Universiteit Antwerpen
Faculteit Geneeskunde en
Gezondheidswetenschappen
Master Verpleeg- en Vroedkunde

Pharmacotherapeutic care in nursing homes

Highlighting and supporting nurses' contribution to drug monitoring

Proefschrift voorgelegd tot het
behalen van de graad van doctor
in de Medische Wetenschappen
aan de Universiteit Antwerpen
te verdedigen door

Tinne DILLES

Antwerpen, 2011

Promotoren: Prof. dr. M. Elseviers
Prof. dr. R. Vander Stichele

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Pharmacotherapeutic care in nursing homes.
Highlighting and supporting nurses' contribution to drug monitoring / T. Dilles
Universiteit Antwerpen, CDE, Universiteitsplein 1, 2610 Wilrijk, Belgium
Thesis Universiteit Antwerpen 2010 – with summary in Dutch

ISBN: 978-90-5728-350-5.
Depotnummer: D/2011/12.293/40
Lay-out, cover & figures: Dirk De Weerdt (ddwdesign@telenet.be)

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Introduction

Chapter 1

Outline

In the PHEBE project (Prescribing in Homes for the Elderly), problems in the use of medication in Belgian nursing homes were uncovered. In order to improve medication use, this project was started, approaching the problems from a nursing point of view. The problem statement gives a short description of the rationales for the research project. In the background section, each element is explicated in more detail. The introduction ends with the hypothesis and aims and the outline of the thesis.

1.1. Problem statement

In the European Union, the share of the population aged 65 years and over is projected to rise from 17% in 2011 to 20% in 2021 (1;2). In Belgium, 7% of this geriatric population is permanently institutionalized in nursing homes (3). (more details in §1.2.1)

A team of family doctors, nurses, care assistants and other professionals, together with family members, care for the nursing home residents, who often suffer from multiple morbidities. In order to treat the health problems, multiple medications are prescribed. The combination of multiple medications and age-related changes in residents, turn medication management into a complex process, increasing the risk for drug related problems (DRPs) in pharmacotherapy (more details in §1.2.2 and §1.2.3).

DRPs are common in nursing homes and can threaten residents' health or quality of life and increase health care costs. In the last decade, a substantial number of studies were published on medical errors, DRPs, medication safety and the possibilities for physicians and pharmacists to address DRPs. However, few studies addressed the specific problems in the nursing home setting and especially the role for the nurse profession in pharmacotherapy (more details in §1.2.3 and §1.2.4).

Nurses have an important role in the medication management process. Based on the medication prescription of the family doctor, they prepare and administer the medication. Furthermore, members of the nursing staff have by far the longest contact time with the resident and are trained in pharmacology and observation skills. Therefore, it seems obvious that, besides physicians and pharmacists, nurses have an important responsibility in preventing, detecting and addressing DRPs (more details in §1.2.5).

Taking into account the perspective of an increasing nursing home population and the incidence and consequences of DRPs, it is important for nurses to take up their responsibilities in preventing, detecting and addressing these

DRPs in nursing homes. It is, however, not clear what the exact role of nurses in pharmacotherapeutic care in nursing homes is. At the start of the project, different physicians and nurses argued that they were not sure what nurses' role included. While some are convinced that nurses do not have the competences to contribute to drug monitoring, others state that nurses' observations and reports are essential for effective monitoring of pharmacotherapy.

This thesis focuses especially on the aspect of drug monitoring by nurses. We studied nurses' role, nurses' competences and barriers in drug monitoring, followed by the development of a multifaceted, interdisciplinary intervention to support nurses' contribution in drug monitoring.

1.2. Background

1.2.1. Nursing homes in Flanders

Care for older persons in Belgium is a shared responsibility between the federal and regional authorities. Only the regulations on nursing homes, relevant to this thesis are described.

The Flemish Decree of March 13th 2009 (B.S.14.05.2009), 'het woonzorgdecreet', focuses on care for older people. The aims are threefold: to support self-care and care by relatives, to provide different and specialized types of care and to improve the cooperation between care providers. Different types of care are addressed, ranging from community care and day care to nursing home care. Nursing homes are defined as arrangements of one or more buildings, creating a functional structure and a home-replacing environment, in which users of 65 years or older receive housing and care for older persons. The users reside permanently in the nursing homes. The care for older persons focuses on maintaining, restoring or supporting the quality of life of its users. Minimal requirements are adjusted housing, usual family and household care, hygienic and nursing care, (re)activation and psychosocial support and animation and social activities.

On January 1th 2011, Flanders, without Brussels, had 745 nursing homes (4). In Belgium about all communities have a nursing home in which older people can reside close to their former homes (5). Depending on their care-dependency level, residents stay in a rest bed or a nursing bed. Rest beds are reserved for those who need support in usual family and household care. Nursing beds are high intensity care beds for residents with long-term care needs, who are heavily dependent on professional help for the activities of

daily living.

Minimal requirements on staffing are specified in appendix XII of the Decree of the Flemish Government of July 24th 2009. A minimum of 2,5 full-time equivalent (FTE) care assistants or nurses per 15 residents is mandatory, of whom at least one FTE nurse. They need to follow 20 hours of additional training each two years. The medical staff is represented by a coordinating and advising nursing home physician (CRA) and residents' family doctors. Residents have the right to chose their own family doctor. The CRA is responsible for the training of the staff and for the general medical coordination and quality by the organization of individual and collective meetings with the family doctors (6).

1.2.2. Pharmacotherapy and medication management

The goal of pharmacotherapy is the optimal treatment with medication, tailored to the patient, creating the most favorable interaction between the patient and the medication, resulting in maximal therapeutic effects and minimal adverse drug reactions (7). Responses to medication differ between individuals. Besides the qualitative selection of medication, good observations of the residents' responses to medication are required to adjust the medication to the resident.

Medication management includes all medication handlings of professionals. Many authors and organizations have developed models of the medication management process. In 2004, Bell et al. designed a functional model with 5 steps (8). Another model of 2004 is the JCAHO medication management standards, which divide the process into six steps: (1) medication selection and procurement (i.e. formulary considerations) (2) ordering and prescribing, (3) storage, (4) preparing and dispensing, (5) administration, and (6) monitoring (9).

In 2008, De Clerq et al. described the medication management model in a similar way as defined by the JCAHO, yet, with a special focus on nurses' role and responsibilities (**Figure 1.1**). Although the model was designed for psychiatric nursing, with some minor adaptations, it is in line with the medication management process in nursing homes. Nurses have a crucial role in all steps from the ordering to the monitoring of medication. The rationale to choose this model is the importance of the details on the nursing process in this thesis which focuses on nurses' role in medication management. The scheme on the nursing processes gives extra details on the different steps and adds important points of attention for nurses, such as patient education and the evaluation of medication adherence (10). In Belgium, there is no

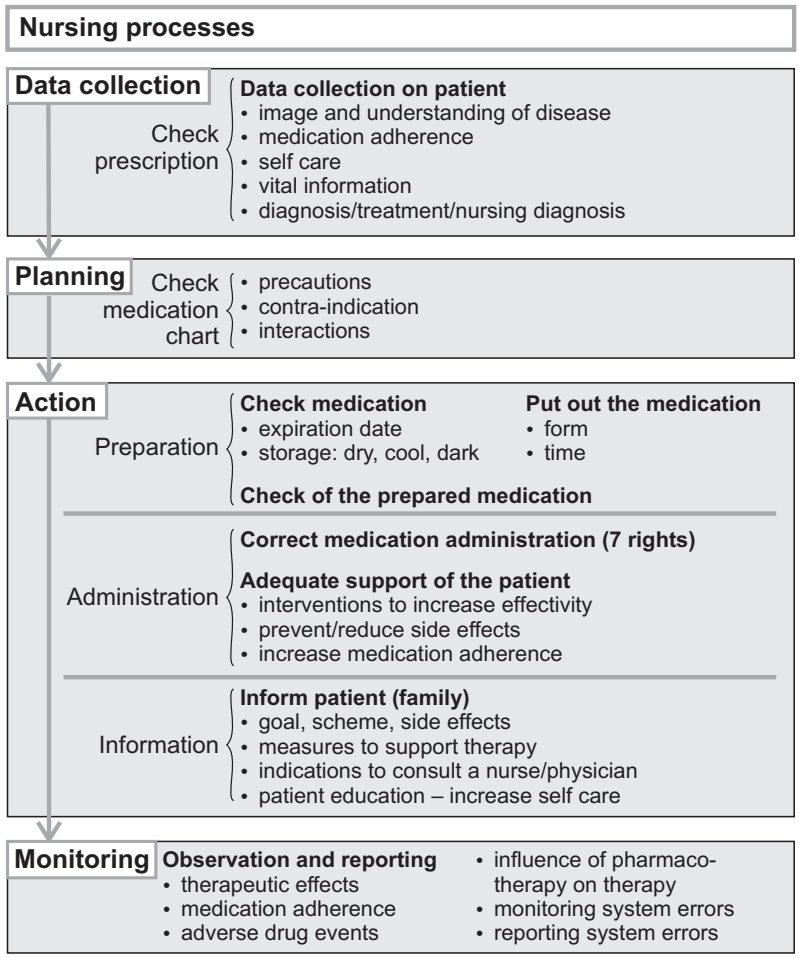

Figure 1.1. The medication process. *Adapted and translated from De Clerq, E., De Clerq, T., & Reynhout, D. (2008). De rol van de verpleegkundige in farmacotherapie. Psychiatrie en verpleging, 84 (1), 17–23.*

medication management model officially endorsed as a standard by a professional nursing association.

The medication management models show the general process as it should be. To get some insight in medication management in practice, details on medication management in Flemish nursing homes are added in Appendix I of this thesis. The data are the result of a survey in Flemish nursing homes in February – March 2011. Publication of the study will follow later on. Appendix II reports on a case of medication management in a nursing home as observed in practice, showing major problems.

1.2.3. Drug related problems in nursing homes

A catalyst to start this doctoral thesis were the results of the PHEBE study, 'Prescribing in Homes for the Elderly in Belgium'(5). The quality of medication prescribing in nursing homes for the elderly in Belgium was investigated and related to institutional characteristics, including the quality of the medication management systems. The study exposed several drug related problems. "A drug-related problem (DRP) is an event or circumstance involving drug therapy that actually or potentially interferes with desired outcomes" (11;12). DRPs have been the cause of deterioration in patients' quality of life, increased hospitalization rates, health care costs, and deaths (13-18).

Residents of nursing homes have a high risk profile for DRPs. A first reason is the high incidence of polypharmacy. In the PHEBE study, residents had a mean of 8.4 prescriptions. The number of chronic medications used ranged from 0 to 22 with a mean of 7.1. The incidence of polypharmacy was very high with 22.9% of the residents having 10 or more chronic prescriptions (5). An intake of nine or more different medications increases the risk of experiencing an adverse drug reaction (ADR) by a factor of 2.3 (19). In this thesis, we focus especially on ADRs, a subgroup of DRPs, defined as "appreciably harmful or unpleasant reactions predicting hazard from future administration and warranting prevention or specific treatment, or alteration of the dosage regimen, or withdrawal of the product" (20).

A second reason for the high risk profile is the characteristics of older persons' responses to medications. Pharmacokinetics change for example by an increase of the stomach pH, a decrease of the surface of the small intestines, an increase in the body fat-water balance or a decrease in the perfusion of liver and kidneys. Pharmacodynamics can be altered by changed sensitivity of receptors. These changes reduce the predictability of the medications' effects in relation to the dosage prescribed (7;21;22). Furthermore, physical and mental problems, such as swallowing problems and dementia, can impede the intake of medication. Observations of residents' responses to medication and residents' abilities to take medications are therefore crucial to tailor pharmacotherapy and to avoid DRPs.

The high risk profile of residents for DRPs is an important causal factor of DRPs. Yet, prescribers are also responsible. In the PHEBE study, various problems in the quality of prescribing were demonstrated, which can cause ADRs. Examples of problems in prescribing are underprescribing, overprescribing, prescribing of inappropriate medications not proven effective in elderly, drug-drug interactions and the inappropriate or unintentional use of medication for a long period of time. Underprescribing occurred in 8% to

23% of the residents. The use of antidepressants, antipsychotics and benzodiazepines was very high, as well as the use of combinations of these products. Other problems were the high use of chronic NSAIDs and inappropriate combinations with other medications. When taking into account all criteria of the PHEBE study, the median number of quality problems in prescribing detected was 2 quality problems per resident (range 0-13) (5).

In a review of Handler et al., in American nursing homes for older persons, the incidence of ADRs ranged from 1.19 to 7.26 per 100 resident months (23). In a study of 256 nursing home residents of the United Kingdom, about 70% of the residents were exposed to an error during prescription, monitoring, dispensing, or administration phases, with a mean of 1.9 errors per resident (24). Of all DRPs in nursing homes that interfered with the desired outcomes of drug therapy, 20% to 50% were considered preventable in an American study (25).

1.2.4. Literature on medication safety and drug related problems

When searching the international literature, the number of publications on medication safety and DRPs is high. In **Figure 1.2**, we give an overview of the PubMed hits for the last ten years when using the search string ('medication related problem' OR 'drug related problem' OR 'medication safety' OR 'adverse drug event' OR 'medication errors'). Although we did not evaluate the relevance of the articles and the precision of the search string, the data are illustrative of the increasing interest on the subject during the last 10 years. When limiting the search by adding the search string "nurs*", the number of hits decreased with about 75%.

1.2.5. Nurses' role in medication management and pharmacotherapy

In Belgium, nursing activities are divided into three levels (Royal Decree 78, 1968):

1. A-activities: activities to observe, define and report on the physical, psychological and social health status of patients.
2. B-activities: technical nurse interventions with (B2) or without (B1) prescription of a physician.
3. C-activities: activities physicians can entrust to nurses.

A specified list of technical nurse interventions is officially published in the Royal Decree of June 18th 1990, and adjusted in the Royal Decrees of 4/9/1990, 25/11/1990, 27/12/1994, 6/6/1997, 2/7/1999, 7/10/2002, 13/7/2006 and 21/4/2007.

The legal framework further defines the three levels by describing nursing activities on each level explicitely in the legal texts. Nursing activities are presented underneath in case the activity is specific to medication management (B-activities), or in case of a more general activity applicable to medication management (A-activities). More general activities are translated to a medication management situation.

1. A-activities

- To observe, define and report on the physical, psychological and social health status of patients in relation to the pharmacotherapy;
- To inform and advise the patient and his family on the pharmacotherapy;
- To permanently support patients in pharmacotherapy and intervene or help patients in activities to maintain, improve and restore the health of patients by pharmacotherapy.

2. B-activities

- To administer medication on medical prescription, which can be a written prescription (by hand, electronically or by fax), or an oral prescription (by

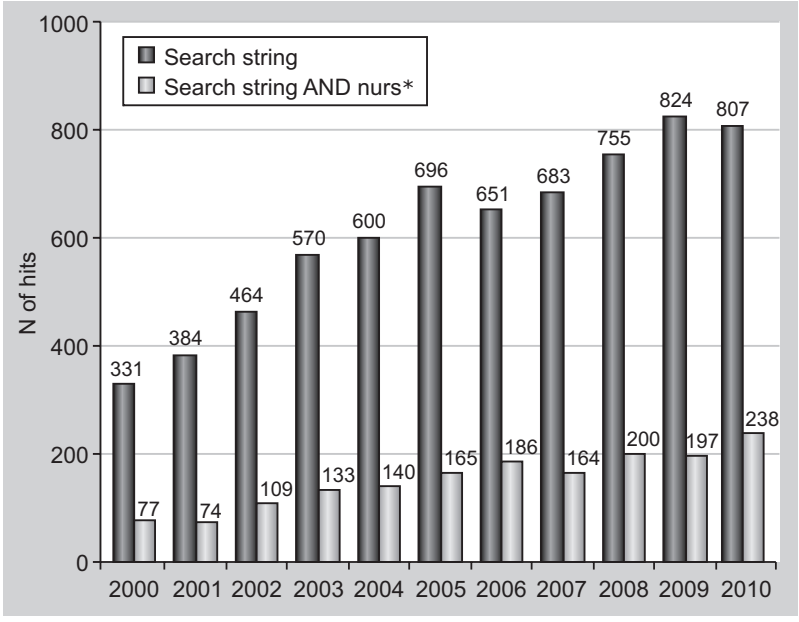

***Figure 1.2**. Literature on medication safety and drug related problems.*
The number of hits in PubMed using the search string ('medication related problem' OR 'drug related problem' OR 'medication safety' OR 'adverse drug event' OR 'medication errors') is presented in black. In grey are the hits in PubMed of the same search string, with the addition of AND nurs*.

phone or webcam), or by a standing order.

- To prepare and administer medication: oral, rectal, vaginal, subcutaneous, intramuscular, intravenous, by airway, hypodermoclysis, by a gastro-intestinal catheter, by drain, eye drips, ear drips and percutaneous.
- To prepare and administer a maintenance dose through a catheter placed by a physician: epidural, intrathecal, intraventricular, in the plexus with analgesic purposes.

The Ministerial Circular of July 19th 2007 stresses that the physician stays in control of the treatment, while every professional is responsible for his own actions. The physician is responsible for the content of the prescription and the nurse for the execution of the prescription. When considering the monitoring of the patients' health status, the Circular states the nurse has to perform clinical observations, to evaluate the health status and to intervene effectively to prevent life or organ threatening events.

It is clear that nurses have responsibilities in medication safety and pharmacotherapeutic practices. Yet, regulations are not explicit on the boundaries of these responsibilities, as in drug monitoring. Members of the nursing staff have by far the longest contact time with the resident, they are trained in observation skills and receive pharmacology courses in basic nurse education. Therefore, it seems obvious that, besides physicians and pharmacists, nurses have an important responsibility in preventing, detecting and addressing DRPs. It is, however, unclear to which extend nurses are currently involved in pharmacotherapy in practice. A better understanding of nurses' role in pharmacotherapy is a first requirement.

Because of the incidence and consequences of DRPs in the growing nursing home population, it is important for nurses to take up their responsibilities and to contribute maximally to drug monitoring to create safe and tailored pharmacotherapeutic care for residents. To define the boundaries of their contribution and to define the support they need to take up their responsibilities, a better understanding of nurses' competences and perceived barriers in pharmacotherapy is required.

1.3. Hypothesis and aims

The scientific hypothesis of this thesis is:

The detection of drug related problems in nursing homes can be improved when the role of nurses, as members of an interdisciplinary team, is highlighted, when barriers perceived in the execution of their role are identified and, finally, when a system is developed to support nurses in their role, taking into account the barriers identified. The research aims to test this hypothesis are as follows:

Aim 1: To describe nurses' practices in pharmacotherapeutic care in nursing homes.

Aim 2: To define and measure barriers for nurses to safe medication management in nursing homes and to identify opportunities for improvement.

Aim 3: To investigate the educational preparation of nurses to take up their role in pharmacotherapy

Aim 4: To develop a support system for nurses in pharmacotherapeutic care in nursing homes, based on their role, their competences and the barriers they experience.

Aim 5: To test the effect of the support system on pharmacotherapy in nursing homes in an intervention study.

1.4. Outline of the thesis

The chapters are in line with the aims of the project. Each of the next chapters consists of an article published or submitted in an international, peer reviewed journal. **Chapters 3** and **4** have extra abstracts in English. Although the contents are relevant to the thesis, the full text articles have been added to the thesis in appendix, since they were published in Dutch. The decision to publish these contents in Dutch was taken to avoid the loss of important nuances in the meaning of qualitative data and to address problems, pertinent to the Belgian situation to the responsible professionals, organizations and governments.

In **Chapter 2**, nurses' involvement in giving pharmacotherapeutic information, in observing adverse drug reactions and in observing non-adherence to medication is described. The involvement of nurses is compared between nursing homes, hospitals and community care and between nurses of different educational levels.

In **Chapter 3**, **Part 3.1**, potential barriers impeding optimal medication management are identified by an expert meeting with nursing home nurses. This part of the study focuses on the whole medication management process, rather than only on pharmacotherapeutic care or medication monitoring. Based on the list of potential barriers, in **Part 3.2** we measure the relevance of the barriers in a large cross-sectional study in nursing homes.

In **Chapter 4**, **Part 4.1**, the lack of knowledge and insight in pharmacology of nurses in practice is described in a study in hospitals, nursing homes and community care. Since basic nurse education should prepare nurses for their role in pharmacotherapy, in **Part 4.2**, graduating nursing students' pharmacology knowledge and medication calculation skills are evaluated. Furthermore, pharmacology courses in nurse education are described in **Part 4.3**.

In **Chapter 5**, the development of the support system for nurses in pharmacotherapy in nursing homes is described. The system is based on the trigger tool methodology and enables nurses to screen for drug related problems in preparation of interdisciplinary medication review.

In **Chapter 6**, the support system is implemented in 8 nursing homes for an intervention study. The effect of the support system is investigated on the identification of drug related problems by nurses, the confirmation of the problems by the family doctor, the resulting changes in prescribing and the related changes in the quality of prescribing.

A general discussion and future perspectives on research and practice are provided in **Chapter 7**.

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Chapter 2

Nurses' practices in pharmacotherapy

This Chapter has been published as:
Tinne Dilles, Robert Vander Stichele,
Bart Van Rompaey, Lucas Van Bortel & Monique Elseviers,
Nurses' practices in pharmacotherapy and their association with educational level.
Journal of Advanced Nursing, 2010; 66, 1072–1079.

Chapter 2

Outline

2.1.
Nurses' practices in pharmacotherapy and their association with educational level

2.1.1. Abstract

Aim. This paper is a report of a study of the association between educational level and nurses' practices in pharmacotherapeutic activities in three clinical settings.

Background. The preparation and administration of medication are at the core of nursing practice, and nurses' involvement in pharmacotherapy is essential to medication safety. Nursing strategies to improve patient adherence to treatment and to identify adverse drug reactions have been described, but nurses' practice patterns in monitoring adherence and adverse drug reactions remain undocumented.

Methods. A cross-sectional correlational survey design was used. Data were collected between 2005 and 2007. Each year, the focus was on a different setting. Nurses were selected by convenience sampling: 260 worked in nursing homes, 82 in community care services and 1070 in hospitals. Questions focused on the provision of medication information, observation of patient medication adherence and identification of adverse drug reactions during the preceding month.

Results. Involvement in providing drug information varied considerably, from 50% among hospital nurses to 82% among nurses in community care services. Statistically significantly fewer nurses observed non-adherence in hospitals (50%) than in the other settings (about 80%). Between 40% and 49% of the nurses had observed an adverse drug reaction. Nurses' information-seeking behaviour and problem responses also varied according to setting. Bachelor's degree holders were 35% more likely than diploma holders to have observed an adverse drug reaction.

Conclusion. Nurses assume considerable pharmacotherapeutic responsibilities. Practice patterns are codetermined by the healthcare setting and nurses' educational level.

2.1.2. Introduction

There is consensus in educational programmes and legislation that the preparation and administration of medication are essential aspects of nursing practice (Thomson *et al.* 2009). What is less clear is whether pharmacotherapeutic activities such as providing medication information, monitoring medication adherence and ensuring drug safety are performed on a regular basis by nurses holding a diploma, or Bachelor's or Master's degree in Nursing who are not licensed to prescribe. Pharmacotherapeutic activities are defined as activities that go beyond medication management, including the ordering, storage, preparation and administration of medications. Pharmacotherapeutic care concerns the evaluation of pharmaceutical therapy and patient guidance. Surprisingly, little is known about nurses' practical involvement in such activities. Although nursing strategies and interventions for improving adherence are described, the extent to which nurses actually intervene is unknown (Ruppar *et al.* 2008). Nurses' involvement in drug safety monitoring is believed to improve the identification rate of adverse drug reactions (ADRs) and patient outcomes (Jordan *et al.* 1999, Nakanichi 2006, Backstrom *et al.* 2007, Bergqvist *et al.* 2008). Again, however, practice patterns are unclear.

Pharmacotherapeutic nursing care is essential to medication safety. Information deficiency about pharmacotherapeutic prescriptions or inadequate patient guidance in pharmacotherapy can lead to suboptimal therapeutic effects (Lehane & McCarthy 2009). Nurses' monitoring and reporting of drug effects and side-effects enable physicians to make timely therapy adjustments (Nakanichi 2006). Given their positive effects on medication safety, nurses' practice patterns in pharmacotherapy deserve closer attention.

Pharmacotherapeutic responsibilities require specific competences. Other studies have indicated nurses feel a lack of training limits their pharmacotherapeutic practice (Jordan *et al.* 1999, Nakanichi 2006, Manias 2008). Therefore, educational level may be an important associated factor to nurses' practice patterns.

2.1.3. Methods

2.1.3.1. Aim

The aim the study was to examine the associations between educational level and nurses' practices of pharmacotherapeutic activities in three clinical settings.

2.1.3.2. Design

A cross-sectional correlational survey design was used with three samples of nursing professionals in varying settings (nursing homes, community care, hospitals).

2.1.3.3. Participants

For three consecutive years, a sample of nurses was selected from different settings (nursing homes: 2005, community care: 2006; hospitals: 2007). In 2005, a random sample of 57 nursing homes was taken. All nurses present on the day of the visit were presented with the questionnaire. In year two, community care nurses were contacted via three professional organizations. Finally, in 2007, surgical, critical care or internal medicine departments of a convenience sample of 28 hospitals were visited. In community care and hospitals, the participating nurses were selected by convenience sampling. There were 260 respondents from nursing homes, 82 from community care and 1070 from hospitals.

2.1.3.4. Data collection

Master's of Nursing students at the University of Antwerp (Belgium) distributed the questionnaires, oversaw the response process and collected the data as part of a study assignment. The written questionnaire probed for demographic characteristics, educational level, and years of professional experience. It also included three specific questions about pharmacotherapeutic care practice in the previous month:

- Did you provide drug information? No/Yes;
- Did you observe patients failing to adhere to prescribed medication? No/Yes;
- Did you observe ADRs? No/Yes.

Handler *et al.* (2006) define ADRs in a conceptual framework for medication-related adverse events. Adherence is defined as the extent to which a person's medication-taking behaviour corresponds with recommendations from a health-care provider (World Health Organization 2003). Drug information includes all information about the pharmaceutical therapy prescribed to the patient.

Nurses who had provided drug information were further questioned about their information sources. Those who had observed non-adherence or an ADR were queried about their ensuing actions. The informants were asked to tick boxes from a set of possibilities. All possibilities are shown in Table 2.3. Multiple responses were permitted.

Nurses in hospital settings were asked whether they were a head nurse. In nursing homes and hospitals, the option 'I consulted the head nurse' was included in the information sources list.

Table 2.1 gives information about nursing qualifications in Belgium, of which there are three types: diploma nurse, Bachelor of Nursing and Master of Nursing. While the educational requirements differ, there is no explicit differentiation in tasks. Nurses are not licensed to prescribe.

2.1.3.5. Ethical considerations

Ethics committee approval is not needed in Belgium for this kind of study since no individual patient data were collected. To guarantee confidentiality in smaller institutions, nursing-home and community-care nurses were not asked whether they were head nurses.

Table 2.1. *Belgian nursing qualifications : definitions.*

Diploma level: Three-year educational programme with focus on the performance of nursing tasks.
Bachelor's degree: Three-year educational programme with focus on the performance of nursing tasks and combining clinical aspects with more theoretical and scientific aspects.
Master's degree: Two-year educational programme requiring a Bachelor's degree. The main focus is on scientific research, management and innovation, clinical expertise and academic development.

The level of medication-related training received by the different types of nurses is not predefined and may vary between schools and teachers. Belgian nurses are not licensed to prescribe.

2.1.3.6. Data analysis

Data were analyzed using SPSS 15.0 (SPSS Inc., Chicago, IL, USA). For the descriptive analysis, data were analyzed by sample. For the exploratory analysis of correlations, results were combined into one database. Differences were examined by One-Way ANOVA or Kruskal–Wallis tests for continuous variables and by chi-square-tests for discontinuous variables. To explore the relationship between practice patterns and level of education, stepwise multiple logistic regression was applied. A *P*-value <0.05 was considered to be statistically significant.

2.1.4. Results

2.1.4.1 Description of samples

Just 2% of the nurses, all belonging to the hospital sample, had a Master's degree. Therefore, these respondents were combined with the Bachelor's degree holders. In nursing homes, 42% had Bachelor's degrees, as compared to 48% in community care and 69% in hospitals. The mean age was 39, 37 and 36 years respectively; the proportion of male nurses was 14%, 31%, and 21% respectively. The median length of overall professional experience was 16, 15 and 13 years respectively (See **Table 2.2**). In the hospital sample, a similar number of nurses were employed in critical care, surgery and internal medicine.

2.1.4.2. Pharmacotherapeutic nursing care

Pharmacotherapeutic information was provided by 83% of the nurses in community care, compared, respectively, to 59% and 50% in nursing homes and hospitals. About 80% of the nurses had observed non-adherence in nursing homes and community care, compared to 59% in hospitals. The proportion having observed ADRs was slightly, although not statistically significantly, higher in nursing homes (49%, 40% and 42% respectively) (See **Table 2.3**).

The main source of drug-related information was the patient package insert (PPI – information leaflet supplied with the medication). Physicians were consulted most often in nursing homes. A statistically significantly higher proportion of nurses in community care trusted in their own knowledge.

Table 2.2. *Characteristics of the three samples.*

	Nursing homes	Community care	Hospitals	p-value
Number of respondents	260	82	1070	
Mean age (years [sd.])	38.8 [8.2]	37.2 [9.5]	36.1 [9.5]	<0.001
Men (%)	14.2	30.5	20.8	<0.003
Level of education (%)				<0.001
- Diploma	57.8	51.9	30.6	
- Bachelor of Nursing	42.2	48.1	69.4	
Engaged in continuing education (%)	26.1	62.2	50.7	<0.001
Years of experience in discipline (median [inter-quartile range])	9.5 [4.0- 16.4]	8.0 [3.8- 17.3]	7.0 [2.5- 16.0]	0.039
Years of professional experience (median [inter-quartile range])	16.2 [9.5- 22.9]	15.5 [6.4- 20.0]	12.0 [5.0- 21.0]	<0.001

p-values are based on Pearson Chi^2-tests for discontinuous variables (sex, educational level, continuing education), continuous variables were tested by One-Way ANOVA (age) or Kruskal-Wallis (experience).

Table 2.3. *Nurses' practice patterns in pharmacotherapeutic care in three settings.*

	Nursing homes *n*= 260	Community Care *n*= 82	Hospitals *n*= 1070	p-value
Nurses providing information about a drug % (n)	59.3 (153)	82.9 (68)	49.5 (526)	<0.001
If yes: Sources used to provide information to the patients and their families (multiple answers possible)				
Trusted in own knowledge (%)	22.2	82.4	35.9	<0.001
Used patient package insert (%)	73.9	82.4	58.2	<0.001
Consulted a head nurse (%) *	-	-	18.3	-
Consulted a physician (%)	64.1	28.4	30.2	<0.001
Nurses observing non-adherence % (n)	79.8 (205)	80.5 (66)	58.5 (622)	<0.001
If yes: Interventions following the observation of non-adherence (multiple answers possible)				
No intervention undertaken (%)	0.0	1.7	0.6	‡
Pointed out the importance of adherence to the patient (%)	*67.8*	81.8	81.4	<0.001
Checked the drug intake (%)	*75.1*	75.8	49.4	<0.001
Reported to a head nurse (%) †	66.8	-	44.9	<0.001
Reported to a physician (%)	50.2	53.0	51.6	0.909
Nurses observing an adverse drug reaction % (n)	48.8 (126)	40.2 (33)	41.6 (443)	0.098
If yes: Interventions following the recognition of an adverse drug reaction (multiple answers possible)				
No intervention undertaken (%)	1.6	6.1	1.1	‡
Advised to stop taking the drugs (%)	9.5	18.2	15.3	0.207
Reported to a head nurse (%) †	59.5	-	39.7	<0.001
Reported to a physician (%)	92.1	81.8	89.7	0.225

p-values are based on Pearson Chi^2-tests

* not questioned in community care

† not questioned in nursing homes

‡ results represent ≤ 5 nurses in one or more healthcare settings

Observation of non-adherence mainly triggered nurses to underline the importance of adherence to a patient. In nursing homes and community care, about 75% of the nurses responded by starting to check the patient's drug intake.

Observation of ADRs usually led nurses in all three settings to report to the physician and, if possible, to the head nurse. In most cases, nurses refrained from interrupting the therapy on their own initiative. After observation of an ADR 1–6% of nurses ignored the observation and did not intervene (see Table 2.3).

2.1.4.3. Association between nurses' educational levels and practices in pharmacotherapy

For analysis of the association between nurses' educational levels and practices in pharmacotherapy, the results for the three samples were combined into a single group of 1412 respondents. To explore associations, a preliminary analysis was performed of the association between sex, professional position, educational degree and professional experience. Among male respondents, 21% were head nurses (7% of females, $P < 0.001$), 78% held a Bachelor's degree (60% of females, $P < 0.001$) and 73% were participants in continuing education (40% of females, $P < 0.001$). Length of professional experience did not differ by sex or educational level, although head nurses were on average 10 years more experienced. Head nurses, 95% of whom had a Bachelor's degree, represented 9% of the hospital sample. In hospitals, twice as many Bachelor's degree nurses as diploma nurses participated in continuing education. In nursing homes, Bachelor's degree holders were four times more involved in continuing education.

Table 2.4 shows the associations between educational levels and pharmacotherapeutic activities. Level of education was not related to involvement in providing drug-related information. However, educational level was related to information sources used. A Bachelor's degree was associated with greater confidence in own knowledge (29.8% vs. 41.8%, $P= 0.001$).

Bachelor's degree holders seemed less involved than diploma holders in adherence monitoring (Table 2.4), but this difference disappeared after controlling for professional role. Non-adherence was reported more often to head nurses by diploma nurses (60.6% vs. 44.5%, $P < 0.001$) and more often to physicians by Bachelor's degree holders (45.9% vs. 54.4%, $P= 0.014$).

More Bachelor's of Nursing holders observed ADRs, irrespective of sex, professional experience and whether or not they were head nurses (see multivariate logistic regression in **Table 2.5**). The statistically significant influence

Table 2.4. *Influence of education on pharmacotherapeutic nursing care (n= 1412).*

	Nursing Qualification			Engaged in continuing education		
	Diploma in Nursing	Bachelor of Nursing	p-value	No	Yes	p-value
Nurses providing information about a drug (%)	51.7	54.2	0.391	52.2	54.6	0.397
Nurses observing non-adherence (%)	67.1	61.6	0.047	64.3	62.6	0.538
Nurses observing an adverse drug reaction (%)	38.2	45.5	0.009	39.2	47.0	0.004

p-values are based on Pearson Chi^2-tests. Yates's continuity correction was applied.

Table 2.5. *Influence of initial nurse education on the recognition of adverse drug reactions: logistic regression analysis.*

Factors related to nurses recognizing an adverse drug reaction		Univariate *n*= 1412			Multivariate † *n*= 1059 ‡
		%*	p-value	RR [CI 95%]	RR [CI 95%]
Education	Bachelor's degree	45.5	0.008	1.35 [1.08- 1.69]	1.38 [1.04- 1.81]
	Diploma	38.2		ref.	ref.
Sex	Male	53.2	<0.001	1.69 [1.30- 2.20]	1.53 [1.12- 2.08]
	Female	40.2		ref.	ref.
Function ‡ (n=1070)	Head nurse	61.1	<0.001	1.59 [1.13- 2.22]	1.40 [1.00- 1.97]
	Staff nurse	39.8		ref.	ref.
Experience	≤10 years	43.4	0.811	/	/
	11– 20 years	41.4			
	≥ 21 years	43.1			

p-values are based on Pearson Chi^2-tests

* % of nurses who observed an adverse drug reaction in the past month;

† R^2 (Nagelkerke)= 0,028; p-value of the model < 0.001;

‡ Function was not questioned in community care and nursing homes

of participating in continuing education on observing ADRs (Table 2.4) disappeared in multiple regression due to the strong correlation with sex. ADRs were reported more frequently to head nurses by diploma nurses (52.8% vs. 39.9%, *P*= 0.004) and more frequently to physicians by Bachelor's degree holders (83.7% vs. 92.6%, *P*= 0.001).

2.1.5. Discussion

2.1.5.1. Study strengths and limitations

This survey is the first systematic attempt to quantify nurses' practice patterns in pharmacotherapy, beyond the preparation and administration of medication. A large sample in three different healthcare settings and covering different educational levels ensured a broad scope. As data collection was part of a study assignment, questionnaires and selection procedures were kept simple. Convenience sampling was used, even though random sampling would have been more reliable. A clear description of non-responders is lacking. Despite these limitations, the data collected are considered to be representative, since key variables match population values in hospitals and nursing homes. The profiles of the hospital nurses tended to correspond with observations in the 'Belimage' study (covering 9941 hospital nurses) in terms of sex (18% male), mean age (37 years) and mean professional experience (15 years) (Dierckx De Casterle´ *et al.* 2003). Median experience in our sample was 12 years and mean experience 13 years. In our nursing home sample, the percentage of Bachelor's degree nurses matched 2005 data from the register of the Belgian National Institute for Illness and Invalidity Insurance (39% with Bachelor's degree). No comparison could be made for the community care sample, as reliable census data are not available for this setting.

As the data were collected through self-reporting rather than observation, the study does not allow a quality assessment of reported interventions. Nevertheless, these data suffice for an acceptable description of nurses' practices in the three pharmacotherapeutic activities.

2.1.5.2. Nurses' role in pharmacotherapy

Providing drug information and monitoring drug therapy are primarily seen as medical or pharmaceutical tasks. This study, covering three different healthcare settings, indicates that nurses regularly engage in pharmacotherapeutic practices, such as providing drug information, monitoring treatment adherence and recognizing ADRs. After all, in most healthcare settings, nurses are almost continuously in patients' immediate presence and therefore well-positioned to deliver pharmaceutical care (Jordan *et al.* 1999, Lata *et al.* 2004, Bergqvist *et al.* 2008). Previous studies have indicated that nurses' involvement in pharmacotherapy leads to higher reporting rates of side effects and better patient outcomes (Jordan *et al.* 1999, Nakanichi 2006, Backstrom *et al.*

2007, Bergqvist *et al.* 2008). Although the results show that nurses assume considerable pharmacotherapeutic responsibilities, there is still opportunity for more nurse involvement in providing drug information and monitoring pharmacotherapy, creating chances to increase patient safety.

2.1.5.3. Practices in nursing homes

Nursing home nurses were generally less educated and less involved in continuing education, but were older and more experienced. This may be due to age-related career choices. Perhaps higher-educated and younger nurses are more interested in acute and technically more complex care in hospitals, offering more career opportunities, while older nurses perhaps prefer quieter job environments.

The overall involvement in pharmacotherapeutic practices was high in nursing homes. The focus on non-adherence was greater in longer-term elder care, i.e. nursing homes and community care services. The longer follow-up period facilitates the observation of changes in adherence over time. In nursing homes, the high prevalence of polypharmacy and dementia (Vander Stichele *et al.* 2006) may increase the necessity to monitor adherence. Mental deterioration may also encourage nurses to respond by checking residents' drug intake rather than simply pointing out the importance of adherence. In responding to observations and providing pharmacotherapeutic information, nurses in nursing homes seemed less inclined to take personal initiative and relied more on input from physicians. This could partly be due to their lower educational levels. The complexity of pharmacotherapeutic care in nursing homes demands higher-educated nurses to ensure patient safety.

2.1.5.4. Practices in community care

While the average educational level of nurses in community care was statistically significantly lower than in hospitals, the former participate more in continuing education. Nurses in community care typically work independently, visiting patients in person, as the results show. Providing drug information is a more important nursing role in community care. In cases of non-adherence, the issue is typically discussed with the patient. Trust in one's own knowledge as a source of pharmacotherapeutic information was high. It is unclear whether these nurses had greater knowledge of pharmacotherapy, or whether they had no access to other sources. Making autonomous decisions about ending a therapy or ignoring side-effects – while still rare – was most prevalent in this sector.

2.1.5.5. Practices in hospital care

Hospital nurses had the highest educational level. However, their intensity of involvement in pharmacotherapeutic care was the lowest. This may be due to higher patient turnover and greater complexity and frequent changes in pharmacotherapy. Furthermore, the head nurse and physicians were closer to the nurses and patients than in the other settings. Hence, certain pharmacotherapeutic tasks could be executed by the physicians, decreasing nurses' involvement.

2.1.5.6. Nurses' educational level

Bachelor's degree holders were 35% more likely than diploma holders to have observed an ADR in the past month. Educational level had no impact on involvement in providing pharmacotherapeutic information or observing non-adherence. Identifying ADRs requires more specific competences, which may explain these findings.

Nurses' behaviour was comparable for the two educational levels, except in two respects. First, Bachelor's degree holders trusted more in their own knowledge when providing pharmacotherapeutic information, although the accuracy of information provided could not be ascertained. Second, diploma holders tended to report more to head nurses and Bachelor's degree holders more to physicians, probably because many Bachelor' degree holders have higher level roles, for example as a head nurse, being responsible for interdisciplinary communication.

Educational programmes should prepare nurses for their pharmacotherapeutic role, particularly in nursing homes, where polypharmacy is prevalent and involvement in pharmacotherapeutic care is high, despite low average educational levels.

2.1.6. Conclusion

2.1.6.1. Practical and policy implications

Nurses have an important role to play in pharmacotherapeutic care in hospitals, nursing homes and community care. Greater awareness of their role in pharmacotherapeutic care is needed among nurses, other members of the interdisciplinary care team, patients and their families. This is essential

to improving the quality of pharmacotherapeutic nursing care and enhancing interdisciplinary co-operation.

2.1.6.2. Research implications

Further research is required into nurses' practice patterns in pharmacotherapy, using randomized selection procedures and observational data collecting. Observations would facilitate assessing the quality of the practice patterns. Barriers to pharmacotherapeutic care perceived by nurses should be examined.

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Chapter 3

Barriers for nurses to safe medication management and pharmacotherapy

This Chapter has been published as:

3.1. *Dilles T, Van Bortel L.M., Vander Stichele R.H., Elseviers M.M. Barriers in medication management in nursing homes: An expert meeting. Verpleegkunde 2011; accepted.*

3.2. *Tinne Dilles, Monique M. Elseviers, Bart Van Rompaey, Lucas M. Van Bortel & Robert H. Vander Stichele. Barriers for Nurses to Safe Medication Management in Nursing Homes. Journal of Nursing Scholarship, 2011; 43, 171–180.*

Chapter 3

Outline

3.1.
Barriers in medication management in nursing homes: *An expert meeting (abstract)*

Aim: To study barriers nurses experience in medication management in Flemish nursing homes.

Method: Expert meeting in which nurses were asked which barriers they experience in different parts of the medication management process. After preparatory actions in their nursing homes, nurses were invited to brainstorm in small groups, followed by a discussion in the entire expert group. The discussion was audio taped. Data were analyzed thematically and validated by the moderators and participants.

Findings: Participants were 12 nurses, representing 6 nursing homes, 3 secretaries and 3 moderators. In each stage of the medication management process, they experienced different barriers, for example a lack of time and knowledge, uncertainty about professional responsibilities, inefficient communication, limited access to informational resources and an inadequate attitude. Barriers were allocated to 4 themes: barriers concerning the nurse, the organization, interdisciplinary cooperation and the resident or his family.

Discussion: Most of the barriers experienced by the Flemish nurses corresponded to those reported in international literature. Despite the attention given to safe medication management, the number of barriers experienced by nurses remains high.

Conclusion: This study gives an overview of barriers experienced in medication management in nursing homes as a start for initiatives to improve medication safety.

*The full article in Dutch is available in **Appendix III**:*
Dilles T, Van Bortel L.M., Vander Stichele R.H., Elseviers M.M. Barrières in verpleegkundige geneesmiddelenzorg in woonzorgcentra: Expertmeeting. Verpleegkunde 2011; accepted.

3.2.
Barriers for nurses to safe medication management in nursing homes

3.2.1. Abstract

Purpose: This study aims to identify and compare the relevance of barriers that nurses in nursing homes experience in medication management in Belgium.

Design: The mixed-method study started with an expert meeting in November 2008 and was followed by a cross-sectional survey in February–March 2009, questioning 246 nurses and 270 nurse assistants in 20 nursing homes.

Methods: Twelve nurses represented nursing homes in an expert meeting and listed all barriers that might cause suboptimal medication management. Based on the results, a survey was developed in which respondents could indicate whether they were involved in a particular stage of the medication process and if yes, rate the relevance of the barriers in that stage on a continuous scale, varying from 1 = *no barrier* to 10 = *strong barrier*. Barriers scored 7 or more were defined as strong.

Findings: Nurses experienced a large number of barriers to safe medication management related to the nurse, organization, interdisciplinary cooperation, or to the patient and family. In preparing medication, medication administration and monitoring, being interrupted, not knowing enough on interactions, and barriers in interdisciplinary cooperation caused the most hindrance. In general, barriers in medication monitoring scored the strongest.

Conclusions: In order to improve safe medication management by tailored interventions in nursing homes, through the use of a standard questionnaire, nurses and nurse assistants can give an overview of barriers they experience and rate their relevance. Nurses and nurse assistants had different opinions on the relevance of barriers, especially in the stage of medication monitoring. Job expectations in medication management were not always clear, creating additional barriers in medication safety.

Clinical Relevance: This study provides an overview of potential barriers to safe medication management in nursing homes, which can be addressed in practice. The relevance scoring of the barriers enables prioritization.

3.2.2. Introduction

Medication safety research is necessary to improve the quality of medication management and the prevention and detection of adverse drug events in the growing nursing home population. In 1994, the World Health Organisation defined an adverse drug event as any untoward medical occurrence while a patient is taking medication but there does not necessarily have to be a causal relationship with the treatment.

Adverse drug events are common in nursing homes, and nursing home residents are vulnerable to such events due to a high incidence of polypharmacy and changed pharmacokinetics and pharmacodynamics (Turnheim, 2003). The latter issues refer to age-related changes in the functions and composition of the human body, which require adjustments of medication selection and dosage for elderly individuals. Elseviers, Vander Stichele, and Van Bortel (2010) recently described drug utilization in Belgian nursing homes, as well as the characteristics of the residents and the institutions. They found that the average number of chronic medications prescribed per nursing home resident was 8, with some residents taking up to 20 different medications. Incidence rates of adverse drug events range from 1.19 to 7.26 per 100 residentmonths (Handler, Wright, Ruby, & Hanlon, 2006). Some adverse drug events are preventable and are caused by errors. Medication errors are those occurring in the medication use process that can result in preventable adverse drug reactions, adverse drug withdrawal events, or therapeutic failure (Handler et al., 2006).

Medication management is complex; errors can occur in all stages of the process (**Figure 1**) and different professionals can be involved (physicians, pharmacists, nurses, and nurse assistants). In the system approach, errors are considered a consequence of system failures– that is, weaknesses in organizational processes or work conditions and a lack of checks and balances (Kohn, Corrigan, & Donaldson, 2000; Reason, 2000; Reason, Carthey, & de Leval, 2001). This means that different barriers throughout the medication management process result in errors that remain undetected prior to a patient taking medication.

Barriers in the system that undermine safe medication management should be identified, and several reviews have addressed factors contributing to medication errors. In a literature review, O'Shea (1999) initially described potential factors related to errors in medication administration, upon which Armitage and Knapman (2003) expanded with reports published until 2003. In 2006, McBride-Henry and Foureur added more factors and divided

them in system issues and personal issues. System issues consisted of a lack of adequate staffing, patient acuity levels, access to policy and medication information, physical environment, organizational culture, organizational communication channels, organizational routines, pharmaceutical-related issues, and the incident-reporting culture. Personal issues were stated as the understanding of how errors occur, failure to adhere to policy and procedure documents, number of hours on shift, distractions, lack of knowledge about medications and dosage calculations, workload, and the care delivery model (Bride-Henry & Foureur, 2006). In 2009, Brady, Malone, and Fleming added some new factors, such as medication reconciliation and medication distri-

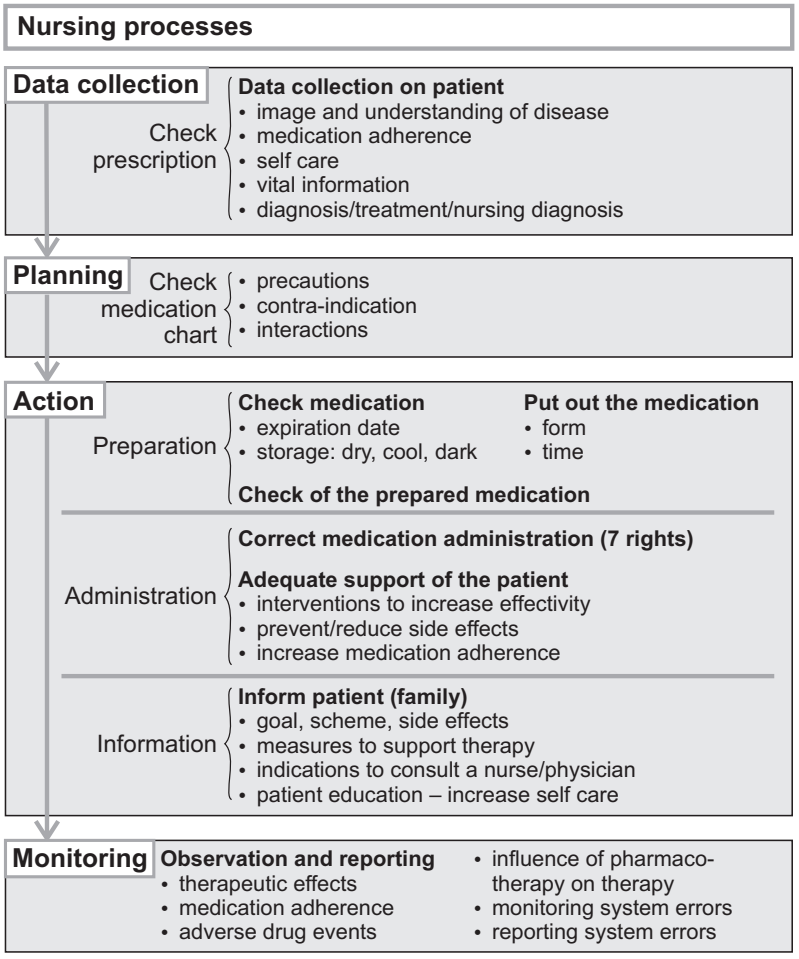

Figure 3.1. The medication process. *Adapted and translated from De Clerq, E., De Clerq, T., & Reynhout, D. (2008). De rol van de verpleegkundige in farmacotherapie. Psychiatrie en verpleging, 84 (1), 17–23.*

bution systems. Reports comparing the importance of factors within medication administration are rare. Mayo and Duncan explored nurses' opinions in multiple settings and asked them to rank 10 possible causes of medication errors. Physicians' illegible or difficult-to-read handwriting was perceived as the most frequent cause of medication errors, followed by distraction of nurses by other patients, coworkers, or events, and tiredness and exhaustion of the nurses (Mayo & Duncan, 2004). In the study of Tang, Sheu, Yu, Wei, and Chen (2005), hospital nurses were asked to recall an error in which they had been personally involved. After a description of the error by the nurse, contributing factors were selected out of a list of 40 possibilities. The need to solve other problems during medication administration was the most commonly selected cause, and personal neglect contributed to medication errors twice as frequently as other categories. Nurses play a key role in the medication process and in medication safety. Therefore, in order to increase medication safety, nurses' opinions on barriers that impede safe care are very valuable. Nurses can locate important system weaknesses, allowing tailored interventions (Bride- Henry & Foureur, 2007). Furthermore, the contribution of nurses to medication safety projects– addressing problems they experience– facilitates implementation later on (Weckman & Janzen, 2009).

Research on medication management in nursing homes is uncommon. Moreover, most studies are limited to the stage of medication administration and do not address other stages of the medication process, such as monitoring the effects of medication. In order to improve the safety of nurses' medication management in nursing homes, causes and risk factors for medication errors and suboptimal medication management in this setting need to be identified. Thus, the aim of our study was to identify the barriers that nurses in nursing homes experience in medication management and to compare their importance as perceived by nurses. Barriers were not restricted to those causing an error because the sum of many smaller barriers could also cause error or a barrier may cause intermittent errors. Furthermore, not only errors but also suboptimal care caused by barriers deserves attention.

3.2.3. Methods

The mixed-method study started with an expert meeting in November 2008. This was followed by a cross-sectional survey in February–March 2009.

3.2.3.1. Expert Meeting

An expert meeting was organized to obtain an overview of barriers that nurses in nursing homes can experience in medication management. Twentyfive institutions in the province of Antwerp were selected from a list of Belgian nursing homes. Private or public nursing homes of all sizes with both rest beds and high-intensity care beds were eligible. The selection of nursing homes was accomplished through convenience sampling, taking into account the car driving range because participation was voluntary. In addition, to avoid selection bias, the researcher who chose the nursing homes from the list did not know the institutions.

A letter was sent to the selected nursing homes asking them to delegate one or two nurses or head nurses for the expert meeting who could represent nursing staff. To further enable delegation, the topics to be discussed were attached to the invitation. Attending nurses could observe practice, ask colleagues, or initiate team discussion in preparation for the meeting.

During the expert meeting, participants were divided into three groups to brainstorm on barriers that might cause suboptimal medication management. Nurses from the same institution were split up. The main question asked was, "Which barriers that you and your colleagues experience in nursing care increase the risk for incomplete, careless, or erroneous medication management?" In each group, a moderator guided the discussion with reference to the medication process scheme (**see Figure 3.1**), ensuring that each part of the process was addressed and that all participants could share their experiences. All barriers mentioned were written down, and consensus was not required. Afterward, the results were presented for the whole group, leaving the opportunity for discussion or remarks and decreasing the risk for wrong interpretations or incomplete results. These final presentations and additions were audio-taped with the consent of the participants.

Analysis started with allocating the brainstorming report data to the concordant phase of the medication process. Thereafter, data were thematically analyzed by the first author. The results of the analysis were compared with the audio-taped data to correct any wrong interpretations or incomplete results. A final check was performed by presenting the results of the analysis to the moderators of the groups, with the finding that there appeared to be no misinterpretations or uncertainties in the results requiring further investigation. (The complete report of the qualitative part is in preparation for publication in the Dutch journal Verpleegkunde.)

3.2.3.2. Cross-Sectional Survey

Based on the results of the expert meeting, a survey was developed to invite a large number of nursing home nurses to appraise the relevance of the barriers. The goal was to receive 200 surveys completed by nurses from 15 to 20 nursing homes (3 to 4 per Flemish province). Institutions were selected at random, stratified per province, from an official list of Belgian nursing homes. Institutions with fewer than 60 beds or without nursing beds (i.e., only rest beds) were excluded. In January 2009, six nursing homes per province were selected and contacted. In the following month, three more nursing homes were selected in provinces in which the goal had not been reached. In addition to nurses, we also invited nurse assistants to participate because of their involvement in medication management in nursing homes. Since 2006, in Belgium, nurses can entrust nurse assistants with administering oral medications if prepared and personalized by a nurse, a pharmacist, or a distribution system. Nurses have to supervise the administration and be available for information and support. Nurse assistants have to report to the nurses. Subjects with less than 6 months' experience or insufficient understanding of Dutch were excluded.

To create a feasible survey, not all barriers reported by the expert group were listed. Instead, we focused on the three main stages of the medication process: preparing medication, medication administration, and monitoring medication effects. Three researchers selected 30 barriers, taking into account improvement opportunities. Participants had to indicate whether they were involved in a particular stage of the medication process, and if this was true, to rate the relevance of the barriers in that stage on a continuous scale, varying from 1 (*no barrier*) to 10 (*strong barrier*; occurrence, hindrance, consequences).

Data were collected from February to March 2009.

Paper questionnaires were distributed by a research assistant together with a cover letter explaining the purpose and the methods of the study and outlining how anonymity of the participants would be protected. After signing informed consent and completion of the questionnaire, documents were anonymously collected in a closed box. Data were analyzed using the statistical program SPSS v. 16.0 (SPSS, Inc., Chicago, IL, USA). The research population was described using the mean, standard deviation, and t tests for continuous variables and proportions and chi-square tests for discrete variables. Relevance of the barriers, as indicated on a 10-point scale, was presented in box plots showing the median, range, and interquartile range. We defined scores of 7 or more as strong barriers. The proportions of nurses and nurse

assistants scoring 7 or more were compared using chisquare tests for discrete variables. A *p* value < .05 was considered significant.

3.2.4. Results

3.2.4.1. Definition of barriers to safe medication management by nurses – Expert meeting

In the expert meeting, six nursing homes participated: two private and four public. The number of beds ranged from 90 to 214. The six nursing teams were represented by a total of 12 nurses (4 of whom were male), of whom 9 held a position as head nurse or similar level. The expert meeting resulted in a large list of barriers spread over the whole medication process, from receiving a prescription to the monitoring and reporting of effects and side effects. The barriers could be divided into four relational categories: nurses, interdisciplinary cooperation, organizational culture or structure, and patient or family. The results are summarized in **Figure 3.2**. A full report of the qualitative results will be published elsewhere.

3.2.4.2. Description of the survey respondents

A total of 246 nurses (response rate 67%) and 270 nurse assistants (response rate 46%), employed in 20 nursing homes (13 private and 7 public), with a mean of 104 beds (range 65–191), scored the relevance of the barriers. All nursing homes cared for residents both with and without dementia, except for one, which was restricted to older people with dementia. Of the respondents, 48% were nurses (0.6% master's degree, 14% bachelor's degree, 33% diploma level) and 7% held a position as a head nurse (**Table 3.1**). Nurse assistants represented 52%.

3.2.4.3. Involvement in medication management

Of the nurses, 92% participated in preparing medication for administration, with 62% involved at least once a week. Of the nurse assistants, 25% participated, with 13% involved at least once a week ($p < .001$). With regard to medication administration, 98% of the nurses were involved, with 87% participating at least once a week. The proportion of nurse assistants involved in medication administration was 87%, with 70% participating at least once a week ($p < .001$).

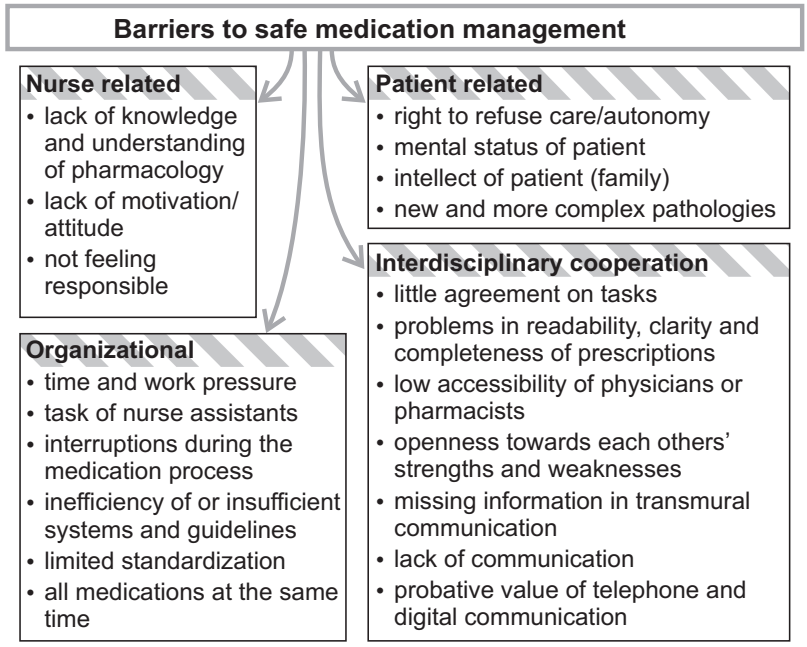

Figure 3.2. *Definition of barriers to safe medication care.*

Table 3.1. *Characteristics of the research population.*

Characteristic	Total	Nurses	Nurse assistants	*p* value of difference
	n = 516	*n* = 246	*n* = 270	
Mean years of age (SD)	38.4 (10.2)	40.2 (9.0)	36.8 (11.0)	<.001
Men (%)	7.4	3.7	11.4	.001
Full time regimen (%)	37.2	47.2	28.1	<.001
Shifts				.052
Only days (%)	72.1	67.1	76.7	
Only nights (%)	11.2	13.4	9.3	
Mean years of experience (SD)				
In health care	15.8 (10.0)	17.8 (9.2)	13.8 (10.4)	<.001
In nursing home	10.5 (8.8)	10.9 (8.3)	10.1 (9.2)	.300

p-values were obtained by t tests for continuous variables and by chi-square tests for discontinuous variables.

Eighty percent of the nurses believed that following the therapeutic effects of medication was part of their job, and 95% felt as if it should be a part of their job. The percentages for the nurse assistants were much lower: 37% ($p < .001$) and 55% ($p < .001$), respectively.

With respect to side effects, 76% of nurses believed that monitoring side effects was part of their job and 92% felt it ought to be, whereas only 45% of

the nurse assistants believed that monitoring side effects was part of their job ($p < .001$) and 62% felt it should be part of their job description ($p < .001$).

An overview of the involvement in medication management is presented in **Table 3.2**. Only those involved in a particular stage rated the relevance of the associate barriers.

3.2.4.4. General relevance scoring of barriers in the medication process

Box plots show the general relevance scoring of barriers in the medication process (**Figure 3.3**). There is a variation in the relevance of barriers as experienced by nurses and nurse assistants with barriers evaluating the effects of medication scoring stronger compared with those in medication administration, which scored stronger than those in medication preparation. Remarkably, nurses' scores ranged from 1 to 10 for all barriers.

3.2.4.5. Relevance scoring of barriers in different stages

The proportion of respondents scoring barriers to safe medication management as highly important (7 tot 10), allowed comparison between nurses' and nurse assistants' opinions (**Table 3.3**). When investigating the scores of the head nurses separately, there was only one significant difference: head nurses scored hindrance of unclear medication charts slightly lower. Yet scores on this factor were very low in all groups, indicating it was not a relevant barrier.

Medication preparation

The most important barrier was being interrupted when medications were being prepared. Over 40% of respondents scored relevance of the barrier as 7 or higher (median = 6). The statements "I do not have enough knowledge on which medications can be crushed" and "Work pressure is too high to prepare medications with care" were rated 7 or higher by about 24%. On the other hand, many respondents did not judge the barriers in these statements as important, resulting in a median under 5. The opinion of nurses and nurse assistants corresponded, except for knowledge on crushing medications and medication calculation, which were scored as a problem by relatively more nurse assistants.

Medication administration

More than 30% scored 7 or more for lack of time to double-check medication before administration and not knowing enough on interactions between

Table 3.2. *Involvement in the medication process.*

	Nurses (%)	Nurse assistants (%)	*p* value of difference
In preparation	227 (92)	67 (25)	<.001
In administration	241 (98)	235 (87)	<.001
In monitoring effects[a]	236 (96)	172 (64)	<.001

[a]All respondents who believed it was a part of their job to monitor effects of medication, or who felt like it should be, were considered to be involved.

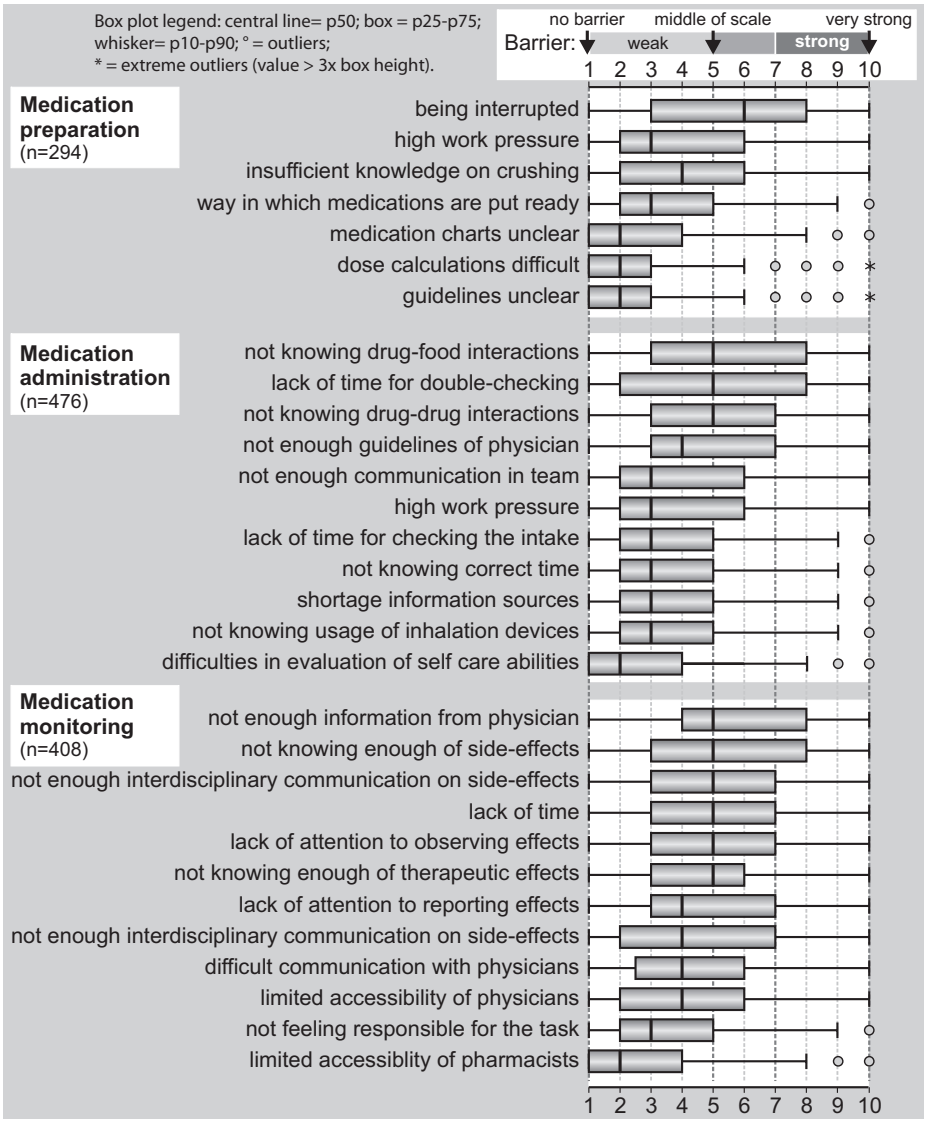

Figure 3.3*. Description of the relevance of barriers to safe medication care in nursing homes. Relevance is rated by nurses and nurse assistants on a 10-point scale with 1 =* ***no barrier*** *and 10 =* ***very strong barrier****.*

Table 3.3. *Relevance of barriers to safe medication care in nursing homes and the differences between nurses' and nurse assistants' opinions.*

Medication preparation	% ≥7	% ≥7	% ≥7	*p* value of difference[a]
	Total *n* = 294	**Nurses** *n* = 227	**Nurse assistants** *n* = 67	
Being interrupted	42.8	44.2	37.3	.340
High work pressure	24.6	24.2	25.9	.795
Insufficient knowledge on crushing	24.4	21.5	35.0	**.031**
Way in which drugs are prepared	14.9	14.8	15.5	.891
Unclear medication charts	8.8	8.9	8.5	.913
Difficulties to calculate doses	7.7	5.6	16.1	**.009**
Guidelines on the topic are unclear	3.9	4.1	3.4	.833
Medication administration	% ≥7	% ≥7	% ≥7	*p* value of difference
	Total *n* = 476	**Nurses** *n* = 241	**Nurse assistants** *n* = 235	
Lack of time for double-checking medication	37.0	43.9	29.0	**.001**
Not knowing enough on interactions with food	36.0	34.9	37.3	.586
Not knowing enough about what medication can be given together	31.3	28.5	34.4	.171
Not enough guidelines of physicians on the topic	26.3	23.6	29.4	.175
Not enough communication in the team on the topic	20.2	23.1	17.0	.106
Not knowing the correct administration time (f.e. before, during or after a meal)	19.5	19.4	19.6	.952
High work pressure	18.0	18.5	17.4	.769
Lack of time to check the actual intake	18.1	17.6	18.7	.774
Shortage of sources of information on the topic	16.9	16.3	17.5	.734
Not knowing enough on the usage of inhalation devices	14.0	8.8	19.7	**.001**
Difficulties to evaluate selfcare abilities of residents	9.7	8.8	10.7	.492
Medication monitoring	% ≥7	% ≥7	% ≥7	*p* value of difference
	Total *n* = 408	**Nurses** *n* = 236	**Nurse assistants** *n* = 172	
Not enough information of the physicians	40.5	42.4	37.9	.363
Not enough interdisciplinary communication on evaluating side-effects	28.4	37.4	15.3	**≤.001**
Not enough attention to reporting observations	28.2	34.2	20.0	**.002**
Not knowing enough on side-effects	35.5	33.5	38.4	.307
Not enough interdisciplinary communication on evaluating therapeutic effects	26.6	32.2	18.4	**.002**
Lack of time to perform the task with care	29.7	30.5	28.5	.662
Difficulties in communicating with physicians	23.5	22.7	24.6	.675
Limited accessibility of physicians	17.9	19.6	15.6	.302
Not feeling responsible for the evaluation of the effects	16.0	18.4	12.9	.136
Not knowing enough on therapeutic effects	24.9	16.9	36.1	**≤.001**
Limited accessibility of pharmacists	10.0	8.5	12.0	.244

[a]*p*-value of difference between nurses and nurse assistants.

medication and food or between different medications when administered together. These factors impeded medication administration the most. Furthermore, about 26% thought that more physician instructions on medication administration would be an improvement, and about 20% experienced a barrier in a lack of communication on this topic within the team of nurses and nurse assistants.

The lack of time to check medications a second time was evaluated as more important by nurses compared with nurse assistants. Significantly more nurse assistants experienced a lack of knowledge on the usage of inhalation devices as a relevant barrier.

Monitoring of Medication Effects

In contrast to the first two categories, with regard to the evaluation of effects, opinions of nurses and nurse assistants on the importance of barriers were clearly different. Nurses rated barriers on interdisciplinary communication, support by physicians' information, and attention to reporting and observing effects as the most important. Nurse assistants rated the barriers on interdisciplinary communication and attention to observing and reporting lower, but rated lack of knowledge on both therapeutic effects and side effects more highly. However, 34% of nurses also rated their knowledge of side effects as a barrier as 7 or more.

3.2.5. Discussion

Throughout the whole medication process, nurses experienced a large number of barriers to safe medication management related to the nurse, the organization, interdisciplinary cooperation, or the patient and family. Of the 30 barriers rated for relevance, 15 were scored as highly relevant (7 to 10) by over 20% of nurses, indicating that these barriers were experienced as major hindrances. Thus, should we still be surprised about the risk of errors? Applying the system approach (Reason, 2000; Reason et al., 2001), we need to break down these barriers to increase medication safety. Nurses and nurse assistants can help identify barriers and prioritize actions, taking into account their legal practice, educational preparation, and actual involvement in medication management.

3.2.5.1. Nurses' involvement in medication management

Nurses are not always sure how far their responsibilities reach. In our study, some doubts were voiced by nurses on the responsibility for monitoring effects of medication. While most felt like as if it should be part of their job, many thought it wasn't at the moment. The situation was even worse with regard to monitoring side effects: A quarter of the nurses believed it was not part of their job. Those who believed it was not part of their job will probably not make efforts to monitor medication side effects.

3.2.5.2. Nurse assistants' involvement in medication management

Because of differences in educational background, legal obligations, and practical job expectations, involvement in stages of the medication process differed significantly between nurses and nurse assistants. However, differentiation in tasks was not always strong enough as 25% of the nurse assistants participated in preparing medication for administration, a task they are not legally allowed to do. Legally, in Belgium, nurse assistants can help nurses regarding patient care in activities coordinated by a nurse in a structured team. However, nurse assistants can only carry out nurse activities with which they are entrusted, and this is a limited list. Listed activities in medication management include helping the patient take oral medication after it has been prepared and personalized by an automatic dispensing system, a nurse, or a pharmacist, and informing and advising the patient and family about this activity. Nurse assistants are also obligated to report to the nurse the same day. On the other hand, nurses are responsible for the correctness of activities and the way they are executed, and have to be available for information and support. Because of a shortage of nurses in nursing homes, nurse assistants perform more tasks than they are legally allowed to perform. Consequently, nursing home administrators and nurses have to be aware of their responsibility and the potentially higher risk for medication errors when deploying professionals to perform a task for which they are not educated.

3.2.5.3. Barriers in medication management

In general, barriers in monitoring the side effects of medication were experienced as more important than those in medication administration, which in turn were experienced asmore important than in preparing medication. In medication preparation, medication administration and medication monitoring, being interrupted, not knowing enough on interactions, and barriers

to interdisciplinary cooperation (informing, reporting, and the frequency of communication) were found to impede the most. When comparing the barriers experienced by nurses and nurse assistants in the three stages of the medication process that were investigated quantitatively, nurse assistants reported a higher importance for lack of knowledge. Nurses also indicated a higher importance of barriers in interdisciplinary cooperation and, although not significant, a feeling of lack of responsibility in monitoring medication effects. Differences in educational preparation and in job responsibilities can cause these differences in opinion. In practice, nurses have more responsibility for interdisciplinary cooperation, which likely increases the importance of barriers on that topic for them. Furthermore, professionals should be more aware of their own and others' professional responsibilities. Although uncertainty on job content was not a rated barrier, it can definitely be considered a barrier; for instance, when one does not know the details of one's own job responsibilities, no clear agreements on interdisciplinary cooperation can be made.

The relevance of barriers on interdisciplinary cooperation and work pressure was scored differently in different stages of the medication process. Barriers in interdisciplinary cooperation can be influenced by the belief that nurses should know about medication administration, but they expect more cooperation with physicians and pharmacists in monitoring effects. Remarkably, time barriers have been judged differently in different stages. For example, in medication administration, a lack of time to double-check medication scored the highest, while a lack of time to check the actual intake of a medication scored much lower. We suggest three possible explanations. Firstly, nurses might have shown in the results that checking the intake is a priority for them over checking the correctness of the medication once more, giving them enough time to check the intake, but leaving no time for double-checking the medication. Secondly, it might be a consequence of nurses' resistance toward rigorous rules; double-checking medication might be experienced as an obligation, while checking the intake is a part of direct patient care. Finally, the amount of time needed to perform a particular task might be important, although there appears to be no evidence for this from the results.

3.2.5.4. Comparison with earlier studies

Both Crespin et al. (2010) and Vogelsmeier, Scott- Cawiezell, and Zellmer (2007) studied barriers in nursing homes. Crespin et al. searched for contributing factors to medication errors, while Vogelsmeier et al. explored staff perceptions and concerns about the medication use process in interviews and

focus groups. Ordered by frequency, contributing factors were (a) human errors; (b) transcription errors, (c) distractions, (d) following faulty policies and procedures, (d) poor communication, incorrect pharmacy dispensing; medication unavailable; medication name (e) confusion; inadequate information, and (f) wrong medication delivered. In an overview of the multiple barriers to safe medication practices as perceived by nursing home staff, communication deficiencies were the most common theme throughout the whole medication use process (Vogelsmeier et al., 2007).

The focus on all barriers is wider than the focus on contributing factors to medication errors. Although barriers may contribute to errors, they can also just hinder an efficient medication process or adverse drug event detection. In all studies, the same barriers seem to occur (including ours), but sometimes new factors are added, contributing to the complex basis for medication errors. While our study does not add any new main factors, it increases the sensitivity of the main factors, stemming from the nurses' own experiences. In this way, a lack of knowledge was restricted to specific topics; for example, interactions between medication and food and communication problems were split into terms of accessibility, frequency of interdisciplinary communications, and difficulties in communicating (e.g., mutual respect or language). This sensitivity can facilitate very specific, adjusted interventions to improve medication safety. Moreover, our study combined research based on qualitative nurse experiences with a quantitative relevance rating on a larger scale, enabling prioritization. Communication is crucial to safe medication management. The importance of communication between physicians and nurses in our study corresponds to the results of Vogelsmeier et al. (2007) in nursing homes.

3.2.5.5. Strengths and weaknesses

The results of our study correspond partially with earlier studies. However, our study had a specific focus on nurses' experiences on barriers in nursing homes. Furthermore, we looked for all barriers and not retrospectively for factors that contributed to a recorded medication error, and in contrast to most other studies, our investigation was not limited to the stage of medication administration. Finally, the questioning of nurses and nurse assistants allowed comparison between groups.

A limitation of our study was the impracticality to include all sensitive factors extracted from the expert meeting in a questionnaire for relevance rating; the questionnaire would have been too long for respondents to complete accurately. Another limitation was the variation in respondents' rel-

evance ratings. Although the proportion of respondents rating 7 or higher on a 10-point scale clearly differed, medians seldom passed 5 and opinions always ranged from 1 to 10, demonstrating contrasts in the strength of barriers. This variation could not be easily explained. Work regimen, educational preparation, private or public institution, and function all seemed to have an influence, yet creating sum scores for separate barrier scores to compare groups is not statistically correct because separate barriers are not part of a concept to be measured.

3.2.6. Conclusions and implications

In order to improve safe medication management in nursing homes by tailored interventions, this study showed that using a standard questionnaire, nurses and nurse assistants can give an overview of barriers they experience and rate their relevance. Throughout the whole medication process, nurses experienced a large number of barriers to safe medication management related to the nurse, organization, interdisciplinary cooperation, or patient and family, all of which threaten patient safety. In preparing medication, medication administration and medication monitoring, being interrupted, not knowing enough on interactions, and barriers to interdisciplinary cooperation (informing, reporting, and the frequency of communication) created the most hindrance. Nurses and nurse assistants had different opinions on the relevance of barriers, especially in the stage of medication monitoring. Job expectations in medication management were not always clear, creating additional barriers to medication safety.

Management teams can use a similar questionnaire approach to identify barriers in their institutions. Furthermore, for the strongest barriers in our study, improvement strategies can be investigated or developed. In addition, special attention is required to clarify the roles with regard to interdisciplinary cooperation in nursing homes. Further research would also help nursing home administrators to define causes of barriers and to select and implement improvement strategies.

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Chapter 4

Educational preparation of nurses

This Chapter has been published as:

4.1. *Tinne Dilles, Charlotte Verrue, Bart Van Rompaey, Robert Vander Stichele, Monique Elseviers. Pharmacology knowledge of nurses in practice. Education in Healthcare, T15, p24.*

4.2. *Tinne Dilles, Robert Vander Stichele, Lucas Van Bortel & Monique Elseviers. Nursing students' pharmacological knowledge and calculation skills: ready for practice? Nurse Education Today, 2011; 31, 499–505.*

4.3. *Lopez Hartmann M, Dilles T, Van Bortel L.M., Vander Stichele R.H., Elseviers M.M. Farmacologie in het verpleegkundig onderwijs. Tijdschrift voor Geneeskunde 2011; accepted.*

Chapter 4

Outline

4.1.
Pharmacology knowledge of nurses in practice *(abstract)*

Tinne Dilles[1], RN, MScN, Charlotte Verrue[2] MPharm, Bart Van Rompaey[1], RN, MS, Robert Vander Stichele[3], MD, PhD, Monique Elseviers[1], MS, PhD.
'Education in Healthcare', T15, p24.
Abstract of oral presentation at Nurse Education Tomorrow Conference, 2-4 septembre 2008, Cambridge, UK

Introduction: The role of nurses in pharmacotherapy seems to expand. In contrast to Belgium in neighboring countries like England and The Netherlands, nurses can already prescribe certain drugs. In this study the knowledge of nurses about the generic names, the indications and the administration of drugs is tested.

Methods: With the help of a pharmacist a knowledge test in pharmacotherapy of 25 questions was drawn up. In different hospitals the questionnaires were completed by nurses under supervision of a visiting master student in nursing. Data was analyzed using SPSS. A p-value <.05 was considered as significant.

Results: The total population of 1070 nurses consisted of 31% graduates and 69% bachelors, of whom 2% had a master degree. Besides Belgian nurses, colleagues from The Netherlands participated (6,5%). Nearly 20% worked in a university hospital. The respondents' mean age was 36 and 21% was male. In general 51% of the answers were correct. In the different subcategories of administration, indications and generic names of drugs, respectively 44%, 58% and 47% of the answers were correct. The Dutch knew more about the administration and the generic names. Belgians knew more about the indications. The amount of knowledge grew with the age. However, nurses over 50 years old scored worse than their younger colleagues as generic names are concerned. While 62% of the bachelors passed the test, only 42% of the graduates did. This difference remained after 20 years of experience. Nurses which followed additional courses after graduation also scored significantly higher. With regard to the functions, head nurses succeeded 25% more often than other nurses. Employment in a university hospital did not influence the results. When comparing critical departments, surgical departments and departments of internal medicine, indications were better known in critical

departments, whereas generic names were better known in departments of internal medicine.

Conclusions: Nurses learn a lot about medication on the job. Pharmacotherapeutic knowledge of nurses is related to their degree of education, even after 20 years of experience. Should the role of nurses in pharmacotherapy in Belgium expand, the boundaries of the role need to be explicit, competences have to be written out and pharmacotherapeutic education has to be evaluated.

*A full article in Dutch is available in **Appendix IV**, including a comparison of nurses' knowledge in hospitals, nursing homes and community care:*
Elseviers M.M., Dilles, T., & Van Rompaey, B. (2009).
Verpleegkundige farmacotherapeutische kennis in ziekenhuizen, verzorgingsinstellingen en de thuiszorg.
In Elseviers M.M. (Ed.), Cahier Ouderenzorg: Kwalitatieve geneesmiddelenzorg (pp. 77-91).
Mechelen: Kluwer.

4.2.
Nursing students' pharmacological knowledge and calculation skills: *ready for practice?*

4.2.1. Abstract

Objectives: To evaluate graduating students' pharmacological knowledge and calculation skills and describe their self-rated readiness to safe medication care in practice on two nurse educational levels. Additionally, the study describes some characteristics of pharmacology in nurse education in Flanders, Belgium.

Methods: Thirty-eight nursing schools (bachelor's degree in nursing [N=18] and diploma in nursing [N=20]) were asked to provide details on their pharmacology curriculum and to let their graduating students participate in a cross-sectional survey using the Medication Knowledge and Calculation test in February/March 2009.

Results: The 29 participating schools showed a large diversity in pharmacology curricula. Mean scores on the pharmacology section and calculation section were 55% and 66%, respectively, for bachelor's degree and 52% and 53% for diploma students. On a scale of 1–10, 27% had a self-rated readiness perception≤5. Results differed significantly between schools.

Conclusions: Just before graduation, nursing students' pharmacological knowledge and calculation skills are limited. Apart from the test results, students did not perceive themselves able to deliver safe medication care in practice. Schools need to address the shortcomings. In practice, awareness is needed regarding possible limitations of the newly graduated.

4.2.2. Introduction

Nurses spend a lot of time administering medication and have an important role in pharmacotherapeutic care. In long-term care a nurse needs 62 to 90 min to administer the medication of 20 residents, starting with organizing the medication cart and obtaining the supplies and ending with the return of the nurse to the medication cart after the last administration (Thomson et al., 2009). In hospitals, observations of the workflow process show an average of 15 min on each medication pass (Elganzouri et al., 2009). Furthermore, nurses are involved in pharmacotherapeutic activities, e.g., in providing medication information, supporting patients' therapy adherence, and monitoring effects (Dilles et al., 2010).

Nurses' theoretical and clinical principles of pharmacology influence their practices (King, 2004; Manias and Bullock, 2002a). Furthermore, nurses' accountability for their actions requires them to know what medication is given, why and how it is given, as well as possible effects and allergies (King, 2004). A lack of pharmacological knowledge and calculation skills can cause medication errors. As Handler et al. defined, medication errors are all errors occurring in the medication use process, from prescription to monitoring, resulting in preventable adverse drug reactions, adverse drug withdrawal events, or therapeutic failures (Handler et al., 2006). Nurses' pharmacology education is crucial to their expected role in medication care and as health educators (Latter et al., 2000, 2001).

4.2.3. Background

4.2.3.1. Pharmacological knowledge

In semi-structured interviews, Ndosi and Newel questioned 42 hospital nurses on their knowledge of pharmacology regarding drugs they commonly administer. The nurses blindly selected one of four frequently used drugs as subject of the test. Questions addressed the name of the drug, its mechanism of action, indications, contraindications, normal adult dose, important interactions, common side effects, and assessment points before administration. The mean score was 6 out of 10 with only 11 nurses scoring 8 or more (Ndosi and Newell, 2009). Grandell-Niemi et al. reported that Finnish hospital nurses and nursing students experienced pharmacology as interest-

ing but rather difficult with self-ratings of pharmacology skills low, especially for pharmacokinetics and pharmacodynamics. Self-ratings were related to actual results on 24 pharmacology questions, of which the mean score for nurses was 77.5% compared to 61.7% for nursing students (Grandell-Niemi et al., 2005). Finally, Manias and Bullock organized focus groups to examine perceptions and experiences on educational preparation in pharmacology. In their study, clinical nurses described graduate nurses' medication knowledge as too superficial and continuing education as unstructured (Manias and Bullock, 2002a). Furthermore, lecturers and students agreed that educational preparation in pharmacology can be improved and deserved a closer look (Manias and Bullock, 2002b).

4.2.3.2. Calculation skills

In Finland, similar to pharmacological knowledge findings, practicing nurses performed significantly better than students on medication calculation skills, with only 1.6% nurses attaining perfect scores and none of the students (Grandell-Niemi et al., 2005). In the Netherlands, 186 nurses working at nine departments of four hospitals completed a calculation test. All questions were answered correctly by 1.6% of the nurses and 85% of questions were answered correctly by 8% of the nurses (De Jong and Koster, 2007). In the United Kingdom, Jukes and Gilchrist tested 37 second-year nursing students. The median score on a 10-item drug calculation test was 6 out of 10 with all students making at least one mistake (Jukes and Gilchrist, 2006). In his study, Brown indicated that bachelor-degree nursing students were able to calculate correctly with whole numbers but were deficient in addition, subtraction, multiplication and division of fractions, decimals, and percentages (Brown, 2006). Bad results on calculation tests were no surprise to nurses. Moreover, nurses' low confidence in medication calculations had a predictive value for their performances (Andrew et al., 2009; Grandell-Niemi et al., 2003).

4.2.3.3. Pharmacology education for nurses and medication care in Belgium

In Belgium, there are two levels of basic nurse education (**Table 4.1**). The Flemish community, which is the Dutch-speaking part of Belgium, has 18 bachelor programs in nursing degree schools and 20 schools with a program to earn a diploma in nursing. The level of medicationrelated training in the different nursing degree programs is not predefined by the government and consequently varies between schools and teachers. Exams are created and

evaluated by the teachers themselves. No formal national tests exist. Legally, there is no differentiation in tasks based on educational level, and nurses with either diploma or bachelor degrees in nursing are allowed to perform the same tasks. On the other hand, competencies may differ based on educational preparation, leading toward differentiation in practice. Belgian nurses are not licensed to prescribe.

Table 4.1. *Basic Belgian nursing qualifications.*

Diploma level: Three-year educational program with focus on training of the execution of nursing tasks.
Bachelor's degree: Three-year educational program with focus on training of the execution of nursing tasks, combining clinical aspects with biomedical, theoretical and scientific aspects.

4.2.4. Methods

4.2.4.1. Aims

This study primarily aims to evaluate graduating students' pharmacological knowledge and medication calculation skills and to describe their self-rated readiness to safe medication care in practice on two nurse educational levels. Because nurse education in pharmacology is not predefined in Belgium, this study also aims to describe some organizational and content characteristics.

4.2.4.2. Research design

The first part was a descriptive cross-sectional study in which information was gathered by a questionnaire to create an inventory of pharmacology education characteristics in Flemish nursing schools. The second part was a cross-sectional, correlation survey in which students were tested with the Medication Knowledge and Calculations Test (MKC test) and their self-rated readiness to safe medication care was assessed. The results were related to educational level.

4.2.4.3. Participants

All Flemish nursing schools (bachelor's degree [*N*=18] and diploma [*N*=20])

were asked to participate in the first part and to let their graduating students participate in the second part in February/March 2009. Graduating students had to follow a full-time nursing education program to be included.

4.2.4.4. Data collection

Schools were asked to provide information on the pharmacological aspects of their curriculum (November 2008–January 2009). A questionnaire probed basic characteristics of the school, contact details of the coordinator of the educational program, data regarding the organization of pharmacology education as a distinct course or integrated in other courses, the amount of hours in each study year, course materials, and the inclusion of specific pharmacology topics in the distinct pharmacology course (if present).

Format of the questionnaire facilitated responses with the possibility of providing comments. Informative documents that supported answers to the questionnaires (e.g., course documents, content tables, or curricula overviews) were also requested. All questionnaires and supporting documents were analyzed for completion and comprehensiveness, respectively. When requested data were unclear or missing, the respective schools, represented by the coordinator of the educational program, were contacted personally. Three to four months before graduation (February–March 2009), coordinators were asked to test graduating students in their school using the MKC test and to assess students' self-rated readiness to safe medication care. Schools could choose an electronic or a written form. A research assistant visited all schools to explain the test, and, if possible, to assist and be present during the test. Schools were advised to permit completion of the test during a lesson, but not all schools complied, and some asked their students to complete the test in their spare time. In these instances, schools were regularly asked to remind their students about the test.

4.2.4.5. The Medication Knowledge and Calculations test (MKC test)

The MKC was developed for the purposes of this study and consisted of two sections: a pharmacological knowledge test and a medication calculations test.

The knowledge section was developed from a local pharmacology knowledge test for nurses in practice, and has been used in different studies in hospitals, nursing homes, and community care settings (Dilles et al., 2008; Elseviers et al., 2009). The goal of this test is to evaluate general pharmacological principles and understanding rather than names or characteristics of specific

drugs, as their importance differs between specialties and places of employment. In order to achieve the goal of our study, test items were adapted. In the final test, pharmacological knowledge was measured by 25 statements about indications of use, normal dosages, administration methods, route and timing of the administration in the context of the patient, pharmacokinetics and pharmacodynamics, generic drugs, therapeutic effects, side effects, food or drug interactions, and the medication process. Topics were based on nurses' responsibilities in practice, and corresponded to those included in earlier studies (Ndosi and Newell, 2009). Students had to judge if a statement was 'certainly true', 'probably true', 'probably not true', or 'certainly not true'. Face validity was assessed by a physician, a pharmacist, a nurse, and a nurse lecturer. To differentiate between the importance of the statements, statements were divided into three categories: basic nursing responsibilities, shared responsibilities of nurses with a physician and/or a pharmacist, and responsibilities of a physician but nurses' knowledge and understanding of the topic is recommended. A panel of seven nurses validated the allocation of the statements to the three categories (**Table 4.2**). This method of differentiation between levels of responsibility enlarged the value of the results, guaranteeing that the statements were relevant and the test not too difficult–certainly not when considering the results in the first category. The categories were not visible to participants.

Table 4.2. *Medication knowledge test: topics and categories.*

Basic nursing responsibilities	Shared responsibilities of nurses with a physician and/or a pharmacist	Responsibilities of a physician but nurses' knowledge and understanding is recommended
→ Crushing delayed-release tablets	→ Gastro-intestinal side effect of psychopharmaca	→ Interaction between anti-epileptic drug and oral contraceptives
→ Meaning of 'parenteral' administration	→ Antipyretic drugs reduce fever	→ Low renal function and drug dosages
→ Inhalation therapy and mouth rinsing	→ Blood-brain barrier crossing by antipyretic drugs in infants	→ Indication of oral anti-diabetic drugs
→ Effect of insulin administration on blood glucose levels	→ Administration of gastric acid suppressants with other drugs	→ Regulations on the content of a drug prescription
→ Interaction of grapefruit juice and some cholesterol lowering drugs	→ Effect of beta blocking agents on blood pressure and heart rate.	→ Oral medication passes bowel wall and the liver
→ Side effects of generic drugs compared to brand name drug	→ Meaning of 'blood level'	→ Delayed onset of action of antidepressant
→ Storing effervescent tablets	→ Influenza vaccination in patients with diabetes	→ Compliance to antibiotic therapy and resistance
	→ Indication of antihistaminic	→ Regulations on reporting side effects
	→ Acetylsalicylic acid and perioperative bleeding	
	→ Dispersion in the blood versus local attraction of the drug	

Medication calculation skills were tested with five medication calculation exercises requiring different mathematical skills (**Table 4.3**). The use of a calculator was not permitted (to have calculators available for all students was impossible and the exercises did not require the use of a calculator.)

Table 4.3. *Medication calculations test.*

1. In stock, you have insulin 100U/ml. You need to inject 28U. How many ml do you have to inject? …. ml
2. In stock, you have morphine 3% (1% = 1g/100ml). How many mg morphine does one ampoule of 2ml contain? …. mg
3. 2,5 mg = …. µg (microgram)
4. You need to administer 25mg Lasix® per hour via an infusion pump. One 10ml ampoule contains 100mg of Lasix®. When you have to set up the infusion pump, how many ml/hour do you program? …. ml/hour
5. A child of 30 kg needs antibiotics at a dosage of 4 mg/kg/day. In stock, you can find ampoules of 100 mg/ 5ml. How many ml do you administer per day? …. ml/day

4.2.4.6. Self-rated readiness to safe medication care

After the MKC test, students were asked to mark on a 10-point numeric rating scale their perceived readiness to deliver safe medication care as a nurse in practice.

4.2.4.7. Data analysis

All data were analyzed using SPSS 16.0. Because of the small number of schools, results regarding the organization of pharmacology in nurse education were described using numbers and percentages for categorical variables and median and range for continuous variables.

In the MKC test, students who judged a pharmacological statement correctly and with certainty scored 2 points. A correct answer, however uncertain, counted for 1 point. Students did not receive any points for wrong or missing answers. The sum of the points on the 25 statements was multiplied by 2 to obtain a percentage per student. General results are presented by the mean and standard deviation of the percentages. Results per question are presented by the percentage of students with a correct answer.

In the calculation section, missing answers were considered wrong. To avoid underestimation of skills by including students who did not attempt the exercises, students not providing answers in the calculation section (5 missing answers; n=81) were excluded from analyses of the calculation test, even if they completed the entire knowledge section. Similar to the knowl-

edge section, general results are presented by the mean and standard deviation of the students' scores. Results per exercise are described in four categories: percentage of correct answers, percentage of answers that were half or less of the correct dose, percentage of answers that were twice or more the correct dose, and non-responders.

Significance of differences in test results between schools was calculated using one-way ANOVA. Differences between diploma and bachelor's degree students were examined by Mann–Whitney tests for continuous variables. The relation between the results on the different sections of the MKC was analyzed using Spearman's correlation coefficient. A p value <0.05 was considered significant.

4.2.4.8. Ethical considerations

Participation was voluntary. Schools and students were informed about the aims and the methods of the study. Students' responses were returned anonymously and all information regarding schools and students was processed confidentially.

4.2.5. Results

4.2.5.1. Pharmacology education for nurses in Flanders, Belgium

Twenty-nine nursing schools participated in the first part of the study (bachelor's degree [n=17], diploma level [n=12]). In 16 schools, of which 11 were diploma schools, pharmacology was completely integrated into other courses of the general curriculum. A separate pharmacology module was offered in one of the diploma programs, with lectures given by a nurse teacher. In 12 bacholor's degree programs a separate pharmacology module was organized, with lectures given by a nurse (7 cases), a pharmacist (3 cases), or a physician (2 cases). Only one of the nurse lecturers had additional pharmacology training.

The total time reserved for the separate pharmacology module (n=13) ranged from 7 to 30 h (median: 12 h), with a range of 0 to 30 h in the first year (median: 0), a range of 0 to 24 h in the second year (median: 10), and a range of 0 to 8 h in the last year (median: 0). In the separate pharmacology modules, lecturer self-developed course documents and PowerPoint presentations were the most frequently used course materials; two lecturers used scientific

articles. A textbook was used as course material in one school.

Table 4.4 shows the number of bachelor's degree curricula addressing different pharmacology topics in their separate pharmacology modules.

Table 4.4. *Pharmacology topics in nurse education*

Topics**	Schools* n=12
Administration methods	12
Pharmacokinetics	12
Pharmacodynamics	12
Galenic form	12
Understanding patient package inserts	12
Dealing with side-effects	10
Drug interactions	8
Medication calculation skills	6
Crushing drugs	5
Dealing with medication errors	4
Correct storage of drugs	3
Following up therapeutic effects	2

*The number of schools in which the topic is addressed in a separate pharmacology module.
** The list of topics is not limitative. Other topics can have been addressed

4.2.5.2. The MKC test

In the second part of the study, 16 of the bachelor's degree schools and 9 diploma schools participated. The MKC was completed by 613 graduating nursing students, 404 in a bachelor's program and 209 in a diploma program. The average student response rate was 45% (24%– 100%) per school. The median age of the students was 21 and 87% were women. Diploma students had more job experience in health care (**Table 4.5**).

Table 4.5. *Description of the population.*

		Total (*n*=613)	Diploma program (*n*=209)	Bachelor's degree program (*n*=404)	*p*-value*
Median age in yrs [range]		21 [19-54]	22 [19- 54]	21 [20- 54]	<0.001
% women		87.0	91.8	84.6	0.012
% with job experience in health care		16.0	26.0	10.9	<0.001
Specialty**	General/ hospital		66.5	56.4	
	Geriatrics		18.7	5.9	
	Mental health		12.4	8.4	
	Children		not available	17.8	
	Social		not available	9.7	
	Other		2.4	1.7	

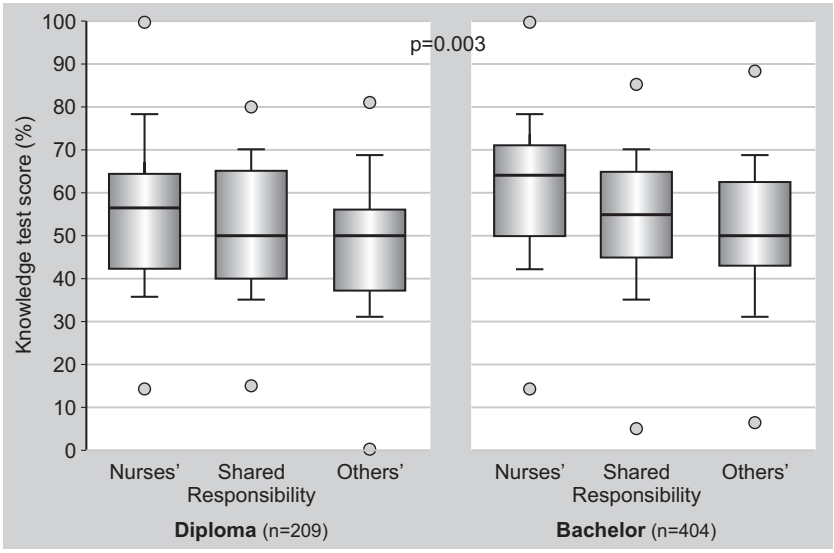

Figure 4.1. *Pharmacological knowledge of diploma and Bachelors' degree students.*

*p-values are obtained by Mann-Whitney tests.
** Specialties differ between nursing degrees. Therefore no totals or differences were calculated.

The mean score on the knowledge test was 52% for diploma students and 55% for Bachelor's degree students (**Figure 4.1**). Only 7% attained a score above 70% and no one attained 85%. Taking into account only basic pharmacological knowledge questions that addressed essential nurse responsibilities resulted in a mean score of 57% for diploma and 61% for bachelor's degree students (**Table 4.6**). When stating that some cholesterol-lowering drugs cannot be taken with grapefruit juice but can be combined with apple juice, only 14% were certain about the correctness of the statement. Only 24% of the students knew for sure that effervescent tablets are damaged when removed from their package hours before administration. A delayed-release tablet would be crushed for a patient with swallowing problems by 22% of the students.

The mean score on the calculation test was 53% for diploma students and 66% for bachelor's degree students (Table 4.6). Dose calculations carried out by the study participants regularly resulted in dosages less than half or more than twice the correct answer (Table 4.6). The answers on questions 1, 2, 3, and 4 were often tenfold the correct dosage. When rating their own readiness to medication care in practice on a scale of 1–10, 27% of the students rated themselves 5 or lower. Only 15% felt ready enough to rate themselves

8 or more (**Figure 4.2**). Compared to bachelor's degree students, diploma students felt more prepared for medication care in practice (Table 4.6).

Table 4.6. *Results on the Medication Knowledge and Calculations test (MKC-test).*

Knowledge section		**Total (n= 613)**	**Diploma (n=209)**	**Bachelor (n=404)**	***p*-value***
All questions (25)	Mean score % (sd)	53.7 (10.9)	51.9 (10.5)	54.6 (10.9)	0.003
Basic questions (7)		59.1 (15.5)	56.5 (16.0)	60.5 (15.1)	0.003
Intermediate questions (10)		52.7 (14.0)	52.0 (14.4)	53.1 (13.8)	0.323
Advanced questions (8)		50.1 (14.4)	47.6 (14.1)	51.4 (14.4)	0.005
Calculation section *n*=532* **		**Total (*n*=532)**	**Diploma (*n*=170)**	**Bachelor (*n*=362)**	***p*-value***
All questions	Mean score % (sd)	61.8 (27.4)	52.9 (27.6)	66.0 (26.3)	<0.001
Calculation section n=613		**Dosage answered**			**No answer given**
		Half or less	**Correct**	**Double or more**	
Question 1	% of students	2.9	69.8	7.5	14.8
Question 2		44.4	28.9	4.9	21.0
Question 3		34.9	38.2	4.2	22.7
Question 4		2.6	65.7	3.4	22.5
Question 5		4.4	65.6	1.1	23.5
Self-rated medication care readiness		**Total (*n*= 608)**	**Diploma (*n*=207)**	**Bachelor (*n*=401)**	***p*-value***
10 point scale	Mean score (sd)	6.2 (1.4)	6.45 (1.3)	6.06 (1.5)	0.004

* p-values are calculated with Mann-Whitney tests.

** sd= standard deviation

*** cases were excluded if all 5 answers were missing

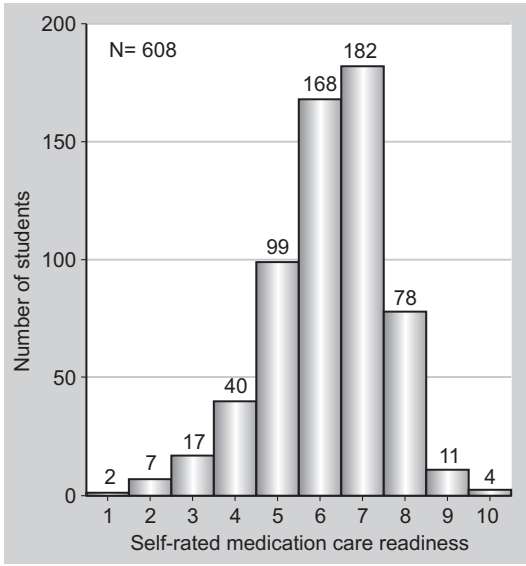

Figure 4.2. *Self-rated medication care readiness of graduating nursing students.*

Students' perceived readiness to deliver safe medication care did not correspond to their results on the medication calculations test (rs= 0.024, p=.587) or the knowledge test (rs=0.090, *p*=.026). The results of the calculations test and the knowledge test correlated significantly, but very weakly (rs=0.140, *p*=.001).

The aggregated mean scores per school ranged from 45% to 58% (*p*=.007) on the knowledge section and from 36% to 85% (*p*<.001) on the calculation section. Students' mean self-rated readiness per school ranged from 4.9 to 7.3 (*p*<.001). No relationships were found with the organization of pharmacology education as a separate module or integrated in other courses, the amount of hours per study year, or the teachers' profession.

4.2.6. Discussion

General scores on the MKC showed persuasive limitations in the pharmacological knowledge and calculation skills of graduating nursing students. The mean score on the knowledge section was 54%. Even when limiting the knowledge section to the most basic nurse responsibilities, the mean score on this section was only 59%, suggesting that newly graduated nurses do not know enough basic principles of pharmacotherapy to deliver safe medication care. The scores on the calculation section also showed deficits in medication calculation skills with 60% of the students making at least two mistakes on five exercises. The calculation errors often resulted in double the correct dosage, creating possible life-threatening situations in practice if not timely observed by the nurse, colleagues, or the organizational system. In general, it can be stated that the deficiencies identified by the MKC (i.e., a lack of pharmacological knowledge and medication calculation skills in graduating nursing students) could lead to medication errors in practice and threaten patient safety. Obtaining a clear view on pharmacology education that is integrated in the general curriculum is not easy, especially content of pharmacology curricula in schools. Too often it was presumed by contacts at the schools that a certain teacher probably addressed a topic, without verifying this was the case. Although course documentation, brochures, and content tables were searched for additional information, data on the curricula may still be incomplete. Only by following all classes or analyzing all course documents in detail could this problem have been better addressed. While schools of nursing could not provide the overview we desired, the results did show a large divergence between schools and some topics; for example,

the correct storage of medication or dealing with medication errors, seemed to be regularly omitted. From the organizational details of the pharmacology curriculum, schools of nursing reported a large variety in the number of hours spent on a separate pharmacology module. Furthermore, the range in mean scores between schools was high. Because of the small number of detailed data on the curricula, no differences in MKC results could be shown related to the characteristics of the curricula. Finally, there was no agreement on how far nurses' knowledge should extend.

In the international literature, different methods to improve pharmacology education have been reported. In 1997, Jordan described the power of applied pharmacology by case studies in pharmacology education (Jordan, 1997). Banning created a theoretical framework for pharmacology education, stressing the importance of applied pharmacology and clinical reasoning; the framework included teaching and assessment strategies (Banning, 2003). A similar framework would be useful for nurse education in Belgium to determine and harmonize educational goals, adjusted to the role of nurses in practice. On-the-job-training could start from the framework to familiarize nurses with the specific characteristics of medication care in their jobs (specific patients, drugs, organization, and multidisciplinary cooperation agreements). Lim and Honey have provided an example of an integrated curriculum for pharmacology that stimulates students' understanding and linking theory with practice (Lim and Honey, 2006). When schools offer integrated pharmacology courses to improve the amalgamation of theory and practice, it is crucial that someone guarantees the presence of all topics of the framework throughout the curriculum.

The worst results of calculation exercises 2 and 3 were provided by the nursing students (Table 4.6). Similar to the findings of Brown, these are the exercises with decimals and percentages (Brown 2006). However, the large number of calculated wrong dosages, found in our study, might not affect patients in practice, a paradigm that Wright explained in a recent critical debate on the basis that nurses use context and tools in clinical practice, such as syringes or ampoules, to calculate drug dosages. Therefore, written calculation tests are said not to be representative of nurses' skills in practice (Wright, 2009c). Because the MKC used written calculation exercises, and taking into account Wright's remarks, the number of mistakes found on the exercises might overestimate the number of mistakes in a practice setting, and thus additional testing in clinical practice might be advisable to obtain a more accurate estimate of this problem. Nevertheless, nurses' low scores on the calculation test are a serious issue; responsibility in dose calculations is high and consequences of mistakes can be serious. Furthermore, nurses also need

mathematical skills to calculate other important clinical parameters, such as fluid balances. Perhaps if nurses had alternative strategies to guide them in dose calculation in practice, this would be helpful in reducing medication errors. Methods to support the development of these strategies in students in nurse education have already been suggested by Wright (Wright, 2009a,b).

The implications of this study are not restricted to schools: results demonstrate that nursing students are not prepared for safe medication care in practice 3 to 4 months before graduation. The number of study hours dedicated to pharmacology education in a separate module in the last year was low and the last months of the program mostly included supervised clinical practice and exams. Therefore, pharmacological knowledge and medication calculation skills would probably not change significantly during those last months. Consequently, the results of the MKC test are representative for newly graduated nurses starting in practice. It is doubtful that extra training in practice and the knowledge and support of colleagues suffice to resolve the observed deficiencies at present.

When reflecting on their own readiness to safe medication care in practice, students rated their competencies low on a 10-point scale. In contrast to other studies, the perceived readiness of students to deliver safe medication care in practice in our study did not correspond to the actual results on the knowledge and calculation tests (Andrew et al., 2009). Therefore, the self-assessment method used in our study seems inadequate to estimate actual preparedness for safe medication care. The cause of the low correlation might be explained by the use of a single question in our study, rather than multiple questions on different domains of medication care. Some students might feel prepared regarding knowledge, yet not in calculation skills, or the other way around. Another possible explanation is a discrepancy between competence and confidence as described by Roberts and Johnson (Roberts and Johnson, 2009). Not only are both concepts different, being confident is revealed as a requisite for learning a competence. Focusing on the influence of the educational levels, compared to the diploma students, bachelor's degree students had a better knowledge of pharmacotherapy and their mean score on the medication calculations was 13% higher. Because stronger students choose a higher educational level, differences might be expected, yet, the difference in calculation skills was very large and both levels lead to the same tasks in medication care. In contrast to the test results, diploma students felt more ready to safe medication care in practice. More practice training in their curriculum is a possible explanation, creating confidence. In Flanders, while no large study has been undertaken to evaluate nursing students' pharmacological knowledge and calculation skills, our study results are comparable

to findings in other countries. A lack of pharmacological competencies is a widespread problem in nursing. Our study additionally showed that pharmacological knowledge and calculation skills depend on the level of nurse education and that these competencies differ between schools as far as graduating students are concerned. As a starting point for change, the diversity of pharmacology education in Flanders has been described.

Due to selection bias, actual abilities of students may have been overestimated. Students' participation was voluntary, and uncertain or weaker students, not wanting to show a lack of competencies, may not have participated. This may be one explanation for students completing all questions, except for some calculations. Furthermore, to cover a large number of nursing students in all of Flanders, most tests were completed online. We did not observe these processes and not all schools were able to organize a guided, observed completion session. Although the instructions were clear, some students might have cooperated or used tools to answer questions. Except for these risks on overestimation of the competencies, a lack of student interest or a possibility of not taking the test seriously may have reduced their effort, leading to lower scores. In addition, some students might not have been willing to make time to complete the test. Finally, the results on the test were not compared to nursing students' actual performances in practice. Despite the limitations of our study, the message of the results is clear.

4.2.7. Conclusions

Pharmacological knowledge of graduating nursing students is not sufficient to deliver safe medication care. On a written calculation test, mistakes were frequent, resulting in possible life-threatening dosages if not countered by the system in practice.

Putting the patient at risk through a lack of professional competency is unethical. Therefore, relevant competencies should be tested regularly and if necessary refined by the student or nurse or be addressed more structurally in nursing schools or in practice. There was a marked difference between schools in pharmacological knowledge and calculation skills, as well as in pharmacology education organization. A framework with clear goals for pharmacology education in nursing should be defined. In practice, awareness is needed regarding possible limitations in pharmacological competencies, especially for the newly graduated.

In further research it would be interesting to acquire a more detailed

view on pharmacology curricula in nurse education. Intensive research using documentary analysis and observations would be needed. Besides research on educational strategies to improve nursing students' and nurses' pharmacological competencies, research should expand the development of strategies to support nurses by the availability of pharmacotherapeutic information and interdisciplinary cooperation, providing nurses the opportunity to obtain information in shortage of the required knowledge. Strategies should be tested and integrated in a pathway for nursing students and nurses to follow throughout their careers, guaranteeing the presence of professional competencies to deliver safe medication care.

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4.3.
Pharmacology in nurse education in Flanders *(abstract)*

Pharmacotherapeutic care has an important place in daily nursing practice. In the patients' interest it is essential that during their training, nurses learn the necessary skills to provide quality pharmacotherapeutic care.

This cross-sectional study aims to describe organizational and substantive aspects of the current pharmacology curriculum in nursing education in Flanders in relation to the pharmacological knowledge and calculating skills of the graduating students.

The pharmacology curriculum varies widely in different educational institutions, both in terms of organization and content of the lessons. Pharmacology is not always organized as a separate course, but is taught more frequently woven into different lessons. In general, the students' results on the knowledge test and the calculation test were low. The previous education level of the students had a clear impact on the results. The self-assessment of the students, the extent to which they feel prepared to provide pharmaceutical care, stood in contrast to the results on the knowledge test and the calculation test.

It is recommended that a multidisciplinary working group reflects on the skills that a nurse needs in order to ensure quality pharmacotherapeutic care.

*The full article in Dutch is available in **Appendix V**:*
Lopez Hartmann M., Dilles T., Vander Stichele R., Van Bortel L. Elseviers M.
Farmacologie in de opleiding verpleegkunde in Vlaanderen.
Tijdschrift voor geneeskunde, 67. 2011.
doi: 10.2143/TVG.67.00.2000000

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Chapter 5

Development of a drug related problem trigger tool

This Chapter has been submitted for publication to BMJ Quality and Safety as:
Tinne Dilles, Robert Vander Stichele, Lucas Van Bortel & Monique Elseviers, Development of a drug related problem trigger tool for interdisciplinary medication review.

Chapter 5

Outline

5.1.
Development of a drug related problem trigger tool for interdisciplinary medication review

5.1.1. Introduction

5.1.1.1. Drug related problems in nursing homes

In the European Union, the share of the population aged 65 years and over is projected to rise from 17% in 2011 to 20% in 2021(1). In Belgium, 7% of this geriatric population, often with multiple morbidities and polypharmacy, is institutionalized permanently in nursing homes (2). About all communities have a nursing home in which older people can reside close to their former homes. Depending on their care-dependency level, residents stay in a rest bed or a nursing bed. Rest beds are reserved for those who need support in usual family and household care. Nursing beds are high intensity care beds for residents with long-term care needs, who are heavily dependent on professional help for the activities of daily living.

Managing medication in nursing homes is a challenging task, as pharmacotherapy is essential to control complex disease states. On the other hand, polypharmacy can lead to drug related problems (DRPs). This can jeopardize the beneficial effects of pharmacotherapy and cause harm to the quality of life of institutionalized elderly, and even cause hospitalizations and premature death (3-8).

The high incidence of DRPs is well documented in a growing body of literature, where a DRP is defined as "an event or circumstance involving drug therapy that actually or potentially interferes with desired outcomes" (9;10). A subgroups of DRPs are adverse drug reactions (ADRs). ADRs are appreciably harmful or unpleasant reactions predicting hazard from future administration and warranting prevention or specific treatment, or alteration of the dosage regimen, or withdrawal of the product (11). In nursing homes the incidence of adverse drug reaction (ADRs) ranged from 1.19 to 7.26 per 100 resident months (12) In a study of 256 nursing home residents, about 70% of the residents were exposed to an error during prescription, monitoring, dispensing, or administration phases, with a mean of 1.9 errors per resident (13).

Patient safety is an interdisciplinary task, involving prescribing physicians, dispensing pharmacists, and administrating nurses, all bound in a medication management system (14).

5.1.1.2. Drug related problem detection methods

Meyer-Massetti et al. systematically reviewed screening methods for DRPs and compared the four methods most commonly described: incident reports, direct observation, medication review and the use of trigger tools (15). Incident reporting, in which health care personnel, patients or family voluntary reported incidents, was the best method to detect high-severity DRPs and the least expensive (15). Direct observation of DRPs resulted in the greatest number of reports (15). Medication review or drug utilization evaluation, which is the assessment of drug prescription against some standard, detected more moderate DRPs in a wider variety (15).

The last method, the use of trigger tools, has extensively been described (16-18) and tested in different settings (19-25). The concept is always about the same: medical records are reviewed, mostly by a computer program, screening for triggers, which are alerts of potential DRPs. Triggers frequently described in literature are high-risk medications, new medications, laboratory results (often combined with medications), orders of antidotes or 'rescue'-medications, the occurrence of falls, patient characteristics (i.e. allergies) and specific diagnoses (ICD-codes) (18-35). Most of these examples were developed for the use in hospital settings. Only Handler et al. have developed a trigger tool specific for the nursing home setting with 15 laboratory and medication combinations, 12 medication concentrations, 10 antidotes, and 3 Resident Assessment Protocols (falls, delirium and deshydratation) as triggers (34;36).

Compared to the other methods, trigger tools were efficient (labor and costs) and had a higher sensitivity than direct observations and incident reports. Yet, a high specificity of the applied triggers was noted as a prerequisite for the effectiveness of trigger tools (15).

5.1.1.3. Interdisciplinary cooperation in drug related problem detection

The importance of interdisciplinary cooperation in medication safety initiatives has been proven before. A systematic review on interventions to optimize prescribing in nursing homes stressed the importance of a multifaceted approach including education, interdisciplinary cooperation and computerized clinical decision support systems (37). However, most inter-

ventions previously described do not encompass interdisciplinary cooperation and are focused on physicians or pharmacists only (37;38).

5.1.1.4. Nurse involvement in drug related problem detection

In the setting of nursing homes, assurance of participation of nurses in the medication review process is of importance, as this profession has the longest contact time with the patient. However, the educational level of the nursing staff in nursing homes is generally lower compared to hospitals or community care (39). There is a large number of barriers, such as a lack of interdisciplinary cooperation, uncertainty about job responsibilities, and gaps in pharmacology knowledge among nurses (39-41). Geriatric patients in this setting suffer from mental deterioration or physical limitation such as difficulties to deblister and decreased self care opportunities, and require more assisted medication administration and tight supervision (42).

Nurse observations of patients' health status are essential information for physicians and pharmacists in evaluating patients' responses to medication and therefore in optimizing pharmacotherapeutic prescribing. We reviewed literature for DRP screening methods, with nurse involvement, applicable in nursing homes. The review resulted in 8 articles in which the effect of the interventions was measured. In the study of Krska (2005), nurses performed medication review on their own and the results were compared to medication reviews of general practitioners. Nurses were less capable of selecting ineffective or poorly tolerated medicines (43). In the study of Sankaran et al. (2010), a clinical nurse specialist participated in interdisciplinary review (44). The method of Halvorsen et al. (2010) involved a pharmacist who performed medication review followed by a discussion of the results with physicians and the nurses to agree upon DRPs (reclassification, rejection, or additions) (45). In other studies, nurses' role was focused on the preparation of the medication review by paying extra attention to the general monitoring of patients' health status, by checking renal function, by screening for drug-drug interactions (DDIs) using web applications, or by revising the data in patient files (44;46-49). The use of checklists to interview or observe patients to detect DRPs, was the only structured strategy described. The checklist by Jordan et al. consisted of a standard list of observations (such as weight, heart rate, blood pressure, signs of infection, posture and movement), directed questions concerning client perceptions of adverse effects (e.g., changes in vision, constipation, drowsiness), and an evaluation of health behavior of patients (50;51). The checklist of a Swedish research group contained a list of common symptoms elicited by diseases and common ADRs for which inconvenience

experienced by the patient could be scored on a Likert scale (46-48). Only three studies involved nurses in interdisciplinary conferences to discuss DRPs or to inform them of changes. One study referred to weekly rounds of physicians and nurses and two studies mentioned systematic reports of detected DRPs to a physician.

The variation in outcome measurements and the lack of methodological rigour in the studies described above did not allow to make a qualitative systematic review or meta-analysis on the effects of the interventions involving nurses in DRP screening. However, nurse involvement always resulted in an increase of the number of DRPs detected. Nurses have the required observation skills, yet, not always the required knowledge for DRP detection (52).

5.1.2. Aims

The aim of this paper is to present the development process of a tool permitting nurses to participate in medication review in a structured way in the nursing home setting. This tool focuses on two kinds of DRPs: adverse drug reactions (ADRs), stemming from active medications on the medication chart, and medication administration problems. The tool is called the DRP trigger tool for nurses, because it permits the nurses to report potential DRPs in the elderly under their supervision to an interdisciplinary team of health care workers during a medication review session.

5.1.3. Functional analysis of the tool to be developed

A first functionality for improvement of DRP detection is not to start from a fixed list of triggers for all residents, but to start from the medication chart of an individual patient to generate personalized triggers. So far, trigger tools have always started from a fixed list of triggers, based on expert consensus and/ or literature review, in order to detect the most relevant DRPs. Using the fixed lists, less frequent or less severe DRPs can be missed. Starting from the patient's own medication, a list of DRPs, which can occur in the individual patient, can be generated and consequently, be used as triggers for observations. Using this method, even more trivial DRPs such as a dry mouth (which can be irritating for the patient) can be detected and minimized or resolved.

A second functionality is to create triggers for nurses, which allow target-

ed observations, even in the absence of advanced pharmacological knowledge . Triggers should be adapted to nurses' terminology and competences and be observable in nursing homes without an authorization of a physician and without external laboratory analyses.

A third functionality is the possibility for nurses to combine their observations with patient and family reports to complete the list of potential DRPs. Trigger tools, nurse observations, patient and family reports and medication review can identify different problems and complement each other (15;43).

A fourth functionality is the use of a standardized communication report, enabling nurses to communicate their observations in a more complete and standardized way in the medication review process, overcoming barriers in interdisciplinary communication and stimulating the cooperation of the nurses with physicians and pharmacists.

A fifth functionality is the inclusion of triggers for the detection of medication administration problems. Non-adherence or swallowing problems are examples of administration problems which can threaten effective pharmacotherapy. Taking these problems into account during medication review is advisable, yet, was not included systematically in medication review interventions before.

5.1.4. Development of the DRP trigger tool

5.1.4.1. Development of an ADR database

During the last decade, for different research purposes, the authors collected information on the use of medication by residents of Belgian nursing homes. From 2005 till 2009, over 25.000 prescription lines of medication were entered into a software program to be classified at the active ingredient level with the 5th level International Anatomical Therapeutic Chemical Classification (ATC) (53). Prescriptions were aggregated on 5th level ATC-code, summarizing the number of times the active ingredient had been prescribed. Active ingredients prescribed to more than 5 patients were included, creating a list of 378 5th level ATC-codes.

In Belgium, the two main sources of information on potential ADRs are the Belgian Centre for Pharmacotherapeutic Information (www.bcfi.be) and the Formulary for Prescribing in Nursing Homes (www.farmaka.be). The Belgian Centre of Pharmacotherapeutic Information has over 15 years of experience in providing information on potential ADRs, evaluated and selected on clini-

cal relevance, taking into account frequency, severity and avoidability. Based on these sources, the 378 ATC-codes were linked to their associated potential ADRs. Potential ADRs were only selected in case the following criteria were fulfilled: (a) ADRs had to be observable by nurses without further clinical examination of other professionals (excluding for example ADRs only detectable by laboratory results); (b) ADRs had to be relevant for the nursing home population (excluding for example ADRs only described in pregnant women or children); (c) ADRs had to be described in normal medication dosages (excluding for example ADRs in case of overdoses or special dosages in palliative care). The goal of the ADR triggers for nurses is to alert a physician. Nurses can observe specific or more general complaints of residents. They can, however, not always define the actual problem. For example in pancreatitis, nurses can alert physicians about abdominal pain, glucose intolerance or gastro-intestinal problems. The physician can evaluate whether the problems are related to pancreatitis and whether they can be considered as a consequence of the residents' medication use. In total, 135 different ADRs were included in the database, classified in 9 organ systems, a category of 'pharmacological ADRs' and a category 'other'.

To increase the usability for nurses, the list of 135 ADRs was then reduced to 107 different concepts of ADRs (**Table 5.1**). In the reduction, (a) ADRs that are indistinguishable based on nursing observations, were merged (for example esophageal ulcers and esophagitis); (b) Difficult terminology was simplified to make sure that the meaning of the ADRs could be understood by nurses; (c) In 9 syndromes of ADRs (for example anticholinergic syndrome or Cushing's syndrome) it was decided to keep the terminology and keep the value of the combination of symptoms, rather than to mention each symptom separately for observation. For the syndromes, nurses were given the information in **Table 5.2**, with nurse oriented information on observable symptoms related to the 9 syndromes included in the DRP trigger tool.

5.1.4.2. Validation of the ADR database

The database was validated by an expert team, including a clinical pharmacologist, a family doctor, a geriatrician, a pharmacist and three nurses.

The pharmacist checked all the potential ADRs in the database using the information of the Belgian Centre for Pharmacotherapeutic Information (www.bcfi.be) and the Formulary for Prescribing in Nursing Homes (www.farmaka.be). Cases of uncertainty or cases in which changes were recommended, were discussed with the first author, the clinical pharmacologist, the geriatrician and the family doctor.

Table 5.1. *107 potential ADRs included in the database of the DRP trigger tool.*
ADRs are divided in categories by analogy with the 1th level ATC classifications.

Gastro-intestinal system
- gastro-intestinal complaints
- bowel cramps
- diarrhea
- constipation (constipation + intestinal obstruction)
- flatulence
- anorexia
- taste disorders
- increase in body weight
- decrease in body weight
- nausea and vomiting
- dry mouth
- thirst
- gingival hyperplasia
- hemorrhoids and fissures
- irritation of the rectal mucosa
- irritation of the gastric mucosa
- gastrointestinal bleeding
- esophageal complaints (esophagitis + esophageal ulcers)
- inflammation of the oral mucosa (stomatitis + candidose)
- abdominal pain
- liver problems (hepatitis + other liver problems)
- pancreatitis

Endocine system
- insuline resistance
- cushing's syndrome
- adrenocortical insufficiency
- thyroid dysfunction (thyroid dysfunction + hypothyreosis)

Nervous system
- depression
- agitation (agitation + nervositas)
- excessive cheerfulness (excitation + euphoriant)
- fear, anxiety
- aggression
- hallucinations
- psychoses
- anticholinergic side effects
- extrapyramidal side effects
- serotonin syndrome
- neuroleptic malignant syndrome
- cognitive disorders
- confusion
- balance and coordination problems
- convusions
- drowsiness (drowsiness + vertigo)
- dyskinesia and dystonia
- tremor
- neuritis
- tingling skin sensation
- weakness
- tiredness
- sleep disturbances
- somnolence
- sedation
- stupor
- falling
- head aches

Cardiovascular system
- tachycardia
- bradycardia (bradycardia + negative dromotropy + negative inotropy)
- palpitations
- arrhythmia
- hypertension
- hypotension
- bleeding
- trombosis
- chest pain
- heart problems

Blood and electrolytes
- deshydratation
- oedema (oedema + water and salt retention)
- lactic acidosis
- hyperglycemia
- hypoglycemia

Respiratory system
- respiratory depression
- tachypnoe
- asthma attack
- coughing
- breathing difficulties

Musculoskeletal system
- gout
- joint problems
- bone pain
- osteonecrosis of the jaw
- muscle pain
- muscle weakness

Dermatological system
- photosensitivity
- hair loss
- skin eruptions
- itching
- skin problems (allergic skin reactions + Leyll disease + Steven Johnson syndrome + skin problems)

Urogenital system
- renal problems (decrease of renal function + renal insufficiency + nephropathy)
- micturition disorders
- urinary incontinence
- urinary retention
- polyuria
- kidney stones
- painfull breasts
- gynecomastia
- erectile dysfunction
- impotence
- priapism
- testicular atrophy
- gynecological problems

Pharmacological ADRs
- dependency
- tolerance
- allergy and hypersensitivity
- anaphylactic shock

Other ADRs
- lipodystrophia
- hyperthermia
- eye problems
- hearing problems
- hoarseness

Table 5.2. *Nurse oriented information on observable symptoms related to 9 syndromes or diagnoses included in the DRP trigger tool.*

Potential ADR	Symptoms to observe, related to the ADR
anticholinergic side effects	agitation, dry mouth, nausea, constipation, eye problems, urinary retention, arrhythmia, confusion
extrapyramidal side effects	dyskinesia and dystonia, agitation, tremor
serotonin syndrome	confusion, hyperthermia, agitation, dyskinesia and dystonia, tremor, convulsions, arrhythmia
neuroleptic malignant syndrome	hyperthermia, muscle stiffness, tachycardia, tremor, convulsions
pancreatitis	abdominal pain, nausea and vomiting, gastro-intestinal complaints, glucose intolerance
lactic acidosis	tachypnoe, vomiting, abdominal pain, hypotension
cushing' s syndrome	hyperglycemia, abnormal body fat distribution, development of diabetes, skin problems, muscle weakness, polyuria, weight gain, sleep disturbances.
adrenocortical insufficiency	tiredness, diarrhea, vomiting, weakness, weight loss, anorexia, hypotension
thyroid dysfunction	tiredness, edema, hair loss, weight gain, congitive disorders, muscle weakness, agitation, constipation, depression, bradycardia

The reduction and simplification of the ADRs was validated firstly by three nurses on understanding. The nurses were asked to indicate on a list of the potential ADRs the words they did not understand or they were not sure of. Thereafter, the first author replaced the indicated words with easier synonyms. The nurses then reevaluated the list to check whether agreement on the understandability was reached. Secondly, the clinical pharmacologist, the geriatrician and the family doctor independently reviewed the list to validate the correctness of the reduction and of the simplification. Afterwards, in consensus, some changes were made, mostly small Dutch-language-related changes. Reversible tooth discoloration was removed, because of the low impact on quality of life and the reversible character. The expert team did not identify problems in the correctness of the simplification of the terminology.

5.1.4.3. Description of the ADR database

The database contains 378 5th level ATC codes of pharmaceutical preparations frequently used in nursing homes. **Table 5.3** gives an overview of the number of different 5th level ATC codes (active ingredients) per system, classified on the first level. Nervous system, cardiovascular system and alimentary tract and metabolism medications clearly stand out with respectively

Table 5.3. *ATC codes in the database and the number of related potential ADRs.*

Database		Number of active ingredients (5th level ATC)	Number of potential ADRs* median (range)
Total		**378**	**4 (0-22)**
ATC level 1			
A	Alimentary tract and metabolism	71	2 (0-10)
B	Blood and blood forming organs	21	3 (0-5)
C	Cardiovascular system	76	6 (0-22)
D	Dermatologicals	10	3 (0-5)
G	Genito-urinary system	12	1.5 (0-9)
H	Systemic hormonal preparations	4	6 (3-15)
J	Antiinfectives for systemic use	13	4 (0-9)
L	Antineoplastic and immunomodulating agents	6	4.5 (0-13)
M	Musculoskeletal system	21	8 (2-12)
N	Nervous system	99	9 (0-18)
R	Respiratory system	31	4 (0-10)
S	Sensory organs	14	1.5 (0-2)

* number of potential ADRs per active ingredient (5th level ATC) in the database.

99, 76 and 71 different active ingredients. When looking at the number of potential ADRs related to the ATC-codes per system, the most potential ADRs are reported for the nervous system with a median of 9 per active ingredient (range 0-18), the musculo-skeletal system with a median of 8 (range 2-12) and the cardiovascular system with a median of 6 (range 0-22). Active ingredients with the most potential ADRs are C07BB07 Bisoprolol and thiazides (22), C07CB03 Atenolol and other diuretics (18), N06AB04 Citalopram (18), H02AB04 Methylprednisolone (15), N05AX07 Prothipendyl (15) and N06CA02 Melitracen and psycholeptics (15). The next eleven active ingredients in the ranked list are all of the nervous system.

Table 5.4 shows per system of potential ADRs (as categorized in Table 5.1) the percentage of active ingredients per 1th level ATC code for which ADRs of the system have been described. Potential ADRs in the gastro-intestinal system , the cardiovascular system and the nervous system are a risk in relatively the most active ingredients. At an individual ADR level, gastrointestinal complaints, allergic skin reactions, hypotension, liver problems, sedation and arrhytmhia were reported as potential ADRs in over 70% of the active ingredients. On the other hand, half of the potential ADRs is reported in less than 11 active ingredients.

Table 5.4. *The percentage of active ingredients per 1th level ATC which can cause the potential ADRs of a certain system.*

Systems to which potential ADRs pertain	Percentage of active ingredients per 1the level ATC code, associated with the potential adverse drug reactions per system					
	ATC1=A (71 active ingredients)	**ATC1=B** (21 active ingredients)	**ATC1=C** (76 active ingredients)	**ATC1=M** (21 active ingredients)	**ATC1=N** (99 active ingredients)	**ATC1=R** (31 active ingredients)
Gastro-intestinal	76.1	52.4	65.8	81.0	64.6	58.1
Blood – electrolytes	32.4	9.5	57.9	38.1	22.2	0.0
Cardiovascular	2.8	57.1	78.9	52.4	59.6	48.4
Dermatological	25.4	14.3	44.7	61.9	15.2	6.5
Urogenital	11.3	0.0	63.2	42.9	40.4	0.0
Endocrine	0.0	0.0	23.7	0.0	1.0	0.0
Musculoskeletal	9.9	0.0	14.5	23.8	11.1	0.0
Neurological	16.9	9.5	65.8	57.1	91.9	67.7
Respiratory	1.4	4.8	27.6	0.0	10.1	19.4
Pharmacological	9.9	0.0	9.2	0.0	2.0	16.1

ATC1 levels: A= alimentary tract and metabolism; B=blood and blood forming organs; C= cardiovascular system; M= musculoskeletal system; N= nervous system; R= respiratory system.
Active ingredients= number of 5th level ATC codes in the database.
Examples:
- of the 76 active ingredients in the database for the cardiovascular system, 65.8% can cause adverse drug reactions in the gastro-intestinal system.
- relatively the most active ingredients of the cardiovascular system have the potential to cause urogenital adverse drug reactions.

5.1.4.4. Expert consensus on medication administration problems

To make sure medication administration problems that influence pharmacotherapy would be taken into account during medication review, they were added to the trigger tool. Problems of not wanting or not being able to take the medication as prescribed are considered.

The selection of medication administration problems was based on expert consensus. Four nurses, a family doctor and two researchers selected 4 problems based on their experiences in nursing home practice and DRP research. The book of nursing diagnoses of Lynda Juall Carpenito – Moyet was used to check whether no relevant medication administration problems were missed (54). Afterwards, the list of four administration problems was presented to the directory board of two large nursing homes, including the head nurses, the coordinating and advising physicians and the pharmacists. No adaptations were recommended. The medication administration problems are

I. Self-care deficit (physical): The resident has difficulties to take the medication as prescribed due to swallowing problems or other physical problems.
II. Self-care deficit (mental): After the medication has been personalized and been handed over to the resident, the resident has difficulties to take the medication by him/ herself , due to mental problems.
III. Non-adherence (execution): The resident does not take his medication as prescribed. (hiding medication, refusing intake, …)
IV. Non-adherence (acceptance): The resident says he/ she does not agree with the pharmacotherapy as prescribed.

5.1.5. Development of the trigger tool software

Using the software to classify medications (brand name or generic name) by ATC codes and the database with ATC codes linked to their potential ADRs, a software program was written to create the list of potential ADRs for individual patients based on their individual medication chart. Afterwards, the medication administration problems were added.

Residents' medication
→ 5th level ATC codes
→ potential ADRs
→ resident specific ADR triggers
+ medication administration problems

5.1.6. Application of the trigger tool in interdisciplinary medication review

The lay-out of the trigger tool form is shown in Tables 5.5 and 5.6.

In **Table 5.5** the left part shows the list of ADR triggers. In the right part, reported ADRs are linked to the medications which may cause the ADR in the patient, enabling medication review with physicians and pharmacists. The medications are presented as prescribed. Medication administration problems on the trigger tool form are presented in **Table 5.6**.

As yet, the trigger tool is being piloted for periodical use for interdisciplinary medication review in 8 nursing homes. When medication use has to be evaluated, nurses can use the trigger tool software to create the list of potential ADRs for the individual resident and the four administration problems.

Table 5.5. *Lay-out of the trigger tool part I: ADR-triggers*

DRP Triggers	Nurse observations of potential ADRs			Interdisciplinary medication review			
Potential ADRs in the resident	**Present?**	**Frequency***	**Additional notes (drug? adherence? changes?)**	**Medication that can cause the ADR in the resident**	**ADR confirmed?**	**Medication changed?**	**Additional notes**
Gastrointestinal complaints	No - Yes	1- 2- 3- 4		Citalopram Sandoz tabl 56 x20 mg	No - Yes	No - Yes	
				Fero-gradumet tabl retard 60 x 525mg	No – Yes	No – Yes	
				Lanoxin tabl 60 x 0.125mg	No – Yes	No – Yes	
Nausea and vomiting	No - Yes	1- 2- 3- 4		Citalopram Sandoz tabl 56 x20 mg	No – Yes	No – Yes	
				Lanoxin tabl 60 x 0.125mg	No – Yes	No – Yes	
				Omeprazol Sandoz caps ec 98 x 20 mg	No – Yes	No – Yes	
Dry mouth	No - Yes	1- 2- 3- 4		Citalopram Sandoz tabl 56 x20 mg	No – Yes	No – Yes	
Irritation of the gastric mucosa	No - Yes	1- 2- 3- 4		Cardioaspirine tab ec 60 x 100 mg	No – Yes	No – Yes	
Gastro-intestinal bleeding	No - Yes	1- 2- 3- 4		Citalopram Sandoz tabl 56 x20 mg	No - Yes	No – Yes	
				Cardioaspirine tab ec 60 x 100 mg	No – Yes	No – Yes	
Liver problems	No - Yes	1- 2- 3- 4		Citalopram Sandoz tabl 56 x20 mg	No – Yes	No – Yes	
Diarrhea	No - Yes	1- 2- 3- 4		Citalopram Sandoz tabl 56 x20 mg	No – Yes	No – Yes	
				Fero-gradumet tabl retard 60 x 525mg	No – Yes	No – Yes	
				Omeprazol Sandoz caps ec 98 x 20 mg	No – Yes	No – Yes	
Constipation	No - Yes	1- 2- 3- 4		Cacit vitd3 1000/880 30 x 1000/880	No – Yes	No – Yes	
				Fero-gradumet tabl retard 60 x 525mg	No – Yes	No – Yes	
Flatulence	No - Yes	1- 2- 3- 4		Cacit vitd3 1000/880 30 x 1000/880	No – Yes	No – Yes	
Anorexia	No - Yes	1- 2- 3- 4		Lanoxin tabl 60 x 0.125mg	No – Yes	No – Yes	
Weight gain	No - Yes	1- 2- 3- 4		Citalopram Sandoz tabl 56 x20 mg	No – Yes	No – Yes	
				Seroquel tabl 60 x 200 mg	No – Yes	No – Yes	

* Frequency: 1= daily, 2= weekly, 3= monthly, 4= less frequent

Table 5.6. *Lay-out of the trigger tool part II: medication administration problems*

DRP Triggers	Nurse observations		Medication review		
Medication administration problems	**Present?**	**Notes**	**DRP confirmed?**	**Medication changed?**	**Notes**
Self-care deficit (physical): The resident has difficulties to take the medication as prescribed due to swallowing problems or other physical problems.	No – Yes		No – Yes	No – Yes	
Self-care deficit (mental): After the medication has been personalized and been handed over to the resident, the resident has *difficulties to take the medication by him/ herself , due to mental problems*.	No – Yes		No – Yes	No – Yes	
Non-adherence (execution): The resident *does not take his medication as prescribed*. (hiding medication, refusing intake, …)	No – Yes		No – Yes	No – Yes	
Non-adherence (acceptance): The resident says he/ she does not agree with the pharmacotherapy as prescribed.	No – Yes		No – Yes	No – Yes	
Other:	No - Yes		No - Yes	No - Yes	

On the document they can score the presence of the DRPs. The document can be used as a standardized report to physicians or pharmacists. During medication review, physicians and pharmacists can use the actual nurse observations and complaints of the resident, along with the theoretical DRPs according to the prescriptions. On the trigger tool form, the link between DRPs and the medication remains. In case of a DRP, it is easier to link the DRP to the medication causing the problem and to judge whether the prescription needs to be adjusted because of the DRP. The use of the trigger tool software facilitates patient centered discussions and patient tailored pharmacotherapy. The tool is being tested in 8 large nursing homes. The results will be published separately. The concept of the trigger tool is met with great interest of physicians, pharmacists and nurses.

5.1.7. Future applications of the trigger tool and future research

In the future, we aim to create a permanent link between the patients' electronic medical files and the software. In situations where the resident is at increased risk of DRPs, for example when a new medication is prescribed, immediate use of the tool at the point of care will be possible. Combinations

with other trigger tools or risk assessments are possible (55).

5.1.8. Conclusion

The DRP trigger tool for interdisciplinary medication review in nursing homes addresses limitations of earlier developed interventions for DRP screening. The main benefits of the tool are: (1) resident specific DRP triggers based on the residents' individual medication use, (2) medication administration problems as triggers, (3) inclusion of nurse observations in medication review, (4) standardized reports of nurse observations of DRPs, (5) interdisciplinary cooperation between physicians, pharmacists and nurses, (6) attention for systematic planning of DRP screening and medication review, (7) immediate links between DRPs and related medication, as well for observations as for the evaluation of prescriptions.

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Chapter 6

Evaluation of the drug related problem trigger tool

This Chapter has been submitted for publication to BMJ Quality and Safety as:
Tinne Dilles, Robert Vander Stichele, Lucas Van Bortel & Monique Elseviers, Effects of a drug related problem trigger tool for interdisciplinary medication review in nursing homes

Chapter 6

Outline

6.1.
Effects of a drug related problem trigger tool for interdisciplinary medication review in nursing homes

6.1.1. Introduction

The residential care for older people in Belgium is organized in polyvalent nursing homes. Most communities have a nursing home, where older people, regardless of their mental or physical health status, can reside close to their former homes. Depending on their care-dependency level, residents stay in a rest bed or a nursing bed. Nursing beds are high intensity care beds for residents with long-term care needs, who are heavily dependent on professional help for the activities of daily living. Rest beds are reserved for those who need support in usual family and household care. Medical care is provided by external family doctors and a coordinating and advising physician. Residents have the right to choose their own family doctor and, mostly, stay with their former family doctor. The coordinating and advising physician is responsible for the general medical coordination and quality. Daily care is provided by a staff of nurses and care assistants.

In nursing homes, drug related problems are common. "A drug-related problem (DRP) is an event or circumstance involving drug therapy that actually or potentially interferes with desired outcomes" (van Mil, Westerlund, Hersberger, & Schaefer, 2004; Pharmaceutical Care Network Europe, 2003). A significant part of the DRPs are adverse drug reactions (ADRs): appreciably harmful or unpleasant reactions predicting hazard from future administration and warranting prevention or specific treatment, or alteration of the dosage regimen, or withdrawals of the product (Edwards & Aronson, 2000). By medication review, Ruths et al. identified 2445 potential DRPs in 1036 residents, of which 26% were ADRs (Ruths, Straand, & Nygaard, 2003). The incidence of ADRs in nursing homes ranges from 1.19 to 7.26 per 100 resident months (Handler, Wright, Ruby, & Hanlon, 2006). ADRs can interfere with patients health or quality of life and increase health care costs (Lundkvist & Jonsson, 2004) .

Problems in medication administration form a specific kind of DRPs. Medication non-adherence and physical or mental problems in taking medica-

tion are seldom considered in medication reviews and seldom addressed in research in nursing homes (Hughes, 2008; Hughes & Goldie, 2009). However, the incidence seems to be high (Wright, 2002) and the impact on pharmacotherapy can be important.

To improve the detection rate, we developed a personalized DRP trigger tool for interdisciplinary medication review in nursing homes. The development is reported elsewhere. The trigger tool generates DRP triggers as a guidance for nurse observations in preparation of medication review (Dilles, Vander Stichele R.H., Van Bortel L.M., & Elseviers M.M., 2011). The triggers include a list of personalized, potential ADRs for each resident, based on the residents individual medication chart, and a check for four medication administration problems. Drug related problems, observed by the nurses based on the triggers, are discussed with the family doctor during an interdisciplinary medication review session.

The aim of this study was to test the effect of the DRP trigger tool in nursing homes on the detection of drug related problems, residents' medication use and the quality of prescribing in an experimental pre-post test design.

6.1.2. Methodology

6.1.2.1. Research population

In September 2010, a convenience sample of ten Flemish nursing homes with a minimum of 80 beds were contacted and asked to participate. Eight nursing homes consented to participate, five in the province Antwerp, three in the province Limburg. In these nursing homes, to be included, residents needed to reside at least one month in the nursing home and to take four or more different drugs. Residents were excluded in case the residents' family doctor opposed to the participation or in case of palliative care.

6.1.2.2. Research design

The study was set up as an intervention study with pre-post test design.

6.1.2.3. Intervention

The intervention consisted of an interdisciplinary medication review, prepared by nurse observations of potential DRPs using the personalized DRP

trigger tool.

The trigger tool has two major parts. The first part is a list of DRPs to guide nurses in patient observations. It consists of a personalized, resident specific list of potential ADRs, constructed based on the residents' medication chart, completed with four potential medication administration problems. The second part is a guide for the interdisciplinary medication review process. It gives an overview of the residents' medication and the associated potential DRPs immediately be linked to the medications which may cause the problem.

In December 2010, the personalized trigger tools were generated. Nurses screened for the DRPs listed on the trigger tools and reported their observations to family doctors in a standardized way on the trigger tool form. Family doctors were informed on their involvement in the study and were invited for a medication review session during their next visit to the nursing home. The family doctor, together with the nurse had to perform the medication review. The contribution of the pharmacist and the CRA in medication review process was advised. In medication review, physicians indicated on the trigger tool form for each nurse observation whether they confirmed the presence of the DRP and whether they chose to change a specific medication to prevent or minimize the DRP in the future.

6.1.2.4. Data collection

The baseline data collection of the pretest started in November 2010. **Table 6.1** gives an overview of the parameters and data collection techniques.

Table 6.1. *Data collection.*

Data collected	Data collection technique	Time*		
Basic characteristics		**pre**	**int**	**post**
Characteristics of the nursing homes	Data provided by the management board	X		
Resident characteristics	Administrative patient data	X		
Clinical data of the residents	Check list to the family doctor		X	
Use of the trigger tool		**pre**	**int**	**post**
DRPs in the resident	Nurse observations on the trigger tool		X	
Evaluation of the DRPs in interdisciplinary medication review	Medication review report of the trigger tool		X	
Practical use of the trigger tool	Medication review report of the trigger tool		X	
Effect of the trigger tool intervention		**pre**	**int**	**post**
Number of medications	Medication chart	X		X
Medication use on ATC level	Medication chart	X		X
Quality of prescribing	Medication chart	X		X

DRP = drug related problem; * Time of data collection in the study: Pretest (pre), Intervention (int), Post test (post)

In the pretest, basic characteristics of the nursing homes and the residents were collected. To avoid software incompatibility problems, in this first test of the trigger tool, the trigger tool software was not installed in the nursing homes and was run on a computer of the researchers. Therefore, medication charts of the residents were copied and manually entered into the trigger tool software. The trigger tool forms per resident were centrally printed and distributed to the respective nursing home departments on paper. Nurses could then start the intervention.

During the intervention, nurses' DRP observations as well as the results of the medication review process were reported on the trigger tools forms. Additionally, the professions of those who contributed to the medication review process and the duration of the medication review were registered. Family doctors were asked to complete a checklist of clinical data for each resident in order to describe the research population and to evaluate the quality of prescribing. The checklist contained 27 potential clinical problems. For each problem the physician had to thick a box: present 'yes' or 'no'.

In march 2011, during the phase of the post test, trigger tool forms were collected for analysis. At least two weeks after medication review, medication charts were copied again to measure the effect of the intervention on medication use and quality of prescribing.

6.1.2.5. Data analysis

Description of scores and classifications

A. Activities of daily living score

In Belgium, scoring activities of daily living (ADL) by the Katz-scale is an obligated element of nursing home care financing (RIZIV/ INAMI, 2011). Therefore, the data are available for all residents. The ADL score is based on 6 physical and 2 mental items. Each item can be scored from 1 (= independent) to 4 (=maximal dependency). The ADL score in this study is the sum of the scores on each item per resident. The physical ADL score ranges from 6 to 24 and the mental ADL score from 2 to 8. The results of the mental ADL scores and mini mental state examinations correlated, yet, the last parameter was not available for all residents and was therefore not used.

B. Medication use

Medication use was described using the ATC classification (International Anatomical Therapeutic Chemical (ATC) (WHO Collaborating Centre for Drug

Statistics Methodology, 2008). Only chronic medications were considered.

C. Quality of prescribing score

The quality of prescribing was evaluated using the PRISCUS list of potentially inappropriate medications (PIMs) in the elderly(Holt, Schmiedl S., & Thürmann, 2010). Medications are categorized as inappropriate if they carry an increased risk of causing adverse drug reactions in older persons which exceeds the expected benefits, and if they can be replaced by better-tolerated alternatives (Laroche, Charmes, Bouthier, & Merle, 2009). The PRISCUS list is mainly based on the original and revised Beers criteria, offering a more European-oriented list of PIMs for the elderly (Beers, 1997; Holt et al., 2010).

The original PRISCUS list included 83 PIMs for elderly patients selected on the base of an adapted Delphi process. We excluded 11 products only considered as PIM if exceeding an upper-limit dose or delivered in the format of non-sustained release.

Intervention and control group

Medication charts of residents were collected regardless of the completion of the intervention. Only cases in which the intervention was completed (nurse observations + medication review) were assigned to the intervention group. Other residents could be considered as a control group.

6.1.2.6. Statistical methods

PASW Statistics 18.0 was used for statistical analysis. Mainly descriptive statistical methods were used. Significance levels of differences in proportions were calculated using chi-square statistics. A p-value <0.05 was considered significant. Significance levels of the differences between the pre- and post test were calculated using paired tests and presented with confidence intervals 95%.

6.1.2.7. Ethical considerations

Permission of the ethics committee of the Antwerp University Hospital was received in October 2010. The study protocol and the implications for the residents and the staff were presented in the nursing homes. Participation was voluntary. Family doctors were informed by a letter or mail of the CRA. The CRA communicated with the family doctors to guarantee their privacy. Family doctors were able to refuse to participate themselves or to refuse to the participation of one of the residents. All names of residents, care

givers, family doctors and institutions were coded and the keys were kept in the institutions.

6.1.3. Results

6.1.3.1. The research population

The nursing homes

The 8 participating nursing homes had a total of 983 beds. The number of beds per nursing home ranged from 90 to 164 (median 120), including 48% to 81% high care nursing beds. Nursing homes had 3 to 5 separate departments, of which at least one with a closed structure to prevent residents from leaving the department without supervision. Nursing homes had between 17 and 44 different visiting family doctors.

The nursing home residents

Descriptive data were collected on 760 residents who met the inclusion criteria (**Figure 6.1** and **Table 6.2**). Residents were on average 85 years old (range 54 – 101) and 74% were women. During the four month study period, 11% of the residents were hospitalized at least once and overall mortality

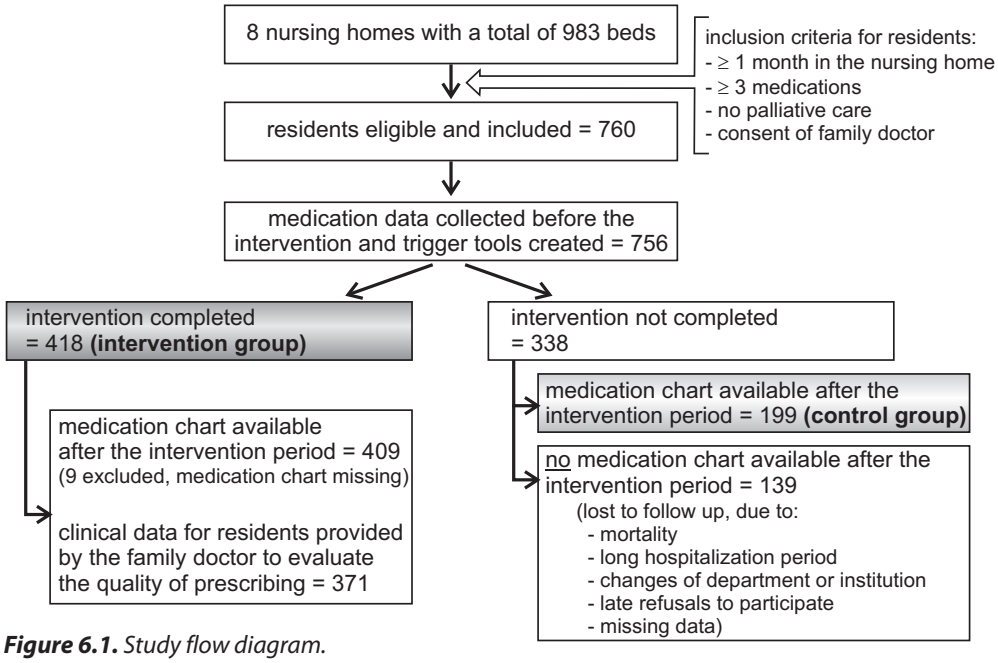

Figure 6.1. *Study flow diagram.*

***Table 6.2**. Description of the research population.*

	Nursing home residents	Intervention group (n=418)	Control group (n=199)	Loss to follow up (n=139)	*p*-value of difference between the 3 groups
General resident characteristics (n=760)					
Age in years (mean, range)	84.9 (54–101)	84.9 (54-101)	84.4 (54-101)	85.4 (61-99)	0.455
Women (%)	74.1	76.6	73.4	67.8	0.117
Hospitalizations and mortality during the four month study period (n=760)					
Hospitalized (%)	11.3	9.8	13.6	12.5	0.182
Mortality (%)	7.5	0	0	39.6	<0.001
Physical activities of daily living (n=760)					
Residents completely dependent for					
Washing (%)	60.1	60.7	59.8	58.7	0.586
Dressing(%)	57.3	57.1	58.8	55.9	0.557
incontinence for urine and/ or faeces (%)	48.1	49.1	43.7	51.1	0.306
Going to the toilet (%)	33.9	32.9	31.7	39.9	0.266
Mobility (%)	23.6	23.0	21.6	28.0	0.855
Eating or drinking (%)	18.2	20.1	17.1	14.0	0.087
ADL score (mean, range)	16.0 (6-24)	16.0 (6-24)	15.9 (6-24)	16.0 (6-24)	0.945
Mental activities of daily living (n=760)					
Residents almost daily disoriented					
In time (%)	47.2	50.3	41.7	45.5	0.307
In place (%)	43.8	46.5	38.7	43.4	0.399
Mental score (mean, range)	4.6 (2-8)	4.8 (2-8)	4.4 (2-8)	4.6 (2-8)	0.089
Number of clinical problems per resident (mean, range)		6.8 (0-18)			

Clinical problems in residents of the intervention group (n=371)			
With a predominant medical burden		**With a predominant nursing care burden**	
Hypertension (%)	52.4	Dementia (%)	54.6
Peripheral vascular diseases (%)	38.0	Fall risk (%)	49.3
Peptic diseases (%)	36.5	Incontinence (%)	46.7
Osteoporosis (%)	35.3	Behavioral problems (%)	40.0
Heart failure (%)	31.6	Chronic pain (%)	37.3
Post infarct or stroke (%)	26.3	Constipation (%)	36.5
Diabetes (%)	22.0	Insomnia (%)	34.3
COPD or asthma (%)	20.7	Depression (%)	33.6
Chronic renal insufficiency (%)	13.6	Body Mass Index > 30 (%)	11.6
Parkinson disease (%)	9.9	Body Mass Index < 18 (%)	7.7
Heart block (%)	8.9	Pressure ulcers (%)	6.2
Benign prostatic hyperplasia (%)	7.2		
Seizures (%)	4.4		
Gout (%)	4.2		
Glaucoma (%)	3.7		
Chronic liver insufficiency (%)	2.2		

was 7.5%. There were no significant differences between residents in the intervention group, the control group and those lost to follow-up (including all deceased) and the sample is representative for the Flemish nursing home population. Residents of whom the physician completed the checklist on 27 clinical problems, had on average 6.8 different problems.

Baseline medication use

Medication use was only studied if the medication charts were obtained in the pre- and post-test. Medication charts of 756 residents were analyzed: 409 residents of the intervention group, 199 residents of the control group (Figure 6.1). The medications most commonly prescribed are presented in Tables 6.4 and 6.5. At baseline, residents took up to 20 different chronic medications (mean = 8.1). There were no significant differences in medication use between the intervention group and the control group.

6.1.3.2. The use of the DRP trigger tool for interdisciplinary medication review

For all 756 medication charts obtained in the pre-test, personalized trigger tool forms were generated. Guided by the trigger tool form, the presence of potential ADRs and administration problems were evaluated by nurses in 536 residents (70.9%). Nurse observations were discussed in interdisciplinary medication review in 418 residents (55.3%) (Figure 6.1).

Most medication reviews were performed by the family doctor (or CRA) and one nurse. The CRA and a visiting family doctor were both present in 2.5% of the medication review sessions. A pharmacist supported the review in 1.4%. The medication review took less than 10 minutes in 88% of the residents. (**Table 6.3**).

Medication administration problems

The observations of the four medication administration problems, the confirmation rate by family doctors and consequent medication changes, are presented in **Table 6.4.**

Self-care problems in taking medication due to mental deterioration were most commonly observed (35% of the residents). Due to physical problems, for example swallowing problems, medication intake was impeded in 15%. Non-adherence was observed in the behavior of 21% of the residents and 10% verbally disagreed with the pharmacotherapy as prescribed. In medication review, family doctors or CRA's confirmed 69% to 78% of nurses' observations. The diagnosis of physical problems in taking medication resulted, relatively, in most medication changes. In total, medication administration

Table 6.3. *Practical aspects of the medication reviews.*

	Total (n=418)
Present at medication review (%)	
- family doctor	76.1
- CRA	26.4
- Pharmacist	1.4
- nurse who observed	78.7
- other nurse	15.6
- others	0.2
Duration of medication review (%)	
- <5 minutes	43.3
- 5 – 9 minutes	44.7
- 10 - 19 minutes	9.1
- 20 – 29 minutes	2.6
- >30 minutes	0.2

The presence of at least one physician (family doctor or CRA) and one nurse was required .
The CRA was not considered as a visiting family doctor for his own patients.
In cases where no DRPs were detected by the nurses, medication review was not always performed. These cases are not included in the results of this table.
Other professionals present at medication review were a psychiatrist and a care assistant.

Table 6.4. *Medication administration problems (n=418 residents).*

DRP-trigger	n (%) diagnosed by a nurse	n (%) confirmed by the family doctor	n (%) resulting in medication change
Self-care deficit (physical): The resident has difficulties to take the medication as prescribed due to swallowing problems or other physical problems.	62 (14.8)	45 (72.5) = 10.8% of all residents	10 (16.1) = 2.4% of all residents
Self-care deficit (mental): After the medication has been personalized and been handed over to the resident, the resident has difficulties to take the medication by him/ herself , due to mental problems.	148 (35.4)	102 (68.9) = 24.4% of all residents	10 (6.8) = 2.4% of all residents
Non-adherence (execution): The resident does not take his medication as prescribed. (hiding medication, refusing intake, …)	86 (20.6)	64 (74.4) = 15.3% of all residents	12 (14.0) = 2.9% of all residents
Non-adherence (acceptance): The resident says he/ she does not agree with the pharmacotherapy as prescribed.	40 (9.6)	31 (77.5) = 7.4% of all residents	6 (15.0) = 1.4% of all residents

problems were detected in 187 residents (44.7%), confirmed in 132 residents (31.6%) and they resulted in medication changes in 19 residents (4.6%). (**Figure 6.2**)

ADR triggers, potential ADRs, confirmed ADRs and planned medication changes

The 418 trigger tool forms for residents in the intervention group, contained 14702 ADR triggers. The average number of ADR-triggers per resident was 35 (range 6 – 61). Using the triggers, nurses observed 1527 (10.4%) potential ADRs. No potential ADRs were observed in 80 residents (19.1%). During the medication review process, physicians confirmed 821 ADRs (53.8%). This resulted in 214 medication changes, related to 202 ADRs (13.2%). (**Figure 6.3**)

Appendix 6 gives an overview per ADR trigger: the number of ADR triggers on the trigger tool forms, the potential ADRs observed by nurses, the ADRs confirmed by the physicians and the medication changes. In **Table 6.5** these data are summarized per anatomical system.

On the ADR trigger level, as presented in appendix I, on the trigger tool forms, hypotension, nausea, headaches, sleep disturbances, diarrhea, gastro-intestinal complaints, sedation, irregular heart rate, liver problems and dizziness were ADR triggers in over 75% of the residents. On the other hand, 30% of the 108 potential ADRs were a trigger in less than 10% of the residents, of which 6 were not used as a trigger in any resident. The number of times nurses observed potential ADRs ranged from 0 to 95 times per trigger (median 5). Problems most identified by nurses were confusion, agitation, tiredness, dizziness, gastro-intestinal problems and headaches. The number of times the potential ADRs were confirmed by a family doctor ranged from 0 to 52 times per trigger (median 2). ADRs most often confirmed were confusion, gastro-intestinal complaints, constipation, medication dependency, dizziness and sedation. The number of times ADRs led towards the planning of medication changes ranged from 0 to 15 per trigger (median 1). Most changes were planned in case of confusion, sedation, gastro-intestinal complaints, drowsiness, constipation and nausea.

Per resident, as presented in Table 6.5, the median number of potential ADRs identified was 3 (range 0-22). The median number of ADRs confirmed was 2 (range 0-17). The median number of ADRs leading towards medication changes was 0 (range 0-8).

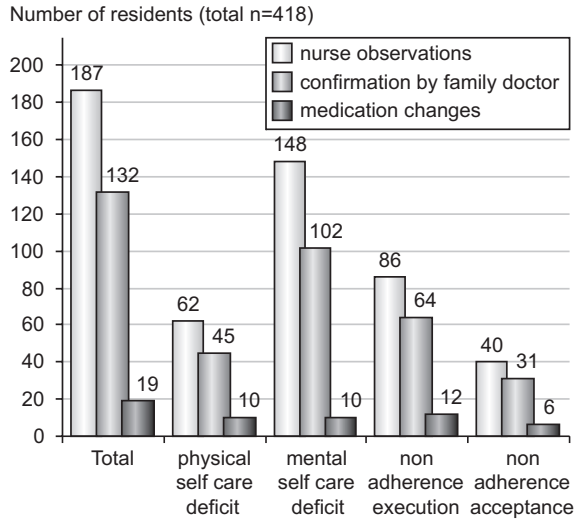

Figure 6.2. *Medication administration problems, nurse observations, confirmations by family doctors and related medication changes.*

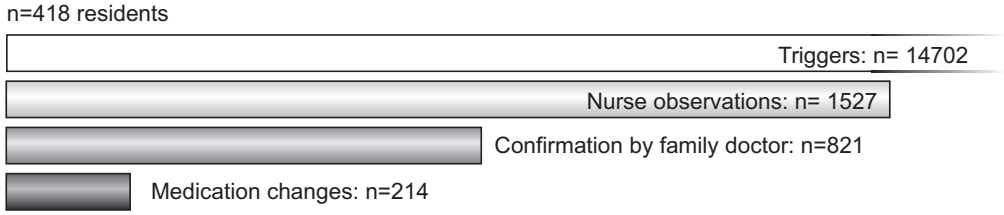

Figure 6.3. *ADR triggers, potential ADRs observed by nurses, ADRs confirmed by family doctors and related medication changes.*

Table 6.5. *ADR triggers, potential ADRs observed by nurses using the ADR triggers, the confirmation of the observations by physicians and consequent medication changes per anatomical system (n=418 residents).*

	ADR triggers			**Potential ADRs observed by nurses**			**ADRs confirmed by physicians**			**ADRs resulting in medication changes**		
	Residents with trigger % (N)	Median (range) per resident	sum	Residents with trigger % (N)	Range	sum	Residents with trigger % (N)	Range	sum	Residents with trigger % (N)	range	sum
Gastro-intestinal (22)	99.7 (417)	7 (0-13)	2966	46.2 (193)	0-7	329	28.8 (120)	0-6	190	7.9 (33)	0-5	50
Water- , blood- and electrolyte balances (6)	91.4 (382)	2 (0-5)	825	16.2 (62)	0-2	71	8.4 (32)	0-2	35	2.1 (8)	0-1	8
Cardiovascular (10)	98.3 (411)	4 (0-7)	1532	14.1 (58)	0-3	76	9.0 (37)	0-3	41	3.2 (13)	0-1	13
Dermatological (5)	85.4 (357)	2 (0-4)	779	17.1 (61)	0-3	88	7.0 (25)	0-3	35	2.0 (7)	0-2	9
Pharmacological (4)	82.3 (344)	2 (0-4)	776	15.1 (52)	0-3	65	12.2 (42)	0-3	50	1.7 (6)	0-1	6
Urogenital (13)	94.3 (394)	3 (0-7)	1268	12.7 (53)	0-2	59	6.1 (24)	0-2	26	1.3 (5)	0-1	5
Hormonal (4)	52.9 (221)	1 (0-4)	266	2.3 (5)	0-1	5	1.4 (3)	0-1	3	0.1 (2)	0-1	2
Musculoskeletal (6)	54.3 (227)	1 (0-5)	402	18.5 (42)	0-4	56	10.1 (23)	0-3	26	2.2 (5)	0-3	9
Neurological (28)	99.3 (415)	12 (0-22)	4896	63.1 (262)	0-12	714	39.8 (165)	0-9	349	10.6 (44)	0-6	79
Respiratory (5)	81.8 (342)	1 (0-4)	618	6.4 (22)	0-3	29	2.6 (9)	0-1	9	1.2 (4)	0-1	4
Other (5)	43.5 (182)	0 (0-3)	244	12.1 (22)	0-2	25	3.8 (7)	0-2	8	0.1 (1)	0-1	1
Total (108)	**100.0 (418)**	**35 (6-61)**	**14572**	**80.9 (338)**	**3 (0-22)**	**1517**	**59.8 (250)**	**2 0-17**	**772**	**21.3 (89)**	**0 0-8**	**186**

ADR triggers are summarized per anatomical system. Behind each system, the number of potential triggers in the study is in brackets.

The column of ADR triggers shows the presence of ADR triggers on the trigger tool forms of residents (denominator = total number of residents= 418). The potential ADRs observed by nurses using the trigger tool, the confirmation of the observations by physicians and the ADRs resulting in medication changes are shown in the next columns (denominator = number of ADR triggers). The range shows the distribution of the incidence in individual residents. The sum shows the total incidence in the study.

6.1.3.3. The effect of the intervention on pharmacotherapy

Changes in medication use between pre- and posttest

In the intervention group, medication was changed in 275 out of 409 residents (67%). At least one extra medication was prescribed in 50% of the residents. At least one prescription was annulled in 48% of the residents. The number of residents with medication changes was significantly higher in the intervention group compared to the control group. In the control group medication was changed is 109 out of 199 residents (55%) (p=0.003 compared to the intervention group). At least one extra medication was prescribed in 41% of the residents (p=0.033 compared to the intervention group). At least one prescription was annulled in 40% of the residents (p=0.073 compared to the intervention group). (**Figure 6.4**)

On medication level, 380 new prescriptions were added and 362 prescriptions were annulled in the intervention group. In the control group, 159 new prescriptions were added (p=0.044) and 197 prescriptions were annulled (p=0.327 compared to the intervention group).

Medication changes did not result in a decrease of medication use in residents. The percentage of residents using medication of specific first level ATC-codes did not change significantly between the pre- and the post test. Details are shown in **Table 6.6.**

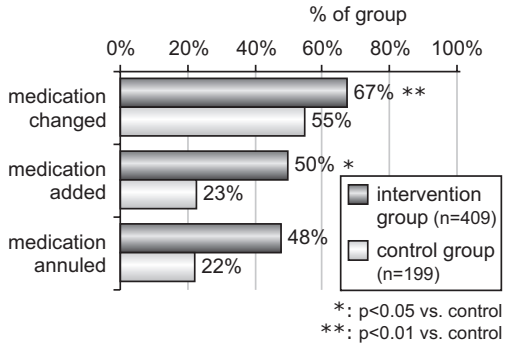

Figure 6.4. *Medication changes in residents between the pretest and the posttest*

Table 6.6. *Medication changes between pretest and posttest on ATC level.*

	Prescriptions pre			Prescriptions post			Difference between pre and post		
	IV	C	difference	IV	C	difference	IV	C	IV vs. C
	%	%	% (CI 95%)	%	%	% (CI 95%)	% (CI 95%)	% (CI 95%)	
A	84.1	87.4	-3.3 (-9.1 to 2.4)	82.6	86.4	-3.8 (-9.8 to 2.2)	1.4 (-0.7 to 3.7)	1.0 (-1.8 to 3.9)	+
A02	44.7	44.7	0.0 (-8.4 to 8.4)	43.8	42.6	1.2 (-7.3 to 9.4)	0.9 (-1.0 to 2.6)	2.1 (-0.5 to 3.5)	-
A06	49.9	54.8	-4.9 (-13.3 to 3.5)	47.9	53.5	-5.6(-13.8 to 3.1)	2.0 (-1.1 to 5.1)	1.3 (-2.7 to 5.1)	+
A10	19.1	19.6	-0.5 (-0.7 to 0.6)	18.8	17.6	1.2 (-5.2 to 7.8)	0.3 (-1.1 to 1.4)	2.0 (-0.4 to 2.0)	-
B	66.0	70.4	-4.4 (-12.2 to 3.5)	67.5	70.2	-2.7 (-10.7 to 4.9)	-1.4 (-3.6 to 0.7)	0.2 (-3.3 to 4.0)	-
B01	61.4	65.3	-3.9 (-12.1 to 0.1)	62.6	65.7	-3.1 (-11.3 to 4.9)	-1.2 (-3.0 to 1.0)	-0.4 (-0.5 to 0.4)	-
C	82.9	85.9	-3.0 (-9.1 to 3.0)	81.9	84.8	-2.9 (-9.2 to 3.2)	1.0 (-0.9 to 2.4)	1.1 (-0.6 to 1.5)	-
C01	23.0	29.1	-6.1 (-13.7 to 1.4)	23.2	27.8	-4.6 (-11.9 to 3.0)	-0.2 (-1.8 to 1.4)	1.3 (-0.6 to 1.5)	-
C03	41.6	42.7	-1.1 (-9.6 to 7.2)	41.1	43.4	-2.3 (-10.5 to 6.2)	0.5 (-2.0 to 2.9)	-0.7 (-2.8 to 2.2)	-
C07	33.7	36.2	-2.5 (-10.5 to 5.6)	31.5	35.9	4.4 (-12.2 to 3.9)	2.2 (-0.1 to 3.8)	0.3 (-1.2 to 1.5)	+
C09	36.2	35.7	0.5 (-7.6 to 8.6)	36.7	34.8	1.9 (-6.1 to 10.1)	-0.5 (-1.1 to 1.2)	0.9 (-1.7 to 2.8)	-
M	22.2	22.6	-0.4 (-7.4 to 6.7)	20.3	21.7	-1.4 (-8.2 to 5.6)	1.9 (-0.2 to 4.1)	0.9 (-1.7 to 2.8)	+
N	88.8	90.5	-1.7 (-6.8 to 3.4)	89.7	87.4	2.3 (-3.2 to 7.8)	-0.9 (-2.3 to 0.9)	3.1 (1.4 to 4.4)*	-
N02	35.9	30.7	5.2 (-2.6 to 13.2)	36.2	29.8	6.4 (-1.3 to 14.4)	-0.3 (-3.0 to 2.5)	0.9 (-3.2 to 4.8)	-
N05	65.3	61.4	3.9 (-4.2 to 12.2)	68.5	57.8	10.7 (2.4 to18.9)*	-3.2 (-5.9 to -0.4)*	3.6 (0.6 to 5.0)*	- *
N06	53.1	60.8	-7.7 (-16.1 to 0.6)	53.1	58.6	-5.5 (-14.1 to 2.6)	0 (-2.1 to 2.1)	2.2 (-1.5 to 5.4)	-
R	25.9	17.6	8.3 (1.6 to 15.1)*	25.2	22.1	3.1 (-4.1 to 10.2)	0.7 (-1.6 to 3.1)	-4.5(-6.9 to 0.3)	+

IV= intervention group (*n*=409); C= control group (*n*=199); + = the evolution of the number of prescriptions is more positive in IV compared to C (more limited increase in IV/ stronger decrease in IV); - = the evolution of the number of prescriptions is more positive in C compared to IV (more limited increase in C/ stronger decrease in C); * = a significant difference.

A= alimentary tract and metabolism (A02=drugs for acid related disorders, A06=Laxatives, A10=drugs used in diabetes); B= blood and blood forming organs (B01= antihemmorhagics); C=cardiovascular system (C01=cardiac therapy, C03= diuretics, CO7= beta blocking agents, C09= agents acting on the rennin-angiotensin system); M= musculo-skeletal system; N= Nervous system (N02= analgesics, N05 psycholeptics, N06 Psychoanaleptics); R= Respiratory system.

Changes in the quality of prescribing

The PRISCUS list scored for 37 of the 72 included PIMs. Of these PIMs, 23 scored positive in less than 1% of residents. Highest frequencies were noted for digoxin (4.3%), for alprazolam (3.9%) and for oxybutinin (3.8%).

There were no significant differences in PIMs before and after the intervention. Before the intervention 34.7% of the residents had PIMs prescribed, compared to 33.9% after the intervention (p=0.975). The mean number of PIMs was 4.4 before the intervention, and 4.3 afterwards (p=0.715).

6.1.4. Discussion

6.1.4.1. The effect of the intervention on pharmacotherapy

Nurses observed a lot of potential DRPs using the trigger tools. Using the ADR-triggers, nurses observed 1527 potential ADRs in 81% of the 418 residents (mean per resident 3.7). Administration problems were observed in 45% of the residents. About half of the DRPs observed, were confirmed by a physician during the medication review session. Physicians confirmed 821 ADRs in 60% of the residents (mean per resident 2.0) and medication administration problems in 32% of the residents. As a result, 214 medication changes were planned in 21% of the residents (mean per resident 0.5) of the residents because of ADRs and in 5% of the residents because of administration problems. Not all DRPs are preventable and require medication changes. In some cases, despite the harm due to a DRP, the indication for the intake of the medication is of superior value and alternatives may not be possible or may not exist. When comparing medication charts in the pre- and the post test, in the intervention group, medication was changed in 67% of the residents. In the control group medication was changed 55% (p=0.003).

In medication reviews, performed by a hospital pharmacist and the patients' physician, Finkers et al. identified a mean of 3.5 DRPs in Dutch nursing home residents with more than nine medications. (Finkers, Maring, Boersma, & Taxis, 2007). In a study of Halvorsen et al in Norwegian nursing home residents using at least one medication, a mean of 5.1 DRPs per resident were detected by medication reviews performed by pharmacists. The patients' physician and nurses confirmed a mean of 3.5 DRPs per resident. Only 9 of all DRPs identified were ADRs, of which only 1 was confirmed (Halvorsen, Ruths, Granas, & Viktil, 2010). Pharmacists' medication reviews may have focused more on DRPs based on the medication chart and written documents, while nurses' observations focused on patient actual complaints. This can partially explain the difference in ADRs. The effect on the incidence of ADRs of interventions to improve medication use has seldom been tested (Marcum, Handler, Wright, & Hanlon, 2010).

By the use of a standard symptoms assessment form, containing 21 potential DRPs, nurse-led medication reviews in elderly hospitalized patients identified a mean of 1.2 clinically relevant DRPs not detected by usual care (Bergqvist, Ulfvarson, & Andersen-Karlsson, 2009). Using a combination of a standard observation form for nurses, computerized drug-drug interaction screening, creatinine clearance calculation and medication review by a nurse

and a clinical pharmacologist, resulted in the detection of a mean of 2 DRPs and 0.6 ADRs per patient in an internal medicine clinic (Mannheimer et al., 2006). The detection and confirmation rate in our study seem to be higher. Differences in DRPs, interventions and study methodology, however, make indisputable comparisons of the standardized lists with our personalized trigger tool impossible.

Besides an increase in DRP detection and in medication changes, the trigger tool intervention aimed for the medication changes to result in an improved quality of prescribing, preferably with a decrease in the number of medications used by residents. The higher number of medication changes in the intervention group did, however, not influence the number of medications taken by residents. To address the DRPs, medications causing the problem were annulled or new medications were prescribed to prevent future harm. This may be the reason why there were no substantial differences in medication use in the pre- and the posttest. With 35% of the residents taking PIMs in the pretest, significant improvements in the quality of prescribing should have been possible. However, medication changes did not result in a decrease of the use of PIMs. Our intervention did not suggest alternatives to improve prescribing in case of drug related problems. A drug related problem may have been treated by adding a prescription instead of by questioning the quality of the existing prescriptions. A higher level of implementation and more support in medication adaptations may increase the effect of the intervention on medication use and the quality of prescribing.

The trigger tool supports nurses in reporting relevant drug related problems. This information can be used by family doctors and pharmacists to improve medication safety. Nurses themselves, have not the power to make family doctors or pharmacists consider their observations and they lack authority and competences to make medication changes.

6.1.4.2. Evaluation of the trigger tool

The average number of ADR-triggers per resident was 35 (range 6 – 61). Some triggers were relevant to almost all residents, while others to none. In the development of the tool we deliberately chose not to leave out less common triggers. This would make the trigger tool incomplete as an information resource for ADRs. The trigger tool was developed based on the information of the Belgian Center for Pharmacotherapeutic Information (www.bcfi.be) with over 15 years of experience in providing information on relevant ADRs, taking into account incidence, severity and avoidability. Furthermore, while nurses screen for the presence of all triggers on the trigger tool form, phy-

sicians only consider those triggers indicated as potential problems by the nurse. The number of problems to be evaluated by physicians is, therefore, strongly reduced. On the other hand, a relevance score based on incidence rates, severity rates and alternative options in prescribing, linked to the ADRs, would increase the usability. We did not record the time needed by nurses to perform the observations. The time to perform medication review rarely exceeded 10 minutes, which seems feasible for practice. Nurses and physicians were asked to evaluate the use of the trigger tool in a cross-sectional survey. The data will be analyzed and published later.

6.1.4.3. Limitations and strengths

This study was a first test of the personalized DRP trigger tool. During the study some limitations were encountered, which should be considered in the interpretation of the results and in future tests of the tool. The first limitations are a consequence of the printed trigger tool forms. Because the trigger tools forms had to be generated and printed centrally, medication charts to generate the trigger tools forms had to be collected in the pretest. At the moment of the intervention, when nurses screened for the presence of the DRPs or in the medication review process, medication use of the residents might already have been changed compared to the moment of the trigger tool form generation. In a digital version the trigger tool form could be generated at the time of the intervention. After the intervention, a period of at least two weeks was waited to recollect the medication charts to make sure planned medication changes were registered. In this period, again, medication changes not related to the intervention were possible. Medication changes between the pre-and the posttest are therefore not always a consequence of the intervention. This is reflected in the number of medication changes in the control group. The medication changes planned on the trigger tool forms, however, give a clear view on the impact of the trigger tool. Furthermore, the comparison with the control group showed an increase in medication changes on the charts of the intervention group.

Since the study was set up with a pre- posttest design, without a control group, the allocation to the groups was not randomized. The allocation is solely based on the completion of the intervention by nurses and family doctors. Fortunately, the characteristics of the residents in the control group and the intervention group were similar, which allowed us to make the comparison.

Besides the limitations, the study has important strengths. To our knowledge, our study has tested an intervention, unique in three ways:

I) structured, guided nurse observations combined with interdisciplinary medication review involving a nurse;
II) a personalized DRP trigger tool based on the residents own medication;
III) the inclusion of medication administration problems in medication review.

Only a few studies involved nurses in medication review, ranging from the preparation of the medication review by the general monitoring of patients' health status, renal function or drug-drug interactions (DDIs) or by revising the data in patient files (Bergqvist, Ulfvarson, Andersen-Karlsson, & von Bahr, 2008; Bergqvist et al., 2009; Mannheimer et al., 2006; Olsson, Curman, & Engfeldt, 2010; Sankaran et al., 2010) to performing medication review on their own (Krska J, 2005). In studies describing 'interdisciplinary chart review', interdisciplinary mostly means the combination of a physician and a pharmacist or a combination of physicians of different specialties.

Medication administration problems can have a major impact on pharmacotherapy. Taking them into account during medication review resulted in a significant amount of medication changes, proving their importance and the lack of attention for the problems when not systematically addressed.

6.1.4.4. Implications for practice and research

The first test of the personalized trigger tool showed promising results. Nurses have the competences to make the required observations, yet, not to pharmacological background to know what DRPs to observe. The tool helped nurses in the observation of DRPs and resulted in medication changes, based on actual problems in nursing home residents. When linked to the electronic medication charts of residents, the DRP trigger tool has the potential to improve pharmacotherapy in nursing homes. Nurses will be able to consult the trigger tool in case of new prescriptions, dosage changes, the withdrawal of medications, in case of observations of potential DRPs or in case of medication review sessions. More research and development is required, taking into account the improvement opportunities of the trigger tool, the limitations of this study and testing the impact of the intervention on the quality of pharmacotherapy and on the long term resident outcomes.

6.1.5. Conclusions

The personalized drug related problem trigger tool for nursing homes enabled nurses to detect and report relevant drug related problems. In interdisciplinary medication review, the information of nurses' observations resulted in medication changes, yet, the medication changes did not result in an improvement of the quality of prescribing.

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Chapter 7

General Discussion and Future Perspectives

Chapter 7

Outline

7.1. Main findings

Nurses assumed considerable pharmacotherapeutic responsibilities in Belgium. As members of a multidisciplinary health care team, they were involved in activities such as giving information about medication, following up medication adherence and drug monitoring. In taking up these responsibilities, however, nurses encountered several problems, increasing the risk for incomplete, careless or erroneous medication management. Problems experienced by nurses could be divided into nurse-related problems (e.g. nurses' competences), organizational problems (e.g. work pressure), problems in interdisciplinary cooperation (e.g. lack of communication) and patient-related problems (e.g. mental status).

In this thesis, we focused especially on drug monitoring. Despite their involvement in practice, nurses were uncertain about the actual borders of their responsibilities. Only 76% of the nurses believed that monitoring adverse drug reactions (ADRs) was part of their job and 92% felt that it should be. These uncertainties in nurses' role in drug monitoring have never explicitly been described before. Furthermore, several barriers impeded drug monitoring by nurses. Nurses experienced 'not receiving enough information from physicians', 'a lack of interdisciplinary communication', 'not enough attention of nurses to reporting observations', and 'a lack of knowledge on ADRs as the most important barriers. The lack of pharmacological knowledge was confirmed in graduating nursing students, whose results on the knowledge and calculation test were substandard, in accordance with low self-rated readiness to provide safe medication care. Educational preparation had an important influence on pharmacotherapeutic practices. This showed in drug monitoring, where fewer diploma nurses observed ADRs compared to Bachelor's in nursing. In nursing homes, the educational level and engagement in continuing education were lower than in community care and hospitals.

Given these problems, we developed a drug related problem (DRP) trigger tool for interdisciplinary medication review in nursing homes. The trigger tool stimulates and enables nurses to perform resident-specific observations of ADRs and medication administration problems, threatening pharmacotherapy, and to report these observations systematically in interdisciplinary medication review. In a test of the trigger tool in 8 nursing homes, the DRP trigger tool positively influenced nurse observations, nurse reports of DRPs and interdisciplinary cooperation. The detection rate of DRPs is an indication of the value of the trigger tool for nurses in drug monitoring. The confirmation of DRPs by physicians and the subsequent medication changes are indi-

cations of the value of the nurse observations for physicians in medication review. Due to the intervention, the number of medication changes increased, yet, without a positive effect on the numbers of medications used or the quality of prescribing.

7.2. Future perspectives on nurses' role in pharmacotherapy in nursing homes

Nurses' role in pharmacotherapy should be strengthened further in the future. The basic requirement to reach this goal, is a fundamental change in the professional nursing culture. This goal is a process which could not be achieved in the context and timeframe of this thesis. More concretely, actions are required in education as well as in practice, focusing on all health care workers involved in pharmacotherapy. With regard to pharmacotherapeutic care, nurses tended to behave rather reserved, showing a lack of initiative and responsibility. This finding was not surprising when considering the gaps in nurses' educational preparation. Nurse education does pay little attention to drug monitoring. Hence, newly graduated nurses may not be sure about their role in drug monitoring resulting in a lack of nurse attention to drug monitoring. Furthermore, when nurses are uncertain about their own responsibilities, the responsibilities will not be clear to other professionals in the interdisciplinary team either, impeding interdisciplinary cooperation. During the project, regularly, nurses expressed a feeling of not being respected for their contribution by some physicians, making cooperation impossible. Nurses in practice are not stimulated to take up responsibilities in drug monitoring. Interdisciplinary agreements on cooperation in drug monitoring can broaden the effectiveness and patient centeredness of drug monitoring and of pharmacotherapy in general.

A lack of pharmacology knowledge in nurses only increases the problems and the consequent lack of initiative and responsibility taking. A positive evolution since the Decree of the Flemish Government of July 24th 2009 is the mandatory 20 hours of additional training every two years for nursing staff in nursing homes. The trust other professionals, residents and visitors have in nurses' competences can also be afflicted by the involvement of care assistants. Care assistants are involved in practices in medication management and pharmacotherapy, beyond their legally defined tasks. Outsiders are often not able to differentiate between care assistants and nurses, placing them at a same competence level. A last potential impediment to nurses' role, respon-

sibilities and competences, is the increasing involvement of pharmacists in preparing and personalizing medication for administration in nursing homes. Their involvement may decrease nurses' work load and decrease the number of errors in medication preparation. It will, however, result in nurses with less knowledge about the medications prescribed, increasing the risk for errors in other stages of the medication management process. Nurses' role needs to be further clarified and highlighted to improve pharmacotherapeutic care in nursing homes. All health care workers have to contribute in order to succeed. Physicians and pharmacists should give nurses the opportunity to be involved in drug monitoring. They need to develop a better insight in the nursing profession and be able to differentiate between educational levels of the care staff. On the other hand, from their point of view, it is understandable physicians and pharmacists do not entrust tasks to nurses if nurses do not earn the position and if they do not stand up to take up their responsibilities. Nurses need to obtain the required competences, take initiative and prove they can contribute to drug monitoring in a valuable way.

Another reason for highlighting nurses' role is the nursing shortage. Job content in nursing homes is often perceived as not very challenging, requiring few competences. Nursing seems to be focused on hygienic care and few technical interventions. This perception is considered one of the reasons for the limited appeal of the sector and the consequent shortage of nurses. Nurses' role in nursing homes should, therefore, be upgraded. Highlighting nurses' role in pharmacotherapy can be a part of the solution and will attract higher educated nurses.

7.3. Future perspectives on supporting nurses' role in drug monitoring

To stimulate nurses' role and to address the barriers identified, we developed a DRP trigger tool for interdisciplinary chart review in nursing homes to support nurses in pharmacotherapy. The intervention study showed that, by the use of the tool, nurses could contribute in a valuable way to the detection of DRPs. The detection of DRPs can improve pharmacotherapeutic care and patient outcome. A prerequisite for improvement is, however, that prescribers react adequately on what nurses report. Nurses do not have the authority and competences to change medication. In case of a DRP, the prescriber has to reevaluate residents' medication use. If a solution exists, the prescriber has to choose the best alternative: prevention of the DRP by change of therapy, or change in the dosage regimen or withdrawal of the product. In further re-

search, interventions should be developed to support prescribers in decision making while adjusting the medication based on the nurse observations. Furthermore, since the DRPs are nurse observations of actual problems in residents, the evolution in the problems experienced by the residents should be monitored with the help of nurses.

The trigger tool still needs to be refined, based on the results of the intervention study. The ADR trigger list should be critically reviewed and the possibilities of a relevance score for the ADRs, based on their frequency, severity, and avoidability have to be studied. Regular updates of the ADR database are required to add new medications or ADRs or to remove obsolete ones. During the project, nurses asked for an extension of the software. They asked for additional applications with medication information, especially evidence-based advice to deal with DRPs and medication administration advices linked to the residents' medications (such as interactions with food).

The support we provided for nurses by the introduction of the trigger tool was met with great interest, enthusiasm and even gratitude and the effects were promising. There is, however, still a lot to be done.

7.4. Recommendations to highlight and support the role of nurses in drug monitoring in the future

- Clarification of nurses' role in pharmacotherapy in nurse education;
- Improvement of nurses' competences in pharmacotherapy through improving nurse education;
- Differentiation in nursing tasks based on educational level;
- Introduction of nurse specialists in medication management and pharmacotherapy by the organization of vocational education;
- Creation of awareness of nurses' role in medication management and pharmacotherapy in all health care workers involved;
- A stronger representation of nurses in relevant interdisciplinary consultative committees;
- Investment in nursing research in medication management and pharmacotherapy in general and particularly in nursing homes;
- Continuing investment in addressing the barriers for nurses in pharmacotherapy and medication management;
- Continuing support of nurses' role in pharmacotherapy and medication management through the development, refinement and implementation of tools.

- Strengthening of an independent professional association which can contribute to the quality of nursing care by formulating and implementing recommendations and by standing up for the nurse profession in practice, in policy, in education and in research.
- Installation of an expert group to promote and support nursing care in nursing homes.

7.4. Strengths and limitations of this project

Pharmacotherapy by nurses, and more specifically drug monitoring, had not been studied in Belgian nursing homes before the start of this thesis. There were little to no scientific fundaments to start from. Even nurses' role was unclear. Therefore, we could not immediately start with the development of electronic support systems. As a result, this project had a wide fundament, clarifying nurses' role and defining problems as a strong base to build on a support system for nurses, tailored to nurses in nursing homes, addressing problems relevant to practice. At the end of the project, the knowledge obtained in the first studies of the project was integrated in the creation of the DRP trigger tool, which showed promising results in the first test. Focusing on the point of prescribing does not prevent most DRPs since they are often a consequence of individual responses to medications (1). The trigger tool facilitates the detection of individuals' responses to medications and to adjust medication prescriptions to the resident.

A lot of opportunities and research gaps are, however, still left untouched or can be studied in more depth. Nurses' role and barriers in medication management were studied by questioning nurses on their own actions and experiences. Responses of nurses on their own actions or experiences may be biased by the tendency to respond in a particular direction (positive, negative, extreme or central) or to respond in a the way they believe is more socially desirable. Observations of nurses in practice, combined with evaluations of the quality of these practices can add more objective data. Knowledge and calculation skills were studied by tests on paper without considering other competences (skills and attitudes). Nurses' competences in pharmacotherapy can still be investigated in more detail. This requires more time-intensive and therefore more expensive research, which was not practicable in our project. The development and testing of the trigger tool has not been finished yet. Data on ADRs reported by nursing home residents before and after the intervention (Chapter 6) and data on the evaluation of the trigger tool by profes-

sionals involved in the intervention study, were collected and still need to be analyzed. Then, the trigger tool needs further refinement and implementation and effects have to be tested on hard patient outcomes and on the long term. Furthermore, additional research in related topics is advisable. This research project has focused on drug monitoring. Yet, clarifying nurses' role and defining problems also showed research gaps in different stages of medication management and pharmacotherapy. These gaps could not all be addressed in the project and ask for further research.

During the project, the international interest in drug monitoring in nursing homes and the use of trigger tools has grown. Especially in Sweden and Norway research groups are investing in research on the topic. This is shown in recent publications by authors such as Fortselund et al. (Norway) (2), Davidsson et al. (Norway) (3), Krüger et al. (Norway) (4) and Hedström et al. (Sweden) (5). Handler and Gurwitz are American researchers who often published on the topic (1). International research cooperation would be valuable. Up to now financial means have, however, not been available. Publications with an important role for nurses in the observation of DRPs remain too exceptional. Most publications are written by physicians or pharmacists who forget about nurses. International, interdisciplinary cooperation in research could support the creation of feasible interdisciplinary frameworks for drug monitoring and medication review in practice. The cooperation of nurses of the Centre of Research and Innovation in Care of the University Antwerp and physicians and pharmacists of the Heymans Institute of Pharmacology of the University Ghent in this project, has ensured our project was approached from different angles.

7.5. Confrontation of the hypothesis with the results of the project

In the beginning of the study, we hypothesized that the detection of DRPs in nursing homes could be improved (e) when the role of the nurse, as a member of an interdisciplinary team, would be highlighted (a), when barriers in the execution of their role would be identified (b & c) and, finally, when a system would be developed to support nurses in their role (d), taking into account the barriers identified. At the end of this PhD project we can accept this hypothesis.

a. Different aspects of nurses' role in the interdisciplinary team were investigated. A part of them has been integrated in a specific tool for nurses in drug monitoring.

b. Barriers to safe medication management have been identified.
c. Nurses' knowledge in pharmacology and pharmacotherapy was insufficient to monitor effects of medication without additional support.
d. The DRP trigger tool has been developed aiming to overcome the most important barriers.
e. A test of the trigger tool in an intervention study showed a high detection rate of DRPs by nurses, confirmed by treating physicians, resulting in a significantly higher amount of medication changes in the intervention group compared to a control group.

Based on the findings of this project, a new hypothesis can be stated, indicating the direction of future research: the DRP trigger tool intervention, implemented digitally in nursing homes linked to the medication charts, including decision support for physicians to adjust medication prescriptions to residents in regularly planned interdisciplinary medication reviews, will improve the quality of prescribing and will result in a decrease of drug related problems in residents.

7.6. Conclusions

This research project has given an important start to improve pharmacotherapeutic care in nursing homes from the side of the nursing profession. Nurses' contribution to drug monitoring in nursing homes had not clearly been described and defined. Nurses as well as other members of the interdisciplinary team were not certain about nurses' responsibilities. Furthermore, drug monitoring was impeded by barriers such as a lack of knowledge and information on medication and a lack of interdisciplinary cooperation and communication. These barriers were made explicit. The development and testing of the DRP trigger tool showed that, when the role of nurses is clarified and when nurses are supported by providing the required information and communication tools, nurses in nursing homes can both detect and report relevant DRPs. The DRP trigger tool for interdisciplinary medication review in nursing homes contributes to interdisciplinary drug monitoring. To affect the health of nursing home residents, refinement and extension of the trigger tool intervention is required.

7.7. References

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Summary

The high incidence of drug related problems (DRPs) in nursing homes, has extensively been described in international literature. The PHEBE study created awareness on problems in pharmacotherapy and medication management in Belgian nursing homes.

The goal of this study was to address DRPs in nursing homes from a nurse perspective. The idea of developing an electronic support system for nurses existed from the beginning. Yet, after the first contacts with nurses and physicians about the idea, it became clear that there was much uncertainty about nurses' role in drug monitoring and their competences. Starting with the development of a support system seemed not an option before the basics of the problem had been clarified. Our hypothesis was that the detection of DRPs in nursing homes could be improved when nurses' role, as members of an interdisciplinary team, is highlighted, when barriers in the execution of their role are identified and, finally, when a system would be developed to support nurses in their role, taking into account the barriers identified.

This hypothesis was translated into 5 research objectives, which were all addressed in different chapters of this thesis.

Objective 1: To describe nurses' practices in pharmacotherapeutic care in nursing homes.

Objective 2: To define and measure barriers for nurses to safe medication management in nursing homes and to identify opportunities for improvement.

Objective 3: To investigate the educational preparation of nurses to take up their role in pharmacotherapy

Objective 4: To develop a support system for nurses in pharmacotherapeutic care in nursing homes, based on their role, their competences and the barriers they experience.

Objective 5: To test the effect of the support system on pharmacotherapy in nursing homes in an intervention study.

To describe nurses' practices in pharmacotherapeutic care, a cross-sectional study was set up, questioning nurses about giving medication information, observing non-adherence and identifying adverse drug reactions (**Chapter 1**). The comparison of the activities of 260 nursing home nurses, 82 community care nurses and 1070 hospital nurses enabled to describe the unique situation in nursing homes.

Nursing homes had a lower number of male nurses, nurses were generally older and had more years of experience. More important were the significant differences in educational level and engagement in continuing education. Only 42% of the nursing home nurses had a Bachelor's degree and only 26% engaged in continuing education, which is significantly less compared

to community care and hospitals. The lower educational level had implications for drug monitoring. Bachelor's degree holders were 35% more likely than diploma holders to have observed an adverse drug reaction in the past month. In general it could be concluded that nurses assume considerable pharmacotherapeutic practices, especially in nursing homes.

Nurses' actual involvement in pharmacotherapeutic practices did, however, not mean they were convinced that these practices were explicitly a part of their job content. Therefore, in the study on barriers (**Chapter 2**), extra attention was given to this aspect. In drug monitoring in nursing homes, 80% of the nurses believed that following the therapeutic effects of medication was part of their job, and 95% felt as if it should be. On the other hand, only 76% of the nurses believed that monitoring side effects was part of their job and 92% felt as it should be. These uncertainties in nurses' role in drug monitoring have never explicitly been described before. They do, however, envisage a lack of nurse attention to drug monitoring. Furthermore, when nurses are uncertain about their own responsibilities, the responsibilities will not be clear to other professionals in the interdisciplinary team either, impeding interdisciplinary cooperation.

In 20 nursing homes, 246 nurses and 270 nurse assistants were asked to score the relevance of barriers in every aspect of the medication management process and pharmacotherapy which were identified in an expert meeting (chapter 2). When focusing on the results in the stage of drug monitoring the following barriers were perceived to be the most important: not receiving enough information of physicians; a lack of interdisciplinary communication; not enough attention of nurses to report observations; and a lack of knowledge on adverse drug reactions.

The lack of pharmacological knowledge was confirmed in a test questioning 1484 nurses, employed in nursing homes, community care and acute hospitals. These results encouraged to investigate nurses' educational preparation in pharmacology in more detail. The Medication Knowledge and Calculations test (MKC-test) was developed and 613 graduating nursing students were evaluated (**Chapter 3**). The mean results on pharmacology knowledge were only 52% in diploma level students and 55% in Bachelor's students. On the calculation exercises the mean results were respectively 53% and 66%. The results confirmed the lack of pharmacology knowledge. Newly graduated nurses were insufficiently prepared to safe medication management and pharmacotherapy. This was reflected in the students' self rated readiness to safe medication care, which was 5 or less on a scale of 10 in 27% of the

students. The descriptions of pharmacology education in Flemish nursing schools showed a wide variation in organizational characteristics such as the number of teaching hours, the organization of separate courses or integrated modules and the profession of the teachers, … Recommendations for improvements in nursing education were formulated.

From the first three chapters the following main problems in drug monitoring were identified:

- Uncertainty about nurses' role in drug monitoring;
- A lack of attention to report nurse observations of medication effects;
- A lack of interdisciplinary cooperation;
- A lack of pharmacology knowledge.

These problems needed to be addressed when developing a support system for nurses in drug monitoring.

Literature was searched for existing screening methods for DRPs. On the one hand, interventions seldom involved nurses. On the other hand, authors stressed the importance of interdisciplinary cooperation, as well as nurses' observational skills and ideal position in close contact to the resident, to detect DRPs. Consequently, it was decided to develop a drug related problem trigger tool for interdisciplinary medication review in nursing homes (**Chapter 4**) with the following functionalities:

1. The combination of a trigger tool, direct nurse observations and chart review.
2. The use of a personalized, resident specific trigger tool, generating triggers from the residents' own medication chart.
3. The clarification of nurses' role by clearly describing their role in screening for DRPs using the trigger tool (direct observations) and the participation in interdisciplinary chart review.
4. The creation of standardized communication reports for nurses to report DRPs to physicians/ pharmacists.
5. The stimulation of interdisciplinary cooperation by clarifying nurses' role in the team and by organizing interdisciplinary medication review.
6. The generation of DRP triggers for nurses, which allow targeted observations even in the absence of advanced pharmacological knowledge, adapted to nurses' terminology and observable in nursing homes without an authorization of a physician and without external laboratory analyses.
7. The inclusion of triggers for detection of medication administration problems. Non-adherence or swallowing problems are examples of administration problems which can threaten effective pharmacotherapy and which

are mainly observable by nurses. These problems were not included systematically in medication review interventions before.

Finally, the DRP trigger tool for interdisciplinary medication review in nursing homes was developed to support nurses in pharmacotherapy and tested in an intervention study in 8 nursing homes (**Chapter 5**).

The trigger tool has been used in a printed form, presented in two major parts. The first part is a list of DRPs to guide nurses in patient observations. It consists of a computer-generated, resident-specific list of potential ADRs, based on the residents' medication chart, completed with four potential administration problems. Nurse observations can be reported on the trigger tool form to inform the family doctor. The second part is a guide for the interdisciplinary medication review process. It gives an overview of the residents' medication, the associated potential DRPs and the observations by nurses. During medication review, nurse observations of potential DRPs can, therefore, immediately be linked to the medications which may cause the problem. The family doctor, together with the nurse have to perform the medication review. The contribution of a pharmacist and CRA in medication review is advised.

As a result of the use of the trigger tool, nurses observed 1527 potential ADRs in 81% of the 418 residents. Administration problems were observed in 45% of the residents. About half of the DRPs observed, were confirmed the family doctor in medication review. As a result, 214 medication changes were planned in 21% of the residents because of ADRs and in 5% of the residents because of administration problems. Medications were changed more frequently in the intervention group than in the control group (without trigger tool and medication review). However, the number of medications and the classes of medication used by the residents did not change. The DRP trigger tool for interdisciplinary medication review in nursing homes revealed to positively influence nurse observations, nurse reports of DRPs and interdisciplinary cooperation. The confirmation of DRPs and subsequent medication changes are indications of the value of the nurse observations for physicians in medication review. More support in medication review is, however, needed so that medication alterations do improve the quality of prescribing.

Samenvatting

De hoge incidentie van geneesmiddelengerelateerde problemen bij oudere patiënten is duidelijk gedocumenteerd in internationale wetenschappelijke literatuur. In België werd de aandacht gevestigd op deze problematiek in het rapport van het PHEBE onderzoek (Prescribing in Homes for the Elderly in Belgium), waarin farmacotherapie en geneesmiddelenbeleid in woonzorgcentra werden beschreven en polyfarmacie en kwaliteitsproblemen in het voorschrijven van geneesmiddelen werden aangetoond. Verbeteringsinitiatieven bleken noodzakelijk. In navolging van het PHEBE rapport, was het doel van deze doctoraatsstudie, om specifiek vanuit een verpleegkundig standpunt, de mogelijkheden te bestuderen om de incidentie van geneesmiddelengerelateerde problemen terug te dringen.

Van bij de aanvang was er de intentie om een elektronisch systeem te ontwikkelen om verpleegkundigen te ondersteunen in hun functie. Al snel bleek er echter veel onduidelijkheid te bestaan over die functie, voornamelijk op het domein van de opvolging van effecten en neveneffecten van geneesmiddelen. Bijkomend werd in vraag gesteld of verpleegkundigen wel over de nodige competenties beschikten om te participeren in farmacotherapeutische zorgverlening. Alvorens te starten met de ontwikkeling van een elektronisch, ondersteunend systeem, werd daarom beslist eerst deze fundamenten te belichten.

De hypothese werd gesteld dat de detectie van geneesmiddelengerelateerde problemen verbeterd zou kunnen worden, wanneer de rol van verpleegkundigen in farmacotherapeutische zorg, als leden van een interprofessioneel team, zou worden verduidelijkt, wanneer barrières in de uitvoering van deze rol zouden worden geïdentificeerd en wanneer, rekening houdend met deze barrières, een systeem zou worden ontwikkeld om verpleegkundigen te ondersteunen in hun rol in farmacotherapeutische zorg. Deze hypothese werd vertaald in vijf onderzoeksdoelstellingen, die elk behandeld werden in een apart hoofdstuk van de thesis.

Doelstelling 1: Het beschrijven van de verpleegkundige praktijkvoering in farmacotherapeutische zorg in woonzorgcentra.

Doelstelling 2: Het identificeren en scoren van de relevantie van barrières die verpleegkundigen ervaren in het geneesmiddelenbeleid en het identificeren van opportuniteiten voor verbeteringsinitiatieven.

Doelstelling 3: Het bestuderen van de voorbereiding die verpleegkundigen krijgen op hun rol in farmacotherapeutische zorg vanuit het onderwijs.

Doelstelling 4: Het ontwikkelen van een systeem om verpleegkundigen te ondersteunen in hun rol in farmacotherapeutische zorg in woonzorgcentra, rekening houdend met de beschreven rol, hun competenties en de geïdentificeerde barrières.

Doelstelling 5: Het testen van het effect van het ontwikkelde ondersteunend systeem in een interventiestudie.

Om de verpleegkundige praktijkvoering in farmacotherapeutische zorg in woonzorgcentra te beschrijven, werd een cross-sectioneel onderzoek opgezet. Hierin werden verpleegkundigen bevraagd over de geneesmiddeleninformatie die ze hadden gegeven, therapieontrouw die ze geobserveerd hadden en nevenwerkingen die ze gedetecteerd hadden (**Chapter 1**). De vergelijking van de handelingen van 260 verpleegkundigen tewerkgesteld in woonzorgcentra, 82 thuiszorgverpleegkundigen en 1070 verpleegkundigen uit ziekenhuizen, maakte het mogelijk de unieke situatie van de woonzorgcentra te beschrijven.

Woonzorgcentra hadden een lager aantal mannelijke verpleegkundigen, verpleegkundigen waren meestal ouder en hadden meer werkervaring. Opvallend waren de significante verschillen in opleidingsniveau en in engagement om bijscholingen te volgen. Slechts 42% van de verpleegkundigen in de woonzorgcentra had een diploma Bachelor in verpleegkunde en slechts 26% engageerde zich om bijscholingen te volgen. Deze percentages waren significant hoger in ziekenhuizen en de thuiszorg. Het opleidingsniveau had een invloed op de opvolging van nevenwerkingen. Meer bachelors in verpleegkunde dan HBO5 verpleegkundigen observeerden nevenwerkingen. Algemeen kon gesteld worden dat, in de praktijk, verpleegkundigen sterk betrokken waren bij de farmacotherapeutische zorg.

Ondanks hun betrokkenheid in de praktijk, bleek dat verpleegkundigen niet overtuigd waren dat de opvolging van therapeutische effecten en nevenwerkingen expliciet deel uitmaakten van hun takenpakket. In de studie naar barrières in het geneesmiddelenbeleid (**Chapter 2**), werd daarom extra aandacht besteed aan dit onderdeel. Slechts 80% van de verpleegkundigen was van mening dat het opvolgen van therapeutische effecten een deel was van hun huidig takenpakket. Anderzijds vond 95% dat het een deel van hun takenpakket zou moeten zijn. Wat nevenwerkingen betreft, beschouwde 76% van de verpleegkundigen de opvolging als een deel van hun huidige takenpakket en 92% vond dat het een taak zou moeten zijn. Deze onduidelijkheden in de taakinvulling van verpleegkundigen werden niet eerder gerapporteerd. Ze zijn echter zeer belangrijk aangezien zij impliceren dat verpleegkundigen in woonzorgcentra te weinig aandacht hebben voor de evaluatie van de farmacotherapie. Daarenboven is het vanzelfsprekend dat andere leden van het interprofessionele team niet weten welke verantwoordelijkheden verpleegkundigen dragen en op welke manier ze kunnen samenwerken, als verpleegkundigen zelf niet zeker zijn van hun eigen betrok-

kenheid.

Om de barrières te bestuderen die verpleegkundigen ervaren in het geneesmiddelenbeleid werd eerst een expert meeting uitgevoerd. De geïdentificeerde barrières werden vervolgens voorgelegd aan 246 verpleegkundigen en 270 zorgkundigen uit 20 verschillende woonzorgcentra met de vraag om het belang van deze barrières te scoren. In de fase van het opvolgen van therapeutische effecten en neveneffecten van geneesmiddelen, werden de volgende barrières beoordeeld als de meest belangrijke: een gebrek aan informatieverschaffing door artsen; een gebrek aan interdisciplinaire communicatie; te weinig aandacht van verpleegkundigen voor de rapportage van observaties; en een tekort aan kennis over neveneffecten.

Het gebrek aan farmacologische kennis werd bevestigd in een test bij 1484 verpleegkundigen, tewerkgesteld in woonzorgcentra, thuiszorg en ziekenhuizen. Deze resultaten leidden tot het bestuderen van het onderwijs in farmacologie voor verpleegkundigen. De 'Medication Knowledge and Calculations test' (MKC-test) werd ontwikkeld en 613 studenten verpleegkunde werden getest, enkele maanden voor het afstuderen (**Chapter 3**). De gemiddelde score van studenten op de kennisvragen was 52% op HBO5 niveau en 55% op bachelor niveau. Medisch rekenen resulteerde in scores van respectievelijk 53% en 66%. Er kon worden geconcludeerd dat afstuderende verpleegkundigen een gebrek hebben aan farmacologische kennis en rekenvaardigheden om hun taak op een veilige manier te kunnen opnemen. Studenten gaven bovendien zelf aan zich onvoldoende voorbereid te voelen in deze domeinen. Op een schaal van 10 evalueerde 27% van de studenten de eigen gereedheid 5 of minder. De beschrijving van het farmacologie onderwijs in de Vlaamse opleidingen verpleegkunde toonde een grote variatie in het aantal uren dat werd besteed aan farmacologie in het curriculum, de organisatie als apart vak of geïntegreerd in andere vakken of modules, de inhouden die werden besproken en de karakteristieken van de verantwoordelijke lectoren.

Vanuit de eerste drie studies werden de belangrijkste problemen in het opvolgen van effecten en neveneffecten van geneesmiddelen geselecteerd:

- Onzekerheid over de verpleegkundige rol in het opvolgen van therapeutische effecten en neveneffecten van geneesmiddelen;
- Een gebrek aan aandacht van verpleegkundigen om hun observaties van effecten van geneesmiddelen te rapporteren;
- Een gebrek aan interprofessionele samenwerking;
- Een gebrek aan farmacologische kennis.

Deze problemen werden gebruikt als basis voor de ontwikkeling van een interventie om verpleegkundigen te ondersteunen in de opvolging van geneesmiddeleneffecten.

Voor de ontwikkeling van de interventie werd gestart met een literatuurstudie naar bestaande methodes om geneesmiddelengerelateerde problemen op te sporen. Eén van de bevindingen was dat verpleegkundigen slechts zelden betrokken waren in de beschreven screeningsmethodes. Anderzijds benadrukten verschillende auteurs het belang van interprofessionele samenwerking om geneesmiddelengerelateerde problemen te identificeren. De positie van de verpleegkundige ten opzichte van de patiënt en de te verwachten observationele competenties van verpleegkundigen, maakten hen bovendien belangrijke partners.

Er werd beslist om een trigger tool te ontwikkelen voor woonzorgcentra, die de detectie en rapportage van geneesmiddelengerelateerde problemen door verpleegkundigen zou faciliteren in voorbereiding op interprofessionele herziening van het geneesmiddelengebruik van residenten (**Chapter 4**). Op deze wijze zouden verpleegkundigen vanuit hun positie kunnen bijdragen aan de optimalisatie van de voorschrijfkwaliteit in woonzorgcentra. De trigger tool werd ontwikkeld met de volgende functionaliteiten:

1. de combinatie van diverse detectie methoden: het trigger tool principe, onmiddellijke verpleegkundige observaties en interprofessionele herziening van het geneesmiddelengebruik;
2. het gebruik van gepersonaliseerde, resident-specifieke triggers, gegenereerd op basis van het geneesmiddelengebruik van de individuele resident;
3. de verduidelijking en stimulering van de verpleegkundige rol door hen duidelijk afgebakende taken en verantwoordelijkheden te geven met het gebruik van de trigger tool en in interprofessionele samenwerking;
4. het gebruik van gestandaardiseerde rapporten voor interprofessionele communicatie van verpleegkundige observaties van geneesmiddelengerelateerde problemen;
5. de bevordering van de interprofessionele samenwerking door het verduidelijken van de rol van de verpleegkundigen aan andere leden van het team en door de organisatie van het interprofessioneel geneesmiddelenoverleg;
6. de afstemming van de triggers van geneesmiddelengerelateerde problemen op verpleegkundigen om het hen mogelijk te maken om gerichte observaties te doen zonder gevorderde farmacologische kennis. Deze afstemming omvat de aanpassing van de terminologie van de triggers en

de focus op problemen die door verpleegkundigen observeerbaar zijn zonder toestemming van artsen en zonder laboratoriumanalyses;

7. de inclusie van triggers voor de detectie en rapportage van problemen bij de toediening van geneesmiddelen, zoals therapieontrouw of slikproblemen. Deze problemen, waarmee voornamelijk verpleegkundigen geconfronteerd worden, kunnen een effectieve farmacotherapie verhinderen, ondanks de aanwezigheid van de juiste voorschriften. Deze problemen werden in voorgaande screening methodes niet opgenomen.

In de laatste fase van het doctoraatsonderzoek werd de trigger tool voor geneesmiddelengerelateerde problemen onderworpen aan een eerste test in een interventiestudie in 8 woonzorgcentra (**Chapter 5**). De trigger tool werd getest in een uitgeprinte versie. De verpleegkundigen kregen een lijst met potentiële geneesmiddelengerelateerde problemen per resident om hen te faciliteren gerichte observaties uit te voeren. De lijst werd gecreëerd met de ontwikkelde software en bestond uit de nevenwerkingen waarop de resident risico liep, rekening houdend met diens individuele geneesmiddelengebruik, aangevuld met 4 potentiële problemen bij de geneesmiddelentoediening. De verpleegkundige observaties konden aangeduid worden op de lijst en op deze wijze gerapporteerd worden aan de huisarts. Vervolgens werd het geneesmiddelengebruik interprofessioneel besproken in aanwezigheid van een verpleegkundige, de huisarts en eventueel een apotheker. Het tweede deel van de trigger tool vormde hierbij een houvast. Het tweede deel omvatte een overzicht van het geneesmiddelengebruik door de resident, gekoppeld aan de potentiële problemen die werden geobserveerd door de verpleegkundigen. Wanneer er zich een bepaald probleem stelde, kon dit bijgevolg onmiddellijk gelinkt worden aan de geneesmiddelen die mogelijks het probleem veroorzaakten.

Als resultaat van het gebruik van de trigger tool, observeerden verpleegkundigen 1527 potentiële nevenwerkingen in 81% van de 418 residenten. Toedieningsproblemen werden gerapporteerd in 45% van de residenten. Ongeveer de helft van de geobserveerde potentiële nevenwerkingen werden bevestigd door de huisarts. Dit leidde tot de planning van 214 wijzigingen van geneesmiddelen in 21% van de residenten omwille van nevenwerkingen en tot de planning van geneesmiddelenwijzigingen bij 5% van de residenten omwille van toedieningsproblemen. Geneesmiddelen werden vaker gewijzigd in de interventiegroep, waar de trigger tool werd gebruikt en interprofessioneel geneesmiddelenoverleg plaats vond, dan in de controlegroep. Desondanks wijzigde het aantal geneesmiddelen en de aard van de geneesmiddelen die gebruikt werden niet significant wanneer het geneesmiddelengebruik voor en na de interventie werd vergeleken. De kwaliteit van voorschrijven wijzigde niet volgens de indicatoren van de PRISCUS lijst.

De trigger tool voor geneesmiddelengerelateerde problemen in woonzorgcentra had een positieve invloed op de verpleegkundige observaties en de rapportage van geneesmiddelengerelateerde problemen en op de interprofessionele samenwerking. De erkenning van de problemen door de huisartsen en de geplande wijzigingen van het geneesmiddelengebruik duiden op de waarde van de verpleegkundige observaties voor het op punt stellen van de farmacotherapie van residenten. Een betere ondersteuning van de evaluatie van het geneesmiddelengebruik lijkt echter aangewezen, aangezien een verbetering van de kwaliteit van voorschrijven nog niet kon worden aangetoond.

Appendices

Appendix I

Medication management in Flemish nursing homes – *statistics*

Method

In February and March 2011 Flemish nursing homes were questioned about their medication management process. All nursing homes with a minimum of 30 beds on the list of the Flemish Agency for Care and Health were asked to participate. One part of the questionnaire had to be completed by the managing director. A second part had to be completed by the head nurses of two departments of the nursing home.

Results

Research population

The response rate was 41%, with completed questionnaires of 253 nursing homes and 466 nursing home departments received. The characteristics of the nursing homes are described in **Table A1.1**. The number of residents per nursing home ranged from 34 to 350 (median 96). The number of different visiting family doctors per nursing home ranged from 2 to 110 (median 26). The percentage of residents treated by the CRA per nursing home ranged from 0% to 97,6% (median 14%). The variation between nursing homes was large. Although it is legally obligated, 15% of the nursing home directors marked not to have a quality coordinator.

Table A1.1. *Characteristics of the nursing homes (n=235).*

Management authority (%)	
Private or non-profit	59
Public	41
Number of residents (median, range)	96 (34 – 350)
Number of nursing beds (median, range)	64 (25 – 249)
Number of rest beds (median, range)	31.5 (0 – 176)
Number of head nurses (median, range)	3 (1 - 10)
Number of departments (median, range)	3 (1 - 11)
% of residents treated by the CRA (median, range)	14 (0 – 97.6)
Number of family doctors (median, range)	26 (2 – 110)
Presence of a quality coordinator (%)	84.8

Medication management

In 79% of the nursing homes, rules and agreements on the medication process were documented on paper. In 73% of the nursing homes, directors indicated that the medication process was evaluated at least every year to enable improvements if advisable. In **Table A1.2**, different elements of organization of the medication process are presented.

Table A1.2. *Organization of the medication management process in Flemish nursing homes.*

The use of information technology in nursing homes (n=253)		
Electronic patient administration system (%)	95.2	
Electronic medical files (%)	20.4	
Electronic nursing files (%)	74.2	
Electronic medication module (%):	79.1	
Electronic prescribing		58.8
with medication formulary as first choice medication (n=107)		*46.7*
Electronic ordering of medication		60.3
Electronic supply management		62.1
Electronic support for medication preparation and administration		70.9
Electronic report of nurse observations of medication effects		52.6
Electronic communication channels between nurses/ physicians/ pharmacist		54.2
Electronic mediation information		60.6
Use of the electronic medication chart per department (n=335) (%)		
On the computer	24.8	
Printed on paper	75.2	
Medication anamnesis and the medication chart in nursing home departments (n=446)		
Professional performing medication anamnesis in new residents (%):		
CRA	1.6	
Family doctor	39.7	
Head nurse	45.2	
Other nurse	13.1	
Care assistant	0.0	
Other	0.5	

Content of the medication charts (%):		
Brand name	99.5	
Product name	34.3	
Dose	100.0	
Galenic formula	95.2	
Administration route	91.2	
Administration frequency	96.6	
Administration time	100.0	
Time of administration related to food intake, sleep, …	55.1	
Specific instructions for administration	91.0	
Start date	96.0	
Stop date	94.8	
Differentiation between acute and chronic medications	23.7	
Standing orders	73.9	
Warnings for potential adverse drug reactions	16.9	
Observation of the intake	34.9	
Medication selection and prescribing in nursing home departments (n=446)		
Prescriptions of medication not included in the formulary have to be motivated (%)	7.6	
New prescriptions are systematically discussed with nurses (%)	47.6	
Topics addressed are (n=209) (%):		
the prescription		75.6
indications		82.8
medication adherence		38.8
therapeutic effects		58.4
adverse drug reactions		56.0
precautions in medication administration		62.2
swallowing problems		36.4
splitting or alteration of medication		47.4
New prescriptions are (%):		
recorded in the medication chart by the physician	16.7	
written down by the physician and recorded in the medication chart by a nurse	58.8	
reported orally to a nurse and recorded in the medication chart by a nurse	56.1	
given to the residents (written), and not communicated directly to a nurse	6.1	
Medication use of residents is evaluated at least every 6 months	59.2	
Supply, packaging and preparation by the pharmacist in nursing homes (n=253)		
Medication supply (%)		
Public pharmacy	83.7	
Hospital pharmacy	6.3	
Wholesale	10.7	
Other	1.2	
Packaging of the supplies (%)		
Per resident & (n=225) &	92.5	
per medication administration moment		25.4
Per day		7.6
Per delivery		67.4
Per department & (n= 8) &	5.1	
per medication administration moment		0.0
per day		12.5
per delivery		87.5
Per nursing home	2.0	

Preparation and personalization of medication for administration to the residents by a pharmacist (%):	22.5			
Per medication administration moment	54.4			
Per day	10.5			
Per 2 to 6 days	1.8			
Per week	33.3			
Personalization and preparation of the medication in nursing home departments (n=446)				
Professional who personalizes and prepares the medication (%):				
Pharmacist (only the pharmacist)	18.2 (5.8)			
Nurses	93.7			
Care assistants supervised by nurses	12.6			
Care assistants	1.6			
Period of time for which medication is personalized and prepared (%):				
Per medication administration	5.4			
Per day	73.4			
> Weekly, < daily	12.6			
Per week	6.3			
Other	2.3			
Preparation and personalization of medication at night (for the whole day) (%)	63.8 (46.1)			
Medication prepared at the moment of administration (%):				
Solutions, suspensions and syrups	83.3			
Effervescent tablets	56.2			
Oral powders	57.6			
Medications to be preserved cool	88.6			
Medication is removed from its packaging at the stage of personalization and preparation (%)	61.5			
Extra control of the medication after preparation:				
No	24.4			
By the same person who prepared the medication	8.1			
By a different person	67.5			
Medication administration in nursing home departments (n=446)				
The intake of medication is checked in persons with dementia by (%):				
checking whether the medication is gone after a while	30.9			
supervision of the swallowing	69.1			
Medication information for staff and residents				
Medication information for staff members (%)	**Not**	**Printed**	**Electr.**	**Both**
Register of the Belgian Centre for Pharmacotherapeutic Information	22.8	51.8	11.1	14.3
Compendium of patient information leaflets	16.1	65.0	9.7	9.2
Pharmacotherapeutic compass	88.9	5.9	4.2	0.9
Nursing Home Formulary	9.0	80.5	6.3	4.1
Patient information leaflets out of medication packages	19.7	74.9	1.8	3.6
Information on medication splitting or alteration	43.7	36.7	17.0	2.7
Medication information is given to the patients by nurses (%)	**None**	**On request**	**On some drugs**	**About always**
About the indication	0.9	24.3	31.8	42.9
About the intake	3.1	21.0	45.8	30.2
About adverse drug reactions	12.0	44.8	37.5	5.7

The role of head nurses

Head nurses in nursing homes have a very prominent role in medication management. An example is the medication anamnesis of new residents, which was performed by head nurses in 45% and by family doctors in 40% of the cases.

Medication charts and medication information

Almost 80% had an electronic medication module. However, electronic medication charts were printed out and used on paper most of the time. The information on medication charts does not always match the legal requirements. Furthermore, references to precautions in medication administration (55%) or warnings for adverse drug reactions on medication charts are rare (17%) in nursing home departments. Most of the medication information for staff members is still on paper. The costs of making these information resources available are very low, and leave much room for improvement.

Communication with physicians on medication

In case of a new prescription, the prescription itself and the indication are discussed with a nurse in respectively 76% and 83% of the nursing home departments. Swallowing problems and problems in medication adherence are discussed in less than 40% of the nursing home departments, the splitting or alteration of medication in less than 50% and therapeutic effects or adverse drug reactions in less than 60%.

Medication review

Medication use of residents is systematically reviewed at least every six months in 59% of the departments.

Medication errors

In 175 of the 253 nursing homes (70%) medication errors were registered. Of these nursing homes, 50% had a standard form to report. Reports were collected on departmental level in 60% and on institutional level in 40%. Anonymity of the person who reported was guaranteed in 28% of the nursing homes.

This study will be prepared for publication. The results will be supplemented with correlations between characteristics of the medication management and characteristics of the nursing homes, as well as with a retrospective comparison with the results of a similar questionnaire in 2005 (PHEBE).

Appendix II

Medication management in a Flemish nursing home – *A case study*

In preparation of the research project, a participating observation was performed in a nursing home. A case is described below, indicating problems in daily medication management practices in nursing homes. This case was presented in various lectures for nursing home nurses. During these lectures, nurses judged this case as not surprising or exceptional.

A nurse with a specialization in geriatrics started with hygienic and nursing care. After the hygienic care, mr. Peeters received his breakfast together with his medications for the morning. The medications he received were a glass of water with a powder almost dissolved in it, a small recipient with a syrup and a small recipient with 7 different deblistered medications. Because all medications were out of their packages, it was not possible to identify them. The nurse could not answer the questions: 'Which medications are these?' 'What are the indications?', 'Should the patient take them before or after breakfast?' Are there any other precautions to be taken into account?' Her general answer was: 'just administer them the easiest way'.

Mr. Peeters was confused and only reacted to questions with incomprehensible noises. Because it did not seem very easy to administer the 7 medications in the recipient to the resident, the geriatric nurse was asked for advice. The best way was to give two or three medications at ones with a coffee spoon. After different failed attempts, the head nurse arrived to help. Even with the extra help of an experienced nurse, the resident did not manage to swallow even one of them. The head nurse checked the indications, decided to stop trying and to contact the family doctor. Medications of the days before were found under the bed of the resident.

The family doctor came and concluded the resident suffered from a respiratory infection. Extra medication to be swallowed was prescribed.

Important observations were:

- Medications were stored in plastic boxes (like for ice cream) per resident.
- The head nurse personalized and prepared the medication.
- Another nurse administered the medications to the residents.
- The nurse did not know the medications she was administering.
- The nurse had no attention for the time of administration in relation to the breakfast.
- The nurse did not know if there were precautions, yes or no.
- The resident could not swallow his medications. The problem already existed before, since medication was found under his bed, yet, had not been diagnosed before.
- After checking the indications of the medications and the consequences of omitting a dose, the head nurse decided not to give the medication and to contact the family doctor.
- Since another medication to be swallowed was prescribed, the communication on the swallowing problem of the resident between nurses and doctor was insufficient.
- When nurses were asked about monitoring therapeutic effects of medications and adverse drug reactions, they admitted they did not really pay attention to it.

Appendix III

Barrières in verpleegkundige geneesmiddelenzorg in woonzorgcentra: *Expertmeeting*

Inleiding

Geneesmiddelenzorg is een belangrijke verpleegkundige taak. Een correcte uitvoering is essentieel om de gewenste therapeutische effecten te bereiken en vermijdbare geneesmiddelengerelateerde problemen te voorkomen. Geneesmiddelenzorg beperkt zich niet tot het toedienen van een geneesmiddel. Zo zijn de begeleiding van de patiënt en de opvolging van de effecten van toegediende geneesmiddelen ook onderdelen van een correct uitgevoerd proces (1). De Clerq et al. schematiseerden het verpleegkundige geneesmiddelenzorgproces (2). De complexiteit van het proces en het belang van een veilige, efficiënte en effectieve geneesmiddelenzorg benadrukken de nood aan goed procesmanagement.

De voorbije jaren werd regelmatig onderzoek verricht naar geneesmiddelengerelateerde problemen. Handler et al. creëerden een conceptueel kader van geneesmiddelengerelateerde problemen bij residenten van woonzorgcentra. Een bijwerking werd gedefinieerd als een reactie op een geneesmiddel die schadelijk en ongewenst is en zich voordoet ondanks het toedienen van de normale dosis voor gebruik bij mensen. Medicatiefouten werden gedefinieerd als fouten in het doorlopen van het geneesmiddelenzorgproces (3). De incidentie van bijwerkingen varieerde tussen 1,2 en 7,3 per 100 residentmaanden (3). In ziekenhuizen werden 15 tot 36% toedieningsfouten geobserveerd (4-6). In een kleinschalige studie in twee Belgische woonzorgcentra werden bij 3 tot 6% van de toedieningen fouten geobserveerd (7).

Fouten zijn meestal het gevolg van onveilig georganiseerde processen. Het is vaak de verpleegkundige die het geneesmiddel toedient en die zo de fout tot bij de patiënt brengt. Dit betekent echter niet dat de verpleegkundige de enige verantwoordelijke is voor de fout. Het proces moet de verpleegkundige voldoende ondersteunen om fouten te vermijden en moet veiligheden inbouwen om fouten tijdig te detecteren. Wanneer er toch iets misloopt, moet de fout gerapporteerd worden en moet geëvalueerd worden op welke manier het proces kan worden bijgestuurd om dergelijke fouten in de toekomst te voorkomen (8).

Om het geneesmiddelenzorgproces te optimaliseren, moeten oorzaken van suboptimale geneesmiddelenzorg dus bestudeerd worden. In dit kwalitatief onderzoek, gericht op woonzorgcentra, is retrospectief bestudeerd welke barrières verpleegkundigen hebben ervaren in het geneesmiddelenzorgproces, waardoor dit onvolledig, onzorgvuldig of foutief wordt uitgevoerd.

Methode

Onderzoeksdesign

Om een breed overzicht te krijgen van barrières die verpleegkundigen ervaren in het geneesmiddelenzorgproces werd een expertmeeting opgezet met verpleegkundigen betrokken bij het geneesmiddelenzorgproces in woonzorgcentra.

Selectie en uitnodiging van verpleegkundigen

Op basis van de lijst van woonzorgcentra van de federale overheid (9) werd een convenience sample van 25 woonzorgcentra getrokken uit de regio Antwerpen. Op die manier bleef de afstand tot de plaats van de expertmeeting beperkt voor de vrijwillig deelnemende verpleegkundigen. Private en publieke woonzorgcentra met bedden voor zwaar zorgbehoevende personen (RVT-bedden) kwamen in aanmerking.

Geselecteerde woonzorgcentra kregen een uitnodiging toegestuurd met informatie over het onderzoek en de vraag om 1 à 2 verpleegkundigen of hoofdverpleegkundigen af te vaardigen voor deelname aan de expertmeeting. Deelnemers moesten betrokken zijn in het geneesmiddelenzorgproces en het verpleegkundig team kunnen vertegenwoordigen. Een aparte uitnodigingsbrief werd voorzien voor de deelnemende verpleegkundigen

met een overzicht van de onderwerpen die besproken zouden worden om voorbereiding te faciliteren, door observatie of eventueel in overleg met collega's. Deze werkwijze kon de input tijdens de expertmeeting concretiseren en vergroten.

Ongeveer 1 à 2 weken na het versturen van de uitnodigingen werden de instellingen telefonisch gecontacteerd om hun deelname te bevestigen of te weigeren. Desgewenst werd tijdens dit contact bijkomende informatie gegeven over het onderzoek.

Het verloop van de expertmeeting

De expertmeeting vond plaats in november 2008 en werd opgebouwd uit 3 grote delen: een introductie, een brainstormsessie in groepjes en een algemene discussie.

De expertmeeting werd ingeleid met informatie over het onderzoek en de doelstellingen en werkwijze van de expertmeeting. Aangezien het ging om de identificatie van alle potentiële barrières, werd gesteld dat alle relevante ideeën genoteerd moesten worden en consensus niet vereist was.

Na de inleiding volgde de brainstormsessie. Hiervoor werden de deelnemers opgedeeld in groepjes van ongeveer 6 personen met een moderator en een secretaris. Moderatoren en secretarissen waren onderzoeksverpleegkundigen van de Universiteit Antwerpen, betrokken bij geneesmiddelenzorg of wetenschappelijk onderzoek in woonzorgcentra. Verpleegkundigen van dezelfde instelling werden zoveel mogelijk in verschillende groepen geplaatst. De groepen kregen de opdracht te brainstormen over volgende vraag:

> *Welke barrières ervaart u tijdens het verpleegkundige geneesmiddelenzorgproces waardoor geneesmiddelenzorg onvolledig, onzorgvuldig of foutief zou kunnen worden uitgevoerd?*

Als leidraad voor de brainstorming kregen alle deelnemers de schematische voorstelling van het geneesmiddelenzorgproces van De Clerq et al. (2). Door het gedetailleerde schema en het inzetten van moderatoren werd bekomen dat alle onderdelen van het proces aan bod kwamen. De secretarissen noteerden alle ideeën.

In een derde deel presenteerden de verschillende secretarissen de resultaten uit de brainstormgroepjes voor de volledige groep . Dit creëerde ruimte voor aanvullingen en discussie vanuit de praktijkexperts en voor vragen tot verduidelijking vanuit de onderzoekers. Deze informatie werd digitaal opgenomen met toestemming van de deelnemers.

Data-analyse

Vooreerst werden de notities uit de verschillende werkgroepen en de

aanvullingen uit de groepsdiscussie geplaatst onder de bijhorende fasen van het geneesmiddelenzorgproces. Gegevens werden vervolgens geanalyseerd volgens de principes van thematische analyse (10) door de eerste twee auteurs . De uitspraken van de verpleegkundigen werden gecodeerd en gemeenschappelijke thema's en subthema's werden geïdentificeerd. Het resultaat van deze analyse werd gecontroleerd aan de hand van de notities uit de brainstormgroepen en de geluidsopname van de groepsdiscussie. Een tweede controle gebeurde door het bespreken van de resultaten met de drie moderatoren van de brainstormgroepjes om interpretatiefouten te voorkomen. Tenslotte werden de resultaten verstuurd naar alle deelnemers van de expertmeeting voor een finale controle op onvolledigheden en interpretatiefouten. Reacties van woonzorgcentra op de ontvangen resultaten waren positief en bevatten geen opmerkingen of vragen tot wijziging of aanvulling.

Resultaten

Beschrijving van de onderzoekspopulatie

Van de 25 woonzorgcentra die uitgenodigd werden om deel te nemen, namen er 6 deel. De voornaamste redenen om niet deel te nemen, waren een gebrek aan tijd en personeel, voornamelijk in kleinere instellingen, en een overaanbod aan vragen tot onderzoeksdeelname. Het aantal bedden in de deelnemende instellingen varieerde tussen 90 en 214. Op de expertmeeting waren 12 verpleegkundigen aanwezig, waaronder 4 mannen. Opvallend was dat 9 verpleegkundigen een functie hadden als hoofd of als verantwoordelijke residentenzorg.

Barrières in verpleegkundige geneesmiddelenzorg

De informanten stelden dat verpleegkundigen in woonzorgcentra als goede huisvaders of –moeders de geneesmiddelenzorg van hun residenten ter harte moeten nemen. Voor elke fase van het geneesmiddelenzorgproces ervoeren zij echter verscheidene barrières. Deze konden toegewezen worden aan vier hoofdthema's, namelijk barrières bij de verpleegkundige zelf, organisatorische barrières, barrières in interdisciplinaire samenwerking en barrières bij de resident en diens familie. De vier thema's werden bepaald vanuit de ervaringen van de verpleegkundigen. Dit impliceert, bijvoorbeeld, dat hoewel een onleesbaar voorschrift te wijten is aan de arts, dit vanuit het oogpunt van de verpleegkundige wordt beschouwd als een barrière in inter-

disciplinaire samenwerking. Per hoofdthema konden de uitspraken geclusterd worden tot subthema's.

De barrières worden volgens de vier hoofdthema's en subthema's weergegeven, opgedeeld in vijf fases van het geneesmiddelenproces.

Barrières in de voorbereidings- en planningsfase

Onder de voorbereiding wordt verstaan het checken van het voorschrift, het raadplegen van de arts bij onduidelijkheden en het verzamelen van gegevens over de residenten waarvoor de voorgeschreven geneesmiddelen bestemd zijn (2). Het nakijken van bestellingen van geneesmiddelen behoorde volgens de informanten eveneens tot de voorbereidingsfase. De planningsfase bestaat uit het controleren van het medicatieplan op basis van het voorschrift en specifieke voorzorgsmaatregelen, contra-indicaties en interacties (2). De barrières die informanten verwoordden in deze fases zijn opgenomen in **Tabel A3.1**.

Er was meestal voldoende informatie beschikbaar om geneesmiddelenvoorschriften te controleren en de nodige gegevens van de bewoners te bekomen. Een tekort aan kennis, aandacht, tijd, samenwerkingsafspraken en communicatie waren belangrijke factoren die een grondige voorbereiding verhinderen. Niet alle verpleegkundigen voelen zich mee verantwoordelijk voor de voorzorgsmaatregelen, contra-indicaties en interacties van geneesmiddelen.

Informanten waren van mening dat verpleegkundigen voorzorgsmaatregelen, contra-indicaties en interacties van courante geneesmiddelen moeten kennen. De eisen mogen echter niet te hoog gesteld worden. De verantwoordelijkheid voor interacties en contra-indicaties blijft bij de arts, maar verpleegkundigen moeten deze wel rapporteren indien ze zich hiervan bewust zijn.

Tabel A3.1. *Barrières in de voorbereiding- en planningsfase.*

Barrières bij de verpleegkundige	
Kennis	Door het gebruik van generische geneesmiddelen weten verpleegkundigen minder vaak welk product is voorgeschreven. Hun kennis van stofnamen van geneesmiddelen is beperkt. Ze kunnen de naam dan ook niet linken aan indicaties, voorzorgsmaatregelen, contra-indicaties of interacties. Er is een gebrek aan kennis wat betreft farmacologie en farmacotherapie, voornamelijk specifiek gericht op ouderen. Het begrijpen van bijsluiters is soms moeilijk. Het vragen naar een attest voor terugbetaling van bepaalde geneesmiddelen kan de resident veel kosten besparen, maar de kennis hierover is beperkt.
Attitude	De historiek van patiënten wordt door verpleegkundigen te weinig nagegaan. Verpleegkundigen besteden te weinig aandacht aan contra-indicaties en voorzorgsmaatregelen.
Rolafbakening en interesse	Sommige verpleegkundigen zien het niet als hun taak om te controleren op voorzorgsmaatregelen, contra-indicaties en interacties. Ze voelen zich er niet mee verantwoordelijk voor en hebben er vaak weinig interesse in.
Organisatorische barrières	
Communicatie-kanalen	Een handgeschreven medicatieplan bevat soms onduidelijkheden of moeilijk leesbare handschriften. Transmurale communicatie na hospitalisatie van residenten is onvoldoende, zowel wat betreft medicatie als diagnose. Ook huisartsen worden vaak onvoldoende geïnformeerd.
Productkeuze	Door het gebruik van generische geneesmiddelen weten verpleegkundigen minder vaak welk product is voorgeschreven.
Informatie-	Het begrijpen van bijsluiters is soms moeilijk. Het vragen naar een attest voor terugbetaling van bepaalde geneesmiddelen kan de resident veel kosten besparen, maar de kennis hierover is beperkt. (onvoldoende info beschikbaar op maat van de verpleegkundigen)
Tijd	Verpleegkundigen hebben te weinig tijd voor het controleren van voorschriften of het medicatieplan. Door tijdsgebrek worden de beschikbare gegevens van patiënten onvoldoende gebruikt.
Werkplanning	Voor verpleegkundigen die ingeschakeld kunnen worden op diverse afdelingen is het moeilijk de patiënten voldoende te kennen. Het werkregime heeft een invloed op kennis. Verpleegkundigen die voltijds werken, hebben vaak meer kennis dan verpleegkundigen die deeltijds werken.
Barrières in interdisciplinaire samenwerking	
Attitude en communicatie	Artsen staan soms niet open voor communicatie met verpleegkundigen.
Communicatie	Transmurale communicatie na hospitalisatie van residenten is onvoldoende, zowel wat betreft medicatie als diagnose. Ook huisartsen worden vaak onvoldoende geïnformeerd.
Handschrift	Onleesbare of slecht leesbare voorschriften.
Productkeuze	Sommige huisartsen houden te weinig rekening met het geneesmiddelenformularium.
Rolafbakening	Verpleegkundigen hebben eigen expertisen. Huisartsen maken hiervan niet altijd voldoende gebruik. Kennis en ervaring zouden meer naar waarde geschat moeten worden. Coördinerende, Raadgevende Artsen (CRA's) kunnen niet zomaar voorschrijven voor andere huisartsen.
Barrières bij de resident en diens familie	
Geen barrières vermeld.	

Barrières bij het klaarzetten

Verpleegkundige taken beschouwd bij het klaarzetten zijn het correct bewaren van de medicatie, het controleren van de vervaldatum en het klaarzetten van het correcte geneesmiddel, in de correcte vorm, op het correcte tijdstip, in de juiste dosis voor de juiste patiënt. Na het klaarzetten volgt een extra controle van de klaargezette medicatie (2). De barrières door verpleegkundigen ervaren bij het klaarzetten zijn opgenomen in **Tabel A3.2**. Het gaat hier voornamelijk organisatorische barrières. Controles worden beschouwd als tijdsintensief en maatregelen om tijdsbesparend te werken kunnen op zich nieuwe barrières inhouden, bijvoorbeeld het klaarzetten voor meerdere dagen tegelijk, het laten wegvallen van de tweede controle en het laten klaarzetten door apothekers.

Tabel A3.2. *Barrières bij het klaarzetten.*

Barrières bij de verpleegkundige	
Attitude en rolafbakening	Controle van de geneesmiddelen in de verpakking (o.a. vervaldatum) hangt af van de interesse en tijd van de verpleegkundige. Sommigen zien dit als de taak van de apotheker en doen het daarom niet.
Communicatie	Er is te weinig communicatie tussen verpleegkundigen over geneesmiddelen. Nieuwe afspraken worden onvoldoende doorgegeven.
Organisatorische barrières	
Verpakking	De tweede controle van klaargezette geneesmiddelen is moeilijk indien verpakkingen reeds eerder verwijderd werden.
Bewaring bij transport	Geneesmiddelen die koel moeten bewaard worden, worden soms niet koel vervoerd van apotheek naar woonzorgcentrum. Bij de laatste instelling waaraan geleverd wordt, liggen de geneesmiddelen mogelijks te lang niet gekoeld.
Storing	Tijdens het klaarzetten worden verpleegkundige vaak gestoord door collega's, residenten of familieleden van residenten.
Tijd	Controle van de geneesmiddelen in de verpakking (o.a. vervaldatum) hangt af van de interesse en tijd van de verpleegkundige. Sommigen zien dit als de taak van de apotheker en doen het daarom niet. De tweede controle van klaargezette geneesmiddelen vervalt soms wegens tijdgebrek. De temperatuur van de koelkasten wordt zelden gecontroleerd. Als gevolg van een tekort aan personeel en tijd wordt er vaak voor meerdere dagen klaargezet, bijvoorbeeld voor drie dagen als het weekend is.
Werkplanning	Indien men 's nachts klaarzet, is men minder alert. Geneesmiddelen enkel op even of oneven dagen toe te dienen en complexe schema's vergroten het risico op fouten.
Rolafbakening en kennis	Verpleegkundigen die niet betrokken zijn bij het klaarzetten, verliezen hun kennis over geneesmiddelen. Een apotheker medicatie laten klaarzetten is in deze context geen goed idee.
Barrières in interdisciplinaire samenwerking	
Geen barrières vermeld.	
Barrières bij de resident en diens familie	
Geen barrières vermeld.	

Barrières bij het toedienen

Het toedienen van geneesmiddelen bestaat volgens het schema van het geneesmiddelenzorgproces uit het toedienen volgens de zeven 'rights' (juiste geneesmiddel, , juiste toedieningswijze, juiste dosis, juiste tijdstip, juiste resident, juiste reden, juiste rapportering) en een correcte begeleiding bij toediening om de effectiviteit te verhogen, nevenwerkingen te beperken en therapietrouw te stimuleren (2). Verpleegkundigen meldden de moeilijkhe-

Tabel A3.3. *Barrières bij het toedienen.*

Barrières bij de verpleegkundige	
Kennis	Er is een kennistekort wat betreft toedieningsrichtlijnen, toedieningsmomenten (bijvoorbeeld voor, na of tijdens de maaltijd), het mogen pletten van geneesmiddelen, interacties met voeding en drug- drug interacties. Verpleegkundigen hebben vaak te weinig inzicht in de relatie tussen geneesmiddelentoediening en observaties of metingen van effecten. Er bestaan tegenwoordig gecompliceerdere puffers. De verschillende werkwijzen kennen en toepassen of toelichten aan residenten is vaak moeilijk.
Vaardigheden	Het is niet eenvoudig om de toestand en mogelijkheden tot zelfzorg van residenten in te schatten.
Organisatorische barrières	
Verpakking	Geneesmiddelen zijn reeds uit te verpakking gehaald bij het klaarzetten. Dit maakt controle bij toediening moeilijk.
Informatie-beschikbaarheid	Er is een gebrek aan middelen om informatie terug te vinden. Zo hebben de meeste verpleegkundigen geen toegang tot internet. Bij geautomatiseerde systemen is er gevaar voor het verlies van info omdat er geen bijsluiters voorhanden zijn. Er is een gebrek aan duidelijke richtlijnen voor toediening.
Bijscholing	Er zijn onvoldoende bijscholingsmogelijkheden rond het toedienen van geneesmiddelen.
Storing	Verpleegkundigen worden vaak gestoord bij het toedienen.
Tijd	Een te hoge werkdruk bemoeilijkt een nauwgezette geneesmiddelentoediening met extra controles, controle van inname en patiëntenbegeleiding. Er is te weinig slikcontrole. Bij gebrek aan controle nemen residenten soms elkaars geneesmiddelen. Zorgkundigen kennen geneesmiddelen meestal niet. Alle toedieningen door zorgkundigen zouden moeten gebeuren onder leiding van een verpleegkundige, maar dit is vanwege de werkdruk vaak niet realiseerbaar
Werkplanning	Veel geneesmiddelen moeten op hetzelfde tijdstip worden toegediend. Er is meer verstrooidheid bij toedieningen 's nachts. Er is minder contact met de residenten, dus minder controle. Indien verpleegkundigen regelmatig wisselen van afdeling, beperkt dit hun kennis van de gebruikte geneesmiddelen, residenten en toedieningsmodaliteiten.
Barrières in interdisciplinaire samenwerking	
Communicatie Rolafbakening	Huisartsen geven weinig toedieningsrichtlijnen. Zorgkundigen kennen geneesmiddelen meestal niet. Alle toedieningen door zorgkundigen zouden moeten gebeuren onder leiding van een verpleegkundige, maar dit is vanwege de werkdruk vaak niet realiseerbaar.
Barrières bij de resident en diens familie	
Gezondheids-toestand resident	Het is niet eenvoudig om de toestand en mogelijkheden tot zelfzorg van residenten in te schatten.

den opgenomen in **Tabel A3.3**. De meeste barrières situeren zich op het vlak van het hebben van kennis of het vergaren van kennis, hetzij door bijscholing, informatiebeschikbaarheid of interprofessionele communicatie.

Barrières bij het verstrekken van informatie aan resident en familie

De mening van de informanten over de taak van de verpleegkundige in het verstrekken van informatie over geneesmiddelen verschilde sterk. Sommigen beschouwden dit als een verpleegkundige taak. Anderen vonden dat de verantwoordelijkheid volledig bij de arts lag. Nog anderen zagen de rol van de verpleegkundige vooral in het herhalen en verduidelijken van informatie die reeds door een arts werd gegeven. Barrières bij het verstrekken van informatie staan vermeld in **Tabel A3.4**. Er werd gesteld dat verpleegkundigen voornamelijk informatie geven bij nieuwe geneesmiddelen, bijna altijd op vraag en zelden spontaan. Familie wordt zelden geïnformeerd.

Voor het geven van informatie hebben barrières vanuit de patiënt en zijn familie een belangrijker aandeel. Hun karakteristieken bepalen mede de mogelijkheden tot informatieoverdracht.

Tabel A3.4. *Barrières bij het verstrekken van informatie.*

Barrières bij de verpleegkundige	
Kennis	Verpleegkundigen hebben te weinig kennis over de geneesmiddelen om correcte informatie te verschaffen aan de residenten.
Attitude	Er is weinig interesse van de verpleegkundigen om informatie te geven. Verpleegkundigen hebben weinig aandacht voor het geven van informatie.
Rolafbakening	Verpleegkundigen zijn het niet eens over hun aandeel in de verantwoordelijkheid voor het infomeren van de residenten.
Organisatorische barrières	
Informatie-beschikbaarheid	Er is een gebrek aan goede informatiebronnen waarop verpleegkundigen zich kunnen baseren bij het geven van informatie.
Barrières in interdisciplinaire samenwerking	
Communicatie	Er leeft soms een zekere schroom bij verpleegkundigen om hulp te vragen aan artsen. De drempel naar de apotheker is soms lager.
Barrières bij de resident en diens familie	
Begripsniveau	Residenten met een lager scholingsniveau of met mentale beperkingen begrijpen de informatie in verband met geneesmiddelen soms niet.
Positie van de resident	Ouders worden standaard geïnformeerd over hun kinderen. Kinderen informeren over hun ouders ligt moeilijker. Ze willen vaak ook het financiële weten en beslissen niet steeds in het voordeel van hun ouders.

Barrières bij de registratie, observatie en rapportage

De evaluatie omvat de registratie van de toediening en de observatie en rapportage van het therapeutisch effect, therapietrouw, bijwerkingen en de invloed van de therapie op de interdisciplinaire behandeling (2). De informanten beschouwden de opvolging van therapeutische effecten en bijwer-

kingen als een verpleegkundige taak. Ze stelden wel dat het ook vaak aan zorgkundigen wordt overgelaten aangezien zij nog meer contact hebben met de patiënt. De barrières die verpleegkundigen vermeldden, zijn opgenomen in **Tabel A3.5**.

Registratie van toediening wordt teveel losgekoppeld van de toediening. Aftekenen van toediening wordt gezien als een administratieve last en niet als een veiligheidssysteem. Aan het observeren van therapeutische effecten en nevenwerkingen wordt niet altijd expliciet aandacht besteed. Bovendien worden de observaties bemoeilijkt door een tekort aan kennis, communicatie en tijd. Verpleegkundigen hebben wel meer aandacht voor therapietrouw. Het zelfbeschikkingsrecht van de bewoners en beginnende dementie kunnen van therapietrouw een delicate discussie maken.

Discussie

Verpleegkundigen die in hun dagdagelijkse praktijk geneesmiddelen toedienen in woonzorgcentra, kunnen een waardevol beeld geven van de factoren die volgens hen een efficiënte en veilig geneesmiddelenzorg bemoeilijken. De lijst met barrières die verpleegkundigen verhinderen om kwalitatieve geneesmiddelenzorg te leveren in woonzorgcentra is enorm lang. Vaak terugkerende thema's zijn een gebrek aan tijd, kennis, een onduidelijke rolafbakening, inefficiënte communicatiekanalen, een beperkte informatiebeschikbaarheid en een onaangepaste attitude.

De barrières konden opgedeeld worden in vier categorieën. De barrières bij de verpleegkundige situeren zich vooral op het vlak van kennis, vaardigheden,attitude, intraprofessionele samenwerking en onduidelijkheid over de grens van de verpleegkundige verantwoordelijkheid. Organisatorisch werden onder andere een tekort aan geschikte communicatiekanalen, informatiebronnen en bijscholing vermeld, een hoge werkdruk en eveneens barrières in de werkplanning. In interdisciplinaire samenwerking zijn mogelijkheden en bereidwilligheid om met elkaar te communiceren een essentiële basis die soms nog ontbreekt. De rolafbakening tussen zorgverleners zou geoptimaliseerd kunnen worden. Tenslotte kunnen de gezondheidstoestand, het begripsniveau en de positie van de resident en diens familie het proces beïnvloeden. De barrières die Belgische verpleegkundigen in woonzorgcentra ervaren in hun geneesmiddelenzorg verschillen weinig van de barrières beschreven in de internationale literatuur. De acht meest frequente oorzaken van medicatiefouten volgens een onderzoek van Tang

Tabel A3.5. *Barrières bij de registratie, observatie en rapportage.*

Barrières bij de verpleegkundige	
Kennis	Er is een kennistekort bij verpleegkundigen over bijwerkingen. Generische producten zijn minder gekend dan de merkproducten. De zorgzwaarte stijgt. Residenten hebben nieuwe en moeilijkere pathologieën. Regelmatig kennen verpleegkundigen de nieuwe behandelingen en geneesmiddelen nog niet of ze hebben er weinig ervaring mee. Een gebrek aan inzicht in farmacologie en farmacotherapie om effecten van geneesmiddelen te begrijpen.
Attitude	Aftekenen wordt te weinig gekoppeld aan toediening. Meestal wordt op een later tijdstip alles samen afgetekend. Soms wordt zelfs vooraf afgetekend. Minder uitgesproken veranderingen in de toestand van de resident worden niet genoteerd. Tijdens de overdracht wordt zelden aandacht besteed aan geneesmiddelen.
Rolafbakening en attitude	Observaties na toediening worden gezien als bijkomende taak. In de psychiatrie wordt de observatie van therapeutische effecten van psychofarmaca zonder twijfel als een verpleegkundige taak aanzien. In woonzorgcentra is dat niet zo. Er is een gebrek aan aandacht voor observatie en rapportage. Er is een gebrek aan verantwoordelijkheidsgevoel voor de evaluatie van geneesmiddelenzorg.
Organisatorische barrières	
Productkeuze	Generische producten zijn minder gekend dan de merkproducten.
Communicatie-kanalen	Voor de registratie van klaarzetten en toedienen wordt soms maar één handtekening gevraagd, hoewel beide taken vaak door andere personen worden uitgevoerd. Er wordt veel geschreven, maar weinig gecentraliseerd en weinig effectief gecommuniceerd. Staande orders verschillen soms sterk tussen huisartsen
Tijd	Tijdsdruk is de belangrijkste oorzaak van onzorgvuldig aftekenen. Men wil geen overuren maken om af te tekenen. De werkdruk beperkt observaties en rapportage.
Werkplanning	Deeltijdse verpleegkundigen zijn minder frequent aanwezig op de werkvloer en kunnen daardoor minder goed de toestand van de resident opvolgen.
Barrières in interdisciplinaire samenwerking	
Attitude	Communicatie over geneesmiddelen tussen verpleegkundigen en artsen verloopt moeilijk door een gebrek aan 'openstaan' voor elkaars sterktes en zwaktes.
Communicatie-kanalen	Telefonische contacten hebben onvoldoende bewijskracht. Soms zijn er in het woonzorgcentra geen verpleegkundige aanspreekpunten voor de arts aanwezig. Arts en apotheker zijn eerder moeilijk bereikbaar voor multidisciplinair overleg.
Rolafbakening	In woonzorgcentra werken veel zorgkundigen met beperkte geneesmiddelenkennis.
Barrières bij de resident en diens familie	
Positie van de resident	Therapietrouw is vaak een moeilijke discussie. De resident heeft zelfbeschikkingsrecht. Het evenwicht tussen controle en autonomie in het kader van therapietrouw is moeilijk bij beginnende dementie.
Gezondheids-toestand resident	De zorgzwaarte stijgt. Residenten hebben nieuwe en moeilijkere pathologieën. Regelmatig kennen verpleegkundigen de nieuwe behandelingen en geneesmiddelen nog niet of ze hebben er weinig ervaring mee.

et al. zijn in volgorde van belang verpleegkundige onnauwkeurigheid, een zware werklast, nieuwe personeelsleden, minder gekende geneesmiddelen, onduidelijke orders van de arts, voor de verpleegkundige in kwestie minder gekende residenten, gecompliceerde voorschriften en een gebrek aan training (11). De onnauwkeurigheid van verpleegkundigen werd voornamelijk veroorzaakt door onderbrekingen om andere problemen op te lossen en een gebrek aan extra controles. Zij deelden de oorzaken in gelijklopende categorieën, namelijk oorzaken bij verpleegkundigen, artsen, patiënt en familie en organisatie (9). Cultuur werd als een aparte categorie beschouwd in een onderzoek van K. McBride-Henry en M. Foureur in een ziekenhuis (12). De verpleegkundige aandacht voor het geneesmiddelenzorgproces werd hierin beschreven als een 'laissez-faire' benadering. Wat interdisciplinaire communicatie betreft, krijgen verpleegkundigen weinig informatie toegeleverd over geneesmiddelen door een eerder beperkte communicatie met andere zorgverleners betrokken bij het geneesmiddelenproces (13). In acute psychiatrie werd aangetoond dat een nauwere samenwerking tussen de arts en de verpleegkundige in farmacotherapie de patiëntenoutcome verbetert (14). Attitude is een cruciale factor in een succesvol geneesmiddelenzorgproces. Zoals tevens werd vermeld door de informanten lijkt het in de psychiatrische zorg veel vanzelfsprekender dat verpleegkundigen zich doorheen het proces kritisch opstellen en aandacht hebben voor observatie en interdisciplinaire samenwerking. Een dergelijke attitude zou overgenomen moeten worden in woonzorgcentra.

Bij het uitwerken van verbeterinitiatieven moet de rolafbakening in acht genomen worden. De verantwoordelijkheid van verpleegkundigen in de geneesmiddelenzorg moet duidelijk geformuleerd worden. Het ontnemen van verantwoordelijkheden, zoals het klaarzetten van geneesmiddelen buiten het woonzorgcentrum, kan ervoor zorgen dat verpleegkundigen de voeling met geneesmiddelen verliezen en het probleem verergert. Een tweede aandachtspunt is dat het probleem niet mag doorgeschoven worden. Verpleegkundigen zijn ideaal gepositioneerd om voor de geneesmiddelenzorg in te staan, onder andere door hun nauw contact met de residenten. Indien de verantwoordelijkheid door een gebrek aan verpleegkundigen wordt doorgeschoven naar zorgkundigen, zal dit het probleem enkel vergroten door hun lagere opleidingsniveau en een nog grotere drempel voor interdisciplinaire samenwerking met artsen. Interventies gericht op de verschillende barrières moeten ontwikkeld en getest worden zodat verpleegkundigen ondersteund worden in het leveren van geneesmiddelenzorg. Behalve deze duidelijke rolafbakening kunnen het verbeteren van de beschikbaarheid van gerichte en begrijpbare informatie over geneesmiddelen en het stimuleren van inter-

professionele samenwerking voorbeelden zijn van verbeteringsinitiatieven. Procesmanagement met tijd om elke stap van het proces goed te kunnen uitvoeren, met effectieve controles, vereist een aangepaste personeelsbezetting. Het expliciteren, toewijzen en erkennen van de verantwoordelijkheid van verpleegkundigen in geneesmiddelenzorg, kan de aantrekkelijkheid van het verpleegkundig beroep in woonzorgcentra ten goede komen.

Omwille van praktische redenen was het niet mogelijk gegevens te verzamelen tot op het moment van datasaturatie. Het beperkte aantal informanten en de selectie op basis van convenience sampling maken dat er mogelijks nog meerdere barrières bestaan die niet door deze expertgroep werden benoemd. Het generaliseren van de resultaten dient daarom met enige voorzichtigheid te gebeuren. Hoewel dit geen garantie vormt, is methodologisch getracht een zo volledig en gecontroleerd mogelijk beeld te geven door de afgevaardigde verpleegkundigen de mogelijkheid te bieden om de expertmeeting voor te bereiden met collega's en door herhaalde controles met de moderatoren en de experts. Dat verscheidene afgevaardigden leidinggevende functie hadden, heeft positieve en negatieve consequenties voor de validiteit. Enerzijds zorgt diversiteit in de sample voor een volledigere weergave van barrières. Anderzijds was het aantal leidinggevenden groot en was een ruimere vertegenwoordiging van verpleegkundigen zonder leidinggevende functie aangewezen geweest. Omdat voornamelijk grotere woonzorgcentra werden vertegenwoordigd zouden kleinere instellingen met andere barrières geconfronteerd kunnen worden.

Op basis van de resultaten van de expertmeeting werd een schriftelijke vragenlijst opgemaakt voor een ruimere bevraging bij verpleegkundigen naar het belang van de verschillende barrières. Zo kunnen prioriteiten gesteld worden bij verbeterinitiatieven. Dit kwantitatieve deel van het onderzoek werd gepubliceerd in Journal of Nursing Scholarship (15). De schriftelijke bevraging faciliteert tevens benchmarking tussen woonzorgcentra.

Conclusie

Over de verschillende fasen van het geneesmiddelenzorgproces ervaren verpleegkundigen in Vlaamse woonzorgcentra een groot aantal barrières bij de verpleegkundigen zelf, in de organisatie, in interdisciplinaire samenwerking en bij de resident en diens familie, die een kwalitatief goede geneesmiddelenzorg bemoeilijken. Binnen deze categorieën keren een gebrek aan tijd, kennis, een onduidelijke rolafbakening, inefficiënte communicatie, een be-

perkte informatiebeschikbaarheid en een onaangepaste attitude regelmatig weer. De werkwijze van een retrospectieve anonieme analyse van problemen in het geneesmiddelenproces faciliteert verbeteringsinitiatieven op maat.

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Appendix IV

Farmacologische kennis van verpleegkundigen in de praktijk *(Pharmacology knowledge of nurses in practice)*

Inleiding

Verpleegkundigen hebben een grote verantwoordelijkheid in de farmacotherapeutische zorg. Van alle gezondheidswerkers staan zij het dichtst bij de patiënt. Naast het uitdelen en toedienen van medicatie, geven verpleegkundigen informatie over geneesmiddelen en observeren zij problemen in verband met therapietrouw en nevenwerkingen. In de opleiding verpleegkunde wordt aan deze aspecten vaak weinig aandacht besteed. De vraag kan gesteld worden in welke mate verpleegkundigen over de nodige kennis beschikken om op een adequate en kwaliteitsvolle wijze te kunnen inspelen op de farmacotherapeutische zorgbehoefte.

In deze bijdrage zal nagegaan worden hoe verpleegkundigen werkzaam in acute ziekenhuizen, verzorgingsinstellingen en acute ziekenhuizen scoren op een kennistest in verband met geneesmiddelen en welke persoons- en arbeidskenmerken deze score beïnvloeden.

Methode

De vergelijkende resultaten van de kennistest zijn gebaseerd op datacollecties van drie verschillende studies. De gegevens van de acute ziekenhuizen werden verzameld in het kader van de ACUMED studie, het leeronder-

zoek van de masteropleiding Verpleeg- en Vroedkunde van de Universiteit Antwerpen. De datacollectie van de kennistest in de rusthuizen en de thuiszorg gebeurde in het kader van de masterproeven van Berten Baets (1) en Stefan Van der Mussele (2).

Alle gegevens werden verzameld tijdens het academiejaar 2007-2008 aan de hand van een gestructureerde vragenlijst. Tijdens de ACUMED studie kregen alle studenten van het schakeljaar de opdracht om een of 2 diensten te contacteren in een acuut ziekenhuis met de vraag om mee te werken aan de studie. Tijdens een dienstvergadering werd de vragenlijst ingevuld door alle aanwezige verpleegkundigen onder toezicht van de student-onderzoeker. Verpleeghulpen en zorgkundigen werden niet opgenomen in deze studie. Ook in de verzorgingsinstellingen en de thuiszorg werd gebruik gemaakt van een overlegmoment om de vragenlijst door alle aanwezigen en onder toezicht te laten invullen.

Naast persoonsgegevens, opleidings- en arbeidskenmerken werd in de drie studies dezelfde kennistest afgenomen. Deze test werd opgesteld door een expertpanel bestaande uit een farmaco-epidemioloog, een klinisch apotheker, een hoofdverpleegkundige van een verzorgingsinstelling en een master verpleegkundige werkzaam in farmacotherapeutisch onderzoek. De geneesmiddelen die behandeld werden in de kennistest, werden in de eerste plaats geselecteerd op basis van hun hoog gebruik in de Belgische verzorgingsinstellingen (3). Uit een interventiestudie in enkele verzorgingsinstellingen bleek dat bij bepaalde van deze geneesmiddelen veel voorkomende misvattingen en toedieningsfouten werden genoteerd (4). De kennistest bestond uit 30 stellingen die handelden over toediening (12 vragen), indicaties (11 vragen) en de merknaam en overeenkomstige generische naam van geneesmiddelen (7 vragen). Iedere stelling kon beantwoord worden via een antwoordschaal gaande van 'niet waar', 'waarschijnlijk niet waar', over 'waarschijnlijk waar' tot 'zeker waar' (zie bijlage 1 voor een overzicht van de kennistest met het juiste antwoord per stelling).

Op basis van de antwoorden van de kennistest werd een totaalscore berekend en deelscores voor kennis van toediening, indicaties en merknamen. Voor een 'zeker juist' antwoord werden 2 punten toegekend, voor een 'waarschijnlijk juist' antwoord 1 punt. Foute en 'niet gekende' antwoorden kregen de score 0. Na sommatie werden de scores omgezet in percentages.

Voor data-analyse werd gebruik gemaakt van het statistisch pakket SPSS. Resultaten die in de tekst als 'verschillend' of 'verhoogd' worden aangeduid, zijn gebaseerd op significante verschillen ($p<.05$). De meeste resultaten worden grafisch weergegeven in de vorm van boxplots waarbij de middellijn in de box een weergave is van de middelste voorkomende waarde (= de medi-

aan), de box zelf de helft van alle observaties bevat (tussen de 25ste en de 75ste percentiel) en de lijnen duiden op de waarden die verder afliggen van de middelste waarde. De invloed van persoons- en arbeidskenmerken op de kennisscore wordt uitgedrukt als een odds ratio (OR) waarbij elke weergegeven waarde boven de 1 duidt op een significant verhoogde kans om te slagen op de kennistest. Bij de multivariantie analyse wordt rekening gehouden met de bijkomende invloed van alle andere kenmerken op de slaagkansen.

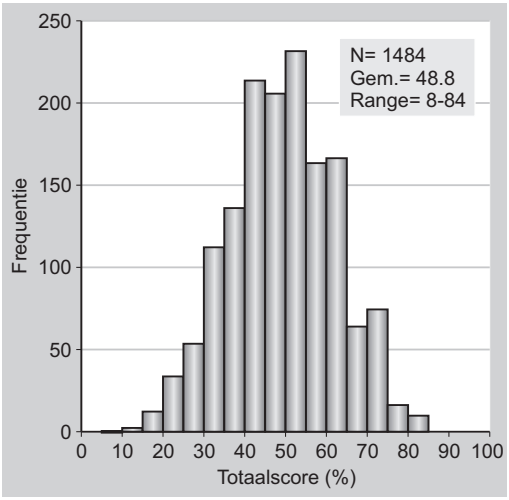
Resultaten

In totaal werd de kennistest afgenomen bij 1484 verpleegkundigen waarvan 142 werkzaam in een verzorgingsinstelling, 276 in de thuiszorg en 1066 in een ziekenhuis. De gemiddelde leeftijd van de respondenten was 37 jaar, 82% waren vrouwen. De opleidingsgraad en arbeidskenmerken van de populatie zijn samengevat in **Tabel A4.1**.

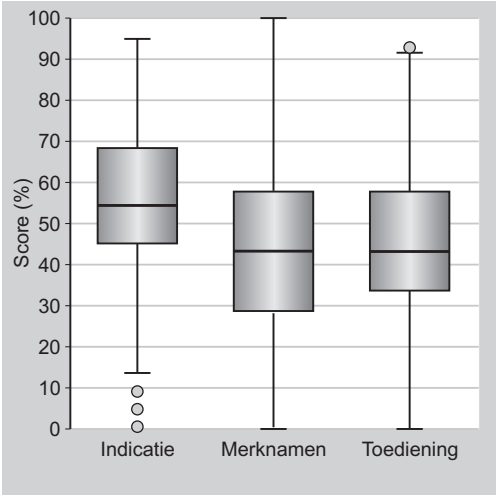
Tabel A4.1. *Beschrijving van de populatie.*

Totaal	Rusthuis	Thuiszorg	Acuut	ZH
	n=1484	n=142	n=276	n=1066
Leeftijd: (jaren) - gemid.(range)	36.9 (21-61)	40.1 (21-57)	38.4 (21-58)	36.1 (21-61)
Vrouwen	82%	87%	88%	79%
Diploma				
gediplomeerd 4de graad	38%	65%	56%	31%
bachelor	60%	32%	44%	67%
master	2%	3%	1%	2%
Bijopleiding gevolgd	46%	49%	25%	51%
Voltijds werkend	60%	52%	47%	65%
Hoofdverpleegkundige	10%	25%	9%	9%
Werkervaring (jaren)				
als VPK: gemid. (range)	14.1 (0-38)	17.7 (1-36)	15.7 (1-35)	13.2 (0-38)
op afdeling: gemid. (range)	10.4 (0-38)	11.9 (1-32)	11.1 (1-34)	9.9 (0-38)

De gemiddelde score op de kennistest bedroeg 48.8%. De laagste score was 8%, de hoogste score 84% (**Figuur A4.1**). Kennisvragen in verband met indicaties werden iets meer correct beantwoord met een gemiddelde score van 54.8%. De laagste deelscore werd genoteerd voor de kennis in verband met de toediening met een gemiddelde van 43.7% (**Figuur A4.2**). Ziekenhuisverpleegkundigen hadden de hoogste gemiddelde score, verpleegkun-



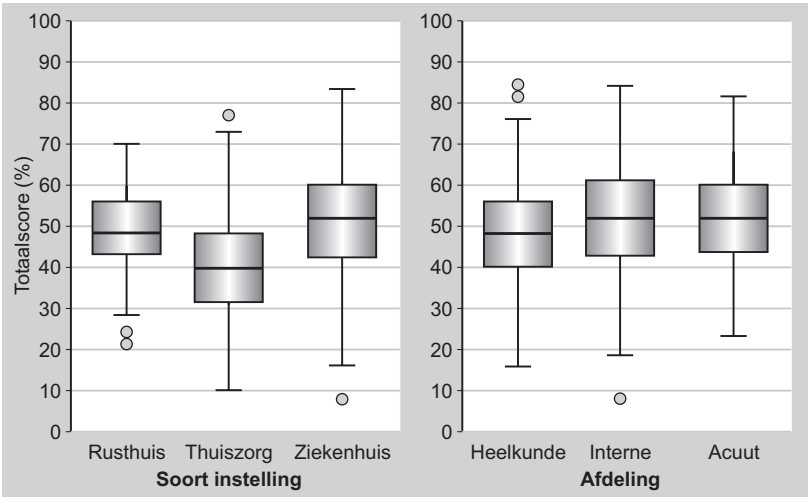
Figuur A4.1. *Totaalscore op de farmacotherapeutische kennistest. De totaalscore is gebaseerd op 30 stellingen.*



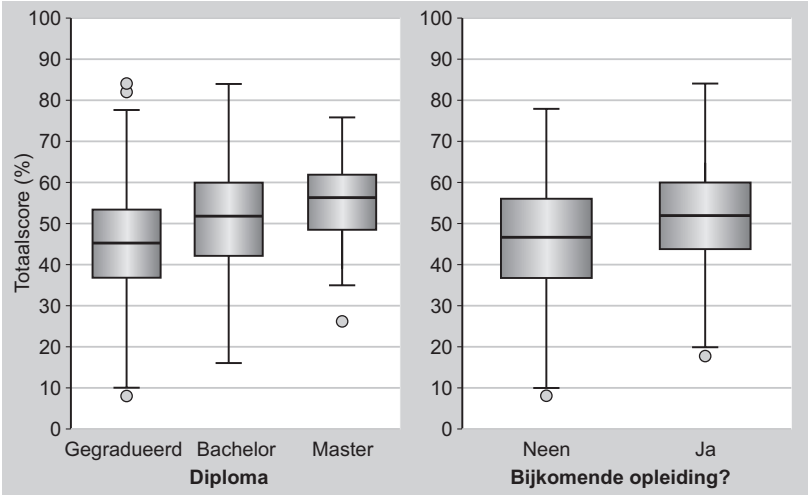
Figuur A4.2. *Deelscores op de farmacotherapeutische kennistest.*

digen uit de thuiszorg scoorden het laagst. Binnen de ziekenhuizen behaalden de verpleegkundigen werkzaam op een interne afdeling gemiddeld een hogere score dan hun collega's van acute en heelkundige diensten (**Figuur A4.3**).

Een hoger diploma en het volgen van bijkomende opleidingen hadden een positieve invloed op de kennisscore (**Figuur A4.4**). Mannelijke verpleeg-



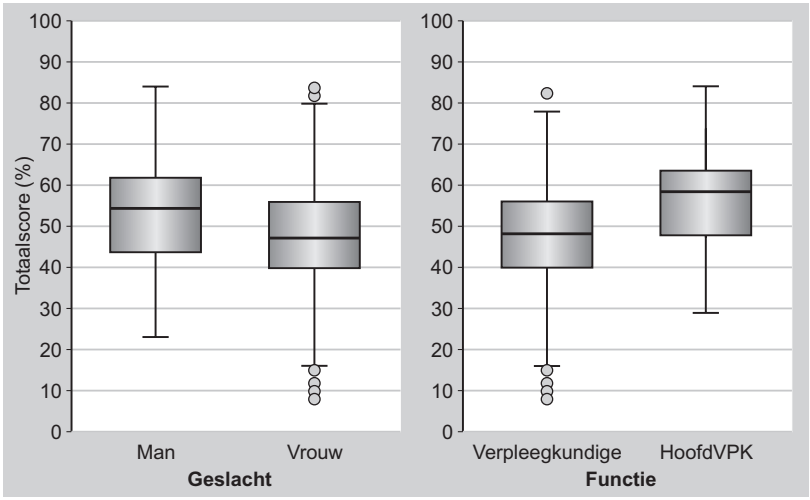
Figuur A4.3. *Totaalscore op de farmacotherapeutische kennistest volgens plaats van tewerkstelling (n=1484) en afdeling binnen de acute ziekenhuizen (n=1066).*



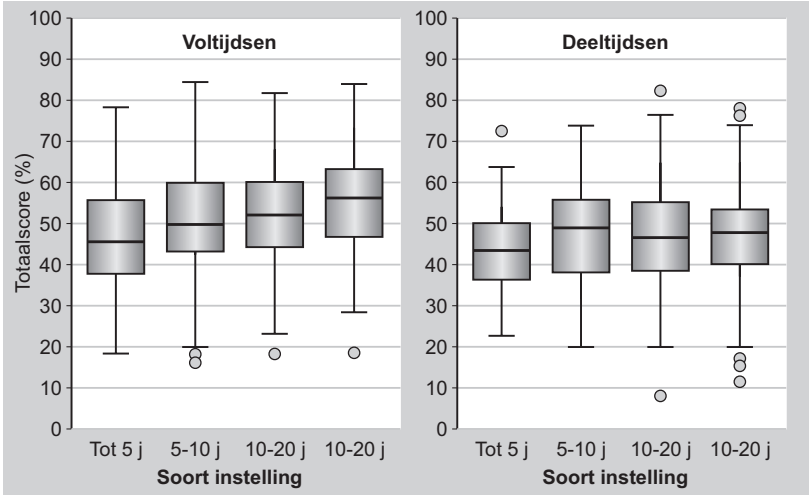
Figuur A4.4. *Totaalscore op de farmacotherapeutische kennistest volgens diploma en het volgen van bijkomende opleidingen*

kundigen en verpleegkundigen werkzaam als hoofdverpleegkundige scoorden hoger (**Figuur A4.5**). Wel dient opgemerkt dat mannelijke verpleegkundigen in hogere mate een bachelor diploma hadden en meer werkzaam waren als hoofdverpleegkundige en in een voltijdse betrekking.

De invloed van de werkervaring op de kennisscore was verschillend voor voltijds en deeltijds werkenden. Bij verpleegkundigen met een voltijdse be-



Figuur A4.5. *Totaalscore op de farmacotherapeutische kennistest volgens geslacht en verpleegkundige functie*



Figuur A4.6. *Totaalscore op de farmacotherapeutische kennistest volgens aantal dienstjaren bij voltijdse en deeltijdse tewerkstelling.*

trekking was er een duidelijk verband tussen de gemiddelde kennisscore en het aantal dienstjaren. Een grotere werkervaring resulteerde in een betere kennis van geneesmiddelen. Bij deeltijds werkenden was dit verband echter niet aanwezig (**Figuur A4.6**).

In totaal kon 49% van de bevraagden beschouwd worden als geslaagd in de kennistest met een score van meer dan 50%. Tabel A4.2 geeft een overzicht van de kenmerken die de slaagkansen op de kennistest positief beïnvloedden. Als elk element op zichzelf bekeken wordt, kan gesteld worden dat mannelijk geslacht, meer dienstjaren, een bachelor diploma, bijkomende opleidingen, een voltijds arbeidsregime en een betrekking als hoofdverpleegkundige de kans op slagen verhoogden. Indien rekening wordt gehouden

Tabel A4.2. *Persoons-, opleidings- en arbeidskenmerken die de kans op slagen voor de farmacotherapeutische kennistest positief beïnvloeden.*

	Univariaat	Multivariaat
Meer kans op slagen indien:	**OR**	**OR**
man	1.7	–
meer jaren dienst	1.2	1.3
bachelor	2.4	2.1
bijopleidingen	2.2	1.6
voltijds	1.6	1.6
hoofdVPK	2.6	–

met het onderlinge verband tussen deze kenmerken dan bleef er 30% meer kans op slagen per 10 jaar langer in dienst, 60% meer kans op slagen indien voltijds werkend en bijopleiding gevolgd en dubbel zoveel kans op slagen indien een bachelor diploma behaald werd (**Tabel A4.2**).

Bespreking

Dit onderzoek toont dat de farmacotherapeutische kennis van verpleegkundigen eerder beperkt is en dat vooral de kennis in verband met de toediening van bepaalde geneesmiddelen opvallend laag is. Vooral het diploma en de bijopleidingen, voltijds werken en het aantal dienstjaren hebben een invloed op de farmacotherapeutische kennis

De vraag kan gesteld worden in welke mate het gebruikte meetinstrument geschikt is om de geneesmiddelenkennis van verpleegkundigen, werkzaam in verschillende settings, te meten. De gekozen geneesmiddelen be-

horen tot de meest gebruikte in de extramurale zorg voor zorgbehoevende ouderen. Voor de acute ziekenhuizen betekent dit dat deze middelen ook wel gekend zijn bij de verpleegkundigen werkzaam op interne afdelingen maar minder frequent gebruikt worden vooral op chirurgische afdelingen.

Persoons- en opleidingskenmerken spelen een duidelijke rol bij het scoren op een kennistest in verband met geneesmiddelen. Dat mannen en hoofdverpleegkundigen gemiddeld hoger scoren hangt sterk samen met het feit dat het vooral mannen zijn in een voltijdse job die werkzaam zijn als hoofdverpleegkundige. Bovendien hebben zowel mannen als hoofdverpleegkundigen in sterkere mate een hoger diploma. De onderlinge samenhang tussen deze kenmerken maakt dat de verhoogde kans op slagen voor mannen en hoofdverpleegkundigen wegvalt als rekening wordt gehouden met de andere beïnvloedende factoren.

Uit dit onderzoek blijkt duidelijk dat geneesmiddelenkennis laag is bij het verlaten van de schoolbanken en groeit door praktijkervaring. Opvallend is echter dat deze groeicurve zich enkel blijkt door te zetten bij voltijds werkenden. Indien ditzelfde fenomeen ook zou worden waargenomen bij andere verpleegkundige activiteiten waar 'on-the-job training' een belangrijke rol speelt, dan dient bijscholing voor deeltijdsen in dit kader te worden herzien en aangepast.

Als gevolg van de bevindingen van deze studie, zal er in de toekomst meer aandacht besteed worden aan farmacologie en farmacotherapie binnen de eigen opleiding. Ook zal het aanbod aan geneesmiddelenleer in de vierdegraad opleiding en de bacheloropleiding voor verpleegkunde nader worden onderzocht.

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Appendix V

Farmacologie in de opleiding verpleegkunde in Vlaanderen

Inleiding

Geneesmiddelenzorg heeft een belangrijke plaats in de dagelijkse verpleegkundige praktijk. De verpleegkundige is meestal de laatste schakel in het medicatieproces voordat het geneesmiddel de patiënt bereikt. Nadat de arts het geneesmiddel heeft voorgeschreven, is de verpleegkundige verantwoordelijk voor de uitvoering van het voorschrift. In de Belgische wetgeving staan medicamenteuze toedieningen beschreven als technische verpleegkundige prestaties van het type B2 waarvoor een voorschrift van de arts nodig is (1). De taak van de verpleegkundige is het voorbereiden en toedienen van het geneesmiddel. Na toediening is het ook een verpleegkundige taak om de therapeutische effecten en nevenwerkingen te observeren en te rapporteren aan de arts (2, 3). In het belang van de patiënt is het essentieel dat verpleegkundigen alle taken in het geneesmiddelenproces op een correcte en verantwoorde manier kunnen uitvoeren (4). Verpleegkundigen moeten hiervoor in hun opleiding de nodige competenties aanleren (5).

Er is nog niet veel onderzoek gepubliceerd dat nagaat of studenten verpleegkunde na hun opleiding voldoende zijn voorbereid op hun rol in de geneesmiddelenzorg. In het Verenigd Koninkrijk en Australië is het aanbod farmacologie in de opleiding Verpleegkunde wel reeds onderzocht (6-9). De resultaten uit deze onderzoeken geven aan dat vele verpleegkundigen na hun opleiding mogelijk nog onvoldoende voorbereid zijn. Gepubliceerde studies naar de geneesmiddelenkennis en rekenvaardigheden van verpleegkundigen en studenten verpleegkunde besluiten algemeen dat er tekorten zijn in kennis en rekenvaardigheid (10-16). Studies naar de mogelijke oor-

zaken van medicatiefouten door verpleegkundigen en studenten verpleegkunde geven vaak 'kennistekort' en 'gebrekkige rekenvaardigheden' aan als twee van de voornaamste contribuerende factoren (17, 18). Om kwaliteitsvolle geneesmiddelenzorg te kunnen garanderen is het belangrijk om het aanbod farmacologie in de opleiding verpleegkunde en de kennis van de toekomstige verpleegkundigen in kaart te brengen en hieruit te leren.

De opleiding verpleegkunde wordt in België op verschillende niveaus georganiseerd. In **Tabel A5.1** wordt bijkomende informatie gegeven over de verschillende opleidingen tot verpleegkundige in Vlaanderen en de belangrijkste veranderingen in de organisatie van de opleiding gedurende de afgelopen jaren.

Tabel A5.1. *De opleiding tot verpleegkundige in Vlaanderen.*

Organisatie van de opleidingen verpleegkunde
De opleiding verpleegkunde wordt in België georganiseerd vanuit de Vlaamse en Franstalige Gemeenschap. Hoewel de manier waarop de opleiding wordt georganiseerd verschilt per Gemeenschap, kan men in beide landsdelen de opleiding tot verpleegkundige volgen op twee niveaus: op niveau van het hoger beroepssecundair onderwijs (HBO) en op niveau van het hoger onderwijs (HO). De informatie in deze tabel wordt beperkt tot de twee reguliere basisopleidingen verpleegkunde in Vlaanderen. Voor meer informatie over niet reguliere opleidingen, specialisaties alsook informatie over het verpleegkundig onderwijs in de Franstalige Gemeenschap dienen bijkomende bronnen geraadpleegd te worden aangezien deze niet onmiddellijk van toepassing zijn voor deze studie.
Tot aan de invoering van het hogescholendecreet van 1994 werd in het aanvullend beroepssecundair onderwijs (ASBO) de driejarige opleiding tot gebrevetteerde verpleegkundige georganiseerd. Voornamelijk studenten uit het beroepssecundair onderwijs (BSO) stroomden door naar deze opleiding verpleegkunde. Daarnaast bestond er een opleiding tot gegradueerde verpleegkundige in het hoger onderwijs die, afhankelijk van de gekozen specialisatierichting, drie of vier jaar duurde en voornamelijk studenten uit het technisch secundair onderwijs (TSO) en het algemeen secundair onderwijs (ASO) aantrok. Typerend voor die tijd was dat de beide niveaus van opleiding vaak onder hetzelfde dak werden georganiseerd en verbonden waren aan een ziekenhuis.
Hier kwam verandering in met de komst van het hogescholendecreet van 1994. Dit decreet schreef voor dat het aanvullend beroepssecundair onderwijs niet meer in een hogeschool mocht georganiseerd worden. Dit leidde, samen met het Besluit van de Vlaamse regering betreffende de omvormingen van de opleidingen en opties van de hogescholen van 19 juli 1995, tot een grondige reorganisatie van de beide niveaus van opleiding tot verpleegkundige.
Verpleegkunde in de vierde graad van het secundair onderwijs
Vanaf 1 september 1995 verhuisde de driejarige opleiding tot gebrevetteerde verpleegkundige naar de secundaire scholen waar het een plaats kreeg in de vierde graad van het BSO. Bij deze reorganisatie bleef het niet voor de opleiding tot gebrevetteerde verpleegkundige. In 2000 stapten alle vierdegraadsopleidingen, uitgezonderd één, in een experiment van de Vlaamse overheid omtrent modulair onderwijs. Door de leerstof in modules aan te bieden in plaats van te werken met de klassieke vakken en leerjaren tracht men een meer flexibel onderwijssysteem te ontwikkelen en het onderwijs beter te laten aansluiten op de arbeidsmarkt. De eerste vier modules duren elk 18 weken, de laatste module 36 weken. Na elke voltooide module ontvangt de student een deelcertificaat wat hem toegang geeft tot de volgende module. Na het succesvol beëindigen van de laatste module ontvangt de student een diploma verpleegkunde. Voor de opleiding verpleegkunde loopt dit experiment nog tot 2011-2012.

Sinds het decreet van 30 april 2009 betreffende het secundair na secundair onderwijs (SenSe) en het hoger beroepsonderwijs (HBO) verhuisde deze opleiding verpleegkunde nog maar eens. Dit keer van de vierde graad BSO naar het Hoger Beroepsonderwijs (HBO). De opleidingen van het hoger beroepsonderwijs zijn beroepsgericht en situeren zich tussen het secundair onderwijs en een professionele bachelor. Momenteel spreekt men van de opleiding HBO 5 verpleegkunde, waarbij 5 verwijst naar de Europese kwalificatieniveaus. Aangezien dit onderzoek is afgerond voor het verschijnen van het decreet van 30 april 2009 zal er in dit artikel nog gesproken worden over de vierde graad van het secundair beroepsonderwijs of vierdegraadsopleiding.

Bacheloropleiding verpleegkunde

Sinds de eerder genoemde reorganisatie in 1995 kende, naast deze hogere beroepsopleiding verpleegkunde, ook de opleiding tot verpleegkunde in het Hoger Onderwijs enkele hervormingen. Voor 1995 was verpleging een afdeling in het paramedisch onderwijs. De opleiding duurde drie jaar, uitgezonderd voor de specialisatierichting sociale verpleging die vier jaar duurde. Vanaf 1995-1996 werd de afdeling verpleging van het paramedisch onderwijs een driejarige opleiding in het studiegebied gezondheidszorg. Vroedkunde werd een afzonderlijke opleiding in plaats van een specialisatierichting. De optie sociale verpleegkunde werd in duur ingekort zodat deze ook één jaar werd zoals de andere opties. Een nieuwe optie, geriatrische verpleegkunde, werd gecreëerd.

Dit bleef zo tot in 2004-2005 als gevolg van het Bolognadecreet de bachelor en masterstructuur werd ingevoerd. De opleiding tot gegradueerde verpleegkundige werd herdoopt tot een professionele bacheloropleiding verpleegkunde. In dit nieuwe onderwijssysteem, dat op een meer flexibele manier studenten wil voorbereiden op de arbeidsmarkt, doorloopt men nu een programma van 180 (3x60) studiepunten wat overeenkomt met drie klassieke studiejaren.

Deze achtergrondinformatie over de evolutie en huidige structuur van het verpleegkundig onderwijs in Vlaanderen kan helpen bij het interpreteren van de resultaten en aanbevelingen in deze studie

Doelstelling

Dit onderzoek heeft tot doel het huidige aanbod farmacologie in de twee reguliere basisopleidingen verpleegkunde in Vlaanderen te beschrijven. Bovendien wordt de relatie geëxploreerd tssen de organisatorische en inhoudelijke aspecten van die opleidingen enerzijds en de geneesmiddelenkennis en rekenvaardigheden van de laatstejaarsstudenten anderzijds.

Onderzoeksmethode

Het aanbod farmacologie in de opleiding verpleegkunde werd onderzocht en gerelateerd aan de geneesmiddelenkennis van de laatstejaarsstudenten verpleegkunde en aan hun mening over het aanbod farmacologie. De resultaten van de studenten op de kennistest en rekentest werden reeds meer gedetailleerd besproken in een eerdere publicatie over dit onderzoek (19).

Bevraging van de onderwijsinstellingen

Om een zo volledig mogelijk beeld te krijgen van het aanbod farmacologie in de opleiding verpleegkunde werden alle directies van de 2 basisopleidingen verpleegkunde in heel Vlaanderen per brief uitgenodigd om deel te nemen. Dit eerste deel van het onderzoek vond uiteindelijk plaats in 17 van de 18 Vlaamse hogescholen en 12 van de 28 secundaire scholen.

De datacollectie met betrekking tot het aanbod farmacologie gebeurde in de periode van 1 november 2008 tot 31 januari 2009. Aan de opleidingscoordinatoren werd gevraagd om informatie omtrent het aanbod farmacologie te verschaffen. Dit gebeurde aan de hand van cursusinhouden, studiegidsen en leerplannen. Op basis van deze informatie werd per onderwijsinstelling een checklist ingevuld. Nadien werd met behulp van deze checklist gericht bijkomende informatie gevraagd aan de opleidingscoördinatoren. De checklist bevatte basisinformatie over de onderwijsinstelling, informatie over de organisatie en inhoud van farmacologie en informatie over recente en/of geplande wijzigingen in de organisatie van farmacologie. Een belangrijk deel van de checklist bestond uit een oplijsting van 13 onderwerpen waarvan werd nagegaan of ze aan bod kwamen tijdens het vak farmacologie.

Bevraging van de laatstejaarsstudenten verpleegkunde

Dit tweede deel van het onderzoek vond plaats in 16 van de 17 deelnemende hogescholen en 9 van de 12 deelnemende secundaire scholen. In dit deel van het onderzoek werden alle voltijdse laatstejaarsstudenten uitgenodigd om deel te nemen. Alle afstudeeropties werden geïncludeerd.

De datacollectie vond plaats in de periode van 1 februari tot 31 maart 2009 door middel van een gestructureerde vragenlijst. Er werd de opleidingscoördinatoren de mogelijkheid geboden te kiezen tussen een elektronische of een schriftelijke bevraging.

De vragenlijst bestond uit verschillende delen. In het eerste deel werden de algemene persoonskenmerken bevraagd. Daarna werd in het tweede deel van de vragenlijst naar de mening van de studenten gevraagd. Daarbij kregen de studenten een lijst waarin de 13 onderwerpen stonden waarvan ook de lesinhoud werd opgevraagd bij de onderwijsinstellingen. De studenten gaven per onderwerp een score van 0 tot 4 naarmate ze vonden dat een onderwerp 'niet' (0 punten), 'onvoldoende' (1 punt), 'voldoende' (3 punten) of 'uitgebreid' (4 punten) aan bod was gekomen. Vervolgens werd hen gevraagd om met een score van 1 tot 10 aan te geven hoe goed ze zich, wat betreft farmacologie, voorbereid voelden om als verpleegkundige te beginnen

werken. In een derde deel werden de geneesmiddelenkennis en rekenvaardigheden van de studenten getoetst. In het artikel van Dilles et al. worden de kennistest en de rekentest meer gedetailleerd besproken en worden voorbeelden getoond van deze stellingen en rekenoefeningen (19).

Data analyse

De kwantitatieve gegevens werden ingevoerd in Excel2007. Voor verdere analyse werd SPSS 15.0 gebruikt. Het significantieniveau van $p<0.05$ werd gehanteerd. Voor continue variabelen werden gemiddelden met standaarddeviaties berekend. Voor discontinue variabelen werden percentages berekend. Bij een scheve distributie werd het gemiddelde met de range weergegeven. Niet-parametrische statistiek werd gebruikt voor subgroepanalyse en bij semi-kwantitatieve gegevens zoals schalen.

Ethische beschouwingen

Aan de directies van de onderwijsinstellingen werd de toestemming gevraagd om informatie over het aanbod op te vragen en de studenten anoniem te bevragen. Alle bekomen informatie over de onderwijsinstellingen werd steeds vertrouwelijk behandeld. De vragenlijst voor de studenten werd voorafgegaan door de informatie dat het deelnemen aan het onderzoek vrijblijvend en anoniem was. Er werd een code toegekend aan de vragenlijsten van de studenten om ze te kunnen koppelen aan hun onderwijsinstelling.

Resultaten

Het eerste deelonderzoek naar het aanbod farmacologie gebeurde in 17 hogescholen en 12 secundaire scholen (Tabel A5.2). Van elke Vlaamse provincie was minstens 1 hogeschool en 1 secundaire school betrokken. Uitgezonderd één, deden alle secundaire scholen mee aan het experiment van de Vlaamse regering omtrent de modulaire onderwijsstructuur.

Er werden in totaal 613 laatstejaarsstudenten verpleegkunde bevraagd, verspreid over 16 hogescholen en 9 secundaire scholen (Tabel A5.2). De gemiddelde response rate per onderwijsinstelling was 45%, variërend tussen 24% en 100%. Van alle bevraagde studenten was 87% vrouw. De gemiddelde leeftijd was 24 jaar. Dit gemiddelde lag in de opleiding vierde graad 2 jaar hoger dan in de bacheloropleiding. Studenten van alle afstudeeropties werden

bevraagd. Zowel in de bacheloropleiding als in de opleiding vierde graad volgde de meerderheid de afstudeeroptie ziekenhuisverpleegkunde. Meer dan de helft van alle studenten in de opleiding vierde graad stroomde door uit het BSO. Bij de bachelorstudenten was dit slechts 4%.

Tabel A5.2. *Beschrijving van het onderzoeksveld en de onderzoekspopulatie.*

			Totaal	Bachelor	Vierde graad	*p*-waarde*
Onderzoeksveld *(onderwijsinstellingen verpleegkunde)*		**(%)**	**n=29**	**n=17**	**n=12**	
Provincie	Antwerpen		27.6	23.5	33.3	0.913
	Limburg		13.8	11.8	16.7	
	Oost-Vlaanderen		20.7	23.5	16.7	
	Vlaams-Brabant		13.8	17.6	8.3	
	West-Vlaanderen		24.1	23.5	25.0	
Onderwijsstructuur	Lineair		34.5	52.9	8.3	0.013
	Modulair		65.5	47.1	91.7	
Onderzoekspopulatie *(laatstejaarstudenten verpleegkunde)*		**(%)**	**n=613**	**n=404*** **	**n=209*** **	
Geslacht	Mannen		13.0	15.4	8.2	0.012
	Vrouwen		87.0	84.6	91.8	
Leeftijd (in jaren)	mean (range**)		24.0 19-54)	23.2 (20-54)	25.5 (19-54)	<0.001
Afstudeeroptie	Ziekenhuis		59.9	56.4	66.5	<0.001
	Pediatrie		11.7	17.8	-	
	Geriatrie		10.3	5.9	18.7	
	Psychiatrie		9.8	8.4	12.4	
	Sociaal		6.4	9.7	-	
	Medisch-technologisch		1.1	1.7	-	
	Thuisverpleegkunde		0.8	-	2.4	
Vooropleiding	ASO		35.1	46.5	12.9	<0.001
	TSO		41.8	48.3	29.2	
	BSO		22.2	4.0	57.4	
	KSO		0.7	0.7	0.5	
	HAVO (Nederland)		0.3	0.5	0.0	
Ander diploma hoger onderwijs			7.5	9.7	3.3	0.005
Jaren ervaring in zorgsector (n=98)		mean (range**)	7.6 (1-35)	5.7 (1-22)	9.1 (1-35)	0.015

* significantie berekend voor het verschil tussen de groepen 'bachelor' en 'vierde graad'.

** range wordt weergegeven in plaats van standaarddeviatie wegens scheve distributie.

*** Eén hogeschool en 3 secundaire scholen participeerden aan het eerste deelonderzoek (aanbod) maar niet aan het tweede deelonderzoek (bevraging van de laatstejaarsstudenten)

Het aanbod farmacologie in de opleiding verpleegkunde in Vlaanderen

In de opleiding verpleegkunde in de vierde graad van het secundair onderwijs werd farmacologie overwegend geïntegreerd in de verschillende modules. Dit gebeurde in de meeste scholen op een gelijkaardige manier. De basisbeginselen van farmacologie en medisch rekenen werden meestal in het begin van de opleiding als een apart thema gegeven. In het verdere verloop van de opleiding werd farmacologie overwegend geïntegreerd in verschillende modules door het te koppelen aan thema's over ziektebeelden of patiëntenpopulaties. Bijvoorbeeld in een module 'Zorg aan de cardiologische patiënt' werd onder andere gedoceerd over cardiale medicatie en anticoagulantia.

Ook in de bacheloropleiding verpleegkunde werd farmacologie in enkele hogescholen op deze manier geïntegreerd in de lessen. Toch werd farmacologie in 12 van de 17 onderzochte hogescholen ook duidelijk als apart vak gegeven (**Tabel A5.3**). Vijf van deze 12 hogescholen gaven enkel een apart vak farmacologie, de overige 7 hogescholen combineerden een duidelijk apart vak farmacologie met integratie van enkele aspecten in andere vakken. Gemiddeld werden 15 lesuren besteed aan het apart vak farmacologie, met een range van 7 tot 30 uren. In de meeste gevallen werd het vak gegeven in het tweede jaar van de opleiding. In de meeste hogescholen werd dit vak gegeven door een verpleegkundig lector in de vorm van een hoorcollege. Van deze verpleegkundige lectoren had er slechts één een bijscholing rond farmacologie gevolgd. Wat betreft lesmateriaal werd meestal de combinatie cursus en diapresentaties gebruikt.

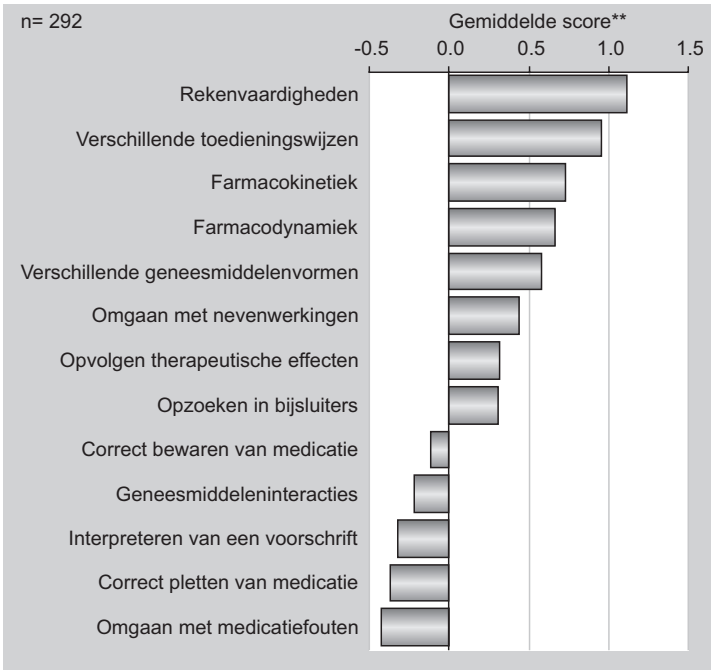
Op basis van de informatie die via de opleidingen zelf werd gegeven, werd in Tabel A5.3 voor 13 onderwerpen aangeduid of ze aan bod kwamen in het apart vak farmacologie in de bacheloropleidingen. Aan de studenten werd voor deze zelfde 13 onderwerpen gevraagd aan te geven in welke mate zij vonden dat het onderwerp aan bod was gekomen (**Figuur A5.1**). Wanneer Tabel A5.3 en Figuur A5.1 naast elkaar bekeken worden, vallen er enkele zaken op. Om het vergelijken gemakkelijker te maken staan de onderwerpen in dezelfde volgorde.

Voor de meeste onderwerpen (10/13) is er een overeenkomst tussen de mening van de studenten en het aanbod in de les. Onderwerpen die volgens de studenten voldoende aan bod zijn gekomen (bijv. verschillende toedieningswijzen) komen in meer dan de helft van de onderwijsinstellingen met een apart vak farmacologie aan bod in de les. Onderwerpen die volgens de studenten onvoldoende aan bod zijn gekomen (bijv. het interpreteren van een voorschrift) komen in minder dan de helft van de onderwijsinstellingen

met een apart vak farmacologie aan bod in de les.

Toch zijn er enkele onderwerpen (3/13) waarvoor de mening van de student niet in overeenstemming is met het aanbod volgens de onderwijsinstellingen. Het onderwerp geneesmiddeleninteracties kwam volgens de studenten onvoldoende aan bod. Dit onderwerp werd nochtans in meer dan de helft van de hogescholen aangeboden.

Twee onderwerpen, rekenvaardigheden en het opvolgen van therapeutische effecten, kregen daarentegen van de studenten een voldoende terwijl ze in slechts de helft of minder dan de helft van de onderwijsinstellingen met een apart vak farmacologie aan bod kwamen in de les. Het onderwerp rekenvaardigheden krijgt van de studenten zelfs de hoogste waardering van alle onderwerpen. Volgens de studenten werd dus aan dit onderwerp het meest aandacht besteed tijdens de les. Bij verdere analyse blijkt dat studenten met een ASO-vooropleiding een gemiddeld hogere beoordeling gaven aan de mate waarin rekenvaardigheden aan bod was gekomen in de les (mean=3.17) dan de studenten met een TSO- (mean=3.13) of BSO-vooropleiding (mean=2.86).



Figuur A5.1. *Mening van de bachelorstudenten* over de mate waarin een onderwerp aan bod is gekomen in het apart vak farmacologie*

* Enkel bachelorstudenten die een apart vak farmacologie hebben gehad.

** Antwoordmogelijkheden: niet (-2), onvoldoende (-1), voldoende(1), uitgebreid(2)

Table A5.3. *Beschrijving van het aanbod farmacologie in de opleiding verpleegkunde en matrix met visuele voorstelling van de organisatie en inhoud van het apart vak farmacologie in de hogescholen.*

		Totaal	Bachelor	Vierde graad
Farmacologie, algemeen	**(n)**	**n=29**	**n=17**	**n=12**
enkel apart vak		5	5	0
zowel apart vak en geïntegreerd		8	7	1
enkel geïntegreerd in andere vakken/modules		16	5	11
geïntegreerd in stages		29	17	12
Farmacologie, als apart vak in de bacheloropleiding (n=12)				
Contacturen	gemiddelde (range*)	15.3 (7 - 30)		

Organisatie van het vak farmacologie		**Hogescholen met apart vak farmacologie**												**Totaal**
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**(n)**
Docent	Apotheker	■				■				■				3
	Arts			■			■							2
	Verpleegkundige		■		■			■	■		■	■	■	7
Lesmateriaal	Cursus	■	■	■	■	■	■	■	■	■	■	■	■	12
	Diapresentaties	■	■	■	■	■	■				■	■	■	9
	Internet		■	■	■	■	■	■						6
	Eigen notities	■	■	■					■		■			5
	Wetenschappelijke artikels				■	■								2
	Handboek								■					1
	Software				■									1
Lesvorm	Hoorcolleges	■	■	■	■	■	■	■	■	■	■	■	■	12
	Werkcolleges	■	■			■	■	■	■	■		■		8
	Casuïstiek	■	■		■		■							4

Onderwerpen in het vak farmacologie**	**Hogescholen met apart vak farmacologie**												**Totaal**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**(n)**
Rekenvaardigheden				■	■	■	■	■	■				6
Verschillende toedieningswijzen	■	■	■	■	■	■	■	■	■	■	■	■	12
Farmacokinetiek	■	■	■	■	■	■	■	■	■	■	■	■	12
Farmacodynamiek	■	■	■	■	■	■	■	■	■	■	■	■	12
Verschillende geneesmiddelenvormen	■	■	■	■	■	■	■	■	■	■	■	■	12
Omgaan met nevenwerkingen		■	■		■	■	■	■	■	■	■	■	10
Opvolgen van therapeutische effecten				■							■		2
Opzoeken in bijsluiters	■	■	■	■	■	■	■	■	■	■	■	■	12
Correct bewaren van medicatie				■		■		■					3
Geneesmiddeleninteracties	■	■	■				■	■		■	■	■	8
Interpreteren van een voorschrift						■		■	■				3
Correct pletten van medicatie		■	■	■		■						■	5
Omgaan met medicatiefouten				■	■	■						■	4

*range wordt weergegeven in plaats van standaarddeviatie wegens scheve distributie.

** de onderwerpen staan in dezelfde volgorde dan in figuur 1 om visueel beter te kunnen vergelijken

Alle hogescholen en secundaire scholen gaven aan farmacologie te verwerken in stageopdrachten. Een stageopdracht kan bijvoorbeeld zijn dat de student de medicatiefiche van een patiënt dient te ontleden en informatie over de medicatie zoals indicatie, mogelijke bijwerkingen, verpleegkundige aandachtspunten, enzovoort moet opzoeken.

Kennis en rekenvaardigheden van de laatstejaarsstudenten

Gemiddelde scores (Tabel A5.4)

De gemiddelde behaalde percentages op de kennistest en rekentest waren laag. Bij de volledige populatie was de gemiddelde score op de kennistest 53.7%. Het gemiddelde lag hoger bij de bachelorstudenten (54,6%) dan bij de studenten van de vierde graad (51.9%; p=0.003). De gemiddelde score op de rekentest was 61,8%. De bachelorstudenten scoorden ook hier met 66,0% gemiddeld beter dan de studenten van de vierde graad met 52.9%. Dit verschil was duidelijk significant (p<0.001).

Slaagpercentage (Figuur A5.2)

Figuur A5.2 toont de verschillen in slaagpercentage bij de studenten. Bij de bachelorstudenten slaagden 71,0% van de studenten op de kennistest. Het percentage geslaagde studenten in de opleiding vierde graad was 60.3% (p=0.007). Van alle bachelorstudenten slaagde 76,0 % voor de rekentest. Bij de studenten van de vierde graad was dit 55,9% (p<0.001).

Tabel A5.4. *Gemiddeld percentage behaald op kennistest en rekentest.*

Kennistest		
Totaal (n=613)	**53.7 %**	
Bachelor	54.6 %	*P*= 0.003
Vierde graad	51.9 %	
ASO	55.0 %	*P*= 0.009
TSO	53.8 %	
BSO	51.4 %	
Vak apart*	54.7 %	*P*= 0.676
Geen vak apart*	54.3 %	
Rekentest		
Totaal (n=532)**	**61.8 %**	
Bachelor	66.0 %	*P* < 0.001
Vierde graad	52.9 %	
ASO	68.6 %	*P* < 0.001

* Enkel bachelorstudenten (n=404)

** Enkel studenten die minstens 1 rekenopgave hebben ingevuld (n=532)

*** Enkel bachelorstudenten die minstens 1 rekenopgave hebben ingevuld (n=362)

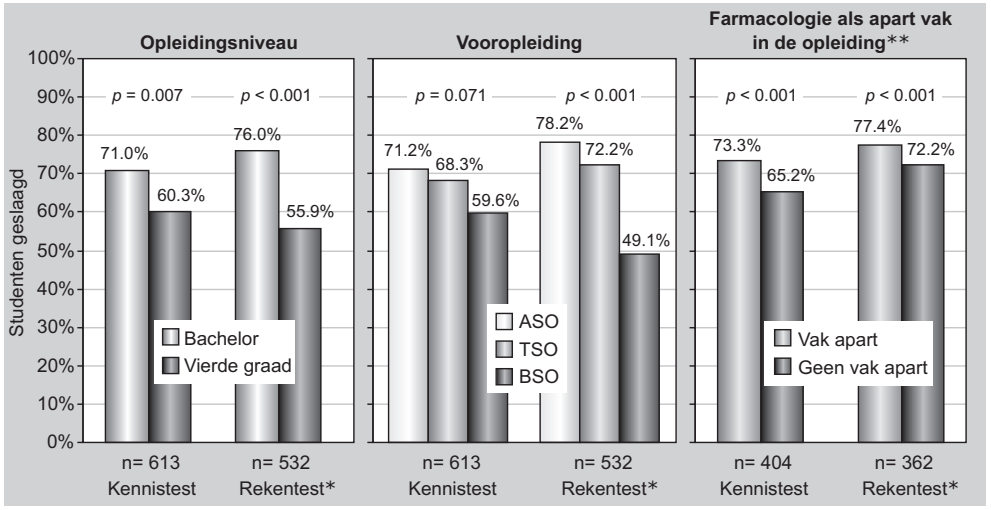
Invloed van vooropleiding

Gemiddelde scores (Tabel A5.4)

Wanneer de resultaten op de kennistest vergeleken werden op basis van vooropleiding, kon een verschil in gemiddelde scores vastgesteld worden. Studenten die doorstroomden uit het ASO scoorden met een gemiddelde van 55.0% beter dan studenten uit het TSO (53,8%) en het BSO (51,4%). Het verschil tussen de 3 groepen was significant (p=0.009). De resultaten op de rekentest werden eveneens vergeleken op basis van vooropleiding. Hier kon een duidelijk verschil in gemiddelde scores vastgesteld worden. Studenten met een ASO-vooropleiding scoorden met een gemiddelde van 68.6% beter dan studenten uit het TSO (63.0%) en het BSO (47.7%). Het verschil tussen de 3 groepen was duidelijk significant (p<0.001).

Slaagpercentage (Figuur A5.2)

Bij de studenten met een ASO-vooropleiding slaagden 71.2% van de studenten op de kennistest. Bij de studenten met een TSO-vooropleiding was dit 68.3%, bij de studenten met een BSO-vooropleiding was dit 59.6% (p=0.071). Voor de rekentest slaagden 78.2% van de studenten met een ASO-vooropleiding. Bij de studenten met een TSO-vooropleiding was dit 72.2%, bij de studenten met een BSO-vooropleiding was dit opvallend minder, namelijk 49,1% (p<0.001).



Figuur A5.2. *Percentage studenten geslaagd voor de kennistest en de rekentest.*

* Enkel bachelorstudenten

** Enkel studenten die minstens 1 rekenopgave hebben ingevuld

Invloed van apart vak farmacologie in bacheloropleiding

Gemiddelde scores (Tabel A5.4)

De bachelorstudenten die farmacologie als vak apart kregen in hun opleiding scoorden gemiddeld iets beter op de kennistest (54.7%) en de rekentest (66,1%) dan de bachelorstudenten die geen apart vak farmacologie hadden (54.3% op de kennistest en 65.6% op de rekentest). Deze verschillen waren echter niet significant.

Slaagpercentage (Figuur A5.2)

Wanneer men kijkt naar het percentage bachelorstudenten dat slaagde voor de kennistest en de rekentest is er een duidelijker verschil tussen de studenten die wel een apart vak farmacologie hebben gehad tegenover de studenten zonder apart vak farmacologie. Voor de kennistest slaagde 73.3% van de bachelorstudenten met een apart vak en 65,2% van de studenten zonder apart vak farmacologie ($p<0.001$). Voor de rekentest slaagde 77.4% van de bachelorstudenten met een apart vak en 72.2% van de studenten zonder apart vak farmacologie ($p<0.001$).

Zelfbeoordeling studenten

Aan de studenten werd gevraagd aan te geven op een schaal van 1 tot 10 in welke mate ze zich klaar voelden om als verpleegkundige taken uit te voeren met betrekking tot geneesmiddelenzorg.

De studenten gaven zichzelf gemiddeld een score van 6.2 (SD 1,4). De studenten uit de vierdegraadsopleiding gaven zichzelf gemiddeld een hogere score (mean=6.45) dan de bachelorstudenten (mean=6,07; $p=0.001$). Wanneer we bij de bachelorstudenten de zelfbeoordelingen vergelijken tussen de studenten die wel en niet een apart vak farmacologie hebben gehad, valt op dat de studenten die wel een apart vak farmacologie hebben gehad zichzelf een lagere score gaven (mean=5,96) dan de studenten die geen apart vak farmacologie hebben gehad (mean=6.36; $p=0.013$).

Aan de studenten werd ook gevraagd om aan te geven op welke manier ze vonden dat ze het meeste hadden bijgeleerd over farmacologie. Voor elke mogelijkheid (theorieles, praktijkles, stage en zelfstudie) gaven ze een cijfer van 1 tot 10. Tabel 5 geeft een overzicht van de scores die de studenten gaven. Algemeen gaven de studenten aan dat ze het meest hadden bijgeleerd op stage (mean=7.92). De beoordelingen van de bachelorstudenten en de studenten van de vierde graad verschilden duidelijk wat betreft de praktijkles

en de stages. Studenten van de vierde graad gaven aan deze mogelijkheden gemiddeld hogere scores dan de bachelorstudenten. Verder werden de bachelorstudenten die een apart vak farmacologie hebben gehad vergeleken met de studenten zonder apart vak farmacologie. De studenten zonder apart vak farmacologie geven duidelijk een hoger cijfer aan het item zelfstudie (mean=7.13) dan de studenten die wel een apart vak farmacologie hebben gehad (mean=6.66; *p*=0.028).

Table A5.5. *Zelfbeoordeling studenten.*
Aan de studenten werd gevraagd om op een schaal van 1 tot 10 aan te geven in welke mate ze, respectievelijk in de theorielessen, de praktijklessen, op stage of door zelfstudie, iets geleerd hebben over farmacologie. Hierbij is 1 de laagste score en 10 de hoogste score.

	Theorie		**Praktijk**		**Stage**		**Zelfstudie**	
	gem.	*p*-waarde	gem.	*p*-waarde	gem.	*p*-waarde	gem.	*p*-waarde
Totaal (n=613)	**6.73**		**5.24**		**7.92**		**6.75**	
Bachelor	6.77	0.505	5.05	0.002	7.82	0.028	6.79	0.469
Vierde graad	6.66		5.61		8.11		6.67	
ASO	6.88	0.350	5.13	0.091	7.90	0.026	6.79	0.923
TSO	6.65		5.15		7.78		6.72	
BSO	6.66		5.58		8.21		6.74	
Vak apart*	6.97	<0.001	5.07	0.745	7.75	0.118	6.66	0.010
Geen vak apart*	6.24		5.00		8.00		7.13	

Gem. = gemiddelde.
* Enkel bachelorstudenten (n=404)

Discussie

Het aanbod farmacologie varieert sterk tussen de verschillende Vlaamse onderwijsinstellingen. Zowel wat betreft de inhoud als de manier waarop farmacologie wordt gedoceerd. Alle vierdegraadsopleidingen en ook enkele bacheloropleidingen integreerden aspecten van farmacologie in verschillende lesmodules in plaats van farmacologie als apart vak te doceren. Dit maakt het moeilijk om een correct overzicht te behouden van alle lesinhouden in die verschillende modules die naar farmacologie verwijzen. Men loopt op die manier het risico dat belangrijke aspecten van farmacologie verloren gaan omdat ze overal en nergens thuishoren. Moet bijvoorbeeld het observeren van therapeutische effecten en neveneffecten besproken worden in een module "de verpleegkundige als observator" of in een module "zorg aan de cardiologische patiënt" ? En wat dan met de nevenwerkingen bij een geriatrische patiënt? Door farmacologie als apart vak of als een aparte module

"geneesmiddelenzorg" aan te bieden kan er beter gewaakt worden over de volledigheid van het lessenpakket in verband met farmacologie. De verantwoordelijke lector van het apart vak farmacologie of de module "geneesmiddelenzorg" heeft een belangrijke taak erover te waken dat het volledige proces van geneesmiddelenzorg aan bod komt (3). Zelfs wanneer er geen apart vak of afzonderlijke module farmacologie is, dient iemand de taak te krijgen erover te waken dat alle fasen van het farmacotherapeutisch proces ergens in de opleiding aan bod komen. De hiaten in dit proces zitten vooral in de voorbereiding en de evaluatie. Het lezen en interpreteren van het voorschrift van de arts kwam slechts in 3 van de 12 hogescholen met een apart vak farmacologie expliciet aan bod tijdens de les. Opvolgen van therapeutische effecten (evaluatiefase van het proces) kwam bijvoorbeeld maar in 2 van de 12 bacheloropleidingen met een apart vak farmacologie aan bod in de les. Het meeste aandacht werd besteed aan farmacokinetiek, farmacodynamiek en de praktische aspecten van het proces, de verschillende toedieningswijzen en geneesmiddelenvormen. Maar zelfs bij deze praktische aspecten van de geneesmiddelenzorg zijn er topics die onvoldoende aan bod komen. Bijvoorbeeld het correct pletten of niet pletten van medicatie kwam maar in 5 van de 12 hogescholen aan bod. Ook de studenten gaven aan dat dit onvoldoende aan bod kwam. Nochtans is dit iets dat eenvoudig kan aangeleerd worden.

De algemeen lage resultaten op de kennistest en de rekentest in dit onderzoek tonen aan dat studenten verpleegkunde na hun opleiding nog onvoldoende voorbereid zijn. Bachelorstudenten scoorden globaal wel beter dan de studenten van de vierde graad. Wat betreft vooropleiding behaalden studenten met een ASO-diploma betere resultaten dan de anderen. Een hoger opleidingsniveau kan in dit onderzoek dus geassocieerd worden met betere resultaten op de kennistest en bijgevolg een betere geneesmiddelenkennis. Dit verband werd ook in de onderzoeken van Grandell-Niemi et al. en Ndosi et al. gevonden (13, 16). De resultaten op de rekentest waren eveneens algemeen laag, zeker bij de studenten van de vierde graad secundair onderwijs. Opnieuw had vooropleiding een duidelijke invloed op de resultaten van de rekentest zoals ook bleek uit resultaten van eerder onderzoek (12). Rekenvaardigheden leert men voornamelijk in de middelbare school en zelfs in de lagere school. Wanneer men aan de opleiding verpleegkunde begint, heeft men met een hogere vooropleiding duidelijk al een voorsprong. Een mogelijk probleem stelt zich wanneer in eenzelfde klas studenten met verschillende vooropleidingen samen zitten. Studenten met een ASO-vooropleiding gaven in deze studie gemiddeld een hogere beoordeling aan de mate waarin rekenvaardigheden aan bod was gekomen in de les dan de studenten met een TSO- of BSO-vooropleiding. Een mogelijke verklaring is dat de stu-

denten met een lagere vooropleiding meer tijd nodig hebben om rekenvaardigheden aan te leren dan de studenten met een hogere vooropleiding en dus minder snel het gevoel zullen hebben dat het onderwerp voldoende aan bod kwam tijdens de les. Een rekentest afnemen aan het begin van het eerste jaar verpleegkunde kan risicostudenten opsporen en het mogelijk maken te differentiëren wat betreft de lessen medisch rekenen. Op die manier kunnen studenten die minder goed kunnen rekenen meer tijd spenderen aan oefeningen en kunnen de studenten die beter zijn in rekenen zich concentreren op andere lessen. Er is in Vlaanderen nog geen gevalideerde test om de rekenvaardigheden van studenten verpleegkunde te beoordelen. Enkele hogescholen gebruiken een eigen toets om aan het begin van de opleiding de voorkennis van de studenten te evalueren en eventueel te differentiëren voor enkele vakken, maar dat is zeker geen algemeen gegeven voor alle opleidingen verpleegkunde in Vlaanderen. In Nederland wordt een rekentest wel al meer gebruikt, zowel in onderwijsinstellingen als op de werkvloer (20).

Uit dit onderzoek blijkt dat de studenten van de vierdegraadsopleiding zichzelf beter voorbereid voelen dan de bachelorstudenten om als verpleegkundige taken met betrekking tot geneesmiddelenzorg op te nemen. Maar het zich beter voorbereid voelen wil nog niet zeggen dat men effectief beter voorbereid is. De resultaten van de kennistest en de rekentest tonen net aan dat de studenten uit de vierde graad gemiddeld slechter presteerden dan de bachelorstudenten. Bij de bachelorstudenten viel op dat de studenten die geen apart vak farmacologie hebben gehad zichzelf een hogere score gaven dan de studenten die wel een apart vak farmacologie hebben gehad. Dit staat eveneens in contrast met de resultaten op de kennistest waarin de bachelorstudenten die een apart vak farmacologie hebben gehad gemiddeld beter presteerden. Hieruit kan afgeleid worden dat wie beter geïnformeerd is niet alleen zijn verantwoordelijkheden maar ook zijn beperkingen beter kent en meer op zijn hoede is wanneer hij als verpleegkundige begint te werken.

In het kader van patiëntveiligheid is het essentieel dat verpleegkundigen over de nodige competenties beschikken om op een verantwoorde manier met medicatie om te gaan. Verpleegkundigen spenderen tot 40% van hun werktijd aan het hele proces van geneesmiddelenzorg (17). Studenten verpleegkunde moeten daarom tijdens hun opleiding bewust gemaakt worden van het belang van farmacologie in de verpleegkundige praktijk en de gevolgen hiervan voor de patiënt.

Dit onderzoek kent een aantal beperkingen en daarnaast ook een aantal sterktes. Een beperking van dit onderzoek is de niet-gevalideerde vragenlijst. De kennistest en rekentest zijn speciaal voor dit onderzoek ontworpen. Deze vragenlijst is echter wel tot stand is gekomen door de inbreng en ex-

pertise van verschillende personen en gecontroleerd is door een arts en een apotheker. Er is bij de datacollectie geopteerd om een groot deel studenten elektronisch te bevragen. Het voordeel hierbij is dat op deze manier meer studenten, verspreid over heel Vlaanderen, bereikt konden worden. De deelname op vrijwillige basis van de studenten is een mogelijke beperking geweest. Het is mogelijk dat studenten met een goede kennis of zij die dit zelf zo percipiëren, eerderbereid waren om de vragenlijst in te vullen. Een sterk punt van het onderzoek is dat het door de grootte en de spreiding van de onderzoekspopulatie een goed beeld geeft van het aanbod farmacologie en de kennis van de studenten in heel Vlaanderen.

Een grondige herziening van het curriculum in de onderwijsinstellingen wat betreft farmacologie kan mogelijke hiaten aan het licht brengen waarvoor gerichte verbeteracties kunnen ondernomen worden. Hoewel farmacologie slechts één aspect is in het volledig verpleegkundig onderwijs, is het noodzakelijk dat er de nodige aandacht aan wordt besteed.

Aanbevelingen

Op niveau van de onderwijsinstelling:

- Er dient over gewaakt te worden dat alle stappen van het farmacotherapeutisch proces tijdens de opleiding in voldoende mate aan bod komen. Wanneer farmacologie als apart vak wordt gegeven is het de taak van de verantwoordelijke lector om dit te controleren. Wanneer er geen apart vak farmacologie is, wordt er best iemand aangesteld om deze taak op zich te nemen.
- Gelet op de sterke verschillen in vooropleiding zou een toets die peilt naar de rekenvaardigheden van de studenten aan het begin van de opleiding verpleegkunde het mogelijk maken te differentiëren en te remediëren.

Op beleidsniveau

- Er dient overleg georganiseerd te worden in een multidisciplinaire werkgroep over de exacte competenties waarover een verpleegkundige dient te beschikken om de beste geneesmiddelenzorg te verlenen in alle fasen van het farmacotherapeutisch proces.
- Er dienen concrete richtlijnen geformuleerd te worden voor wat betreft het organiseren en invullen van het lespakket farmacologie.

Voor verder onderzoek

- Er dient een gevalideerde rekentest ontwikkeld te worden. Deze test moet het moelijk maken om enerzijds in het begin van de opleiding te differentiëren en anderzijds aan het einde van de opleiding te evalueren of de student klaar is om op een verantwoorde manier zijn rol als verpleegkundige in het geneesmiddelenproces op te nemen.

Besluit

Dit onderzoek toont aan dat het aanbod farmacologie in de verschillende onderwijsinstellingen sterk varieert, zowel wat betreft organisatie als invulling van de lessen. Niet alle fasen van het farmacotherapeutisch proces krijgen voldoende aandacht, hier zou beter over moeten gewaakt worden. De resultaten van de kennistest en de rekentest duiden op een mogelijk onvoldoende kennis bij verpleegkundestudenten om in de praktijk kwaliteitsvolle en veilige geneesmiddelenzorg te kunnen garanderen. Voor de kennistest en de rekentest behaalden de bachelorstudenten gemiddeld hogere scores dan de studenten van de vierde graad. De vooropleiding van de student had een duidelijke invloed op de behaalde resultaten. In contrast met de resultaten op de kennistest en de rekentest gaven de studenten van de vierde graad zichzelf gemiddeld een hogere beoordeling dan de bachelorstudenten wanneer hen gevraagd werd of ze zichzelf voldoende voorbereid voelden om in de praktijk taken met betrekking tot de geneesmiddelenzorg op te nemen. Het is belangrijk dat verpleegkundigen over de nodige competenties beschikken om op een verantwoorde manier met medicatie om te gaan. De exacte oplijsting van deze competenties dient te gebeuren.

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Appendix VI

The use of the DRP trigger tool: ADR triggers, potential ADRs, confirmed ADRs and planned medication changes

Table A6. *Appendix to Chapter 6 (Effects of a drug related problem trigger tool for interdisciplinary medication review in nursing homes) listing all reported triggers to adverse drug reactions in the studied population of 418 residents after intervention.*

	Triggers		Potential ADRs identified by nurses		ADRs confirmed by physicians		ADRs resulting in medication change	
	%	N	%	N	%	N	%	N
example	**x/418**	**x**	**y/x**	**y**	**z/x**	**z**	**w/x**	**w**
Gastro-intestinal problems								
Gastro-intestinal complaints	80.9	338	17.8	60	11.2	38	3.6	12
Bowel cramps	18.2	76	14.5	11	9.2	7	3.9	3
Diarrhea	81.6	341	14.7	50	8.2	28	1.8	6
Constipation	56.5	236	22.9	54	14.8	35	3.4	8
Flatulence	23.9	100	8.0	8	2.0	2	1.0	1
Anorexia	14.6	61	8.2	5	1.6	1	0.0	0
Taste disorders	0	0						
Increase in body weight	68.7	287	12.9	37	8.0	23	1.0	3
Decrease in body weight	12.0	50	6.0	3	4.0	2	0.0	0
Nausea and vomiting	85.9	359	15.0	54	7.0	25	2.2	8
Dry mouth	31.1	130	19.2	25	12.3	16	2.3	3
thirst	5.0	21	4.8	1				
Gingival hyperplasia	22.5	94	1.1	1	0.0		0.0	
Hemorrhoids and fissures	0	0						
Irritation of the rectal mucosa	1.4	6	33.3	2	33.3	2	0.0	0
Irritation of the gastric mucosa	49.3	206	4.4	9	2.4	5	1.5	3
Gastro-intestinal bleeding	63.4	265	.4	1	0.4	1	0.4	1
Esophageal complaints	6.7	28	3.6	1	3.6	1	3.6	1
Abdominal pain	.5	2	.0	0				
Inflammation of the oral mucosa	4.8	20	10.0	2	10.0	2	0.0	0
Liver problems	78.0	326	1.2	4	0.6	2	0.3	1
Pancreatitis	4.8	20	5.0	1	0.0	0	0.0	0

	Triggers		Potential ADRs identified by nurses		ADRs confirmed by physicians		ADRs resulting in medication change	
	%	N	%	N	%	N	%	N
Neurological problems								
Depression	41.1	172	22.1	38	7.6	13	0.0	0
Agitation	70.8	296	22.6	67	8.8	26	1.4	4
Excessive cheerfulness	21.8	91	2.2	2	0.0	0	0.0	0
Fear/ anxiety	56.7	237	12.2	29	3.8	9	0.4	1
Agression	4.3	18	.0	0				
Hallucinations	21.3	89	18.0	16	11.2	10	1.1	1
Psychoses	12.9	54	13.0	7	7.4	4	1.9	1
Anticholinergic side effects	45.0	188	5.9	11	3.7	7	1.1	2
Extrapyramidal side effects	54.8	229	8.3	19	6.1	14	2.2	5
Serotonin syndrome	27.3	114	2.6	3	0.9	1	0.9	1
Neuroleptic malignant syndroom	26.1	109	0	0				
Cognitive disorders	20.3	85	29.4	25	18.8	16	5.9	5
Confusion	69.1	289	32.9	95	18.0	52	5.2	15
Balance and coordination problems	1.2	5	40.0	2	0.0	0	0.0	0
Convusions	63.2	264	1.5	4	0.4	1	0.0	0
Head aches	83.5	349	17.2	60	6.0	21	0.9	3
Drowsiness	77.3	323	18.6	60	10.5	34	0.9	3
Dyskinesia and dystonia	30.6	128	14.1	18	8.6	11	3.9	5
Tremor	56.2	235	6.8	16	3.8	9	0.4	1
Neuritis	21.1	88	4.5	4	3.4	3	0.0	0
Tingling skin sensations	33.5	140	5.0	7	1.4	2	0.7	1
Weakness	33.5	140	13.6	19	5.7	8	0.0	0
Tiredness	67.9	284	23.2	66	8.5	24	1.1	3
Sleep disturbances	83.3	348	13.2	46	6.9	24	1.4	5
Somnolence	65.3	273	16.5	45	10.3	28	3.3	9
Sedation	78.5	328	10.7	35	9.5	31	4.0	13
Stupor	4.8	20	5.0	1	5.0	1	0.0	0
Falling	17.7	74	25.7	19	13.5	10	5.4	4
Dermatological problems								
Photosensitivity	42.8	179	3.4	6	1.1	2	0.6	1
Hair loss	4.8	20	15.0	3	10.0	2	0.0	0
Skin eruptions	64.1	268	10.4	28	3.7	10	0.7	2
Itching	7.9	33	12.1	4	9.1	3	3.0	1
Skin problems	66.7	279	16.8	47	6.5	18	1.8	5
Musculoskeletal problems								
Gout	4.8	20	10.0	2	0.0	0	0.0	0
Joint problems	18.7	78	17.9	14	6.4	5	3.8	3
Bone pain	10.5	44	11.4	5	4.5	2	4.5	2
Osteonecrosis of the jaw	6.5	27	0	0				
Muscle pain	30.9	129	15.5	20	10.1	13	1.6	2

	Triggers		Potential ADRs identified by nurses		ADRs confirmed by physicians		ADRs resulting in medication change	
	%	N	%	N	%	N	%	N
Muscle weakness	24.9	104	14.4	15	5.8	6	1.9	2
Urogenital problems								
Renal problems	63.2	264	4.9	13	2.7	7	0.4	1
Micturition disorders	.0	0						
Urinary incontinence	10.5	44	50.0	22	22.7	10	2.3	1
Urinary retention	.2	1	0	0				
Polyuria	4.5	19	26.3	5	15.8	3	0.0	0
Kindey stones	10.0	42	0	0				
Painfull brests	1.4	6	16.7	1	16.7	1	16.7	1
gynecomastia	45.9	192	0	0				
Erectile dysfunction	73.4	307	1.6	5	0.3	1	0.3	1
Impotence	52.6	220	3.6	8	0.5	1	0.0	0
Priapism	13.6	57	0	0				
Testicular atrophy	.7	3	0	0				
Gynecological problems	27.0	113	4.4	5	1.8	2	0.9	1
Cardiovascular problems								
Tachycardia	24.6	103	1.9	2	1.0	1	0.0	0
Bradycardia	47.6	199	3.5	7	2.5	5	1.0	2
Palpitations	.2	1	0	0				
Arrhytmia	78.2	327	5.5	18	2.1	7	0.0	0
Hypertension	13.9	58	10.3	6	3.4	2	1.7	1
Hypotension	86.6	362	5.8	21	4.1	15	1.7	6
Bleeding	73.2	306	2.9	9	2.6	8	0.7	2
Trombosis	4.1	17	5.9	1				
Chest Pain	0	0						
Heart problems	38.0	159	7.5	12	1.9	3	1.3	2
Problems in water- , blood- and electrolyte balance								
Deshydratation	43.5	182	7.7	14	3.3	6	1.6	3
Oedema	42.8	179	19.0	34	10.6	19	0.6	1
Hyperkalemia	49.3	206	1.9	4	1.9	4	1.5	3
Lactic acidosis	9.8	41	.0	0				
Hyperglycemia	51.9	217	6.5	14	2.8	6	0.5	1
Hypoglycemia	13.4	56	8.9	5	3.6	2	1.8	1
Respiratory problems								
Respiratory depression	17.7	74	0	0				
Tachypnoe	0	0						
Asthma attack	33.3	139	1.4	2	0.0	0	0.0	0
Coughing	28.5	119	10.1	12	3.4	4	1.7	2
Breathing difficulties	68.4	286	5.2	15	1.7	5	0.7	2
Hormonal problems								
Insuline resistance	48.6	203	1.5	3	1.0	2	0.5	1
Cushing's syndrome	4.5	19	10.5	2	5.3	1	5.3	1

	Triggers		Potential ADRs identified by nurses		ADRs confirmed by physicians		ADRs resulting in medication change	
	%	N	%	N	%	N	%	N
Adrenocortical insufficiency	5.5	23	0	0				
Thyroid dysfunction	5.0	21	0	0				
Pharmacological problems								
Dependency	59.1	247	16.6	41	14.2	35	1.2	3
Tolerance	57.9	242	5.8	14	4.1	10	0.8	2
Allergy and hypersensitivity	59.1	247	4.0	10	2.0	5	0.4	1
Anaphylactic shock	9.6	40	0	0				
Other problems								
Lipodystrophia	7.7	32	3.1	1	3.1	1		
Hyperthermia	0	0						
Eye problems	17.2	72	11.1	8	2.8	2	1.4	1
Hearing problems	28.9	121	11.6	14	3.3	4	0.0	0
Hoarseness	4.5	19	5.3	1				
General Total		**14702**	**10.4**	**1527**	**5.6**	**821**	**1.4**	**202**

List of Abbreviations

ADL	Activities of Daily Living
ADR	Adverse Drug Reaction
ATC	Anatomical Therapeutic Chemical classification
BCFI	Belgian Centre for Pharmacotherapeutic Information
CI	Confidence Interval
CRA	Coordinating and Advising Physician (Coordinerende en Raadgevende Arts)
DDI	Drug Drug Interaction
DRP	Drug Related Problem
FTE	Full Time Equivalent
ICD	International Classification of Diseases
MKC test	Medication Knowledge and Calculations test
PASW	Predictive Analytics SoftWare (=SPSS)
PHEBE	Prescribing in Homes for the Elderly in Belgium (study)
PIM	Potentially Inappropriate Medications
RR	Relative Risk
SD of sd	Standard Deviation
SPSS	Statistical Package for the Social Sciences

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Awards

Award of the most meritorious student in Master in Nursing Science 2007, University of Antwerp.

Publications

ARTICLES PEER REVIEWED

1. Dilles T., Vander Stichele R.H. , Van Rompaey B., Van Bortel L. M., Elseviers M.M. Nurses' practices in pharmacotherapy and their association with educational levels. Journal of Advanced Nursing 2010;66(5):1072-9
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4. Dilles T, Van Bortel L.M., Vander Stichele R.H., Elseviers M.M. Barrières in verpleegkundige geneesmiddelenzorg in woonzorgcentra: Expertmeeting. Verpleegkunde 2011; accepted.
5. Lopez Hartmann M., Dilles T., Vander Stichele R.H., Van Bortel L. Elseviers M. Farmacologie in de opleiding verpleegkunde in Vlaanderen. Tijdschrift voor geneeskunde, 67. 2011.
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1. Dilles T., Van Rompaey B., Elseviers M. Pharmacotherapeutic nursing practice. 'Nurse Education Tomorrow 2008 conference', University of Cambridge , 2- 4 september 2008. Publicatie in abstractboek 'Education in Healthcare', T15, p24 – Oral presentation

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5. Dilles T., Vander Stichele R.H., Lopez Hartmann M., Van Bortel L., Elseviers M.M. Nursing students' pharmacological knowledge and calculation skills acta clin Belg 2010; 65(2): 154 – Oral presentation
6. Dilles T., Elseviers M.M., Van Bortel L.M., Vander Stichele R.H. Development of a trigger tool for interdisciplinary drug utilization review. Aging Clin Exp Res 2011, 23 S1: O.26.4 – Oral presentation

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1. Dilles T., Van Rompaey B. Verpleegkundige handelingen in de geneesmiddelenzorg in rusthuizen. Cahier Ouderenzorg. Hoofdstuk 4. p49. Wolters Kluwer Belgium. 2009
2. Dilles T. Verpleegkundige handelingen in de geneesmiddelenzorg in rusthuizen. Verpleegkunde & Vroedkunde Zakboekje 2008-2009. Hoofdstuk 4. p 53- 60. Wolters Kluwer Belgium. 2008
3. Elseviers M.M., Dilles, T., & Van Rompaey, B. (2009). Verpleegkundige farmacotherapeutische kennis in ziekenhuizen, verzorgingsinstellingen en de thuiszorg. In Elseviers M.M. (Ed.), Cahier Ouderenzorg: Kwalitatieve geneesmiddelenzorg (pp. 77-91). Mechelen: Kluwer.
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1. Dilles T. Medicatiekennis studenten ondermaats. Nursing. 2011 Mar.
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SCIENTIFIC REPORTS

1. Dilles T. Hoger op de kwalificatieladder: Oriëntatie in verpleegkunde. Symposium Vlaamse Onderwijsraad. 11 december 2009. Eindrapport en presentatie via www.vlor.be, HBO-sam.
2. Consensusrapport RIZIV – Het doelmatig gebruik van geneesmiddelen bij migraine – juryrapport. http://www.riziv.fgov.be/drug/nl/statistics-scientific-information/consensus/2009-11-26/pdf/lv.pdf

SCIENTIFIC COMMUNICATIONS

Oral presentations on international congresses

Nursing interventions in medication management. 'Nurse Education Tomorrow 2008 conference', University of Cambridge , United Kingdom. 2 September 2008.

The knowledge of nurses about medication management. 'Nurse Education Tomorrow 2008 conference', University of Cambridge , United Kingdom. 3 September 2008.

Nursing students' pharmacological knowledge and calculation skills', Autumn meeting of the Belgian Society of Fundamental and Clinical Pharmacotherapy and Pharmacology. 24 October 2009.

Nursing students' pharmacological knowledge and calculation skills. 'Nursing Research Conference 2009', University of Alicante, Spain. 11-13 November 2009.

Barriers to medication safety in nursing homes. 'Nursing Research Conference 2009', University of Alicante, Spain. 11- 13 November 2009.

Development of a drug related problem trigger tool. 'International Association of Geriatrics and Gerontology congress', Bologna, Italy. 14 – 17 April 2011

Presentations on national congresses/ symposia

Poster presentation: 'Congenital Heart Diseases' op symposium 'Onderzoek en Praktijk in Dialoog', UA, CDE, 27 november 2007

Poster presentation: 'Begincompetenties voor studenten verpleegkunde'

Onderzoeksdag van de associatie K.U.Leuven, 3 februari 2009

Oral presentation: Onderzoeksresultaten 'hoger op de kwalificatieladder' , Symposium Vlaamse Onderwijsraad, 11 december 2009

Oral presentation 'Evidence Based Nursing, NVKVV, 27 October 2010

Oral presentation 'correct meten in de gezondheidszorg', Avondsymposium MaVVerAnt, 18 oktober 2010

Other scientific communications

Medeorganisator jaarlijks 'Symposium Onderzoek en Praktijk in Dialoog', Vakgroep Verpleeg- en Vroedkunde, UA, CDE

Medeorganisator avondsymposia MaVVerAnt, alumnivereniging Master Verpleegkunde en Vroedkunde, Universiteit Antwerpen

Jurylid RIZIV Consensusvergadering 'Het doelmatig gebruik van geneesmiddelen bij de behandeling van migraine.' 26 en 27 november 2009 + opmaak juryrapport.

Moderator symposium beroepsvereniging voor recovery verpleegkundigen 'Een gewichtig probleem op recovery'. UZA, 10 juni 2010

Panellid van debat m.b.t. medicatiedistributiesystemen, Katholieke Hogeschool Kempen, campus Geel, 19 mei 2010

Moderator symposium alumnivereniging MaVVerAnt maart 2010

Reviewopdrachten (2) voor artikels ingediend voor publicatie in Nurse Education Today.

Dankwoord

De doctoraatsthesis is afgewerkt. Het is 30 november 2011. De juryleden hebben het werk geëvalueerd en goed bevonden voor verdediging. De laatste hand wordt gelegd aan de kaft.

Het dringt nog niet helemaal tot mij door. Vier jaar heb ik gewerkt aan dit doctoraatsproject. Werkdagen waren vaak zeer lang en weekends en vakanties werden geïnvesteerd. De voorbije jaren is het doctoraat een belangrijk deel van mijn leven geweest. Nu is de thesis klaar, of toch bijna. Bij de totstandkoming heb ik kunnen rekenen op de steun van zeer veel mensen. Een dankwoord aan hen is het laatste deeltje dat nog moet worden toegevoegd. Het lijkt echter haast onmogelijk om mijn dank uit te drukken in woorden die in verhouding staan tot de steun, het vertrouwen, het geduld en de inhoudelijke feedback die ik heb gekregen. Om volledig te zijn, zou ik het dankwoord zelfs moeten uitbreiden met personen die een belangrijke rol hebben gespeeld in mijn leven voor de start van mijn doctoraat. Ik beperk mij hier echter tot de personen die het meest betrokken waren bij de totstandkoming

Januari 2007, mijn semesterexamens van het masterjaar van de opleiding tot 'Master in Verpleeg- en Vroedkunde' aan de Universiteit Antwerpen (UA) waren bijna afgerond, kreeg ik telefoon van Bart Van Rompaey. Hij vroeg, in naam van de vakgroep, of ik interesse had in een doctoraat binnen het onderzoeksdomein 'kwaliteit van geneesmiddelenzorg bij ouderen'. Een maand later diende ik een onderzoeksvoorstel in bij het Fonds voor Wetenschappelijk Onderzoek (FWO). Het voorstel werd gunstig prioritair gerangschikt door het FWO, maar werd niet weerhouden voor financiering door de universiteit. Op 1 oktober 2007, kon ik toch, ondersteund door een Dehoussemandaat voor 1 jaar, mijn doctoraatsonderzoek aanvangen.

Vanaf die beginfase tot nu heb ik altijd kunnen rekenen op drie personen: prof. dr. Monique Elseviers (promotor), prof. dr. Robert Vander Stichele (co-promotor) en prof. dr. Bart Van Rompaey. Naar hen gaan mijn eerste woorden van dank.

Monique, waar moet ik beginnen … Als promotor heb je alles gedaan wat je kon om mij te begeleiden bij mijn onderzoek en om mij de competenties bij te brengen die te verwachten zijn van een doctor in de medische wetenschappen. Je bent mijn zelfstandigheid steeds meer gaan respecteren, appreciëren en verdedigen. Je hebt me de mogelijkheid gegeven om van het oorspronkelijke protocol af te wijken en zelf de richting van mijn onderzoek te bepalen. Met mijn ideeën kon ik steeds terecht voor een kritische discussie. Ondanks je drukke agenda, waren besprekingen van analyses en publicaties altijd zeer gedetailleerd. Je hebt me uitdagingen geboden die mij hebben doen groeien als persoon en als professional. Bedankt voor de begeleiding, je vertrouwen in mij en de aanmoedigingen gedurende meer dan vier jaar.

Bob, jouw expertise en connecties als huisarts, klinisch farmacoloog en onderzoeker hebben niet enkel inhoudelijk bijgedragen tot de totstandkoming van de thesis. Ze hebben ervoor gezorgd dat het interprofessioneel karakter van het onderzoek vergroot werd, dat interprofessionele samenwerking mogelijk gemaakt werd en dat niet voorbij gegaan werd aan de visies van andere disciplines. De besprekingen met jou en Monique waren steeds een belevenis met leerrijke resultaten. Bedankt voor je vertrouwen en je begeleiding.

Bart, je was geen promotor, geen co-promotor, maar wel een soort van mentor. Op een congres werd ik wel eens je 'protégé' genoemd. Jij was het die me helemaal in het begin meenam naar een receptie op de universiteit en zei; "Dit is nu je nieuwe biotoop". Ik was nog onwennig, maar jij hebt ervoor gezorgd dat ik me nu thuis voel in die biotoop. Je hebt me geholpen alles in het juiste perspectief te plaatsen. Je hebt steeds heel sterk ik me geloofd en getracht mij te overtuigen van je gelijk. Je hebt in ieder geval gelijk gekregen dat ik mijn doctoraat zou behalen. Bedankt voor je voortdurende steun. Bedankt voor de gezellige babbels met een Leffe.

Na een jaar Dehousse-mandaat, kon ik niet meer over middelen beschikken om mijn onderzoek verder te zetten. Aan de UA kreeg ik een vrijwillig BAP-statuut en de nodige infrastructuur om mijn onderzoek te kunnen uitvoeren. Met de hulp van de eerder vernoemde drie personen, kreeg ik nieuwe kansen. Prof. dr. Lucas Van Bortel van het Heymans Instituut voor Farmacologie van de Universiteit Gent (UGent) geloofde sterk in het onderzoeksproject en zorgde voor een financiering van 20%. Deze financiering kreeg ik voor de resterende duur van mijn doctoraatstraject. Zonder deze financiële steun van prof. Van Bortel was het waarschijnlijk onmogelijk geweest om mijn onderzoek verder te zetten.

De overige 80% vulde ik in met een nieuwe job als lector aan de Katho-

lieke Hogeschool Kempen (KHK), departement gezondheidszorg, te Lier. De combinatie van onderwijstaken aan de UA, mijn onderzoek (UA – UGent) en mijn nieuw job als lector (KHK) vereisten een goed timemanagement en flexibiliteit van alle partijen. Het departementshoofd van de Hogeschool, mevr. Annie Goossens en mijn collega's mogen daarom niet ontbreken in deze bedankingen.

Vanaf 2009 werd ik opnieuw aangesteld als bezoldigd academisch medewerker aan de UA. De faculteit geneeskunde en gezondheidswetenschappen heeft me de mogelijkheden geboden om bij te dragen als assistent aan de opleiding tot Master in Verpleeg- en Vroedkunde, waarvan ik de waarde hoog inschat. Ook mijn collega's van de vakgroep wil ik bedanken, met in het bijzonder nog Olaf Timmermans, die mij vergezelde op mijn eerste internationale congres.

Het is onmogelijk om alle woonzorgcentra en scholen met de deelnemende verpleegkundigen, zorgkundigen, artsen, apothekers, CRA's, directieleden, docenten en studenten individueel te vermelden. Zonder hun vrijwillige inzet was datacollectie onmogelijk geweest. Mijn dank gaat dan ook uit naar alle deelnemers. De interventiestudie vereiste de meest intensieve samenwerking. In het bijzonder wil ik daarom Zorgbedrijf Antwerpen, WZC De Lindelo, WZC De Meerminne, Huize St. Anna en Heyvis bedanken. Dr. Ivan Leunckens, dr. Luc Hanegreefs en apr. Wil Rooyackers hebben de interventiestudie op bijzondere wijze mee gefaciliteerd. Bij de ontwikkeling van de trigger tool kon ik rekenen op de hulp van Dirk Van Nimwegen voor de programmatie. Elke Van den Brande, Tina Weyns, Sonja Greyn, Maja Lopez Hartmann, Kateleine Panneels, Silas Rydant, Peter Soogen, Thijs Karman en Heidi Creemers droegen tijdens hun opleiding bij aan het proces van datacollectie.

Diegene die ik heel speciaal wil bedanken is mijn man Kristof Van Eepoel. Hij heeft mij gemotiveerd om een master te studeren, ondanks de tijdelijke financiële gevolgen. Hij heeft me overtuigd het doctoraat aan te vangen. Ruim vier jaar heeft hij mij op regelmatige basis moeten aanmoedigen om vol te houden. Omdat ik publicaties schreef in verlofperiodes, hebben we minder kunnen reizen. De lange werkdagen maakten dat ik vaak niet thuis was. Meer huishoudelijke taken kwamen bij hem terecht. Bezoekjes aan vrienden en familie waren niet gemakkelijk te plannen. Zelfs ons huwelijk hebben we snel tussendoor gepland. Mijn vermoeidheid kon de sfeer wel eens verpesten. Herhaaldelijk moest hij mij overtuigen van mijn kunnen. Maar, desondanks, heeft hij mij met heel veel geduld de hele periode bijgestaan. Zonder hem was ik niet gestart en had ik zeker het einde niet gehaald.

Kristof, bedankt voor je vertrouwen, je geduld, je hulp, je verdraagzaamheid, je begrip, je overtuigingskracht, je soms harde maar correcte en con-

structieve feedback. Je hebt me alle kansen gegeven om mezelf te ontwikkelen, soms ten koste van jezelf. Jij hebt mijn leven veranderd op alle domeinen, maar volledig naar mijn zin!

De meeste andere familieleden en vrienden konden me wel eens de oren van het hoofd zeuren over de bezoekjes die achterwege bleven. Hoewel bezoekjes inderdaad schaars waren, zijn ze mij blijven steunen en zijn ze hun interesse in mijn werk niet verloren. Ik heb geluk door deze warme mensen omringd te mogen zijn.

Mijn laatste woorden gaan uit naar onze dochter. Je zit nu nog warm opgeborgen in mijn buik, maar je komst zal niet lang meer op zich laten wachten. Je geboorte is uitgerekend over twee maanden. De voorbije maanden heb je me vergezeld bij het afronden van het laatste onderzoek, het schrijven van de laatste twee publicaties, het samenstellen en opmaken van de doctoraatsthesis, het organiseren van de verdediging, … De tijd resterend voor je komst om het doctoraatsonderzoek af te ronden was zeer kort. Ik heb er alles aan gedaan om dit toch gerealiseerd te krijgen. Je papa en ik hadden trouwens afgesproken geen kinderen te hebben voor de afronding van het onderzoek. Dankzij het goede verloop van de zwangerschap en dankzij de extra inspanningen van mijn promotoren, de juryleden, de mensen die de opmaak van de thesis mee hebben verzorgd en mevr. Kristin Deby, zal alles tijdig afgewerkt geraken. De verdediging is gepland op 20 december. Daarna beloof ik extra tijd voor jou en je papa te maken.

Tinne Dilles
30 november 2011