type / dosage of medication

Management of dosing
 Determining dosage and type of medication (based on protocol)
 Dose titration
 Medication titration
 Dose adaptation
 Reducing dosage of current medication
 Optimising medicines administration by changing route and formulation

Addressing needed medication changes
Changing the medication regimen to safer alternatives
Adjusting medication
Adjusting medical treatment
Decision on continuation / cessation of medication
Deprescribing
Initiating timeouts
Reducing polypharmacy
Continuation of prescriptions
PRN (pro re nata, 'if needed' medication) / standing prescription order
No other terminology used in included papers
Medication reconciliation (anamnesis, medication histories, ...)
Medication anamnesis
History taking
Obtaining medication histories
Performing medication history interviews
Assessing medication history
Creating an accurate up-to-date medication list
History collection in preparation of medication reconciliation
(Discharge) medication reconciliation
Reconciling medication discrepancies
Comparing medication lists
Detecting medication order discrepancies
Identifying medication discrepancies
Evaluating drug discrepancies
Identifying potentially inappropriate prescribing
Medication review
Preparing medication review
Initiating pharmaceutical review
Medication review
Interprofessional medication review
Drug utilization review
Reviewing medicines and advising on changes
Reviewing medicines and making recommendations to change patients' medication regimen
Evaluating prescribing practices and safe prescribing
Overseeing safe prescribing
Intervention in case of emergency
No other terminology used in included papers
Follow-up of patients and medication regimens
Performing follow-up care
Follow-up counselling
Performing follow-up visits
Performing follow-up calls
Performing follow-up tele-medicine
Performing post discharge follow-up
Following-up medication, symptoms, discharge instruction comprehension, needs, medication adherence
Discharge planning, transition of care planning
Transitional care collaboration
Transmural communication
Informing and coordinating healthcare personnel
Exchanging health information between hospitals and human healthcare
Care coordination
Coordinating care transition
Coordinating transitional care
Coordinating transition of care on medicines
Care coordination for drug-drug interactions
Medication management across care transitions
Transitional care management
Transitional pharmaceutical care
Discharge management
Discharge planning
Hospital discharge planning
Preparing well-informed discharge summaries
Performing handovers between nurses
Collegial mentoring
No other terminology used in included papers

Appendix 5.1

Table: Percentages of physicians, pharmacists and nurses considering 26 tasks in seven pharmaceutical care domains as nurses' tasks in order to obtain best quality of care and patient outcomes

Task number	Management of therapeutic and adverse effects (n=734)			Management of medicines adherence (n=796)			Management of medication self-management (n=726)			Management of patient education and information (n=731)			Prescription management (n=669)			Medication safety management (n=738)			(Transition of) care coordination (n=711)		
	Nurses (n=486)	Physicians (n=133)	Pharmacists (n=115)	Nurses (n=513)	Physicians (n=136)	Pharmacists (n=101)	Nurses (n=487)	Physicians (n=141)	Pharmacists (n=103)	Nurses (n=449)	Physicians (n=133)	Pharmacists (n=115)	Nurses (n=486)	Physicians (n=127)	Pharmacists (n=93)	Nurses (n=494)	Physicians (n=142)	Pharmacists (n=102)	Nurses (n=474)	Physicians (n=135)	Pharmacists (n=102)
1	98.0	95.8	89.8	96.3	97.2	92.5	97.3	100	85.7	97.5	97.2	85.6	77.1	55.3	48.4	96.9	67.8	87.7	95.4	68.8	87.0
2	95.5	95.6	91.2	95.4	97.7	94.2	98.0	98.6	89.1	97.0	97.2	83.7	80.3	55.6	47.8	97.2	65.1	85.7	95.7	68.1	87.5
3	96.3	98.5	90.2	97.5	97.8	93.1	97.6	99.3	90.5	97.2	97.9	89.6	82.1	86.4	68.9	96.8	95.1	88.6	95.9	95.7	88.7
4	96.9	93.9	85.7	96.8	98.5	81.5	97.4	97.1	85.4	97.4	97.9	89.6	80.8	86.6	53.1	96.7	93.8	81.6	96.0	92.1	81.2
5	91.3	91.0	79.1	93.7	91.8	78.4	94.8	96.3	77.7	95.0	97.2	86.8	80.0	85.3	60.0	95.0	92.1	78.6	92.9	93.9	77.2
6	94.1	93.9	83.9	95.2	97.1	85.0	96.1	96.5	82.9	94.3	93.9	79.8	78.9	88.5	69.4	96.2	91.7	85.8	94.5	93.6	82.5
7	94.9	87.6	82.0	94.3	92.1	81.5	93.9	94.0	83.2	94.3	93.9	79.8	76.3	83.6	54.5	94.2	89.9	77.1	93.9	89.1	83.8
8	84.7	79.1	73.9	88.0	83.8	70.5	88.4	85.5	73.5	90.1	87.9	71.4	67.3	75.2	36.7	87.5	81.9	65.3	86.3	80.9	71.6
9	94.0	91.3	86.1	95.3	95.5	86.9	96.3	97.2	85.0	95.5	97.9	83.7	79.7	90.6	66.3	95.2	95.0	89.4	95.3	92.1	85.6
10				96.6	98.5	85.3															
11				96.8	96.2	89.8	95.2	96.5	88.3	95.3	97.9	82.5									
12	87.2	84.4	80.4	90.3	88.7	78.7	88.9	91.2	80.2	89.7	87.5	72.5	71.5	80.2	50	88.8	86.8	77.6	88.6	85.6	77.1
13	85.4	64.9	63.2	88.9	63.6	68.5	88.1	92.0	72.0	88.6	88.8	63.4	69.1	81.4	47.9	88.9	85.6	62.5	89.2	65.9	71.8
14	96.3	69.5	80.0	97.5	96.2	88.1	97.0	97.1	84.3	97.8	97.2	82.7	73.9	82.5	50.5	96.4	93.0	85.6	95.6	93.3	85.4
15	93.6	89.2	82.5	95.2	92.5	82.7	93.4	90.4	80.8	94.1	92.1	81.0				93.1	92.2	81.4	93.2	84.0	82.0
16													53.8	40.6	26.9						
17													57.1	38.1	27.7						
18													55.2	39.0	28.1						
19													57.0	35.2	26.9						
20													64.8	54.0	43.0						
21													68.5	59.4	38.3						
22													66.0	49.2	43.7						
23													77.8	65.2	45.7	94.8	94.6	85.4			
24																			88.4	90.2	76.0
25	90.6	90.2	84.7	94.2	92.4	86.5	94.3	92.2	86.4	92.9	94.2	79.8	78.6	68.2	55.4	92.8	93.5	85.7	91.8	93.3	84.7
26	95.3	86.6	86.8	93.8	93.8	85.1	92.3	97.7	82.8	94.3	95.6	83	75.9	66.7	53.7	92.3	94.3	85.6	92.7	93.2	84.8

Overview of tasks 1-26: see table 5.1

The colours indicate the level of responsibility that was most prevalent for each task per professional group (= mode): green = full autonomy; yellow = shared responsibility; orange = under supervision; red = not allowed. p-value calculated with chi squared tests for the difference in opinion (to be performed by nurses or not) between nurses, pharmacists and physicians

Appendix 5.2

Table: Restrictions to optimise nurse prescribing in an ideal interprofessional healthcare situation (n =537)















Restrictions	All %(n)	Physician s %(n)	Pharmacist s %(n)	Nurses %(n)	p
Only after specific training	60.9 (325)	57.6 (38)	78.7 (37)	59.1 (247)	0.028
Only a restricted list of medicines	54.1 (289)	62.1 (41)	57.4 (27)	52.9 (221)	0.340
Only in a specific context, pathology / specialisation	43.3 (231)	51.5 (34)	51.1 (24)	40.9 (171)	0.140
Only within an individual patient clinical management plan	36.3 (194)	47.0 (31)	46.8 (22)	33.5 (140)	0.032
Only low risk medicines	31.1 (166)	28.8 (19)	44.7 (21)	29.9 (125)	0.106
Only long-term chronic medicines	30.3 (162)	39.4 (26)	51.1 (24)	26.8 (112)	0.001
Only in emergency	23.2 (124)	25.8 (17)	17.0 (8)	23.7 (99)	0.524
Prescription-only medicines only	19.1 (102)	18.2 (12)	19.1 (9)	19.4 (81)	0.974
No restrictions	6.8 (39)	2.9 (2)	4.1 (2)	7.7 (35)	0.251
Other	1.7 (9)	4.5 (3)	0	1.4 (6)	0.123

Chi² tests were used to calculate p-values for the difference in opinion between physicians, pharmacists & nurses.

Bold numbers indicate p<0.05.

Appendix 5.3








Table: Percentages of healthcare professionals considering 19 tasks within six^{\$} pharmaceutical care domains as nurses' tasks in order to obtain best quality of care and patient outcomes, split up for 14 countries

	 Belgium n = 710	 Czech Republic n = 233	 Germany n = 48	 Greece n = 218	 Hungary n = 24	 Italy n = 676	 The Netherlands n = 54	 North Macedonia n = 75	 Norway n = 50	 Portugal n = 64	 Slovakia n = 691	 Slovenia n = 400	 Spain n = 337	 UK n = 107	p
T1	97.4	93.3	94.6	98.6	75.9	98.1	98.7	88.0	100	100	83.4	93.3	93.9	93.9	<0.001
T2	95.9	95.4	88.7	97.4	77.8	98.1	100	87.7	100	100	85.4	93.3	93.0	92.1	<0.001
T3	95.5	95.8	94.4	96.6	77.8	98.9	96.8	87.3	100	100	97.9	92.2	94.4	94.5	<0.001
T4	92.5	94.1	97.7	97.3	78.3	98.4	100	82.6	100	100	94.5	91.9	93.4	96.3	<0.001
T5	85.0	92.0	95.3	96.8	77.3	97.1	86.1	70.5	100	100	93.1	88.8	90.8	91.6	<0.001
T6	88.8	92.2	98.0	98.2	76.0	95.2	98.1	90.8	100	100	99.0	88.8	92.0	94.9	<0.001
T7	83.6	92.0	93.5	96.1	76.9	96.0	98.0	80.3	93.8	100	96.8	87.8	91.6	95.2	<0.001
T8	69.9	93.8	71.4	88.2	73.1	92.6	90.4	64.9	97.1	97.0	86.7	85.5	84.0	88.2	<0.001
T9	90.8	95.9	90.6	93.1	69.2	97.3	98.4	87.2	100	100	97.5	90.1	90.2	97.6	<0.001
T10	96.1	90.9		97.9		98.5					96.6	89.2	94.1		<0.001
T11	95.6	94.7	96.6	91.5		97.6	96.8	78.9	100	100	98.6	89.5	91.6	90.7	<0.001
T12	74.8	90.1	63.6	93.5	70.8	95.7	89.4	72.2	91.9	100	90.4	86.8	85.7	89.0	<0.001
T13	77.1	90.4	90.4	92.6	69.6	96.9	96.7	82.4	100	100	65.5	84.2	84.6	80.0	<0.001
T14	93.1	95.9	98.0	96.6	76.9	97.2	100	93.4	100	100	92.8	88.1	93.2	96.0	<0.001
T15	85.4	92.2	94.0	96.6	76.9	94.7	100	83.6	100	100	96.8	96.0	90.1	87.1	<0.001
T23	90.2	88.4		97.6		97.1					97.9	90.0	95.7		<0.001
T24	81.6	80.0		97.6		94.2					88.3	78.8	82.8		<0.001
T25	85.5	91.9	94.0	93.8	75.0	95.6	100	87.2	98.1	100	94.7	87.7	90.9	94.8	<0.001
T26	89.6	92.3	95.8	95.6	76.0	93.8	100	84.8	100	100	95.3	87.9	89.0	95.0	<0.001

Overview of tasks (T1, T2,...,T26): see table 5.1. ^{\$}six domains: 1) Management of therapeutic and adverse effects of medicines; 2) Management of medicines adherence; 3) Management of patient medication self-management; 4) Management of patient education and information; 5) Medication safety management; 6) (Transition of) care coordination. The colors indicate the level of responsibility that was most prevalent for each task per country (= mode): green = full autonomy; yellow = shared responsibility; orange = under supervision; red = not allowed. Blank cells: no percentage presented because of insufficient valid responses for this task in this country (n<28). p calculated with Kruskal-Wallis test for the difference in level of responsibility between countries. Only countries with ≥28 responses were taken into account. n = mean number of valid responses. Numbers differ from respondents per country since tasks were part of several PC domains and hence shown multiple times.

Appendix 5.4

Table: Percentages of healthcare professionals considering 22 tasks within prescription management as nurses' tasks in order to obtain best quality of care and patient outcomes, split up for seven countries

	 Belgium (n=134)	 Czech Republic (n=38)	 Greece (n=43)	 Italy (n=130)	 Slovakia (n=127)	 Slovenia (n=74)	 Spain (n=64)	p-value
T1	76.3	77.5	81.8	85.1	15.4	81.6	81.8	<0.001
T2	79.5	81.8	86.4	87.8	17.3	83.3	82.4	<0.001
T3	79.4	80.0	86.0	93.0	64.8	82.2	89.4	<0.001
T4	76.1	74.4	88.4	91.5	56.2	81.6	83.3	<0.001
T5	71.5	71.8	88.4	91.5	64.6	81.6	80.3	<0.001
T6	70.1	76.3	88.6	87.7	71.4	75.8	80.3	<0.001
T7	62.1	66.7	87.8	89.2	63.5	78.4	82.0	<0.001
T8	47.6	68.6	75.0	84.1	46.0	78.4	68.8	<0.001
T9	77.8	74.4	84.4	90.7	65.9	82.4	85.7	<0.001
T12	57.9	67.6	85.4	86.6	48.0	80.8	82.0	<0.001
T13	60.0	66.7	86.0	89.3	42.6	73.3	71.0	<0.001
T15	70.7	69.2	88.9	86.0	50.0	81.3	67.7	<0.001
T16	30.7	53.3	72.1	78.0	11.1	51.4	65.6	<0.001
T17	37.7	55.8	68.9	77.1	12.5	51.4	65.1	<0.001
T18	39.7	52.3	66.7	76.6	11.1	52.1	58.7	<0.001
T19	39.4	60.5	62.8	75.4	10.2	50.0	66.7	<0.001
T20	79.0	61.1	76.2	79.8	14.0	49.3	67.7	<0.001
T21	75.4	75.7	76.2	82.0	21.5	53.4	75.0	<0.001
T22	56.6	61.5	67.4	77.3	13.3	76.3	82.1	<0.001
T23	78.2	70.0	88.6	92.2	18.4	81.6	81.5	<0.001
T25	73.2	77.8	90.7	91.4	31.8	84.9	85.7	<0.001
T26	75.4	66.7	90.2	85.2	33.6	81.7	80.6	<0.001

Overview of tasks (T1, T2,...T26): see table 5.1. The colours indicate the level of responsibility that was most prevalent for each task per country (= mode): **green** = full autonomy; **yellow** = shared responsibility; **orange** = under supervision; **red** = not allowed. p calculated with Kruskal-Wallis test for the difference in level of responsibility between countries. Only 7 countries with ≥ 28 responses were taken into account.

Appendix 5.5

Table: Percentages of healthcare professionals considering 26 tasks in seven pharmaceutical care domains as nursing tasks in order to perform best quality of care and patient outcomes, distinguished between level 5-6-7-8* nurses

Task number	Management of therapeutic and adverse effects (n=336)				Management of medicines adherence (n=356)				Management of medication self-management (n=338)				Management of patient education (n=328)				Prescription management (n=250)				Medication safety management (n=335)				(Transition of) care coordination (n=311)			
	Level 5 nurse	Level 6 nurse	Level 7 nurse	Level 8 nurse	Level 5 nurse	Level 6 nurse	Level 7 nurse	Level 8 nurse	Level 5 nurse	Level 6 nurse	Level 7 nurse	Level 8 nurse	Level 5 nurse	Level 6 nurse	Level 7 nurse	Level 8 nurse	Level 5 nurse	Level 6 nurse	Level 7 nurse	Level 8 nurse	Level 5 nurse	Level 6 nurse	Level 7 nurse	Level 8 nurse	Level 5 nurse	Level 6 nurse	Level 7 nurse	Level 8 nurse
1	98.6	99.7	100	100	99.7	100	99.7	100	99.7	100	99.7	100	98.9	100	100	100	95.0	98.6	99.3	99.6	99.2	99.7	100	100	99.1	99.4	100	99.7
2	99.1	100	100	100	99.2	100	99.7	100	99.4	100	99.7	100	99.4	100	100	100	96.0	98.2	99.6	99.6	99.4	100	100	100	99.7	99.1	99.7	99.4
3	98.9	100	100	100	98.6	100	99.7	100	99.2	100	99.7	100	99.4	100	100	100	97.5	97.9	99.6	99.6	99.7	100	100	100	99.7	99.1	99.7	99.4
4	98.0	100	100	100	98.4	99.7	99.5	99.7	98.9	99.7	99.4	100					95.8	97.9	100	100	98.9	99.5	99.4	99.7	98.1	99.4	99.7	99.4
5	97.3	99.1	100	100	96.2	99.2	99.4	99.7	98.2	100	99.4	99.7					96.0	97.9	99.6	100	98.5	99.1	99.7	99.7	98.1	99.1	99.7	99.3
6	97.9	99.4	99.7	100	97.8	99.2	99.7	100	97.4	99.7	99.4	99.7	97.9	100	100	100	96.0	98.6	100	100	98.6	99.7	100	100	98.1	99.4	100	99.7
7	94.7	97.9	99.4	100	96.4	98.0	99.7	100	96.9	99.1	99.7	100	95.9	99.4	100	100	93.6	97.7	100	100	96.6	98.8	100	100	97.0	98.4	99.3	99.0
8	95.7	99.4	99.7	99.7	93.1	97.0	98.2	99.4	97.7	99.0	99.7	100	96.7	100	100	100	90.0	96.6	99.2	99.6	96.3	98.7	98.7	99.3	95.4	97.2	99.3	98.9
9	98.0	100	100	100	98.1	100	99.7	100	99.2	100	99.4	100	99.1	100	100	100	95.4	98.6	100	100	98.8	100	100	100	98.8	99.7	100	99.7
10					98.4	100	99.7	100																				
11					97.5	99.7	99.7	100	98.8	99.4	99.4	99.7	98.5	99.7	100	100												
12	95.5	97.2	99.4	100	93.5	98.8	99.7	100	96.7	98.4	99.0	100	95.9	99.3	100	100	93.1	95.9	99.6	100	96.0	99.3	100	100	95.2	98.0	99.0	99.3
13	95.3	98.2	100	100	97.0	98.5	99.4	99.7	97.3	99.0	99.7	100	97.6	98.7	99.7	99.7	93.7	98.1	99.6	100	96.5	99.4	100	100	96.2	99.0	99.7	99.3
14	98.5	99.7	100	100	97.8	99.5	99.7	100	98.6	99.7	99.7	100	98.9	99.4	100	100	98.0	99.4	100	100	98.0	99.4	100	100	98.8	98.8	100	99.7
15	95.6	98.8	99.7	99.7	96.5	99.2	99.4	100	98.7	99.7	99.7	100	96.6	99.7	100	100	91.4	96.6	100	100	98.2	100	100	100	93.2	84.0	82.0	99.3
16					83.3	90.2	96.4	98.9									83.3	90.2	96.4	98.9								
17					82.1	91.3	96.1	98.0									82.1	91.3	96.1	98.0								
18					80.2	89.1	96.0	97.5									80.2	89.1	96.0	97.5								
19					84.4	90.1	97.0	98.5									84.4	90.1	97.0	98.5								
20					89.3	95.3	99.1	98.7									89.3	95.3	99.1	98.7								
21					91.4	95.8	99.2	99.1									91.4	95.8	99.2	99.1								
22					89.2	93.6	98.3	98.7									89.2	93.6	98.3	98.7								
23					93.6	97.2	100	99.6									93.6	97.2	100	99.6	96.8	99.4	100	100	94.1	97.3	99.0	99.0
24																												
25	95.4	99.4	100	100	97.1	99.1	99.7	100	98.2	99.7	99.7	100	97.8	99.7	100	100	94.7	97.0	100	100	97.8	99.7	99.6	99.7	96.1	99.0	100	99.7
26	93.3	98.2	99.7	100	94.2	98.8	99.4	100	95.9	99.4	99.4	99.7	95.2	99.4	100	100	91.7	95.4	99.6	100	96.3	99.1	99.7	99.7	95.3	98.7	100	99.7

Overview of tasks 1-26; see table 5.1. *Level 5-6-7-8 nurses: level of education according to the European Qualifications Framework (EQF)³⁸

The colours indicate the level of responsibility that was most prevalent for each task per level of nurse education and per PC domain (= mode): green = full autonomy; yellow = shared responsibility; orange = under supervision. Blank cells indicate the task was not presented to the participants

Appendix 6.1

Table: Detailed database search strategy

Database	Search terms	Number of articles
PubMed	("Vocational Education"[Mesh]) OR "Education, Nursing"[Mesh] OR training[Title/Abstract] AND (Nursing[Mesh] OR Nurses[Mesh] OR Nurse[tiab] OR Nursing [tiab]) AND (Role*[tiab] OR Responsibilit* [tiab]) AND (Professional Competence[Mesh] OR Technical Expertise[tiab] OR Clinical Competence[Mesh] OR Competenc*[tiab] OR Skill*[tiab] OR Attitude of Health Personnel[Mesh] OR Staff Attitude* [tiab] OR Health Personnel Attitude*[tiab] OR Health Knowledge, Attitudes, Practice[Mesh] OR Knowledge[tiab] OR Collaboration[tiab] OR Cooperation[tiab]) AND (Treatment Adherence and Compliance[Mesh] OR Pharmacotherapeutic [tiab] OR Drug Prescription[Mesh] OR Medication[tiab] OR Drug*[tiab]) AND (Monitoring[tiab] OR Adherence[tiab] OR Safety[tiab] OR Process[tiab] OR Management[tiab])	235
ERIC	Vocational Education OR Education OR training) AND (Nursing OR Nurses) AND (Responsibility) AND (Professional Competence OR Technical Expertise OR Clinical Competence OR Competence OR Skill OR Attitude OR Knowledge OR Collaboration OR Cooperation) AND (Treatment Adherence OR treatment Compliance OR Pharmacotherapeutic OR Drug Prescription OR Medication OR Drug) AND (Monitoring OR Adherence OR Safety OR Process OR Management	154

Appendix 6.2

Table: Results of the scoping review

	Reference number	Described competence in literature
Knowledge	1-13	Anatomy, physiology, pharmacokinetics, pharmacodynamics, toxicology, medication delivery routes, medicine forms
	4, 13, 14	Legislation
	15	Know to link medications to medical conditions
	15, 16	How to identify current drug use, use of over-the-counter drugs, drug-related problems and clinical parameters
Skill	5, 17	Adjust medication in response to signs and symptoms, lab results
	18	Being able to perform initial assessment and diagnosis of a patient's condition
	5, 7, 17, 19-23	Prevention and monitoring (side effects/ therapeutic effects, adverse events, medication non-adherence)
	5, 15, 19, 24-26	Identifying (potential drug errors/ risk factors of adverse drug reactions)
	1, 13, 15, 21, 25, 27	Evaluation of therapeutic, adverse and side effects and potential interactions
	5	Survey changing patient factors/observation the patient
	1, 4, 9, 18, 23, 28-40, 66	Drug prescribing (independently/dependently/supplementary)
	13, 20, 21, 29, 41-52	Apply intervention: patient education
	26, 53	Educate colleagues/students
	20, 21, 54, 67	Contribution to adherence
	55	Delegation medication tasks by nurse to community care aids, prompting clients to self-administer medicines, removing medicines from packaging, crushing tablets, assisting with administration of oral/topical medicines.
	5, 7, 13, 45, 56	Documentation of therapeutic, adverse/side effects and potential interactions
	1, 4, 7, 13, 22, 51, 57-60	Shared decision making/treatment decision making (between nurse-patient/ nurse-pharmacist)
	13	Ordering drugs
	18	Consult independent prescriber + discuss desired prescription before issuing it
	61	(technology) skills to work with prescribing software
	1, 2, 3, 15, 20, 35, 46, 54, 62-64	Interprofessional collaboration (nurses, pharmacists, doctors) for prescribing
Attitude	28, 65	Adequate and consistent attitude based on knowledge
	57	Confidence in own decision making

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Appendix 6.3

Table: Competences expected to be relevant based on nursing competence related literature and added to the list of competences extracted during the scoping review, preceding the Delphi study

Knowledge	<p>Is familiar with protocols and able to act according to protocols</p> <p>Has knowledge of potential causes of adverse effects of medications</p> <p>Has knowledge of potential causes of medication non-adherence</p> <p>Understands that addressing patient/family needs is important</p> <p>Has knowledge on how to assess patients' competences</p> <p>Understands the importance to assess patients' competences</p> <p>Understands the importance to communicate and discuss with the patient/family</p> <p>Understands the importance to use evidence based practice in clinical practice</p> <p>Has the knowledge and understands the process of clinical reasoning</p> <p>Has knowledge of interventions that aim to support medication management</p> <p>Has knowledge of interventions that aim to support self-care</p> <p>Understands the importance to follow-up issues/problems in the medication therapy</p> <p>Is aware of the importance of care coordination</p> <p>Is aware of the role of each health care professional in case of referrals and care transitions</p> <p>Is aware of the role of each health care professional in case of discussion of treatment choices/changes</p> <p>Is familiar with which health care professional should be contacted in case of referrals and care transitions</p> <p>Is familiar with which professional health care professional in case of discussion of treatment choices/changes</p> <p>Knows when collegial mentoring is needed</p> <p>Has the knowledge of educational interventions</p> <p>Is aware of the importance of intervening in emergency situations</p> <p>Has the knowledge of motivational theories</p> <p>Understands that medication reconciliation is desired at every point of transition in care (whether admission, transfer or discharge)</p> <p>Understands the role of each health care professional in a medication reconciliation or medication review</p> <p>Has knowledge of the nurse independent/dependent prescribers' formulary</p> <p>Has knowledge of prescribing software and electronic drug references</p>
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Skill	<p>Is able to observe patients' level of competences</p> <p>Is able to recognize and apply interventions to optimize self-care</p> <p>Is able to communicate and discuss therapeutic effects and adverse effects, medication non-adherence, referrals to patients, patient advocates and health care professionals</p> <p>Is able to interview patients about the use of prescription medications and over-the-counter medications</p> <p>Is able to recognize the needs and preferences in self-care of the patient/informal caregiver</p> <p>Is able to empower and involve the patient/informal caregiver</p> <p>Is able to act according to patients' level of competences</p> <p>Is able to monitor supervisees' progress</p> <p>Is able to accept feedback from colleagues</p> <p>Is able to promote critical self-reflection</p> <p>Is able to apply clinical reasoning,</p> <p>Is able to apply motivational interviewing techniques</p> <p>Is able to undertake safe storage, transportation and disposal of medicines</p>
Attitude	<p>Is able to respond to and respect patients' preferences</p> <p>Is able to verify patients' understanding of education/information</p> <p>Is able to provide a learning environment</p> <p>Takes the opportunity to mentor colleagues</p> <p>takes responsibility to document therapeutic, adverse and side effects and potential interactions</p> <p>Takes a proactive attitude to perform a task in order to improve patients' medication therapy</p>

Used references: (European Commission for Education and Culture, 2008; European Federation of Nurses Associations, 2016; Ličen and Plazar, 2019; Sasso et al., 2008)

Appendix 6.4

Equation to calculate disagreement index (DI)

Lower Limit IPR = 30th percentile of the series of ratings

Upper Limit IPR = 70th percentile of the series of ratings

$IPR = (\text{Upper Limit IPR}) - (\text{Lower Limit IPR})$

$IPRCP (\text{Central Point of IPR}) = \text{Average of Upper Limit IPR and Lower Limit IPR}$

$\text{Asymmetry Index} = 5^* - (IPRCP)$

$IPRAS = 2.35^* + (1.5^* \cdot \text{Asymmetry Index})$

$\text{Disagreement Index (DI)} = IPR/IPRAS$

Abbreviations: IPR = Interpercentile Range; IPRCP = Interpercentile Range Central Point; IPRAS = Interpercentile Range Adjusted for Symmetry.

*Numbers determined by RAND/UCLA Appropriateness Method (Fiß et al., 2013)

Appendix 6.5

Table: Changes in competence framework during Delphi round 3

Action	Result	
	Before the action	After the action
Combing 3 tasks into 1 + renaming the overall task	<ul style="list-style-type: none"> -Recognising + preventing risks/complications/ MEs -Identification, reporting and addressing contra-indications, drug related problems -Detection of non-adherence, drug abuse/misuse 	Recognising, addressing, and preventing DRPs
Splitting up 1 task into 2	Observation, documentation, registration, report	<ul style="list-style-type: none"> -observing -documenting
Combining multiple competences in 1 competence	<ul style="list-style-type: none"> -Takes a proactive attitude to perform a task in order to improve patients' medication therapy -Takes the responsibility to perform a task 	Takes the responsibility and a proactive attitude to perform a task in order to improve patients' medication therapy
	<ul style="list-style-type: none"> -Has knowledge of potential causes of adverse effects of medications -Has knowledge of potential causes of medication non-adherence 	Has knowledge of potential causes of drug-related problems
	<ul style="list-style-type: none"> -Is able to observe medication non-adherence -Is able to observe therapeutic/adverse effects 	Is able to observe and recognize therapeutic effects and drug-related problems
	<ul style="list-style-type: none"> -Is able to prevent adverse effects -Is able to prevent medication non-adherence -Is able to recognize and apply interventions for adverse effects -Is able to recognize and apply interventions for medication non-adherence 	Is able to propose and implement interventions that aim to prevent drug-related problems
	<ul style="list-style-type: none"> -Is able to communicate and discuss changes in the medication therapy -Is able to communicate and discuss medication non-adherence -Is able to communicate and discuss referrals -Is able to communicate and discuss therapeutic/adverse effects to patients, patient advocates and healthcare professionals 	Is able to communicate and discuss drug-related problems, referrals, changes in the medication therapy to patients/patient advocates/healthcare professionals clearly
	<ul style="list-style-type: none"> -Is able to provide a learning environment -Takes the opportunity to mentor colleagues 	Takes the opportunity to mentor colleagues
	<ul style="list-style-type: none"> -Is able to accept feedback from colleagues -Is able to supervise colleagues and to provide ongoing feedback 	Is able to supervise colleagues and to provide ongoing feedback and is able to accept feedback from colleagues
Renaming competences	Has knowledge of national legislation	Has knowledge of national laws and legislation
	Is aware of the role of each health care professional in case of discussion of treatment choices/changes	Knows the role of each health care professional in case of discussion of treatment choices/changes
	Has knowledge how to seek for medication-related information effectively to address DRPs	Has knowledge how to seek for medication-related information effectively to address DRPs
	Is able to seek for information effectively (ask colleagues, other professionals, seek in patients' reports, use available resources including IT, ...)	Is able to seek for medication-related information effectively to address DRPs
	Understands the importance of sharing knowledge and information	Understands the importance of sharing knowledge and medication-related information
	Is able to recognize the needs and preferences in self-care of the patient/family	Is able to recognize the needs and preferences in self-care of the patient/patient advocates
	Is able to delegate medication tasks to patients and others	Is able to delegate medication tasks to patients/their advocates/healthcare professionals
	Transcultural competence	Is able to function effectively taking into account the different cultural backgrounds, to work appropriately with patients (advocates) and healthcare providers from different cultural backgrounds.

Appendices

	Understands that addressing patients/family needs is important	Understands that addressing patients/patient advocates needs is important	
	Understands the importance to follow-up issues/problems in the medication therapy	Understands the importance to follow-up issues/problems	
	Is aware of each healthcare professional's role in case of referrals and care transitions	Knows the role of each health care professional in case of referrals and care transitions	
	Is able to observe and recognize therapeutic effects and drug-related problems	Is able to observe and recognize clinical change	
	Is able to communicate and discuss drug-related problems, referrals, changes in the medication therapy to patients/family, health care professionals clearly	Is able to communicate and discuss drug-related problems, referrals, changes in the medication therapy to patients, patient advocates, health care professionals clearly	
	Is able to empower and involve the patient/family	Is able to empower and involve the patient/patient advocates	
	Is able to document therapeutic, adverse and side effects and potential interactions	Is able to document observations and potential risks	
	Takes responsibility to document therapeutic, adverse/side effects and potential interactions	Takes responsibility to document clinical change	
	Collaboration	Is able to collaborate inter/intraprofessionally, is aware of own shortcomings, identifies situations where interdisciplinary consultation is needed and recognizes chances to share expertise with other health care professional	
	Teamwork	Takes responsibility to jointly clarify relevant reasoning processes and construct common meaning through dialogical discourse with patients (advocates) + healthcare professionals	
Removing and renaming duplicates		Competences removed	Remaining competences
	- Leadership -Takes the responsibility and a proactive attitude to perform a task in order to improve patients' medication therapy - Is able to respond to and respect patients' preferences	Leadership	-Takes responsibility and proactive attitude to perform a task to improve patients' medication therapy -Is able to respond to and respect patients' preferences
	- Is able to link changes in health conditions to desired/undesired med effects, non-adherence - Is able to observe and recognize therapeutic effects and drug-related problems - Is able to apply clinical reasoning	Is able to link changes in health conditions to the desired/undesired effects of a medicine, to non-adherence	-Is able to observe + recognize therapeutic effects and DRPs -Is able to apply clinical reasoning
	- Is aware of the importance of intervening in emergency situations - Understands the importance to follow-up issues/problems in the medication therapy	Is aware of the importance of intervening in emergency situations	Understands importance to follow-up issues/problems in medication therapy
	- Is able to communicate and discuss desired prescriptions before issuing the prescription with other care professionals - Is able to communicate and discuss drug-related problems, referrals, changes in the medication therapy to patients, patient advocates, health care professionals clearly	Is able to communicate and discuss desired prescriptions before issuing the prescription with other professionals	Is able to clearly communicate/discuss DRPs, referrals, changes in medication therapy to patients, patient advocates, healthcare workers
	Is able to evaluate therapeutic, adverse and side effects and potential interactions - Is able to observe and recognize therapeutic effects and drug-related problems	Is able to evaluate therapeutic, adverse and side effects and potential interactions	Is able to observe and recognize therapeutic effects and drug-related problems

Appendix 6.6

Table: Changes in competence framework during Delphi round 4

Action	Result	
	Before the action	After the action
Renaming competences	Is able to work with prescribing software and electronic drug references	Has (technology) skills to work with (electronic) drug references and or prescribing software
	Has knowledge of prescribing software and electronic drug references	Has knowledge of (electronic) drug references and or prescribing software
	Is able to delegate medication tasks to others	Is able to delegate medication tasks to patients/patient advocates/healthcare professionals
	Is able to document therapeutic, adverse and side effects and potential interactions	Is able to document observations and potential risks
	Is able to order medications	Is able to order medication for/with patients and/or patient advocates
	Is able to recognize the needs and preferences in self-care of the patient/informal caregiver	Is able to recognize the needs and preferences in self-care of the patient and/or patient advocates
	Understands the importance to communicate and discuss with the patient/family	Understands the importance to communicate and discuss with patients, patient advocates, healthcare professionals
	Understands the importance to follow-up issues/problems in the medication therapy	Understands the importance to follow-up issues/problems
	Understands that addressing patient/family needs is important	Understands addressing patients' (advocates') needs is important
	Takes responsibility to document therapeutic, adverse and side effects and potential interactions	Takes responsibility to document clinical change
	Is able to undertake safe storage, transportation and disposal of medicines	Is able to undertake safe storage, transportation and disposal of medicines for/with patients (advocates)
	Is able to prescribe medication of the nurse (in)dependent prescribers' formulary	Is able to (de)prescribe medication of (in)dependent prescribers' formulary
	Is able to recognize and apply interventions to optimize self-care	Is able to apply interventions to optimize self-care
	Has knowledge of interventions that aim to support self-care	Has knowledge of interventions that aim to prevent DRPs + to support self-care
	Has knowledge of psychology, sociology, ethics and related sciences	Has basic theoretical knowledge of relevant social sciences and knows how to apply that knowledge in order to improve self-care
Removing competences because tasks were removed (or vice versa)	Tasks: -medication reconciliation -medication review Competences: -Understands that medication reconciliation is desired at every point of transition in care (whether admission, transfer or discharge) -Understands the role of each health care professional in a medication reconciliation or medication review	Tasks removed Competences removed
	Competence: medication reconciliation and medication review Task: Is aware of the role of each healthcare professional in a medication reconciliation or medication review'	Competence removed Task removed
	Task: Facilitation of medication management Competence: Has knowledge of interventions that aim to support medication management	Task removed Competence removed

Changing relevance outcomes of competences within specific nursing tasks	Competences indicated as irrelevant during round 3: -Knows how to receive the best possible medication history and current medication regimen within task: Recognising, addressing and preventing DRPs -Is able to obtain timely, accurate, and thorough medication histories within task: Recognising, addressing and preventing DRPs -Is able to undertake safe storage, transportation and disposal of medicines for/with patients and/or patient advocates within task: Recognising, addressing and preventing DRPs -Is able to undertake safe storage, transportation and disposal of medicines for/with patients and/or patient advocates within task: Self-care support and therapeutic education -Is able to order medication for/with patients and/or patient advocates within task: Recognising, addressing and preventing DRPs -Is able to order medication for/with patients and/or patient advocates within task: Self-care support and therapeutic education	Changed to relevant competence
Changing relevance outcomes of competences within general nursing tasks	Competences indicated as irrelevant during round 3: -Knows the roles of each healthcare professional in case of referrals and care transitions within task: Inter/intraprofessional referrals -Has knowledge of ethics within task: Decision making -Is able to collaborate inter/ intraprofessionally, is aware of own shortcomings, identifies situations where interdisciplinary consultation is needed and recognizes chances to share expertise with other healthcare professionals within task: Communication / discussion with patients / patient advocates	Changed to relevant competence
	Competences indicated as relevant during round 3: -Has knowledge of ethics within 'Collegial mentoring' -Has knowledge of ethics within 'Advice (patient or other healthcare professional)'	Changed to irrelevant competence

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Activities Medical examinations as part of preventive healthcare in school children (2.5 - 21 years) as a nurse. Support and guidance of psychosocial functioning of primary school children in multidisciplinary school teams.

■ Nurse

Kind & Gezin, Antwerp

Period July 2006 – December 2008

Activities Consultations and home visits as part of preventive healthcare in young children (0 - 2.5 years) as a district nurse in Wilrijk, Hoboken and Antwerp-Kiel

EDUCATION

- **Doctor in Medical Sciences**

University of Antwerp

Period October 2017 – December 2021

- **Specific teacher training**

HBO5, Antwerp

Period February 2017 – January 2018

Degree Maxima cum laude

- **Master of Science in Nursing and Midwifery**

University of Antwerp

Period September 2014 – June 2016

Degree Cum laude

Master's thesis Follow-up of postpartum weight trajectories (written in Dutch: Follow-up studie van spontane gewichtsevolutie bij pasbevallen vrouwen)

- **Bachelor of nursing (social nursing)**

Karel de Grote Hogeschool, Antwerp

Period September 2003 – June 2006

Degree Magna cum laude

Bachelor's thesis Aspartame – Safe or sweet lie? (Written in Dutch: Aspartaam – Veilig of zoete leugen?)

- **Biomedical sciences**

University of Ghent

Period September 2000 – June 2003

Degree Bachelor's degree: Cum laude, Master: not started

- **Latin-Mathematics**

Nieuwen Bosch Humaniora, Ghent

Period September 1994 – June 2000

Degree Cum laude

RELEVANT ADDITIONAL COURSES

- **Summer school European Academy of Nursing Science (EANS) for doctoral studies**

University of Ghent, July 2018

Escola Superior de Enfermagem de Lisboa, July 2019

University of Cologne (online), July 2021

SCIENTIFIC ACTIVITIES

- **Publications**

Bogaerts A, De Baetselier E, Ameye L, Dilles T, Van Rompaey B, Devlieger R. (2016). Postpartum weight trajectories in overweight and lean women. *Midwifery*, 49, 134-141. doi:10.1016/j.midw.2016.08.010

De Baetselier E, Van Rompaey B, Batalha L, Bergqvist M, Czarkowska-Paczek B, De Santis A, ... Dilles T. (2020). EUPRON: nurses' practice in interprofessional pharmaceutical care in Europe. A cross-sectional survey in 17 countries. *BMJ Open*, 10(6), e036269. doi: 10.1136/bmjopen-2019-036269

De Baetselier, E. (2020). De verborgen rol van verpleegkundigen in farmaceutische zorg. *Nursing*, 26 (9), 10-11.

Logan V, Keeley S Akerman K, De Baetselier E, Dilles T, Griffin N, Matthews L, Van Rompaey B, Jordan S. (2020). Did we do everything we could have? Nurses' contributions to medicines optimization: A mixed-methods study. *Nursing Open*, 2021, 8(2), 592-606. doi: 10.1002/nop2.664

De Baetselier E, Dilles T, Batalha L, Dijkstra N, Fernandes I, Filov I, ...Van Rompaey B. Perspectives of nurses' role in interprofessional pharmaceutical care across 14 European countries: A qualitative study in pharmacists, physicians and nurses. *PloS ONE*, 2021, 16(5), e0251982. doi: 10.1371/journal.pone.0251982

De Baetselier E, Dilles T, Feyen H, Haegdorens F, Mortelmans L, Van Rompaey B. Nurses' responsibilities and tasks in pharmaceutical care: a scoping review. *Nurs Open*, 2021, 8(5). doi: 10.1002/nop2.984

Dijkstra N, De Baetselier E (shared first author), Dilles T, Van Rompaey B, Batalha L, Filov I, Grøndahl V, Heczkova J, Helgesen AK, Jordan S, Kafková Z, Karnjus I, Kolovos P, Langer G, Lillo-Crespo M, Malara A, Padyšáková H, Prosen M, Pusztai D, Talarico F, Tziaferi S, Sino C. Developing a competence framework for nurses in

pharmaceutical care: A Delphi study. *Nurse Education Today*, 2021, 104, 104926. doi: 10.1016/j.nedt.2021.104926

Mortelmans L, De Baetselier E, Goossens E, Dilles T. What Happens after Hospital Discharge? Deficiencies in Medication Management Encountered by Geriatric Patients with Polypharmacy. *Int J Environ Res Public Health*, 2021, 18(13), 7031. doi: 10.3390/ijerph18137031.

De Baetselier E, Van Rompaey B, Dijkstra N, Sino C, Akerman K, Batalha L, Fernandez D, Filov I, Grøndahl V, Heczkova J, Helgesen AK, Keeley S, Kolovos P, Langer G, Licen S, Lillo-Crespo M, Malara A, Padyšáková H, Prosen M, Pusztai D, Raposa B, Riquelme-Galindo J, Rottková J, Talarico F, Tziaferi S, Dilles T. The NUPHAC-EU framework about nurses' role in interprofessional pharmaceutical care: cross-sectional evaluation in Europe. *Int. J. Environ. Res. Public Health*, 2021, 18(15), 7862. doi: 10.3390/ijerph18157862

Riquelme-Galindo J, Lillo-Crespo M, De Baetselier E, Van Rompaey B, Dilles T. Understanding pharmaceutical care and nurse prescribing in Spain: a grounded theory approach through healthcare professionals' views and expectations. *PloS ONE*, 2021, accepted for publication on 10 November 2021.

▪ Conference presentations

EuroDURG, Glasgow (UK), November 2017, poster presentation: Self-medication in various professional groups.

Care4, Antwerp (Belgium), February 2017, oral presentation: Postpartum weight trajectories in overweight and lean women.

Investen, Cordoba (Spain), November 2017, oral presentation: EUPRON. A quantitative description of nurses' practices in interprofessional pharmaceutical care in Europe.

Investen, Cordoba (Spain), November 2018, poster presentation: The association between self-medication and occupational ailments in various professional groups.

Care4, Leuven (Belgium), February 2019, oral presentation: The association between self-medication and occupational complaints in various professional groups.

Care4, Leuven (Belgium), February 2019, poster presentation: EUPRON - Nurses' practices in multidisciplinary pharmaceutical care in Europe. A cross-sectional survey in 17 countries.

Espacomp, Porto (Portugal), November 2019, oral presentation: Nurses' role in monitoring adherence and interprofessional collaboration

NuPhaC Symposium, Antwerp (Belgium), February 2020, oral presentation: Verpleegkundigen in interprofessionele farmaceutische zorg: zijn ze voldoende geschoold?

EuroDURG, Szeget (Hungary), March 2020, oral presentation: Nurses' role in interprofessional pharmaceutical care

EuroDURG, Szeget (Hungary), March 2020, poster presentation: EUPRON - Nurses' practices in interprofessional pharmaceutical care in Europe. A cross-sectional survey in 17 countries. (Award for first poster price)

EANS summer conference, Cologne (online), July 2021, poster presentation: The NUPHAC-EU framework about nurses' role in interprofessional pharmaceutical care: cross-sectional evaluation in Europe

▪ Other relevant presentations

EANS Summer School, Ghent (Belgium), July 2018, oral presentation: My PhD - Developing a Model for nurses' role in interprofessional Pharmaceutical Care in Europe.

NuPhaC meeting, Peer (Belgium), September 2018, oral presentation: DeMoPhaC - Developing a Model for nurses' role in interprofessional Pharmaceutical Care in Europe.

Erasmus+ transnational meeting, Alicante (Spain), October 2018, oral presentations: 1) Presentation of the EUPRON results + discussion. 2) Research protocol for qualitative research. Content and project management. 3) Kick-off meeting: agreements on model for pharmaceutical care and interview guide.

Erasmus+ intensive study programme, Antwerp (Belgium), November 2018, oral presentation: EUPRON - Nurses' practices in multidisciplinary medicines management and pharmaceutical care in Europe. A cross-sectional survey in 17 countries.

Erasmus+ transnational meeting, Frederikstad (Norway), June 2019, oral presentation: A SWOT analysis on the role of nurses in interprofessional pharmaceutical care in 14 European countries: an interview study.

NuPhaC meeting, Peer (Belgium), September 2019, oral presentation: DeMoPhaC - Development of a model for nurses' role in interprofessional pharmaceutical care.

Epos Grensverleggers, Brussels (Belgium), September 2019, poster presentations: 1) EUPRON - Nurses' practices in multidisciplinary pharmaceutical care in Europe. A cross-sectional survey in 17 countries. 2) The NuPhaC-eu Model - A model for nurses' role in interprofessional pharmaceutical care in Europe.

MDMJ event, Mol (Belgium), September 2019, poster presentations: 1) EUPRON - Nurses' practices in multidisciplinary pharmaceutical care in Europe. A cross-sectional survey in 17 countries. 2) The NuPhaC-eu Model - A model for nurses' role in interprofessional pharmaceutical care in Europe.

Erasmus+ intensive study programme, Antwerp (Belgium), March 2021, oral presentation: DeMoPhac, overview of the project parts. Methods & results.

NuPhaC research videos, Antwerp, 2021: 1) General introduction of the DeMoPhaC project, 2) The EUPRON study, 3) DeMoPhaC interview study, 4) DeMoPhaC scoping review, 5) the NuPhaC-EU model.

- **Organisational activities for scientific conferences**

NuPhac Symposium, Antwerp (Belgium), February 2020

NuPhaC Winter Conference, Antwerp (Belgium), December 2021

- **Reviewer for following journals**

Journal of International Medical Research

Patient Preference and Adherence

PlosOne

- **Memberships**

Nurse and Pharmaceutical Care (NuPhaC), October 2017 - today

Ethics Committee of the University Hospital Antwerp and University of Antwerp, November 2017 - today

European Association for Nursing Science (EANS), student member, 2018-2021.