POLYPHARMACY AMONG NURSING HOME RESIDENTS IN LOLLAND

- CAN THE PHARMACOTHERAPY BE RATIONALIZED BY MEDICATION REVIEWS?
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Title: Polypharmacy among nursing home residents in Lolland – can the pharmacotherapy be rationalized by medication reviews?
Preface
This project is conducted in collaboration with Region Zealand and is part of the project “Broen til Bedre Sundhed”, which focus on enhancing the overall health in Lolland and Falster. The project was initiated 1st September 2013 and completed 1st June 2014, and was executed at nursing homes in Lolland and at the Region headquarters in Sorø. Charlotte Vermehren, Cand. Pharm., PhD, and Regional Pharmaceutical Consultant, is the primary supervisor. We would like to express our gratitude for Charlotte’s extensive dedication and support throughout the entire project. The project has been formulated in collaboration between Mette Pedersen and Cecilie W. Skovholm, who has contributed equally to every section of the report.

Abstract
Polypharmacy, the consumption of more concomitant drugs, increases the risk of drug related problems, like ADRs. Age is known to predispose to polypharmacy as the number of chronic diseases and thereby the number of drugs consumed increases especially for people aged ≥65. Furthermore, polypharmacy patients account for an extensive part of the yearly medicine expenses. Medication reviews have been proposed as an approach to enhance rational pharmacotherapy for elderly polypharmacy patients and result in cost savings for patient and society. In this project, medication reviews have been conducted for 47 nursing home residents in Lolland. The residents’ medicines have been assessed by MAI and START/STOPP in order to investigate if medication reviews can increase the appropriateness of pharmacotherapy. Along with medication reviews, two educational sessions for nursing home health care personnel were held. The aim was to give the health care personnel more knowledge about appropriate medication administration and prevent inadvertent incidents, in order to optimize the pharmacotherapy of the elderly nursing home residents. Results showed that medication reviews can improve the appropriateness of medical treatment of nursing home residents, when assessed by the STOPP criteria and MAI score. Education of health care personnel increased their knowledge about correct medicine administration, common diseases in elderly, and the medical treatment of these diseases. The rational pharmacotherapy of nursing home resident in Lolland is improved after the conduction of medication reviews, despite the minor savings achieved.
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1. Definitions

ADR: a reaction that is noxious and unintended, and which occurs at dosages normally used in humans for prophylaxis, diagnosis, or therapy.

Appropriate polypharmacy: prescription of medicine in accordance with best evidence, i.e. the treatment known to be effective for a specific disease or condition.

Drug related morbidity: clinical or biosocial manifestation of unsolved drug-related problems that may be recognized by the patient, a caretaker, or a clinician.

Drug related problem: when a drug does not provide the most optimal treatment for the patient but instead potentially causes harm to the patient.

Elderly: People aged ≥65.

Health care personnel: personnel with an educational background as social and health care assistant or social and health care worker.

Inadvertent incident: known or unknown events or errors occurring in the healthcare business, and not caused by the patient's illness and are either harmful or potentially harmful.

Inappropriate polypharmacy: prescription of several medications without achieving the intended effect.

Medication reconciliation: a procedure to ensure a complete and actual overview of drugs consumed by the patient compared with the drugs prescribed by physicians.

Medication review: a structured and critical review of the patient's medication with the aim to optimize pharmacotherapy.

Multidisciplinary team: collaboration between different professions in the health sector.

Multimorbidity: the occurrence of two or more long-term diseases in the same person.

Polypharmacy: The concomitant daily consumption of ≥6 drugs.

Rational pharmacotherapy: the use of a pharmacotherapy that is scientifically justified, economically sound, and practical to use.
## 2. Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<tr>
<td>ADL</td>
<td>Activities of daily living</td>
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<td>ADR</td>
<td>Adverse drug reaction</td>
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<tr>
<td>CIRS-G</td>
<td>Cumulative illness rating scale</td>
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<td>COPD</td>
<td>Chronic obstructive pulmonary disease</td>
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<td>CPG</td>
<td>Clinical practice guideline</td>
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<td>C\textsubscript{ss}</td>
<td>Steady state concentration in plasma</td>
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<td>DHMA</td>
<td>Danish health and medicine authority</td>
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<td>DPSD</td>
<td>Danish patient safety database</td>
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<td>DSAM</td>
<td>The Danish college of general practitioners</td>
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<td>ESS</td>
<td>Exton-smith scale</td>
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<td>GPGP</td>
<td>Good palliative geriatric practice</td>
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<td>IADL</td>
<td>Instrumental ADL</td>
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<td>IRF</td>
<td>Institute for rational pharmacotherapy</td>
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<td>MAI</td>
<td>Medication appropriateness index</td>
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<tr>
<td>MNA</td>
<td>Mini nutritional assessment</td>
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<td>NaSSA</td>
<td>Noradrenergic and specific serotonergic antidepressants</td>
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<td>NSAID</td>
<td>Non-steroid anti-inflammatory drugs</td>
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<td>SPMSQ</td>
<td>Short portable mental status questionnaire</td>
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<tr>
<td>SSRI</td>
<td>Selective serotonin reuptake inhibitor</td>
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<tr>
<td>START</td>
<td>Screening tool to alert doctors to right treatment</td>
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<tr>
<td>STOPP</td>
<td>Screening tool for older persons’ prescriptions</td>
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<td>WHO</td>
<td>World health organization</td>
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3. Background
Polypharmacy can have a negative impact on patients’ lives in terms of e.g. ADRs, falls, hospitalizations, and reduced quality of life. (13-16) Several factors have shown to affect the prevalence of polypharmacy, where ageing is one of the most essential factors. However, factors like demographics and health status are also important (17). Elderly and people living in deprived counties are more likely to have multiple chronic conditions, which require more medical treatment and therefore more often become polypharmacy patients (18).
In Lolland, the percentage of elderly is higher compared to other areas of Denmark. Additionally, the citizens in Lolland have a lower educational level, a higher unemployment rate, and a lower average income. Therefore, Lolland is a region where many of the factors correlated to polypharmacy are present. (19)
Elderly nursing home residents are in greater risk of inappropriate pharmacotherapy, both in terms of over-prescription, under-prescription, and misuse, emphasizing the importance of optimizing the appropriateness and rationality of pharmacotherapy for this patient group (20).
Polypharmacy furthermore increases the medication related expenses for both patient and society, why a reduced number of drugs will benefit all concerned (21).
Inadvertent incidents are commonly seen among nursing home residents who consume more concomitant medication, and often concern administration and dispensing errors. Literature has suggested education of health care personnel as an effective method to prevent the occurrence of inadvertent incidents (22, 23).

4. Purpose
The aim of this project is to investigate if the conduction of medication reviews and education of health care personnel can effectively improve the appropriateness and rationality of the pharmacotherapy of elderly nursing home residents in Lolland and prevent the occurrence of inadvertent incidents. The medication reviews are conducted by means of official guidelines and recommendations used by Danish physicians and the appropriateness of pharmacotherapy is assessed by the use of the START/STOPP criteria and MAI scores.
5. Thesis Statement

Can the appropriateness of medical treatment of elderly living in nursing homes in Lolland be improved by conducting medication reviews, and hence achieve an increased rational pharmacotherapy for the elderly resulting in more appropriate medical treatments and cost savings for both the elderly and society?

Is the medical treatment of nursing home residents in Lolland rational?
- Can the conduction of medication reviews increase the appropriateness of pharmacotherapy of polypharmacy patients when assessed by the START/STOPP criteria and MAI scores?
- Can Region Zealand reduce health care related costs by conducting medication reviews for polypharmacy patients in Lolland?
- Will the health care personnel at nursing homes in Lolland gain more knowledge about appropriate medicine administration and treatment of specific diseases through education?
6. Introduction to Polypharmacy

The term “polypharmacy” has no clear definition but is generally applied when describing the concurrent use of multiple drugs (13, 14, 17, 24-27). Definitions differ between studies and institutions and have special focus areas, varying from a simple count of medicine to consumption of medicine with no indication (13, 25, 28-30). Nevertheless, many studies refer to polypharmacy as the consumption of ≥5 concomitant drugs (25, 28, 30). Polypharmacy tend to have a negative connotation and is considered a phenomenon physicians should strive to avoid. However, some conditions, such as diabetes mellitus and hypertension need treatment with a combination of concomitant drugs in order to obtain the most effective treatment (31, 32). In general, this is especially evident for patients with multiple chronic conditions and polypharmacy can be a natural part of a treatment regimen following good clinical practice and guidelines (13, 14, 32, 33).

Duerden et al. (14) have made an extensive report covering different aspects of polypharmacy with focus on making it safe and sound. They divide polypharmacy into two terms; “appropriate polypharmacy” and “problematic polypharmacy” (14). According to Duerden et al. (14) appropriate polypharmacy is the prescription of medicine in accordance with best evidence, i.e. the treatment known to be effective for a specific disease or condition. Appropriate polypharmacy provides the optimal treatment in terms of quality of life, a decreased risk of drug reactions, and a longer life expectancy (14).

Problematic polypharmacy is however inappropriate prescription of several medications without achieving the intended effect. Examples of problematic polypharmacy are prescription of medicine with no evidence or a regimen of drugs interacting and thereby creating harmful reactions for the patient (14).

A harmful reaction can also be noted an adverse drug reaction (ADR) and is a common consequence of polypharmacy (24, 25, 34, 35). WHO defines an ADR as “a reaction that is noxious and unintended, and which occurs at dosages normally used in humans for prophylaxis, diagnosis, or therapy” (25). The risk of an ADR increases with an increasing number of drugs consumed on a daily basis (13-15, 25).

Changes in pharmacokinetic and pharmacodynamic parameters cause elderly to be more vulnerable to ADRs, which naturally have unwanted consequences (8). Generally, ADRs experienced by elderly affect their everyday-life negatively in terms
of e.g. urinary incontinence, sedation, constipation, and an overall reduced quality of life (16). Additionally, ADRs can cause elderly to exhibit geriatric syndromes including impaired balance, which in worse cases lead to falls (6, 13, 16). For elderly, the consequences of falls are radical; 20-30% of falls lead to injuries decreasing independence and mobility, and in worst cases increase the risk of an early death (6, 36).

As the risk of ADRs increases with an increasing number of drugs and age, so does the risk of hospital admission (14-16, 25). Hospitalizations related to medication account for approximately 6-14% of all admissions in Denmark (37). It can be difficult for physicians to detect ADRs in elderly because they often have more chronic conditions and ADRs can be misinterpreted as symptoms of the condition. If a physician misinterprets an ADR as a new symptom or disease the physician will often prescribe new medicine in order to relieve symptoms, which can lead to a cascade effect aggravating polypharmacy (6, 16, 25).

Polypharmacy has shown to be more widespread among the elderly population (13, 15, 17, 28, 38, 39). In general, people live longer (6, 40, 41) which is also the trend in Denmark (9) and give birth to fewer children (1), as seen in figure 6.1 and 6.2 respectively. As a result of this trend, the elderly will inevitable account for an increasing part of society (17-21). WHO defines an elderly person as one being ≥65 years old (42). During the past century the percentage of people aged ≥65 has increased from 7% to 16% and it is estimated that this population will account for 25% in 2050 (17, 22). Additionally, the number of chronic diseases and thereby also the need for medical treatment increases especially for people aged ≥65, statistically leading to an increasing number of polypharmacy patients (20, 23, 13, 15, 32).

Various factors affect the prevalence of polypharmacy (17). Three of them are demography, health status (17), and guideline recommendations (6). Firstly, the
demographic category includes educational level and residential county among others (17, 18, 31). People living in deprived counties are more likely to have multiple chronic conditions, which they additionally develop in an earlier age compared to people living in affluent counties. Furthermore, populations in deprived counties have a shorter life expectancy and are more likely to develop mental diseases. This uneven distribution of health makes people in deprived counties ill for a longer period of time and they die in a younger age compared to people in affluent counties (18, 43, 44).

Secondly, studies have shown that multiple concomitant diseases are a contributing factor to polypharmacy (6, 41, 45). Naturally, multiple chronic conditions call for a greater need of medical treatment, resulting in a higher risk of becoming a polypharmacy patient (18).

Thirdly, clinical guidelines are often based on single diseases and do not include recommendations for patients with multiple diseases (6). Applying single disease guidelines on patients with multiple diseases can in many cases lead to excessive drug use and polypharmacy, as further explained in section 7 (6).
Lolland is a county in Denmark that can be defined as a deprived area, as several of the mentioned factors are present here. As seen in figure 6.3, Lolland has a lower educational level compared to the average educational level in Denmark.

Additionally, the average income is lower and the average unemployment rate is higher compared to all of Denmark (7, 8, 46). The average income in Lolland and all of Denmark is seen in figure 6.4. Lolland also has a greater percentage of elderly residents than the average percentage of elderly residents in Denmark (19). These are all factors contributing to the risk of becoming a polypharmacy patient.
Polypharmacy is not just an increasing problem for the elderly but also for the socio-economy (6). In 2005 people aged ≥65 constituted of 16% of the total Danish population but accounted for 40% of the 16 billions that the Danish government had reserved for medicine that year (47), underlining that elderly patients are major drug consumers (6, 45, 47). An article by Köberlein et al. (21) state that health care expenses are correlated to the intensive care patients receive in the last six months of their life, overmedication, and polypharmacy (21). Furthermore, it states that managing the patients’ medication could possibly decrease the healthcare expenses (21).

In 2009, 13% of the Danish population was considered polypharmacy patients as they daily consumed ≥6 drugs and accounted for 58% of the total medicine costs in primary care (48). In 2009, the Danish population consisted of 5,511,000 people, corresponding to 716,430 polypharmacy patients (49). The average price of a drug was 4.50 DKK a day, in 2009, corresponding to a cost of 1,643 DKK a year pr. drug pr. patient. If every Danish polypharmacy patient discontinued treatment with one drug, the annual savings would be approximately 1.2 bn. DKK, emphasizing the high socioeconomic expenses of polypharmacy patients.

7. Multimorbidity and Physical Changes in Elderly
Multimorbidity is by the Danish Health and Medicines Authority (DHMA) defined as “The occurrence of two or more long-term diseases” (4, 14). Statistics show that the occurrence of multimorbidity increases with age, as seen in figure 7.1, which depicts the increasing incident of multimorbidity with increasing age, among the Danish

![Percentage of people with multimorbidity](image)

*Figure 7.1 shows the percentage of people in Denmark in 2010 with multimorbidity divided among age groups and gender (4).*
Prevalence of specific diseases among 65-84 year old people in Denmark in 2005

Figure 7.2 shows the prevalence of specific diseases among 2,746 65-84 year old people in Denmark in 2005. (3)

countries stated in an English report by Duerden et al. (4, 14). Additionally, studies have shown that women tend to consume more drugs than men (15, 28, 39). A report from 2005 by the DHMA states that the 3 most common diseases among 65-84 year old people in Denmark were osteoarthritis/rheumatoid arthritis, hypertension, and back-related disorders (3). This is illustrated in figure 7.2, where the 19 most common diseases from the report are seen (3).

7.1 Physical Changes in Elderly

The ageing process is complex and influenced by individual factors such as genetics, social and psychological conditions, making the health status among elderly widespread (16, 37, 51, 52). The decline that naturally occurs with age is evidence of the processes happening inside the body and especially the cardiovascular and renal system are affected by aging (53, 54).

When aging, arteries loose their elasticity because the intima and media layer become hypertrophic, which damage the elastic layer resulting in an increased systolic blood pressure (54).
The renal system is one of the systems highly affected by aging (47, 54). From a person is 50 years old the average kidney mass will be reduced by 30% over a 40 year time span, primarily because of a reduction of the cortical mass. This results in a reduced ability to absorb and excrete electrolytes, reduced drug clearance, and reduced ability to concentrate and dilute urine (54).

8. The Challenge of Treating Polypharmacy Patients

Healthcare systems and governments worldwide are currently confronted with the growing prevalence of patients with multimorbidity and the challenge of treating these patients appropriately (18). Appropriate pharmacotherapy for elderly is more challenging than treatment of younger individuals (41). This is due to physiological changes in elderly, individuality of their health status, and the fact that a higher number of elderly suffer from multimorbidity, all making it difficult for physicians to follow clinical guidelines (16, 41, 52).

The general purpose of clinical guidelines is to standardize treatment of specific diseases and thereby reduce the treatment variability and prevent errors (41). Unfortunately, most guidelines are based on clinical trials with participants who only have a single condition and excluding patients with multimorbidity and high age. Therefore, guidelines does not consider elderly with multiple conditions, which makes it harder for the physician to follow guidelines and ensure appropriate pharmacotherapy (6, 14, 40, 41). A study, investigating the effect of applying single disease guidelines on multiple morbidities, found that a patient with five chronic diseases lead to a prescription of 19 doses of 12 different drugs, which should be administered five times a day (55). Besides the overwhelming amount of drugs to consume for the patient, which can lead to problematic polypharmacy, it furthermore increases the risk of ADRs, e.g. in terms of drug-drug interactions and drug-disease interactions (14, 43).

The Danish College of General Practitioners (DSAM) develop many of the guidelines used in clinical practice in Denmark in order to prevent common issues, uncertainty, and variations in the general practice (56).

Danish guidelines for specific diseases do take few other diseases into account, diseases that are often seen in relation to the specific disease, but it is impossible for guidelines to cover all diseases. Therefore, the physician must focus on the individual
patient and prioritize treatments, in order to ensure rational pharmacotherapy and avoid problematic polypharmacy (37, 57). Due to lack of guidelines for patients with multimorbidities it is necessary to thoroughly assess elderly patients e.g. by the use of multidisciplinary teams, consisting of e.g. nurses, physical therapists, social workers, physicians, and geriatricians, who consider both the clinical guidelines and patients’ geriatric status, including social and economic factors (6). The assessment by multidisciplinary teams, have shown improvement in the medical care of elderly patients in terms of reduced drug related problems, which ultimately results in decreased mortality, longer life expectancy, and an optimized pharmacotherapy (6, 58-60).

Sergi et al. (6) have developed a flowchart, as seen in figure 8.1, pointing out the differences in treating elderly compared to other adults and how multidisciplinary teams can positively affect the treatment of elderly patients. As shown in the figure,

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Figure 8.1 shows a flowchart developed by Sergi et al. describing the difference in treating adults compared to elderly patients.

elderly patients should undergo a comprehensive geriatric assessment by a multidisciplinary team in order to consider several factors i.e. functional, cognitive, and nutritional status along with prognosis and life expectancy. Furthermore, treatment has to be prioritized and tailored for the individual elderly patient in order to ensure appropriate and rational pharmacotherapy (6).

8.1 The Barthel Index

In 1958, the Barthel Index was developed by the American physiotherapist Dorthea Barthel as a tool to monitor chronically ill patients’ degree of dependence in doing 10 activities of daily living (ADL) (61). In an article by Hartigan et al. the Barthel Index was compared to another tool for assessment of functionality. They found (62) that the Barthel Index is a simple and comprehensive tool, which require little resources and is often used in elderly (62)

The 10 ADL-categories include activities such as eating, personal hygiene, and mobility. Different versions of the Barthel Index exists e.g. Barthel 20 and Barthel 100. There are 4 response-categories in the Barthel 20 there and 5 in the Barthel 100. With Barthel 20, the assessor can quickly get an overview of the patient’s need of help where the Barthel 100 provides a more precise picture of the patient’s degree of dependence of help. However, all versions assess the functionality of the patient and can clarify the degree of functional loss (61). When assessing the functionality of a patient by means of the Barthel ADL-test, the user needs to be aware of the risk of obtaining subjective results. However, studies have shown that concordant results have been obtained when different users, e.g. the patient itself, nurses, or physiotherapists, have assessed the functional level (62).

In Denmark, the Barthel Index has for many years been used to assess elderly and chronically ill patients both in daily practice and research, as it is a standardized method to obtain comparable results (61). The scores obtained in the Barthel 100 are divided into 5 ADL-categories. A higher ADL-score results in allocation to a higher ADL-category, which means that the patient is less dependent on help when performing daily activities (61, 63). The 5 categories are seen in table 8.1. As an example, a patient scoring 65 is allocated to the ADL-category 3 meaning that the patient is in moderate need of help in the daily activities. Moderate help means that the patient is in need of 20 hours of help pr. week (64).
ADL-category | Score | Explanation | Hours of Help
--- | --- | --- | ---
1 | 0-24 | Total dependent | 27
2 | 25-49 | Essential help is required | 23
3 | 50-74 | Moderate help is required | 20
4 | 75-90 | Little help is required | 13
5 | 91-99 | Minimal help is required | <10

Table 8.1 shows how the scores obtained in Barthel 100 are distributed into 5 categories (64).

9. Rational Pharmacotherapy

Rational use of medicine is the use of a pharmacotherapy that is scientifically justified, economically sound, and practical to use (65). Medical treatments should be based on randomized controlled trials including a clearly defined population and presenting results indicating the therapeutic difference between placebo or an already proven therapy and the new treatment. However, even though this is preferable it is not evident for all therapies available on the market (65). Therefore, it is important that physicians make careful considerations when prescribing in order to obtain the most rational use of medicines, which in the end benefits both the patients and the socio-economy (65). Generally, rational pharmacotherapy relies on four cornerstones: a therapy with the highest effect, fewest serious adverse events, fewest adverse events, and least expensive (66).

When prescribing for elderly it is particularly paramount that physicians make well-considered decisions before prescribing. The indication for a specific therapy should be carefully considered relative to age, other medical therapies, and the expected effect for the patient (65). It is important to consider the effect of adding additional drugs to a polypharmacy patient’s medicine regimen. The physician should therefore always consider the possibility of a non-medical treatment e.g. weight loss in the case of uncomplicated hypertension or stable type 2 diabetes (65).

A physician should ensure that the prescribed regimen is realistic for the patient to follow. It is often advantageous to administer medicine 1-2 times a day. More frequent administrations and especially consumption of more than three drugs leads to a decreased compliance and an increased risk of ADRs and interactions. When prescribing for elderly, it is essential to consider factors like tablet size and appearance, divisibility of the tablet, and ease of swallowing. (65). Medicine lists and dispensing boxes are often of great help to ensure correct administration of daily
medicine. In nursing homes, social and health care assistants and nurses are responsible for dispensing medicine in medicine boxes. This is an effective method but also time consuming (65). Another way to dispense medicine is dose dispensing where the local pharmacy administers the dosage of medicine according to prescriptions made by the physician. An advantage of dose dispensing is that it runs automatically ensuring that the patient always receive a correct dose of their medicine (65, 67). A predetermined treatment period is often preferable because it can prevent unnecessary continuation of a therapy with reduced effect, ensure correct phasing out of a drug, and prevent exceeding of recommended duration of treatment (65).

A central focus of rational pharmacotherapy is the economical aspect. Among equal drugs physicians should choose the least expensive. The requirement of economic prescription is not only of moral character, but physicians are obligated according to Danish legislation to choose the cheapest drug when prescribing in order to reduce cost for the patient and the society (65).

In 1999 Institute for Rational Pharmacotherapy (IRF) was established as an institute under the DHMA. IRF is directed towards primary and hospital care and work to promote rational use of medical treatment in Denmark. IRF evaluate existing and new medicinal products in terms of effect and economy. To guide physicians and other health care personnel, IRF make guidelines and lists covering the most rational choices of pharmacotherapy (66).

10. Drug Related Problems, Morbidity, and Mortality

When physicians prescribe medicine for their patients, it is with the aim to improve the health status and ultimately improve their quality of life (12, 68). However, there is always a risk of the opposite occurring, which can be the result of a drug-related problem, a term described by Hepler and Strand (12). A drug-related problem is when a drug does not provide the most optimal treatment for the patient but instead potentially causes the patient harm. Table 10.1 explains the eight categories of drug-related problems formulated by Hepler and Strand (12).
Drug-related problems usually lead to drug-related morbidity, which by Hepler and Strand (12) is defined as “the clinical or biosocial manifestation of unsolved drug-related problems and may be recognized by the patient, a caretaker or a clinician”. According to Hepler and Strand (12), there are five possible causes of drug-related morbidity, illustrated in table 10.2, with the last one “Inappropriate Monitoring” being the most important to prevent. If drug-related problems leading to drug-related morbidity remain unsolved it will in worst cases result in drug-related mortality, another term described by Hepler and Strand (12). Naturally, some drug-related morbidities cannot be predicted and are therefor not preventable. However, the majority of the drug-related problems are preventable and Hepler and Strand (12) propose that pharmacists could play a key role in foreseeing drug-related problems (12).

<table>
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<tr>
<th>Drug-related Problems</th>
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<tr>
<td>Untreated Indications</td>
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<td>The patient has an indication for a medical treatment but does not receive the drug for the indication</td>
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<tr>
<td>Improper Drug Selection</td>
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<td>The patient has a drug indication but takes the wrong drug</td>
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<tr>
<td>Subtherapeutic Dosage</td>
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<tr>
<td>The patient is treated with a too low dose for his/her indication</td>
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<tr>
<td>Failure to Receive Drugs</td>
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<tr>
<td>The patients does not receive a drug due to e.g. economic reasons</td>
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<tr>
<td>Overdosage</td>
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<tr>
<td>The patient is treated with a too high dose for his/her indication</td>
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<tr>
<td>Adverse Drug Reactions</td>
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<tr>
<td>The patient develops a medical problem due to ADRs</td>
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<tr>
<td>Drug Interactions</td>
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<tr>
<td>The patient develops a medical problem due to interactions</td>
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<tr>
<td>Drug Use without Indication</td>
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<tr>
<td>The patient consumes a drug without having the indication for the drug</td>
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</table>

Table 10.1 lists the eight categories of drug-related problems formulated by Helper and Strand. (12)

In Denmark, health care personnel are obliged to report inadvertent incidents to the Danish Patient Safety Database (DPSD), an initiative that serve to prevent drug-related problems and events leading to increased morbidity for the patient (69). Since September 2010 this obligation has included personnel in the municipal health sector. An inadvertent incident can be defined as: “Known or unknown events or errors occurring in the healthcare business and not caused by the patient’s illness and are
either harmful or could have been” (70). Studies have shown that elderly nursing home residents are in greater risk of inadvertent incidents and that there in 2011 was a discrepancy in 7% of the dispensed medicine at Danish nursing homes during a random check (69). Furthermore, a report shows that 72% of all reported inadvertent incidents from the municipal health sector were medicine-related. This emphasizes the necessity and importance of well-educated health care personnel in the municipal health sector (69).

11. Interventions to Improve Rational Pharmacotherapy
Medication reviews are a common method to assess and improve the pharmacotherapy of elderly patients. Medication reviews are often performed by a physician, a pharmacist, or multidisciplinary teams (2). Furthermore, few studies have also implied that education of health care personnel can improve the pharmacotherapy of elderly (22, 23).

11.1 Medication Reviews
IRF suggests medication reviews as a method to enhance rational pharmacotherapy. In Denmark, the Danish Regions and the Ministry of Health advice physicians to complete a medication review for all polypharmacy patients once a year if this is not already done regularly (71). Physicians and pharmacists have often mistaken medication reviews for medication reconciliation. Medication reconciliation is “a procedure to ensure a complete and actual overview of drugs consumed by the patient compared with the drugs prescribed” (37). An example of medication reconciliation is when a physician assures that the nursing home’s list of medicine is in accordance with the physician’s prescriptions. Often, there is an incomplete overview of the

<table>
<thead>
<tr>
<th>Possible Causes of Drug-related Morbidity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inappropriate Prescribing</strong></td>
</tr>
<tr>
<td>An inappropriate or unnecessary regimen</td>
</tr>
<tr>
<td><strong>Inappropriate Delivery</strong></td>
</tr>
<tr>
<td>The drug is not available or there is a dispensing error</td>
</tr>
<tr>
<td><strong>Inappropriate Behavior by the Patient</strong></td>
</tr>
<tr>
<td>Patient compliance with an inappropriate regimen or non-compliance with an appropriate regimen</td>
</tr>
<tr>
<td><strong>Patient Idiosyncrasy</strong></td>
</tr>
<tr>
<td>An idiosyncratic response to the drug or a mistake or an accident made by the patient</td>
</tr>
<tr>
<td><strong>Inappropriate Monitoring</strong></td>
</tr>
<tr>
<td>Failure to detect and resolve an inappropriate therapeutic decision or failure to monitor the effects of the regimen</td>
</tr>
</tbody>
</table>

Table 10.2 lists the five possible causes of drug-related morbidity. (12)
patient’s medicine and therefore medication reconciliation generally precedes a medication review. A medication review is “a structured and critical review of the patient's medication with the aim to optimize drug therapy” (37) and is according to DSAM especially relevant for patients consuming ≥4 drugs i.e. polypharmacy patients, even though others define polypharmacy as consuming ≥5 drugs (2).

Generally a medication review includes two to three steps, which should clarify if any changes should be made to the current medicine regimen. First step involves assessment of the patient’s regular medicine e.g. correct dose and indication. Information about this is typically extracted from the physician’s database. Second step is to gather information about the patient’s current and previous conditions and other relevant medical information, which is also extracted from the physician’s database. If possible, a third step will be performed, namely interviewing the patient in regards to e.g. possible ADRs and other factors related to their daily medication (72).

A medication review can lead to e.g. correction of dose, discontinuation, or addition of new drugs in order to obtain appropriate pharmacotherapy (65). However, various studies have concluded that medication reviews are time consuming for physicians (2, 72, 73). An article by Lowe et al. (73) claim that yearly medication reviews would create an additional one-week workload for each physician (73). Instead, Lowe et al. (73) suggest that clinical pharmacists should implement the yearly medication review in their daily practice, a suggestion supported in an article by the Danish pharmacist Dorte Glintborg (2, 73).

Physicians have a central role when conducting medication reviews but other health care personnel such as pharmacists may also assists in the conduction and contribute with essential knowledge about medicine. Dorte Glintborg has, based on an English guideline, made a “medication review stair” including four steps (0-3) describing different ways to conduct medication reviews, as seen in figure 11.1 (2).

![Figure 11.1 shows different levels of medication reviews based on Dorte Glintborg’s figure (2)](image-url)
Step 0 is called “ad hoc” and is not an actual medication review. An example could be if the patient presents a new symptom, which the physician interprets as caused by a certain drug in the patient’s regimen. The physician will discontinue the drug without making sure that the symptom is not caused by another drug or interactions (2).

Step 1 is a technical medication review often performed by other health care personnel than a physician e.g. pharmacists. The pharmacist will get information about the patient’s medicine through the medicine profile or the patient itself. The pharmacist do not have access to clinical data and test results and can therefore have difficulties assessing the medicine e.g. when assessing the indication for a drug that is used for both hypertension and heart failure (2).

In Step 2, the medicine and clinical information is used to conduct the review. The information is used to optimize the medicine according to guidelines, economy, and treatment duration. The patient is not included in this step (2).

In Step 3, a combination of the medicine profile, clinical information, and an interview with the patient is needed to conduct the medication review. This situation could likely take place in the patient’s own home, which makes it possible to also assess the mobility and cognitive function of the patient (2).

A review made by Graabæk et al. (74) studied the effect of medication reviews for hospitalized patients conducted by pharmacists. The review included 31 articles, all evaluating the effect of medication reviews among different age groups, where eight of the studies were exclusively with elderly patients. The review revealed both positive and less positive results in favor of medication reviews. One of the positive results was of economical character as all articles showed evidence of cost savings. Furthermore, the appropriateness of prescribing was improved, which was assessed by using different tools such as the Medication Appropriate Index (MAI). The recommendations made by the pharmacists were moderate to highly agreed upon by the physicians (39-100%) indicating a good cooperation between pharmacists and physicians, which was in line with results from other studies not included in the review by Graabæk et al. (72, 75, 76). However, the medication reviews, included in the review by Graabæk et al., did not show to have any effect on mortality rates or readmissions and the same applies to health related quality of life (74).

Alldred et al. (77) have made a similar review but solely with elderly nursing home residents aged ≥65. The review included eight studies of which seven had medication reviews as an intervention to optimize prescribing. Results originated from studies
including 7,655 residents divided between 262 nursing homes in six different
countries, all assessing the effect of different interventions on specific outcome
measures e.g. ADRs, mortality, medication costs, and prescription appropriateness.
Beside medication reviews, the interventions included the use of multidisciplinary
teams and education of health care personnel. Results showed that there was no
evidence of effect on any of the outcome measures. The only significant outcome was
medication related problems were revealed and thereafter resolved. No definite
conclusion was made regarding costs, as the results were ambiguous (77).
Three other studies (20, 75, 76) showed independently that medication reviews made
by clinical pharmacists improved appropriateness of elderly’s medicine assessed by
either MAI (20, 75, 76) or the Screening Tool to Alert doctors to Right Treatment
(START) and Screening Tool for Older Persons’ Prescriptions (STOPP) criteria (20).

11.2 Education of Health Care Personnel
Inadvertent incidents are commonly seen among patients who consume more
concomitant medication and who live in nursing homes (23).
Inadvertent incidents often concern administration and dispensing of medication and
are often due to human errors such as omission, incorrect dosage, incorrect technique,
or unauthorized drug administration (22, 23). Incidents related to medicine can
increase patient morbidity and mortality and prevention of such errors can improve
patient outcome (22). An article by Verrue et al. (22) describe a study investigating the
effect of education of health care personnel in two nursing homes, concerning
appropriate administration of medicine. A pharmacist and a geriatrician evaluated the
overall error rate before and after the educational session. The education included
subjects like correct administration of medication e.g. crushing and splitting of tablets,
special warnings, and drug interactions. Results showed a significant decrease in
errors one month after the educational session, suggesting education as an effective
method for preventing medicine related errors. (22)

12. Tools for Evaluating Medication Appropriateness
No definite definition of appropriate prescribing exists nor a description of what the
term encompasses. However, appropriate prescribing is usually applied when
characterizing prescription of high quality both for patient and society. In context to
appropriate prescription there is also inappropriate prescribing, which often covers
various aspects of inappropriateness; underprescription, overprescription and misprescription. Assessment of appropriateness depends on how the investigator chooses to measure it i.e. which tools are used (72).

Various tools are available to help assess prescribing and they can generally be classified as explicit and implicit tools. The START/STOPP criteria and the MAI are examples of validated explicit and implicit tools respectively (13). Explicit tools are based on standards originating from reviews and expert opinions published in the literature. Explicit tools are focusing on drugs, symptoms, and disease and are often advantageous to use because they are not time consuming and can be used with little or no clinical assessment. However, explicit tools do not take the individual patient into account in terms of e.g. multimorbidity and the patient’s wishes. To get a more comprehensive picture of the individual patient implicit tools can be applied. These tools rely on judgments from the user and are based on the patient’s medical history, which is used to assess appropriateness. Implicit tools are, opposed to explicit tools, time consuming and can be of lower reliability, due to individual judgment by the user, but consider more factors than explicit tools (51, 52, 78).

12.1 START/STOPP Criteria

The STARTT/STOPP criteria are developed on the basis of Beer’s criteria and can be used to assess appropriateness of medicine during medication reviews (78). Geriatrician Mark Howard Beers developed the first Beers’ criteria in 1991, which have been updated several times since. The Beers’ criteria are 53 listed drugs or classes of drugs classified as “should be avoided”, “should be avoided with specific diseases and syndromes”, and “should be used with caution”. Because the Beers’ criteria were developed for use in Northern America and many of the drugs are unavailable in Europe, it was difficult to adjust the tool to European conditions. Furthermore, the Beers’ criteria lack important factors that can identify potential inappropriate prescribing, which can result in ADRs like drug-drug interactions. Therefore the START/STOPP criteria were developed in 2007, as an updated European counterpart to the Beers’ criteria. (78, 79)

The START/STOPP criteria were developed by O’Mahony et al. (78) and consist of 22 START and 65 STOPP criteria, and were subsequently approved by a group of 18 experts in geriatric medicine, clinical pharmacology, and primary care etc. before published (78). The 22 START and 65 STOPP criteria are seen in appendix 1. The
START criteria include drugs that should be considered for elderly patients with specific diseases. The STOPP criteria consist of drugs, which are considered inappropriate for elderly and should be avoided or discontinued. The START/STOPP criteria are an explicit tool, focusing on drugs, symptoms, and diseases. It is easy to use and not time-consuming, but does not consider the individual patient (78).

12.2 Medication Appropriateness Index (MAI)

MAI was developed in 1992 by Joseph T. Hanlon and Kenneth E. Schmader with the aim of making a sensitive implicit tool usable to enhance quality in prescription of medicine for elderly patients and is a tool commonly used in the literature (51). MAI is an implicit tool to assess the appropriateness of prescribing using a score system. The index consists of 10 questions concerning aspects of medicine administration, as seen in appendix 2. Each question is rated from 1-3 (1 = appropriate, 2 = marginally appropriate, 3 = not appropriate). The rating results in a summated score for each drug, used as a measure of the appropriateness of the specific prescription (52, 80). MAI have operational classifications and instructions for users, which aids a standardized rating. MAI is a time consuming tool because the user has to clinically evaluate each patient in regards to each question. However, MAI is an especially useful tool in regards to polypharmacy patients since three of the questions can be used to identify inappropriate polypharmacy: question 1, 2 and 8 about indication, effectiveness, and duplication respectively (52).

12.3 Risk Situation Drugs

In 2008, the DHMA formed a working group with the purpose of identifying drugs related to serious adverse event (81). The serious adverse events were specified as hospitalization, prolonged hospitalization, the need for acute lifesaving treatment, permanent injuries, or death. During the investigation it was found that since the 1970’s the same drugs or groups of drugs had been involved in situations leading to serious adverse events, either because of their pharmaceutical properties (e.g. narrow therapeutic window), because of incorrect administration by personnel, or inappropriate use by the patient (81). This resulted in the formation of two lists covering the specific drugs or groups of drugs called Risk Situation Drugs, meaning that it is not the drug itself that is dangerous, but the drug used in specific situations. The lists can be used during medication reviews to identify potentially harmful drugs,
as the drugs or groups of drugs at the lists are known to have caused preventable serious inadvertent incidents. These lists are seen in appendix 4 (81, 82).

12.4 National and Regional Recommendations

In Denmark, national recommendations are made by IRF and the DHMA e.g. the National Recommendation list and the Interactions Database. Regional recommendations are formulated by each of the five regions in Denmark e.g. The Basic List.

The subject of national and regional recommendations is to provide the newest evidence based information about medical treatments in order to assist e.g. help physicians to prevent inappropriate prescribing.

The purpose of the National Recommendation list is to guide practitioners to choose the most appropriate drugs for their patients among the available drugs within a therapeutic class. The recommendations are based on assessment of evidence of efficacy and safety, but not costs, of available drugs within a therapeutic class. The list is divided into three categories: “Recommended”, “Tentatively Recommended”, and “Not Recommended” (83).

IRF have additionally made a list called “Medicine where the indication should be reassessed in elderly” containing specific drugs whose indication should be reassessed if prescribed for elderly patients. This list is also divided into three categories: Red, Yellow, and Green, and therefore also called the Red-Yellow-Green list. The red category represents drugs that should not be prescribed to elderly unless special circumstances exist. The yellow category includes drugs that the physician should follow up on in order to ensure there is an accurate and current indication for the drug. Drugs in the green category should be reevaluated due to lack of evidence for long-term use and ADRs (84).

In 2003, the DHMA launched a web page called the Interaction Database, made by IRF and the Danish Pharmacy Association among others. The purpose of the database is to contribute to a safer pharmacotherapy by avoiding prescription of medicine that could lead to harmful drug-drug interactions. The user can type in a specific drug or active ingredients and look up any potential interactions associated with the specific drug or active ingredient. Alternatively, a complete medicine list can be typed in and thereby see if there are possible interactions among the drugs on the list (85).

The Basic List is an online tool developed in collaboration between the regions in
Denmark and IRF aimed at the primary sector. The list covers recommendations for first choice of drugs and is to be used in the prescription of drugs. The recommendations rely on assessment of which drugs are most effective, have fewest side effects, and the lowest price, which is in accordance with recommendations of IRF. Each region in Denmark has its own regional drug committee who has the overall responsibility for maintaining the basic list (85).

Every national and regional recommendation tool serve to ensure appropriate prescribing and safer treatment of patients, and can be used in the daily work of physicians and when conducting medication reviews.
13. Method

13.1 Study Design

This project is classified as a quality and development project and will be performed as an intervention study. The project includes 2 interventions: medication reviews and 2 educational sessions for health care personnel. The medication reviews will be conducted for 60 residents in 2 nursing homes in Lolland. It will be evaluated if medication reviews can improve the rationality of the medication of nursing home residents assessed by the START/STOPP criteria and MAI and if medication reviews can lead to potential savings. Additionally, an evaluation of if education of the health cares personnel can reduce the number of inadvertent incidents. The education will be conducted for personnel at 2 nursing homes at Lolland and will include information about common diseases among elderly in Denmark and the medical treatment of them. Additionally, information about inadvertent incidents will be presented. The education will be evaluated by the difference in number of inadvertent incidents 1 month before and after the education and the number of correct test answers before and after the educational session.

13.1.1 Outcome Measures

Primary outcome measure

- Can the rationality of pharmacotherapy of elderly nursing home residents be improved by medication reviews when assessed by the START/STOPP criteria and MAI?

Secondary outcome measures

- Can drug related costs be reduced by conducting medication reviews for polypharmacy patients?
- Can education of health care personnel at nursing homes reduce the number of inadvertent incidents and increase their knowledge about common diseases and the medical treatment of them?
13.1.2 Flowchart of the 2 Interventions in the Project

Figure 13.1 shows flowcharts of the 2 interventions of the project.
13.2 Initiation of the Project
Initially, coordination of start-up meetings with physicians, nurses, and the team leaders and health care personnel at the 2 participating nursing homes are planned. The project will be introduced to physicians at an “after-work meeting” and hopefully increase their engagement in the project. At the meetings with team leaders and health care personnel the inclusion and exclusion criteria will be presented, as they will select the 60 eligible residents. To inform residents, relatives, and health care personnel about the project, a pamphlet will be made. The pamphlet is seen in appendix 5.

Inclusion:
- Nursing home residents in Lolland
- ≥65 years of age
- Daily consumption of 6 or more drugs

Exclusion:
- Nursing home resident that do not fulfill the inclusion criteria
- Residents who are terminally ill

Medication Reviews
The medication reviews will be conducted in collaboration between a medication review team consisting of 2 thesis students, a pharmacist, and a geriatrician. After completing the medication reviews, the medication review team with hold meetings with the included physicians. At the meetings, potential drug related problems will be presented for the physicians. The potential drug related problems include actual drug related problems and questions needing clarification. The effect of the medication reviews will be assessed by:
- The number of recommended changes to medicine based on the actual drug related problems compared to the number of accepted recommended changes to medicine and the number of implemented recommended changes to medicine
- The difference in the appropriateness assessed by the START criteria before and after the conduction of medication reviews
• The difference in the appropriateness assessed by the START criteria before and after the conduction of medication reviews
• The difference in the appropriateness assessed MAI before and after the conduction of medication reviews
• The difference in the number of risk situations drugs before and after conduction of medication reviews
• The potential savings of the accepted discontinuations, generic substitution, and analogue substitution.

**Education**

Two educational sessions will be held for the health care personnel at the 2 nursing homes. A test including topics of the education will be handed out before and after the educational sessions. The effect of the educational sessions will be assessed by:

• The difference in number of correct test answers before and after the sessions
• The difference in number of inadvertent incidents for the 60 included residents 1 month before and 1 month after the education
• Feedback on the sessions from the health care personnel.
13.2.1 Timeline over the Planning and Executing of the Project

September 2013
- Coordination of meetings with nurses, team leaders and health care personnel at the 2 nursing homes

October 2013
- Hold meetings with team leaders, nurses, and the health care personnel at the 2 nursing homes

November 2013
- The 60 residents are identified and the medication reviews will be completed

December 2013
- Meetings with the included physicians

January 2014
- Accepted recommendations are implemented by the physicians before the end of January

February - March 2014
- Prepare and execute the 2 educational sessions

March - May 2014
- Process and analyse the results and complete the report

Figure 13.2 shows the timeline of the project.
13.2.2 Characterization of Residents
The database Care will be used to extract data and information about the selected residents. Care is daily used by the health care personnel and contains basic information about the residents.
A characterization of the included residents will be made by means of a modified Barthel 100 index (63), as seen in appendix 6. The Barthel 100 index is used to evaluate the residents’ ability to perform 10 ADL criteria, e.g. personal hygiene, dressing, lavatory visits etc. Regularly, health care personnel evaluate the residents’ ability to perform predefined everyday tasks and report this in Care. Scores between 0-99 can be obtained in the ADL-assessment. A low ADL-score indicates that the resident depends on more help from the health care personnel, whereas a high ADL-score means that the resident is more independent (64).
The information to be extracted is gender, age, diagnoses, and number of daily consumed drugs.

13.3 Interventions
Medication reviews
1. The health care personnel at the 2 nursing homes will select 60 eligible residents on basis of the inclusion and exclusion criteria.
2. The included residents will have their medicine reviewed by the medication review team. Identified potential drug related problems, including actual drug related problems and questions needing clarification will be stated. Additionally, recommendations based on the actual drug related problems will be stated.
3. Meetings with the health care personnel at the 2 nursing homes will be held, where they can comment on the recommendations and add further information. This will be noted and presented to the physicians, together with the recommendations and clarifying questions stated by the medication review team.
4. Meetings with the physicians will be held after the meetings with health care personnel. The potential drug related problems, the recommendations of change to medicine, and the questions needing clarification will be presented.
5. The effect of medication reviews will be assessed by the difference in the number of START/STOPP criteria and MAI scores before and after the medication reviews. Additionally, the difference in number of risk situation drugs will be stated before and after conducting medication reviews.

6. A potential saving will be calculated based on the recommendations made by the medication review team and the recommendations accepted by the physicians.

7. Two educational sessions will be held for the health care personnel at the 2 nursing homes. A test will be handed out before and after the session, in order to determine if education increases the knowledge of the health care personnel. Additionally, the number of inadvertent incidents that occurred 1 month before the sessions and 1 month after will be stated.

**Education**

1. Before the conduction of the 2 educational sessions, a statement of inadvertent incidents for the included residents will be made and used in the preparation of the education.

2. A test will be handed out before and after the sessions. The test will include questions regarding the subjects in the teaching resources. The difference in the number of correct answers before and after the education will be used to evaluate the effect of the education.

3. A statement of the number of inadvertent incidents 1 month before and 1 month after the education will also be used to assess the effect of the education.

**13.4 Medication Reviews**

**13.4.1 The Method used to Conduct Medication Reviews**

The medication reviews will be conducted on basis of the residents’ medicine lists and nursing home records of the past 3 months. The following guidelines and tools will be used in the conduction of medication reviews. These guidelines and tools will be used, as they are nationally recommended, well documented, and evidence-based.

- DSAM guidelines
- The lists of risk situation drugs by the DMHA
- The basic list for Region Zealand
- The IRF’s national recommendations
- The IRF’s Red, Yellow and Green list
- The interactions database by the DMHA
- The website www.pro.medicin.dk

A predefined template will be used when conducting medication reviews in order to ensure uniform and comparable observations and results. The template includes basic information about the resident, their medicine list, potential interactions, and potential drug related problems (12). Examples from the template are shown in figure 13.3 and 13.4. The full template is shown in appendix 7.

<table>
<thead>
<tr>
<th>Drug</th>
<th>Drug Group</th>
<th>Dose</th>
<th>Interval</th>
<th>Basic list (Y/N)</th>
<th>Risk situation drug? (Y/N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Citalopram “Orifarm”</td>
<td>SSRI</td>
<td>40 mg</td>
<td>1 tablet daily (08:00)</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

Figure 13.3 shows an example of a completed medicine list.

<table>
<thead>
<tr>
<th>Drug</th>
<th>Citalopram “Orifarm”, 40 mg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reason for change</td>
<td>The recommended dose for elderly is maximally 20 mg daily</td>
</tr>
<tr>
<td>Reference</td>
<td>Pro.medicin.dk, and “Den ældre patient” (DSAM) (37)</td>
</tr>
<tr>
<td>Recommended change</td>
<td>Reduce dose to 20 mg daily</td>
</tr>
<tr>
<td>Accepted (Y/N)</td>
<td>Y</td>
</tr>
</tbody>
</table>

Figure 13.4 shows an example of a recommended change to medicine.

Each actual drug related problem will be allocated into 5 predefined categories based on the drug related problems described by Hepler and Strands (12). The 5 categories and examples of them are seen in table 13.1.

<table>
<thead>
<tr>
<th>Predefined Category</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discontinuation</td>
<td>If the recommended treatment duration is exceeded</td>
</tr>
<tr>
<td>Start of new treatment</td>
<td>If the resident has a disease that requires a specific treatment not included in the current medicine regimen</td>
</tr>
<tr>
<td>Change of dose</td>
<td>If the dose is too low or too high according to recommendations</td>
</tr>
<tr>
<td>Change to another drug</td>
<td>If the drug is not recommended as first-line treatment</td>
</tr>
<tr>
<td>Change of direction</td>
<td>If the drug is not administered as recommended, e.g. at an incorrect time.</td>
</tr>
</tbody>
</table>

Table 13.1 shows the 5 predefined recommendation categories.
13.4.2 Meetings with Health Care Personnel and Physicians

During the conducting of medication reviews, meetings with the involved physicians and nursing homes will be coordinated and planned, see figure 13.2. Firstly, meetings with the health care personnel will be held and afterwards with the physicians.

**Meetings with the Health Care Personnel**

At the meeting with health care personnel, the potential drug related problems will be presented and the personnel can comment on the findings and add valuable information e.g. suspected ADRs, non-compliance, or problems with the administration method. This information will be noted and presented to the physician, along with the identified drug related problems.

**Meetings with the Physicians**

Initially, medicine and diagnosis reconciliation will be performed in order to assure that the nursing homes medicine lists and the physician’s medicine lists are in agreement. The medication review team will present the potential drug related problems identified during the medication reviews. It will be considered an actual drug related problem, if it can be assessed whether the medication is appropriate or not without the need for further information from the physician. It will be considered a question needing clarification if additional information from the physician is needed in order to assess if the medication is appropriate or not. If the medication is assessed as inappropriate on the basis of the additional information, it will then be stated as an actual drug related problem. Furthermore, the recommended change to medicine based on the actual drug related problems and the comments from the health care personnel will also be presented. The physicians will accept or reject the recommended changes to medicine. If the accepted recommendations will be implemented immediately after the meeting. A summation of the accepted changes will be emailed to the respective physician and nursing home in order to enhance compliance with the accepted changes and implementation.

13.5 Assessment of Medication Reviews

The aim of conducting medication reviews is to enhance the rationality and appropriateness of the pharmacotherapy, which can be measured by the
START/STOPP criteria and MAI.
The effect of the medication reviews will be measured by the difference in the number of START/STOPP criteria and MAI scores. The medication will be assessed 2 times:

1. Before the conduction of medication reviews
2. After the physicians have accepted or rejected the recommended changes

### 13.5.1 Evaluating Appropriateness by the START Criteria

The START criteria are a list of 20 recommended drugs for elderly with specific diseases, if no contraindications exist. The START criteria can indicate whether or not a resident is under-prescribed, i.e. if the resident does not fulfill the START criteria for his/her specific diseases he/she is not under prescribed for that specific disease. Conversely, a high number of unfulfilled START criteria indicate that the resident may be under-prescribed. The START criteria are based on diagnoses why these are necessary for the assessment.

#### Example of how to assess the appropriateness by the START criteria

A resident is diagnosed with *apoplexy* and *diabetes type 2*. As the START criteria are based on diagnoses, these will be used when assessing the appropriateness.

- **Apoplexy**
  According to a START criterion residents with apoplexy should be treated with:
  
  “*Statin therapy with a documented history of coronary, cerebral or peripheral vascular disease, where the patient’s functional status remains independent for activities of daily living and life expectancy is >5 years*” (78)

  Therefore, if there is no statin on the resident’s medicine list and the resident is expected to live more than 5 years, this will result in the resident unfulfilling 1 START criterion.

- **Diabetes type 2**
  According to a START criterion residents with diabetes type 2 should be treated with:

  “*Metformin with type 2 diabetes ± metabolic syndrome (in the absence of renal impairment)*” (78)

  Therefore, if there is no metformin on the resident’s medicine list, this will result in another START criterion being unfulfilled, which ultimately results in
the resident unfulfilling 2 START criteria. This means that the resident is not treated with two otherwise recommended drugs and is therefore potentially under-prescribed.

13.5.2 Evaluating Appropriateness by the STOPP Criteria

The STOPP criteria are a list of 65 potential inappropriate drugs for elderly. The STOPP criteria are mainly based on drugs, but diagnoses also needs to be considered. A high number of fulfilled STOPP criteria indicate that the resident is prescribed with a high number of inappropriate drugs.

Example of how to assess the appropriateness by the STOPP criteria

The resident is diagnosed with heart failure and daily consumes Pantoprazol (40 mg) and Ibuprofen, which he has done for 14 weeks.

- **Pantoprazol (40 mg)**
  According to a STOPP criterion residents should not be treated with:
  
  “PPI for peptic ulcer disease at full therapeutic dosage for >8 weeks (earlier discontinuation or dose reduction for maintenance/prophylactic treatment of peptic ulcer disease, esophagitis or GORD indicated)” (78)
  
  Because the resident have received a full dosage of Pantoprazol for more than 8 weeks this results in the resident fulfilling 1 STOPP criteria, meaning that the resident consumes 1 drug that is considered inappropriate for elderly.

- **Ibuprofen**
  According to a STOPP criterion within the muscular-skeletal system, the resident should not be treated with:
  
  “NSAID with heart failure (risk of exacerbation of heart failure)”
  
  As the resident is diagnosed with heart failure while also being treated with Ibuprofen, a total number of 2 STOPP criteria are fulfilled, meaning that the residents consumes 2 drugs that are considered inappropriate for elderly.

13.5.3 Evaluating Appropriateness by MAI

The original MAI consists of 10 questions scoring the appropriateness of each drug. The original index consists of 10 questions concerning different aspects of the medication with individual drugs, as seen in appendix 2. Each question is rated from 1-3 (1 = appropriate, 2 = marginally appropriate, 3 = not appropriate).
In this project, a weighted MAI score will be applied. In the weighted score, the 10 questions are weighted in regard to the level of importance, as seen in table 13.2. The “non-inappropriate” scores from the original MAI (i.e. appropriate and marginally appropriate) receive the score 0, resulting in a total score of 0 for each appropriate or marginally appropriate drug. If the diagnosis is known, the questions rated as inappropriate can receive scores from 1-3 depending on the weighing of the question. This method results in a total score of 1-18 for each inappropriate drug. If an indication for a drug is unknown to the authors (but known to the physician) question 1 will score 3. An assumed indication is then noted and the rest of the questions will be assessed according to the assumed indication in order to achieve reasonable scores for the rest of the questions and the total score will be between 3-21. If the indication is unknown to both the physician and the authors, question 1 will score 9 and an assumed indication will be stated. The drug is then able to obtain a total score of 9-27. The MAI scores will be distributed into 6 predefined groups shown and explained in table 13.3:

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is there an indication for the drug?</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Is the medication effective for the condition?</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Is the dosage correct?</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Are the directions correct?</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Are there clinically significant drug-drug interactions?</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Are there clinically significant drug-disease interactions?</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Are the directions practical?</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Is this drug the least expensive alternative compared to others of equal utility?</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Is there unnecessary duplication with other drugs?</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Is the duration of therapy acceptable?</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

*Table 13.2 lists the weighed MAI-scores (11).*
### Group Scores Characterization

<table>
<thead>
<tr>
<th>Group</th>
<th>Scores</th>
<th>Characterization</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>Appropriate</td>
</tr>
<tr>
<td>2</td>
<td>1-5</td>
<td>Nearly appropriate</td>
</tr>
<tr>
<td>3</td>
<td>6-10</td>
<td>Marginally appropriate</td>
</tr>
<tr>
<td>4</td>
<td>11-15</td>
<td>Marginally inappropriate</td>
</tr>
<tr>
<td>5</td>
<td>16-20</td>
<td>Nearly inappropriate</td>
</tr>
<tr>
<td>6</td>
<td>21+</td>
<td>Inappropriate</td>
</tr>
</tbody>
</table>

*Table 13.3 lists the 6 predefined MAI-groups.*

**Example of how to assess the appropriateness by the weighted MAI score**

The resident is diagnosed with *depression* for which she has received the trademark drug *Cipramil 40 mg* daily in 3 months. As the dose is too high, when administered in elderly, the drug scores 2 in the question regarding dose. Furthermore, Cipramil is not the least expensive drug, as less expensive generic products with the active ingredient citalopram exist. Therefore, the drug scores 1 in question 8. This results in a total score of 3 and the drug is thereby allocated to group 2, indicating that Cipramil is nearly appropriate for the resident. This example is seen table 13.4.

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is there an indication for the drug?</td>
<td>Yes, there is an indication for the drug</td>
<td>0</td>
</tr>
<tr>
<td>Is the medication effective for the condition?</td>
<td>Yes, Cipramil is effective for depression</td>
<td>0</td>
</tr>
<tr>
<td>Is the dosage correct?</td>
<td>No, the dose is too high, when administered to an elderly</td>
<td>2</td>
</tr>
<tr>
<td>Are the directions correct?</td>
<td>Yes, the resident follows recommended directions</td>
<td>0</td>
</tr>
<tr>
<td>Are there clinically significant drug-drug interactions?</td>
<td>No, there are no significant drug-drug interactions</td>
<td>0</td>
</tr>
<tr>
<td>Are there clinically significant drug-disease interactions?</td>
<td>No, there are no significant drug-disease interactions</td>
<td>0</td>
</tr>
<tr>
<td>Are the directions practical?</td>
<td>Yes, the directions are practical for the resident</td>
<td>0</td>
</tr>
<tr>
<td>Is this drug the least expensive alternative compared to others of equal utility?</td>
<td>No, there are less expensive generic drugs available</td>
<td>1</td>
</tr>
<tr>
<td>Is there unnecessary duplication with other drugs?</td>
<td>No, there are no duplications</td>
<td>0</td>
</tr>
<tr>
<td>Is the duration of therapy acceptable?</td>
<td>Yes, the duration is acceptable</td>
<td>0</td>
</tr>
</tbody>
</table>

**Total score** 3

*Table 13.4 shows an example of a drug assessed by MAI.*
If the diagnosis was unknown to the authors in the above-mentioned example, additionally 3 points will be added to the score, resulting in a total score of 6 and allocation to group 3. If the diagnosis was unknown to the authors and the physician, additionally 9 points would be added to the score, resulting in a total score of 12 and the drug would be allocated to group 4.

Question 8 concerning the price of the drug is assessed by using the website www.medicinpriser.dk by the DHMA (60). Therefore, the score for this question depends on the current days prices.

13.5.4 Evaluating Appropriateness by Risk Situation Drugs
The list of risk situations drugs can be used to identify potentially harmful drugs. The number of risk situations drugs before conduction of medication reviews and after physicians have accepted or rejected the recommendations will be stated. This will be used to assess whether medication reviews can reduce the number of risk situation drugs.

13.6 Potential Savings
In order to see if medication reviews can lead to economical savings both for patients and Region Zealand, 3 calculations will be made. Firstly, savings of discontinued drugs will be calculated. Secondly, calculations of substituting trademarks with generics will be made and thirdly, potential savings with analogue substitution will be estimated.

13.7 Assessment of Potential Savings
The assessment of potential savings will be calculated based on the discontinuations and substitutions recommended by the medication review team and the actual implemented changes. The potential savings of trademarks and analogue substitution will be estimated on the basis of examples from the medication reviews.

13.8 Education
Representatives from Region Zealand and Lolland municipality have predefined the specific educational topics shown in table 13.5:
### Inadvertent incidents and medicine administration and distribution
- Health care personnel’s legal obligations to report inadvertent incidents
- Common inadvertent incidents
- The potential consequences of inadvertent incidents
- Ways to prevent inadvertent incidents
- Common errors when administering and distributing medicine

### Heart diseases and their medical treatment
- Heart failure, atrial fibrillation, and angina pectoris
- Risk factors
- Signs and symptoms
- Anti-thrombotics, nitrates, beta-blockers, diuretics, and angiotensin II antagonists and common ADRs

### Hypertension and its medical treatment
- The physical changes in the arteries
- Risk factors
- Signs and symptoms
- ACE-inhibitors, beta-blockers, diuretics, and angiotensin II antagonists and common ADRs

### Depression and its medical treatment
- The physical changes in the brain
- Signs and symptoms
- The difference between being depressed and sad
- SSRI, TCA and NaSSA and common ADRs

### Parkinson’s disease and its medical treatment
- The physical changes in the brain
- Signs and symptoms
- Levodopa and common ADRs

Table 13.5 lists the subjects included in the educational sessions. Teaching materials for the subjects is seen at the attached CD.

Besides the predefined topics, the education will include assignments and practical examples identified at nursing homes at Lolland, so the health care personnel can relate to these in their daily work. It is considered important to engage the health care personnel in the education and emphasize the importance of correct medicine administration in order to optimize the medical treatment and prevent inadvertent incidents related to medicine.

### 13.9 Assessment of Education
The effect of the education will be measured by two means:
- The difference in the number of inadvertent incidents 1 month before and 1 month after the educational sessions.
- The difference in the number of correct answers before and after education.
Inadvertent Incidents
In order to see if the education regarding inadvertent incidents has an effect on the number of incidents, the number of inadvertent incidents will be stated 1 month before the education and 1 month after.

The Test
A test including questions regarding the topics included in the education will be made and handed out before and after the educational sessions. The test will provide insight in the health care personnel’s knowledge about common diseases in the elderly, the medical treatment of them, and inadvertent incidents.

Additional material
In addition to the education, a pamphlet will be created including some of the most common inadvertent incidents and steps to prevent them. This pamphlet is seen in appendix 9. The difference in number of correct answers before and after will be used to evaluate if the health care personnel have gained new knowledge and if education can be used to enhance appropriate pharmacotherapy.

13.10 Financial Aspect
The participating physicians will be economically compensated by Region Zealand for their participation after the meeting.

13.11 Statistics
Descriptive data will be presented in simple graphs and tables according to the data presented. In order to see whether there are any significant correlations between gender and number of drugs, age and number of drugs, and ADL-category and number of drugs, chi-squared tests will be performed. A chi-squared test can be used to test whether two variables are independent or not. A null-hypothesis saying there is no correlation between the two variables will be stated for each test. Chi-squared tests are used for categorical data, which is data without units and in some cases for metric data, data with units, if the number of values is small. When using this test the P-value has to be less than 0.05 in order to reject the null-hypothesis.

13.12 Literature Search
Articles included in this project are found via the PubMed NCBI database where original articles were preferred over reviews. Other articles and reports are found
through the DHMA, the Danish Medical Bulletin, IRF, and production by Region Zealand.

14. Results

14.1 Study Design

The initial work involving coordination and communication with several stakeholders in Lolland, proved to be extensive and very time-consuming as meetings with team leaders and health care personnel at 5 nursing homes, instead of 2 nursing homes, had to be included in order to obtain a sufficient number of residents.

A meeting was held with the team leaders and health care personnel at the 2 nursing homes as planned. The team leaders and health care personnel were presented with the project, and they identified eligible residents according to the inclusion- and exclusion criteria. After these 2 meetings, it became clear that the 2 nursing homes did not have enough residents fulfilling the inclusion criteria as they only identified 9 polypharmacy patients among their residents. Therefore, 3 additional nursing homes were included in the project. Meetings with the team leaders and health care personnel were held and after the presentation of the project and the inclusion and exclusion criteria they identified 46 eligible residents resulting in a total sample population of 55 residents. Of the 55 residents, 4 passed away, 2 consumed 5 drugs, and 2 were <65 years of age. The 8 residents was excluded from the project, resulting in 47 eligible residents and their 16 physicians being included in the project. Before completion of the project, 1 physician withdrew, meaning that only 45 residents are included in some results, which is thoroughly noted in the presented results. Two (6.4%) of the residents included in the project did not meet the inclusion criterion of 6 drugs. However, when selected they consumed 6 drugs according to Care but after medicine reconciliation with the physician, it was found that they only consumed 5 drugs daily. The 2 residents remains in the project and their medication is reviewed and included in the results.
14.1.1 Actual Timeline for Planning and Execution of the Project

Figure 14.1 shows the actual timeline for the planning and execution of the project.

- **September - November 2013**: Coordination and holding of meetings with nurses and team leaders and the health care personnel at 5 nursing homes. An "after work" meeting was held for the physicians.
- **December 2013**: 55 residents were identified and medication review for each resident was completed.
- **January - March 2014**: Meetings with each included physician and the health care personnel at the 5 nursing homes. Implementation of some recommended changes to medicine.
- **February**: Preparation and execution of the 2 educational sessions.
- **May 2014**: Process and analyse the results and complete the report.

14.1.2 Characterization of Residents

The functional level of the participating residents was assessed on basis of the modified Barthel 100 Index (64). Figure 14.2 shows, in percentage, how the ADL-scores of the 47 residents were allocated into the 5 ADL-categories. As seen, 53.2%
(17% + 36.2%) of the residents were allocated to the first and second ADL-category, meaning that more than half of the residents require essential or total help from the health care personnel when performing the 10 ADL. Additionally, only 21.3% (17% + 4.3%) were allocated to category 4 and 5, meaning that approximately a fifth of the residents were slightly to minimally dependent on help from the health care personnel. The average ADL-scores is 51, corresponding to category 3, which correspond to the need of moderate help from the health care personnel.

In order to identify if there was a correlation between the ADL-categories and the number of consumed drugs, a chi-squared test was performed on the basis of the following null-hypothesis:

*There is no correlation between the ADL-category and the number of daily-consumed drugs*

The test resulted in a P-value of 0.48 and the null-hypothesis can therefore not be rejected. The result of the chi-squared test is seen in appendix 10.

Of the 47 residents included in the project, 70% (33) were women and 30% (14) were men, as seen in figure 14.3. In order to see if there is a possible correlation between gender and number of daily-consumed drugs, a chi-squared test is done on the basis of the following null-hypothesis:

*There is no correlation between gender and the number of daily-consumed drugs.*

The test resulted in a P-value of 0.17 and can therefore not be rejected. The result of the chi-squared test is seen in appendix 10.
The average age of the 47 residents was 86 years. For clarity, age is divided into seven age groups, as depicted in figure 14.4. As seen, the majority (68%) of the residents are between 81-95 years of age.

To see if there was a possible correlation between age group and the number of daily-consumed drugs, a chi-squared test with the following null-hypothesis is performed:

There is no correlation between age group and the number of daily-consumed drugs.

The test resulted in a P-value of 0.65 and the null-hypothesis could therefore not be rejected. The result of the chi-squared test can be seen in appendix 10.

Figure 14.4 depicts the distribution of age in the sample population of 47 residents, divided into seven age groups.

Figure 14.5 illustrates the known diagnoses within the sample population of 47 residents.
Figure 14.5 shows the 97 known diagnoses for the 47 residents. Hypertension was the most frequent diagnosis and accounted for 13.4% (13) of the total 97 diagnoses. The second most frequent diagnoses were dementia (10.3%), apoplexy (10.3%), and Diabetes Type 2 (9.3%) as illustrated in figure 14.5. Ischemic heart disease and COPD/Asthma each accounted for 6.2% of the diagnoses and Glaucoma accounted for 5.2% of the diagnoses. Depression, mental diseases, and atrial fibrillation each accounted for 4.1% of the diagnoses. The category “Mental diseases” covers schizophrenia, anxiety, mania, and hallucinations. Heart failure, Parkinson’s disease, and hypothyroidism each account for 3.1% of the diagnoses and cancer, cystitis, epilepsy, and anemia each accounts for 2.1%. Osteoporosis, prostate hypertrophy, goiter, hernia, Alzheimer’s disease, cor pulmonale, skin diseases, gastric ulcers, and rheumatoid arthritis each accounted for 1% of the diagnoses. “Skin diseases” cover eczema, urticaria, and psoriasis.

97 diagnoses were known to the authors corresponding to an average of 2 diagnoses per patient. Figure 14.6 shows the distribution of the number of known diagnoses among the 47 residents in percentage, which ranged from 1-8 diagnoses per resident. Figure 14.6 also shows that 31.9% of the diagnoses, corresponding to the diagnoses of 15 residents, were unknown to the authors and/or the physicians. Additionally, 63.8% of the residents are considered to be multimorbid as they have two or more concomitant diseases.
Figure 14.7 illustrates the total number of drugs consumed by the residents on a daily basis, showed in percentage. In average, the residents consumed 8 drugs daily. Additionally, 59.5% of the residents consumed 8-13 drugs daily and 25.5% consumed 10 or more drugs.

![Graph showing number of daily consumed drugs](image)

**Figure 14.7 shows the number of daily-consumed drugs by 47 residents.**

### 14.2 Medication Review

As the planned timeline could not be kept, it was not possible to hold the meetings with the health care personnel before the meetings with the physicians. It was prioritized to arrange meetings with physicians first in order to give them more time to implement the accepted changes and for the authors to be able to evaluate the effect

![Graph showing recommendation of changes to medicine](image)

**Figure 14.8 shows the distribution of the 95 recommended changes to medicine for the 47 residents.**
of the implementations within the time period of the study. Therefore, it was not possible for the health care personnel to comment on the potential drug related problems before presenting these to the physicians.

Each meeting with the physician was initiated with medicine and diagnoses reconciliations. In some cases, it was observed that the nursing home medicine list was not in agreement with the physicians’ medicine list.

In total, 170 potential drug related problems, including the actual drug related problems and the questions needing clarification, were identified for the 47 residents, corresponding to approximately 4 potential drug-related problems per resident. The evaluation of the potential problems resulted in the identification of 95 actual drug related problems, corresponding to 2 actual drug related problems per resident. Figure 14.8 illustrates the distribution of recommended changes to medicine based on the 95 drug-related problems.

The most frequent recommended change was discontinuation, which accounted for 72.6% of the total number of recommendations. Start of a new treatment accounted for 6.3%, change of dose accounted for 10.5%, change to another drug accounted for 6.3%, and change of directions accounted for 4.2% of the total number of recommendations.

Table 14.1 shows the 5 recommendation-categories based on the 95 identified actual drug related problems divided between drug groups. As the table shows, cardiovascular and psychotropic/neurological drugs were the drugs most frequently recommended discontinued as they accounted for 53.6% (29% + 24.6%) of the

<table>
<thead>
<tr>
<th>Drug Group</th>
<th>Discontinuation</th>
<th>Start treatment</th>
<th>Change to another drug</th>
<th>Change of dose</th>
<th>Change of directions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular drugs</td>
<td>29 %</td>
<td>16.7 %</td>
<td>33.3 %</td>
<td>10 %</td>
<td>75 %</td>
</tr>
<tr>
<td>Respiratory/allergy drugs</td>
<td>3 %</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Endocrinology drugs</td>
<td>1.4 %</td>
<td>50 %</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Analgesic drugs</td>
<td>2.9 %</td>
<td>-</td>
<td>33.3 %</td>
<td>30 %</td>
<td>-</td>
</tr>
<tr>
<td>Muscular/skeletal drugs</td>
<td>4.3 %</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Gastro-intestinal drugs</td>
<td>11.6 %</td>
<td>-</td>
<td>20 %</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Psychotropic/neurological drugs</td>
<td>24.6 %</td>
<td>-</td>
<td>16.7 %</td>
<td>20 %</td>
<td>-</td>
</tr>
<tr>
<td>Urogenital drugs</td>
<td>3 %</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Vitamins/supplements</td>
<td>13 %</td>
<td>33.3 %</td>
<td>16.7 %</td>
<td>20 %</td>
<td>-</td>
</tr>
<tr>
<td>Dermalogical drugs</td>
<td>7.2 %</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ophthalmic drugs</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>25 %</td>
</tr>
<tr>
<td>N =</td>
<td>69</td>
<td>6</td>
<td>6</td>
<td>10</td>
<td>4</td>
</tr>
</tbody>
</table>

Table 14.1 describes the recommended changes in percentage divided by drug groups for the 47 residents.
recommended discontinuations e.g. due to exceeded treatment duration. Drugs for the endocrine system were most frequently recommended as “start of new treatment”, as they accounted for 50%, e.g. start of treatment with metformin. Cardiovascular and analgesic drugs were most frequently recommended changed to another drug, e.g. the change from Atorvastatin to Simvastatin and Codeine to Tramadol. They each accounted for 33.3% of the recommended changes to another drug. Analgesic drugs, gastro-intestinal drugs, psychotropic/neurological, and vitamins/supplements were often administered in an incorrect dose according to guidelines and therefore most frequently recommended to change dose. As an example, proton pump inhibitors and antidepressants were often administered in a too high dose for long-term use in elderly and it was therefore recommended to reduce the dose. In cases where the recommended directions were not followed, it was recommended to change the directions. Change of directions was most frequently recommended for cardiovascular drugs, e.g. statins should be administered in the evening.

Figure 14.9 shows the 95 recommendations (100%) based on the actual drug related problems, the 71 (74.7%) recommendations accepted by the physicians, and the 30 (31.6%) implemented recommendations, per 1st May 2014. As seen, only 31.6% of the accepted recommendations have been implemented, even though the physicians had 1 to 3 months to implement the changes, depending on the date each meeting with
the individual physician was held. Furthermore, it is worth mentioning that 1 physician out of 16 was responsible for implementing approximately 77% of the accepted recommendations.

14.2.1 Assessment of Medication Reviews

The START Criteria

When using the START criteria, the residents could theoretically have 0-20 medically untreated diagnoses. However, as figure 14.10 shows, the residents unfulfilled a maximum of 3 START criteria. The figure shows the percentage of residents unfulfilling 0, 1, 2, or 3 of the 20 START criteria. If a resident unfulfilled 0 START criteria there was no indication for starting a new medical treatment, if a resident unfulfilled 1 START criterion there was 1 indication for starting a new treatment, and so on. As seen, only the percentage of residents unfulfilling 0 and 2 START criteria has changed before the conduction of medication reviews and after the meetings with the involved physicians. As seen, there is a difference of 4.5% (13.4% - 8.9%) between the number of residents unfulfilling 2 START criteria before and after the medication reviews. 4.5% of the 45 residents correspond to 2 residents. This means, that 2 recommended treatments were initiated for 2 residents, who are no longer being under-prescribed according to the known diagnoses. The appropriateness of the 2 residents medication has thereby been improved.
The STOPP Criteria

When assessing the medication using the STOPP criteria, the residents’ medication could in theory fulfill 0-63 of the STOPP criteria. However, the residents fulfilled a maximum of 3 STOPP criteria. Figure 14.11 illustrates the percentage of residents fulfilling 0, 1, 2, or 3 of the 63 STOPP criteria. If a resident fulfilled 0 STOPP criteria no drugs should be discontinued, if a resident fulfilled 1 STOPP criteria there was indication for the discontinuation of 1 drug, and so on. Here, the percentage of residents, fulfilling 0 STOPP criteria, has increased with 33.4% from before the conduction of medication reviews till after meetings with physicians. The percentage of residents fulfilling 1 STOPP criteria is decreased by 8.9%, the percentage fulfilling 2 STOPP criteria has decreased with 20%, and the percentage fulfilling 3 STOPP criteria has decreased 4.5%. This indicates that the medication of the 45 residents have become more appropriate after conduction of medication reviews when assessed by the STOPP criteria.

Figure 14.10 describes the START scores for 45 residents before the conduction of medication reviews and after meetings with the involved physicians.
When using the weighted MAI scores, each individual drug was assessed. Figure 14.12 shows the allocation of MAI-scores for all drugs before conducting medication reviews, thus reflecting the appropriateness of the residents’ initial medication. In total, 373 drugs are included in figure 14.12. As seen, 18.5% of the 373 drugs obtained a MAI-score of 0 indicating that these drugs were appropriate. 11.8% of the
drugs scored 1 and 5.9% scored 2. The score most frequently scored was 3, accounting for 26.8% of the drugs. 22% of the drugs scored 4, 7.2% scored 5 and 3.2% scored 6. A smaller part of the drugs scored 7, 8, and 10, 1.6%, 1.6%, and 0.5% respectively. 0.8% of the drugs, corresponding to 3 drugs, scored 18 or 19. In these 3 cases the diagnoses were unknown by both the physicians and the authors and the drugs scored an additionally 9 points in question 1 regarding indication. Before the conduction of medication reviews, 92.3% of the drugs obtained a MAI-score between 0 and 5. When allocated to the 6 groups, 92.3% of the drugs were appropriate or nearly appropriate (figure 14.13). When each MAI-score was allocated to the 6 MAI-categories, no scores were allocated to group 4 and 6. As seen in figure 14.13, 18.5% of the drugs were allocated to group 1, meaning that 18.5% of the 373 drugs were appropriate, 73.7% of the drugs were allocated to group 2 and were thereby nearly appropriate, 7% were allocated to group 3 and were marginally appropriate, and 0.8% of the drugs were allocated to group 5, meaning that 0.8% of the drugs assessed were nearly inappropriate.

**Figure 14.13** depicts the MAI-scores in percentage for the 373 drugs of 45 residents before the conduction of medication reviews, allocated to four different groups.
Figure 14.14 depicts the MAI-scores after the physicians have accepted or rejected the recommended changes to medicine. As the physicians accepted 71 of the 95 recommendations, the figure shows the MAI-scores for 322 drugs (373 drugs – 58 discontinuations + 7 start of new treatment). This means that the figure indicates the improvement in MAI-scores if each accepted recommendation was implemented, i.e.

![MAI-score after meetings with physicians](image)

Figure 14.14 shows the MAI-scores in percentage for the 304 drugs of 45 residents after meetings with the physicians.

both discontinuation, start of new treatment, change of dose, change to another drug, and change of directions. In the end, the 45 residents received 58 drugs less than before the medication reviews, which included the medicine of two residents who had all their medicine discontinued as they both had become terminal.

When comparing the MAI-scores obtained before medication reviews and after meetings with the physicians, 7.9% (26.4% - 18.5%) more drugs received a MAI-score of 0. This indicates that 7.9% more drugs are appropriate after meetings with the physicians. After meetings with physicians, 96.9% of the drugs obtained a MAI-score of 0-5. When allocated to the 6 MAI-groups, 96.9% were appropriate or nearly appropriate. When compared to the MAI-scores obtained before the conduction of medication reviews this is an improvement of 4.6%, meaning that 4.6% more drugs are appropriate or nearly appropriate.
Figure 14.15 shows the grouped MAI-scores after meetings with the physicians, indicating the actual improvement in grouped MAI-scores. No drugs were allocated to group 4 and 5, as no drugs were marginally inappropriate or inappropriate. As seen, 26.6% of the 322 drugs were allocated to group 1, indicating that 26.6% of the drugs were appropriate. When comparing the grouped MAI-scores before the conduction of medication reviews, 8.1% (26.6% - 18.5%) more drugs were allocated to group 1, meaning that 8.1% more drugs were appropriate. 70.4% of the drugs were nearly appropriate, 2.3% of the drugs were marginally appropriate, and 0.7% of the drugs were nearly inappropriate.

**Grouped MAI-scores after Meetings with Physicians**

![Graph showing grouped MAI-scores](image)

*Figure 14.15 depicts the MAI-scores in percentage for the 322 drugs of the 45 residents after the conduction of medication reviews, allocated to four different groups.*

**Risk Situation Drugs**

In this study, the 45 residents consumed between 0 and 5 risk-situation drugs daily. The number of daily-consumed risk situation drugs before the conduction of medication reviews and after meetings with the physicians, are shown in figure 14.16. Figure 14.16 shows that the number of residents not consuming any risk situation drugs has increased from 10.5% to 33.3%, corresponding to an increase of 22.8%. The number of residents consuming 1 risk situation drugs is decreased by 8.8% (42.1% - 33.3%), the number of residents consuming 2 risk situation drugs is decreased by 14.6% (36.8% - 22.2%), the number of residents consuming 3 risk situation drugs has decreased 0.2% (7% - 6.8%), the number of residents consuming 4 risk situation drugs is increased by 2.6% (1.8% - 4.4%), and the number of residents
consuming 5 risk situation drugs has decreased 1.8% (1.8% - 0%).

14.3 Potential Savings

Most of the residents already consume generic products and the saving of substituting with generic drugs is very low. Therefore, not every potential saving of substitution to a generic drug was recommended to the physicians. Furthermore, only 3 cases where analogue substitution was possible were identified.

14.3.1 Assessment of Saving

Figure 14.17 shows the yearly savings for Region Zealand and the residents if every recommended discontinuation was implemented. As seen, the savings mount up to 84,873.45 DKK every year. If every accepted discontinuation was implemented the residents and Region Zealand would save 71,342.9 DKK every year, corresponding to the amount of money potentially saved every year. Lastly, the figure shows the actual savings achieved per 1st May 2014 as a result of the implemented discontinuations, which amounts to 33,211.35 DKK. The savings are calculated on the basis of the average price for the defined daily dose (DDD) for a drug.
In Region Zealand the average price for DDD is 3.37 DKK pr. drug. As an example, the physicians accepted 58 discontinuations:

\[
58 \text{ discontinuations} \times 3.37 \text{ DKK} \times 365 \text{ days} = 71,342.9 \text{ DKK/year}
\]

The actual savings of 33,211.35 DKK corresponds to a yearly saving of 738.03 DKK per resident.

![Yearly Savings for Region Zealand](image)

*Figure 14.17 shows the yearly total savings for Region Zealand and the patients if every recommended discontinuation was implemented, if every accepted discontinuation was implemented, and actual savings for the already implemented discontinuations.*

**Potential savings by generic substitution**

When residents consume a trademark it is often more expensive both for patient and society, than consuming a generic drug. In this project, the potential savings, when changing to a generic drug with the same API, were insignificant, as seen in the following 3 examples:

**Cipralex vs. Escitalopram Actavis (10 mg)**

In this study two residents consumed Cipralex, the trademark. The price difference of Cipralex and Escitalopram Actavis is 8.42 DKK.

\[
9.80 \text{ DKK} – 1.38 \text{ DKK} = 8.42 \text{ DKK} \times 365 \text{ days} = 3,073.3 \text{ DKK/resident/year}
\]

As two residents consumed Cipralex the potential yearly saving when changing from Cipralex to Escitalopram Actavis is 6,146.6 DKK.
Panodil vs. Pamol (500 mg)
The price difference between Panodil and Pamol is 0.67 DKK.

\[10.38 \text{ DKK} - 9.71 \text{ DKK} = 0.67 \text{ DKK} \times 365 \text{ days} = 244.5 \text{ DKK/resident/year}\]

The potential saving when changing from Panodil to Pamol is 244.5 DKK/resident yearly. Ten residents are treated with Panodil, resulting in a total potential saving of 2,445 DKK yearly, if Panodil was changed to Pamol.

Dolol vs. Tramadol Actavis (50 mg)
The price difference between Dolol and Tramadol Actavis is 0.06 DKK.

\[9.21 \text{ DKK} - 9.15 \text{ DKK} = 0.06 \text{ DKK} \times 365 \text{ days} = 21.9 \text{ DKK/resident/year}\]

The potential yearly saving when changing from Dolol to Tramadol Actavis is 21.9 DKK/resident. Only one resident was treated with Dolol, which was discontinued after the medication reviews. Thereby a yearly saving of 21.9 DKK has been obtained.

Potential Savings by analogue substitution
In this project, only 2 residents were treated with Cipralex, that can be substituted with Citalopram, which will result in a yearly saving of 1,902 DKK per resident (86). Therefore a potential saving for substituting Cipralex in these 2 cases would result in a yearly saving of 3,804 DKK. However, the physicians did not accept these changes and therefore no saving was achieved.

One resident was treated with Norspan patch, which may be substituted with Contalgin tablets. This will result in a yearly saving of 2,249 DKK per resident. In this case, the physician chose to change Norspan patch to buprenorphine tablets and therefore, the yearly saving of 2,249 DKK was not achieved.

14.4 Education
Two educational sessions were held for the health care personnel at 3 of the 5 included nursing homes. For both sessions, a summary of useful web sites like min.medicin.dk, ppsnett.dk, and the interaction database was included. For the second session, a description of the physical consequences of ageing was added in order to enhance the understanding of the underlying causes to some of the diseases

Figure 14.18 depicts the 216 reported inadvertent incidents for the 47 residents in 2013. As the figure clearly demonstrates, omitted administration by the health care personnel was the most frequent inadvertent incident related to medicine. The second most frequent inadvertent incident was when resident did not take their medicine even
though the health care personnel had provided the medicine. The rest of the inadvertent incidents accounted for a smaller part of the total number of 198 inadvertent incidents, which correspond to 4 inadvertent incidents yearly per resident.

![Distribution of Inadvertent Incidents in 2013](image)

*Figure 14.18 shows the distribution of inadvertent incidents occurring during 2013 for the 47 residents. The information is extracted from Care.*

### 14.4.1 Assessment of Education

Figure 14.19 depicts the number of inadvertent incidents before and after the education at the three nursing homes that had health care personnel participating in the education. The figure shows a 50% decrease in the number of inadvertent incidents.

![Number of Inadvertent Incidents Before and After Education](image)

*Figure 14.19 depicts the number of inadvertent incidents one month before the education of health care personnel and one month after the education, for the 24 residents at the nursing homes invited to the educational sessions.*
Tests

Figure 14.20 shows the distribution of correct answers before and after the health care personnel attended the educational sessions. The test included 16 questions, which in some instances required up to 3 answers per question. Therefore, it was possible to obtain 27 correct answers. The test is seen in appendix 8. Before the education, 53 health care personnel answered the questionnaire. Here, 5 (9.4%) answered 50% or more of the questions correct. After the education, 48 health care personnel answered the test. Here, 30 (62.5%) of the health care personnel answered 50% or more of the questions correctly. This is a 53.1% increase in health care personnel answering 50% or more questions correct.

![Distribution of Correct Answers](chart.png)

*Figure 14.20 shows the distribution of correct answers to the questionnaire handed out to health care personnel before and after they received education.*

Feedback

In the tests, the health care personnel were able to give feedback on the education. After the educational sessions, 27 out of 48 who had answered the test gave feedback on the education. Out of the 27 feedbacks, only 6 were somewhat negative or negative. Examples on positive feedback are seen in table 14.2.

Most negative feedback concerned the level of difficulty, as the health care personnel had two types of educational backgrounds. Some were social and health care assistants and others were social and health care workers. Some social and health care workers found the level of the educational session too high.
Discussion

In this project, the Barthel Index was used for the assessment of the residents’ functional level. 50% of the residents had a functionality level corresponding to ADL-group 1 and 2, as seen in figure 14.2. However, approximately 20% of the residents were allocated to ADL-group 4 and 5. This may be because some of the residents are cognitive impaired, but not physically impaired, and thereby are able to perform physical tasks. A study by Zermansky et al. (87) investigated, in a randomized controlled trial, the effect of pharmacist conducted medication reviews in nursing home residents aged ≥65 years, and consuming 1 or more drugs. In the study by Zermansky et al. the Barthel Index was used to assess if medication reviews could improve the functional level of the residents. They found no significant difference in the functional level between the intervention group and the control group (87). Based on the study by Zermansky et al. (87) the functional level is a factor not affected by the conduction of medication reviews. However, the residents included in that study were not polypharmacy patients (87). It is known that polypharmacy patients are in greater risk of ADRs, e.g. urine incontinence, which negatively can affect their everyday life (16). Therefore, the functional level of polypharmacy patients might be positively affected by the conduction of medication reviews.

The polypharmacy patients included in this project have been, beside the Barthel Index, characterized on the basis of 4 factors; gender, age, number of diagnoses, and number of daily-consumed drugs. The residents had an average age of 86 years and they had an average of 2 diagnoses. Furthermore, they each consumed an average of 8 drugs daily and 70% of the residents were women. A study by Kraska et al. (72)

<table>
<thead>
<tr>
<th>Examples of Positive Feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td>“We are able to use the information in our daily work”</td>
</tr>
<tr>
<td>“The educational session provided food for thought”</td>
</tr>
<tr>
<td>“A dry subject delivered in a inspirational way – credit to all of you”</td>
</tr>
<tr>
<td>“Really good day with many useful informations”</td>
</tr>
<tr>
<td>“Good and easy understandable teaching from all three educators”</td>
</tr>
<tr>
<td>“Good course, good presentation”</td>
</tr>
<tr>
<td>“Very interesting and useful”</td>
</tr>
<tr>
<td>“Very good – we were able to interrupt and ask questions”</td>
</tr>
</tbody>
</table>

*Table 14.2 shows examples of the positive feedback received from health care personnel after an educational session.*
investigated, in a randomized controlled trial, the effect of pharmacist conducted medication reviews on solving drug related problems and medicine related costs among others. The study included patients consuming ≥4 drugs and that were ≥65 years of age. In this study, 168 patients included in the intervention group had an average age of 74.8 years, they had 3.9 diagnosed in average, consumed 7.4 drugs in average, and 56.5% were women. They found that medication reviews could reduce the number of drug related problems (72). In a study by Region Zealand (88), it was investigated if pharmacist conducted medication reviews could increase the rationality of pharmacotherapy in 465 polypharmacy patients consuming ≥6 drugs. Here, the average age was 72.2 years, they consumed 12.4 drugs in average, and 65% were women. It was found that medication reviews can increase the rationality of pharmacotherapy of elderly polypharmacy patients if all changes to medicine were implemented (88).

To summarize, the 2 mentioned studies (72, 88) included residents with an average age of 72.2 to 74.8 years, that consumed an average of 7.4 to 12.4 drugs, and were 56.5% to 65% were women. The studies found that pharmacist conducted medication reviews could reduce the number of drug related problems and increase the rationality of pharmacotherapy. Residents included in this project possess similar characteristics as the patients included in the 2 above mentioned studies. Therefore, medications reviews conducted for this population seems to be able to increase rational pharmacotherapy.

15.1 Medication Reviews

The medicine reconciliations with the physicians showed disagreements between the medicine lists provided by the health care personnel and the medicine lists provided by the physicians. It is suggestive that the 2 medicine lists were in disagreement, but this is apparently not uncommon. A study in North Funen, included in a report by Region South Denmark (89), conducting medication reviews for 10 polypharmacy nursing home residents, found discrepancies in the medicine lists provided by health care personnel and medicine lists provided by physicians (89). The study found that the physicians’ medicine lists were incorrect, probably due to a variety of physicians prescribing medicine to the patients, e.g. specialists, emergency doctors, and physicians at hospitals. Since 2002, the health inspectors in Denmark have supervised the Danish nursing homes yearly (90). They have also found discrepancies in the
medicine lists and assume that this is due to the health care personnel lacking the necessary knowledge regarding medicine and insufficient communication between the health care personnel and the physicians (90).

In this project, not only shortcomings in residents’ medicine lists were found. In some instances, the physicians did not know all the diagnoses of each resident. Therefore, one can question if some of the residents are under prescribed. Furthermore, during the meetings with the physicians it became clear that many of the included residents have not had a blood sample taken for several years. This further question if some of the residents might have conditions the physicians are unaware of and therefore are under prescribed. The lack of diagnoses was considered a barrier during the medication reviews, as it was difficult to evaluate a resident’s medicine without knowing the diagnoses e.g. when assessing the dose or treatment duration. This barrier was also noted by pharmacists conducting the medication reviews in the report by Region South Denmark mentioned earlier (89). This emphasizes the importance of having access to residents’ diagnoses in order to complete a comprehensive medication review.

The medication review team identified 170 potential drug related problems whereof 95 were considered actual drug related problems and were presented as recommended changes at the meetings with the physicians. Of the 95 recommendations, 71 recommendations were accepted by the physician, corresponding to 74.7% of the total number of actual drug related problems, as shown in figure 14.9. Region South Denmark has made a similar project where 3 of the municipalities belonging to the region have conducted medication reviews for elderly (89). In the 3 studies, 25-33 elderly were included and the number of drug related problems ranged from 34 to 94 of which physicians accepted 45% to 65%. A retrospective study by Nishtala et al. (91), investigated the effect of pharmacist conducted medication reviews on the number of drugs related problems and the physicians acceptance and implementation rate. The study included 480 randomly selected nursing home residents for whom 1,433 drug related problems were identified. The physicians accepted 72.5% of the recommended changes to medicine and implemented 58.1% (91). Based on this project and the abovementioned studies, physicians appear to have a positive attitude towards the recommendations made by pharmacists. Nevertheless, despite the high acceptance rate the physicians are more reluctant to implement the accepted recommendations. If physicians do not implement the accepted recommendations,
medication review cannot increase the rationality of pharmacotherapy for elderly. The DHMA recommends that physicians conduct medication reviews for polypharmacy patients yearly (71). Physicians have often claimed this to be a time consuming procedure and hard to implement in their daily praxis (72, 92, 93). Therefore, it is suggestive that even when a medication review team has conducted the medicine reviews and the physicians “only” had to consider the recommendations and to implement the accepted recommendations, only 31% were implemented 2-4 months after the meetings. However, in some cases the accepted recommendations required that the physicians saw the resident e.g. in order to take a blood sample and based on the results implement the recommendations. Yet, the physicians had 2-4 months to see their patients and still the implementation rate was low. Initially, a low implementation rate was not expected, as other studies have shown that recommendations made by pharmacists were moderate to highly agreed upon by physicians (72, 75, 76). In this project, 1 physician managed to implement all his accepted recommendations within 14 days, which he stated only was possible due to his commitment to this project. In these 14 days he met with all his included patients to ensure the accepted recommendations were appropriate for each patient. This physician did not have less patients compared to other included physicians, in fact he had more, and therefore he proved that it was not an impossible task to implement the recommendations and therefore increase the rationality of pharmacotherapy.

In this project, 5 types of recommendations to medicine were made, seen in table 13.1. Discontinuation was the major recommendation of change to medicine, as seen in figure 14.8. Cardiovascular drugs were most frequently recommended discontinued. Within this group, furosemide accounted for most recommended discontinuations, as it is a risk situation drug and known to cause electrolyte imbalances (94, 95) which can increase the risk of falls in elderly (96). Hereafter, anti-psychotics/neurological drugs were most frequently recommended discontinued, which is also seen in table 14.1. Within this drug group, benzodiazepines were most frequently recommended discontinued. Often, the treatment duration exceeded the recommended treatment duration and benzodiazepines are generally not recommended for long term use due to the high risk of ADRs like balance disturbances, daytime sedation, and cognitive impairment (97). Additionally, antipsychotic drugs are not recommended for use in demented patients, as the mortality increases (98). In most cases, the physicians did not accept discontinuation of benzodiazepines because they assumed that the residents
would not approve. The resistance from the physicians is surprising, as the treatment potentially causes more harm than benefit for the residents. More surprising is the fact that physicians rejected the recommendations before even consulting the residents. Physicians often possess a natural authority and may have been able to convince the residents that the discontinuation was in the resident’s best interest. The second most recommended change to medicine was change of dose, as seen in figure 14.8. As an example, SSRIs were often administered in a too high dose as a 50% dose reduction is recommended when prescribed to elderly (37).

After cardiovascular and psychotropic/neurological drugs, gastro-intestinal drugs were frequently recommended discontinued. As an example, PPIs were often administered in a too high dose or exceeded the recommended treatment duration. Long-term (>8 weeks) treatment with PPIs can cause a rebound phenomenon, which can result in acid related symptoms. These symptoms can proceed for 4 weeks after discontinuation (99). Therefore, the most problematic drug groups within discontinuations were cardiovascular drugs, anti-psychotics/neurologic drugs, and gastro-intestinal drugs, as seen in table 14.1. These results correlate to results obtained in 2 studies by Verrue et al. (20) and Nisthala et al. (91). In the study by Verrue et al. (20) regarding pharmacist conducted medication reviews at a nursing home, the most problematic drug groups were drugs for the nervous system, gastro-intestinal drugs, and cardiovascular drugs (20). Nishtala et al. (91) found that most problematic drug groups were drugs for the alimentary tract or metabolism, drugs for the nervous system, and drugs for the cardiovascular system (91).

Results regarding problematic drug groups obtained in this study are therefore en line with other similar studies indicating that these drug groups should be especially carefully considered when prescribed for elderly in order to insure appropriate pharmacotherapy.

15.2 Assessment of Medication Reviews

START

As the assessment by the START criteria is based on the residents’ diagnoses, these are essential in order to achieve useable results. Even though the appropriateness of the residents’ medication was assessed after the meetings with the physicians and thereby also after reconciliation of diagnoses, the authors did not known all diagnoses. Before the conduction of the medication reviews, half of the residents met 0 START
criteria, as seen in figure 14.10, meaning that they did not have any diseases/conditions included in the list of START criteria that were not medically treated. However, as the authors did not know all the diagnoses, this result might not reflect the reality.

The medication reviews only resulted in a more appropriate pharmacotherapy for 2 of the residents, when assessed by the START criteria. A study by Verrue et al. (20) investigated how pharmacist conducted medication reviews could impact the appropriateness of pharmacotherapy for nursing home residents, assessed by the START/STOPP criteria and MAI score. A comparison of the appropriateness of the medication showed that there was no difference between the intervention group and the control group when assessed by the START criteria (20). Furthermore, a study by Gillespie et al. (100), retrospectively investigated the effect of a comprehensive pharmacist intervention during hospital admission, including e.g. medication reviews, assessed by the START/STOPP criteria and MAI score. The medication was assessed by the START/STOPP criteria and MAI scores at admission and at discharge. 368 patients were allocated to an intervention group, receiving the comprehensive pharmacist intervention, or control group, receiving regular hospital care. The study showed a 21% improvement in START scores at discharge for the intervention group, compared to an improvement of 4% in START score for the control group (100).

The study by Gillespie et al. (100) indicates that medication reviews can improve the appropriateness of pharmacotherapy in some settings, e.g. during hospital admissions, when assessed by the START criteria. However, medication reviews in other settings, including the settings of this project, does not provide any significant improvements in pharmacotherapy, when assessed by the START criteria. In this project, the insignificant improvement of the pharmacotherapy, when assessed by the START criteria, may be due to the lack of diagnoses.

**STOPP**

When assessing the medication reviews by the STOPP criteria a more apparent difference before and after the medication reviews were observed. Before medication reviews, a maximum of 3 STOPP criteria were fulfilled by the residents meaning that the residents were prescribed with maximum 3 inappropriate drugs. As figure 14.11 shows, an overall reduction of fulfilled STOPP criteria was observed meaning that there was a reduction of prescribed inappropriate drugs for the included residents.
Therefore, the medication reviews lead to a more appropriate pharmacotherapy when assessed by the STOPP criteria. The study by Gillespie et al. (100), found a 42% improvement in STOPP scores at discharge for the intervention group, compared to an improvement of 25% in STOPP score for the control group (100). A review by Hill-Taylor et al. (101) investigated the application of the START/STOPP criteria. The review found that the evidence of applying the START/STOPP criteria were limited in terms of a clinical and economical aspect but the criteria were however a more sensitive tool than the Beers criteria (101).

The START/STOPP criteria are not time consuming, but may not sufficiently optimize the medical treatment of patients if used as a single tool as it does not take treatment doses, treatment duration, or interactions into account. However, it may be used to rapidly get an overview of the appropriateness of a medical treatment, e.g. when physicians add another drug to the medical treatment of a polypharmacy patient and in that situation use it as a checklist. Additionally, as the START/STOPP criteria require diagnoses and knowledge about the patients’ health status it may be a tool more suitable for physicians.

MAI
After the medication reviews, 26.4% of the drugs scored 0 compared to 18.5% before the medication reviews, as seen in figure 14.12 and 14.14. Therefore 7.9% more drugs were appropriate after the medication reviews when assessed by MAI. Furthermore, 4.6% more drugs were assessed as appropriate or nearly appropriate after the medication reviews. This indicates that medication reviews can improve the appropriateness of medical treatment for elderly, when assessed by the MAI score.

A study by Gallagher et al. (102), investigated the difference in appropriateness, by use of MAI, of the medication of $\geq 65$ year old patients, at hospital admission and after either usual hospital care or screening with START/STOP. The study showed an improvement of 71.1% in the MAI-score after screening with START/STOPP and an improvement of 35.4% in the MAI-score after usual hospital care (102). This study indicates that the MAI score is a useful tool to evaluate the appropriateness of medical treatments hospital admitted patients.

An observational study by Stuijt et al. (103), investigated the quality of prescribing for 30 nursing home residents before and after medication reviews, assessed by MAI. They found that the quality of prescribing had significantly increased after the
medication reviews, when assessed by the MAI score (103). The results obtained in this project and the study Stuijt et al. (103) indicate that medication reviews can increase the appropriateness of pharmacotherapy of elderly nursing home residents, when assessed by MAI.

Risk Situation Drugs
Risk situation drugs are known to increase the risk of serious ADRs and serious inadvertent incidents (81). Before the conduction of medication reviews, 89.5% of the residents consumed between 1 and 5 risk situation drugs, as seen in figure 14.16. When compared to the number of risk situation drugs consumed after the conduction of medication reviews, 22.8% less residents received between 1 and 5 risk situation drugs daily. This indicates that medication reviews is an effective method to minimize the consumption of risk situation drugs in elderly polypharmacy residents and thereby prevent the occurrence of serious adverse events, i.e. hospitalization, prolonged hospitalization, the need for acute lifesaving treatment, permanent injuries, or death (81).

Potential Savings
In this project, the potential savings of discontinued drugs was calculated. As seen in figure 14.17, the potential saving calculated on the basis of discontinued drugs was 71,342.9 DKK. However, only savings of 33,211.35 DKK was obtained per 1st May 2014, due to the lack of implemented changes. This means that only 46.6% of the potential savings have been obtained. As long as the implementation rate is this low, medication reviews cannot result in noteworthy savings for the residents or Region Zealand.

Savings based on substituting trademarks with less expensive generic drugs was also estimated. However, the potential savings were insignificant, as seen in the examples at pages 60-61. No savings have been obtained by substituting trademarks with generics, as these substitutions were not recommended to the physicians. Additionally, only few residents received trademarks instead of generics. This indicates that the physicians already prescribe generic drugs, which is also a legal obligation for the Danish physicians. Other studies conducting medication reviews (89, 104) have shown, that savings can be obtained by analogue substitution. In this study, only 3 cases where analogue substitution was possible were identified. As seen at page 61,
the two cases regarded substituting Cipralex with Citalopram and Norspan with Contalgin. Analogue substitution in these 3 cases, would lead to savings of 6.053 DKK per year. However, as the physicians accepted none of these changes, no saving was obtained.

Based on these calculations, medication reviews can only lead to significant saving for patients and society if the accepted recommendations are implemented.

15.3 Education

One of the aims of the 2 educational sessions was to increase the health care personnel’s knowledge about common diseases seen in elderly and the medical treatment of them. Hypertension, depression and heart diseases, which are among the 6 most common diseases among the residents in this study, were included in the education. Therefore, the health care personnel could relate the educational subjects to their work at the nursing homes. In a study by Rossing et al. (90), also aiming to optimize the pharmacotherapy of elderly nursing home residents, education was also included. The education included subject like diabetes type 2, antidepressants, and anxiolytics (90). In a study conducted by Region South Denmark aiming to optimize the quality of medicine use for elderly, health care personnel were educated in the pharmacology of common drugs used by elderly (89). Education of Danish health care personnel seems like a good method to increase focus on appropriate medicine administration for elderly nursing home residents, which ultimately can reduce the number of inadvertent incidents.

In total, 216 medicine related inadvertent incidents occurred for the 47 residents in 2013, corresponding to 4.6 inadvertent incidents per resident per year. The most observed inadvertent incident related to medicine between the 47 included residents, was omitted drug administration both by the health care personnel and the resident, as seen in figure 14.18. The effect of some drugs is highly dependent on maintaining steady state, which an omitted dose could disturb. Therefore, an important focus of the education was prevention of this specific inadvertent incident and the legal obligations of reporting inadvertent incidents. In the study by Rossing et al. (90) the number of inadvertent incidents was also stated. Among 44 residents at 3 nursing homes 231 inadvertent incidents were registered in 2007 and 2008. Omitted medicine administration and dispensing errors were the most frequent inadvertent incidents (90). During the education, personnel were asked if they had some ideas to prevent omitted
drug administration. The personnel were very engaged and suggested that a special alarm or a more specific work plan may prevent omissions. Additionally, the personnel suggested that the most common ADR’s of specific drugs could be noted at the residents’ medicine list, in order to increase the attention to them. Even if the ideas are not implemented, the educational session hopefully lead to an increased attention to prevention of inadvertent incidents. One nursing home had already implemented some of the knowledge gained from the education into their daily practice. The personnel did no longer administer the laxantia Movicol along with other drugs, which can be interpreted as a direct effect of the education.

15.4 Assessment of Education

Inadvertent Incidents

A statement of the number of inadvertent incidents for the 24 residents living in the 3 nursing homes, where the health care personnel were invited to the educational sessions, was made 1 month before and 1 month after the education. The statement is seen in figure 14.19. Even as it sounds promising that the number of inadvertent incidents was decreased by 50%, 1 month after the sessions, the statement is based on very few observations and therefore it is impossible to conclude anything significant. Ideally, a statement of inadvertent incidents 3 months before and 3 months after the educational session should have been made for a larger sample size. However, this was not possible due to the time perspective of this project.

Test

The test was created with the aim to determine the potential effect of the education. The personnel’s knowledge about common diseases in elder, their treatment, and inadvertent incidents was clearly increased after the educational sessions, indicating that they had paid attention and gained new knowledge during the sessions. However, the results can be misleading; the intention was to hand out the first test before the sessions and the second test after the sessions. However, by mistake, both tests were handed out simultaneous to the first educational session. The personnel could therefore fill out the final tests during the education, making it easier to answer the questions. This mistake was corrected for the second educational session. Furthermore, during both sessions there was not enough time for the personnel to answer the test questions. The number of correct answers before and after the sessions
can be seen in figure 14.20.
When evaluating the test answers it was clear that some of the words used in the test were misleading or too advanced. This made it difficult for the personnel to answer the questions, as they did not know exactly what the words encompassed. As an example, it was clear that none of the health care personnel understood what “risk factors” encompassed, as each answer to that question was incorrect. The personnel may have known the correct answer but as they did not understand the question, a higher number of correct answers may have been obtained if the wording of the question had been different.

Feedback
The majority of the feedback at the 2 educational sessions was positive, as seen in table 14.2, indicating that the health care personnel found it interesting to gain new knowledge related to their work. In the study by Rossing et al. (90) the health care personnel also demonstrated a high degree of satisfaction with the education. However, in this project some of the health care personnel stated that the level of the education was too high for the social and health care workers. Therefore, in the future it might be a good idea to offer separate education to the social and health care workers and the social and health care assistants, like it was done in the study by Rossing et al. (90)

15.5 Medication Reviews in the Future
It is inevitable that the number of polypharmacy patients will increase in the future, as people live longer. In order to ensure the appropriate and rational pharmacotherapy for these patients, medication reviews are a key factor.

During this project, it has become evident that a multidisciplinary team is essential when conducting medication reviews, in order to optimize the rationality of pharmacotherapy. An ideal multidisciplinary team would consist of a physician, a clinical pharmacist, specialists, a geriatrician, and health care personnel according to the authors’ convictions. However, a realistic multidisciplinary team could consist of a physician, a clinical pharmacist, and health care personnel.

The physician should be the initiator, as he/she has the overall responsibility for the medical treatment and possesses the required knowledge about the resident’s medical history and diagnoses. The physicians is furthermore responsible for the
implementation of recommended changes to medicine, and the implementation rate will most likely increase if the physician is the initiator of the reviews. The clinical pharmacist can conduct the medication reviews, by means of extensive knowledge about drugs, including drug-drug interactions and ADRs. Additionally, the health care personnel can contribute with essential knowledge about the residents’ daily lives and possible difficulties concerning medication. In order for this to be a success, good communication between all concerned is paramount.

It is evident that the conduction of medication reviews is time-consuming and a standardized method based on previous experience could be advantageous. The standardized method could be based on the START/STOPP criteria and the MAI score, as the combination of these tools provides essential factors enhancing the appropriateness and rationality of pharmacotherapy. If education should be part of the enhancement of appropriate pharmacotherapy, it should focus on preventing inadvertent incidents and provide an overview of the most common treatments in elderly and the possible ADRs related to these treatments, instead of a comprehensive description of specific diseases and treatments. Nevertheless, the education of health care personnel seem like an effective approach to enhance the attention to inadvertent incidents and thereby prevent these, ultimately leading to a more appropriate pharmacotherapy.
16. Conclusion

Medication reviews cannot increase the appropriateness of pharmacotherapy of polypharmacy patients when assessed by the START criteria, as only insignificant improvements in appropriateness were observed in this project. This is most likely due to the authors lacking information about the patients’ diagnoses. On the contrary, medication reviews can lead to a more appropriate pharmacotherapy for polypharmacy patients when assessed by the STOPP criteria, as a reduced number of STOPP criteria were observed after the conduction of medication reviews. Additionally, the MAI scores were somewhat improved after the medication reviews, indicating that medication reviews to a lesser extent that the STOPP criteria can improve the appropriateness. As a result of this project, no worth mentioning savings were achieved. Medication reviews can potentially lead to cost savings for patients and the society if the physicians implement the accepted recommended changes to medicine. This emphasizes that the effect of medication reviews highly depend on the engagement of the physicians.

Despite some errors, education of health care personnel seems like an effective method to increase their knowledge about appropriate medicine administration, specific diseases, and the medical treatment of these.

Overall, an improvement in the rational pharmacotherapy for nursing home resident in Lolland is obtained after the conduction of medication reviews, despite the minor savings achieved.
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