Summary

This thesis focuses on drug use in the elderly, in particular those residing in Dutch nursing homes: the frail elderly. These elderly are especially prone to drug-related problems because of their age, frequently occurring co-morbidity and polypharmacy. Relatively little is known of drug use and drug-related problems in these frail elderly. The studies described in this thesis aim to increase the knowledge on drug use and drug-related problems in this population. The thesis comprises four main parts.

In chapter 1, the introductory chapter, the scope and the objective of this thesis are described and the problems of drug use in elderly people are outlined. Because of co-morbidity, reduced homeostatic mechanisms and the prescription of several drugs simultaneously, elderly people are at an increased risk of drug-related problems such as drug-drug interactions, drug-disease interactions and adverse drug effects. Drugs may also inadvertently be withheld from the elderly, sometimes as a result of underdiagnosing. In view of these considerations, prescribers need a thorough understanding of the risks and benefits of drug therapy in the elderly, especially in the frail elderly, most of whom will be residing in nursing homes. In the Netherlands, relatively few epidemiological studies on drug use in nursing homes have been carried out. The objective of this thesis is to provide insight in the extent, determinants and characteristics of drug use, as well as the outcomes of drug use in frail elderly. Section 1.2 gives an overview of the Dutch health care system for ambulatory and institutionalised elderly. The Dutch nursing home is a healthcare institution for chronically ill persons in need of permanent medical and paramedical attention and complex nursing care. The type of care can be characterised as continuous, long-term, systematic and multidisciplinary. Recently it was concluded that quality aspects should be more incorporated in medication distribution processes and in pharmaceutical care activities in Dutch nursing homes. Hospital pharmacists play a role in drug and therapeutics committees, the evaluation of prescribing practices on patient level, and development and implementation of drug formularies.

Chapter 2 describes several studies that investigated drug use in nursing home residents and elderly outpatients. The first part describes the studies performed in nursing home residents. In section 2.1 an introduction is given to the field of drug utilisation studies and studies that describe the quality of drug use in nursing homes. Many studies have investigated the extent of drug use, whereas only few studies used longitudinal prescription data to evaluate drug effects over time. The studies showed an average number of drugs prescribed per resident...
The studies that were carried out in the Netherlands involved relatively small numbers of residents, and did not study overall drug use on individual patient level. In particular in the United States, much attention has been given to rationality and appropriateness of prescribing in nursing homes. Several studies have focused on applying tools, also referred to as quality or prescribing indicators, to measure medication appropriateness. These studies have shown that a considerable proportion of the nursing home residents received inappropriate prescribing. However, prescribing indicators used in one health care system are not automatically applicable to other health care systems due to differences in pharmacotherapy guidelines and drug formulations. Section 2.2 describes how computerised medication order data were used to build a nursing home database with the aim to perform drug utilisation studies. We collected medication order data of all nursing home residents from 6 nursing homes in Friesland, the Netherlands, for a 2-year study period between 01-10-1993 and 01-10-1995. These records were subsequently record-linked with a national information system on nursing home residents (SIVIS). The SIVIS database contains information on medical (such as diagnoses), nursing (such as activities of daily living and mobility) and administrative data collected on individual nursing home residents. The source population consisted of 2,966 patients. As a result of the record-linkage with SIVIS, missing data and age-limits (residents aged < 65 years were excluded), the final study population consisted of 2,355 residents. We have made several recommendations for those who want to collect medication order data from nursing home residents to perform pharmacoepidemiological studies. For example, an adequate sample size is necessary, and data confidentiality must be guaranteed. Data should be as accurate and complete as possible, which can be ensured by adequate data entry in hospital pharmacy computer systems and checks against other sources, e.g. SIVIS data. Furthermore, it is important that the data can be collected on a continuous basis, as longitudinal data are required to study drug use over time. Keeping individual medication histories for several years is therefore a prerequisite. Another important aspect is the registration of admission and discharge dates in (pharmacy) computer systems so actual duration of stay in the nursing home can be calculated and provide person time as the denominator when studying person time exposed to drugs. We found little agreement between SIVIS diagnoses data and pharmacy prescription data for both diabetes mellitus and Parkinson’s disease, indicating that both pharmacy data and SIVIS should be verified against each other in order to get the right estimation of disease prevalence in the nursing home population. In section 2.3 we performed a drug utilisation study among 2,355 nursing home residents. During the two-year study period, 89%, 77% and 56% of the study population used a drug from ATC main group N (central nervous system), A (alimentary tract and metabolism), and C (cardiovascular system), respectively. The average number of different drugs (based on 5th level of Anatomical Therapeutic Chemical (ATC) code) per resident was 8.9 (SD 4.9). Duration of drug use was relatively long: eight of the ten therapeutic drug groups prescribed most frequently were used for more than 50% of the time spent in the nursing home. In particular psycholeptic drugs, diuretics, and laxatives were used chronically (83%, 81% and 80% of the nursing home stay, respectively). Except for laxatives and diuretics, the prescribed daily dosages were relatively low. We concluded that drug use in the nursing homes was high and many drugs were used chronically. In view of possible adverse effects and the risks of parallel prescribing and drug-drug interactions, the prescribing of psycholeptic drugs, laxatives, loop diuretics, and ulcer-healing drugs should be re-evaluated. In section 2.4 a study is presented on drug-drug interactions (DDIs) in the nursing home. We developed prescribing indicators based on the frequency, nature and duration of DDIs to systematically assess potential DDIs in the cohort of nursing home patients. We found 32% of all residents were exposed to at least one clinically relevant DDI. The number of medications prescribed was a strong predictor of the occurrence of a potential DDI. Drug groups most frequently involved in DDIs were oral anticoagulants, antibiotics and theophylline. The interaction between non-steroidal anti-inflammatory drugs (NSAIDs) and loop diuretics, and between NSAIDs and oral anticoagulants were the potential DDIs most frequently encountered. The number of days on which drugs were prescribed concomitantly was relatively high. Nineteen out of 32 DDIs were prescribed for an average of 50 days or more per 100 days of index drug use. The prescribing indicators developed in this study provide the tools to audit DDI occurrence in nursing homes systematically. Finally, in section 2.5 a pilot study is presented that used several prescribing indicators, based on the studies in sections 2.3 and 2.4, to evaluate drug prescribing in Dutch nursing homes. We evaluated prescribing of benzodiazepines, NSAIDs, ulcer-healing drugs and diuretics. Prescribing indicators were used to identify prescribing that was potentially not in line with recommendations in national and regional prescribing guidelines. Both descriptive indicators, such as percentage of users, and indicators reflecting potentially suboptimal prescribing, such as use of drugs outside the drug formulary and prescription of drug dosages above recommended values were used. We found the majority of prescribing to be in line with recommendations upon which we based our prescribing indicators. Clinical information from the prescriber was necessary to get insight into actual prescribing appropriateness. The second part of chapter 2 describes two drug utilisation studies that were performed in ambulatory elderly, and partly in nursing home patients. Section 2.6 presents a study on the concomitant use of benzodiazepines and antidepressants in two cohorts of elderly outpatients and the nursing home cohort. We assessed whether differences in co-prescribing between tricyclic antidepressants (TCAs) and selective serotonin reuptake inhibitors (SSRIs) existed. Pharmacy dis-
drugs that exhibit moderately to strongly constipating effects and occurrence of constipation was found, the risk was not as high as seen in previous studies. In section 3.2 the clinical effect of a DDI was investigated. In a cohort of elderly outpatients attending the Groningen Outpatient Thrombosis Service, we studied the effects of the interaction between three NSAIDs (diclofenac, naproxen and ibuprofen) and the oral anticoagulantacenocoumarol on prothrombin time, expressed as the International Normalised Ratio (INR). Genotyping of cytochrome P450 2C9 was performed to determine whether genotype was a predictive variable for the occurrence of an increased INR as a result of this DDI. The study population consisted of 112 patients stable on acenocoumarol therapy, of whom 52 (46%) showed an elevation of the INR above the desired therapeutic level (average INR increase between 1 and 4 units). In 12 patients, the INR increased above 6, indicating a clinically relevant risk of severe haemorrhage. No association between CYP2C9 genotype and an increased INR as a result of the DDI was found, and no other predictive variables were identified. We recommend close monitoring of the INR of all patients receiving NSAIDs and acenocoumarol as at present we cannot predict who will and who will not be affected by this DDI.

In chapter 4 the results of the studies described in the thesis are placed in a broader perspective and suggestions for clinical practice and further study are given. For example, hospital pharmacists can play a leading role in the monitoring of drug-related problems in the frail elderly both on an individual and a population based level.

In chapter 3, outcomes of drug use are studied in nursing home patients and elderly outpatients. Section 3.1 presents a study among nursing home residents, in which the association between drug use and constipation was investigated. We performed a prospective cohort study of 2,355 nursing home patients to estimate the incidence relative risk of constipation associated with drug use using prescription sequence analysis of each resident’s detailed pharmacy records and data on morbidity and mobility. Use of drugs that according to the summaries of product characteristics and the literature on adverse effects have moderately to strongly constipating properties was associated with a relative risk of 1.6 (CI 1.2-2.0) for the occurrence of constipation during exposure. Use of drugs with mildly to moderately constipating effects was not associated with an increased frequency of laxative use. Although an association between...