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Chapter 1

**General introduction**



# Chapter 1

## General introduction

### 1 General introduction

The overall aim of this thesis is to assess the health care burden related to chronic diseases, and to identify incentives that can curb the expected increase in the health care burden of chronic diseases. In this introductory chapter we provide a general background of the health care burden of chronic diseases. Furthermore, the aims and research questions of this thesis will be addressed. At the end an outline of this thesis is given.

#### 1.1 Background and research issues

Chronic diseases have become one of the major challenges of this century. The health care burden of chronic diseases has increased tremendously during the last centuries as a consequence of epidemiological and demographic transitions.

The epidemiological transition addresses changes in cause-of-death patterns in a population, and consists of several stages (1-4). The first stage (*the age of pestilence and famine*) is characterized by poor conditions of sanitation and health care services, and the dominance of infectious diseases, causing high mortality rates. The life-expectancy in this stage, which lasted until about 1875, was low, varying between 20-40 years. In the next stage (*the age of receding pandemics*) improvements in the sanitary life conditions and medical conditions were achieved, which resulted in an increase of the life expectancy to 50 years and a sustained population growth (5). Although infectious and parasitic diseases were replaced by non-infectious diseases like cardiovascular diseases and cancer, infectious diseases still remained the leading cause of death. During the second half of the 20th century, the third stage (*age of degenerative and man-made diseases*) emerged in which chronic conditions gradually replaced infectious diseases as the leading cause of death, as a consequence of the elimination of infectious diseases (6). In this phase, the average life-expectancy exceeded 70 years. From 1970 onwards, a further improvement of the survival rates at older ages took place, resulting in a further increase in life-expectancy. This last stage of the epidemiological transition is called *the age of delayed degenerative diseases*. Figure 1.1 presents the increase in the life-expectancy at birth in the Netherlands for the time-period 1850 till 2004. In that time-period the life-expectancy has doubled, from 36.1 in 1850 to 76.3 years in 2004 in men, and from 38.5 to 80.7 years in women (7;8).

The demographic transition is characterized by a shift in patterns of high fertility and high mortality rates to a pattern of low fertility and delayed mortality rates in a population (3). In the first half of the 20th century the overall mortality rates declined and were followed by declines in fertility rates. The reasons for the decline in fertility rates were diverse, but most can be related to modernization processes, economic growth, increased level of education, emancipation of women and the widespread use of contraception (9;10). As a consequence of this shift in mortality and fertility rates, the proportion of elderly has increased substantially since the 1950s, and is continuing to increase in the next coming decades (Figure 1.2). The peak of the aging process of the Dutch population

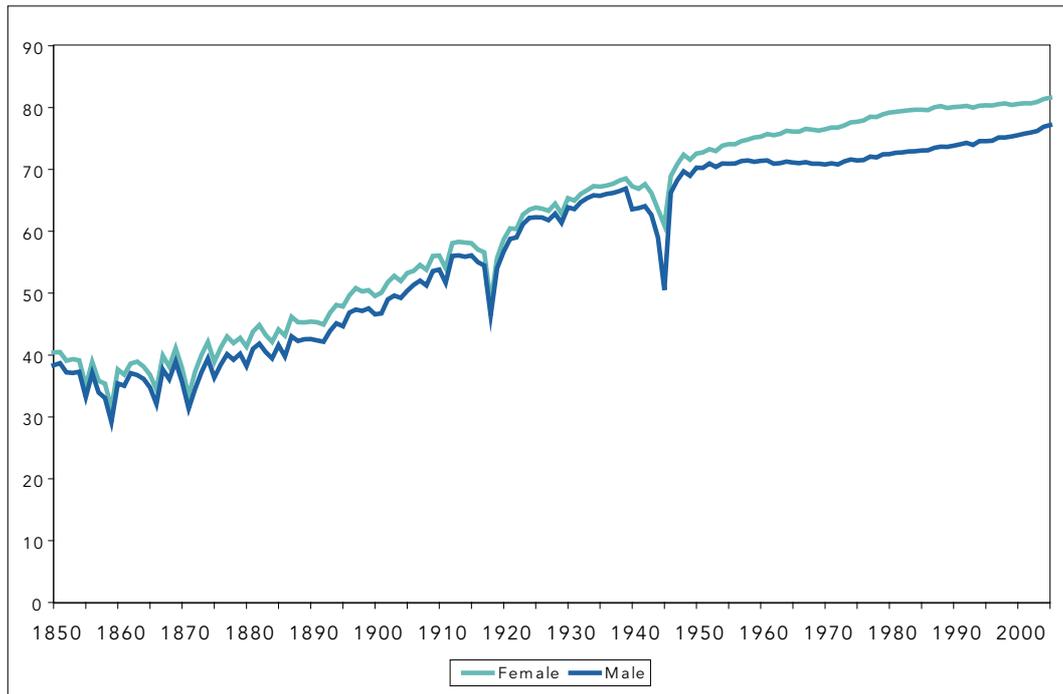


Figure 1.1: Life-expectancy at birth in the Netherlands for the period 1850-2004 (7;8)

is expected at the end of the fourth decade of this century (7). In 2039, the percentage of persons over 65 years is estimated to be 25.1% as compared with 14.5% in 2007 (11). Figure 1.2 presents the observed and predicted percentage of persons over 65 years in the Dutch population during the period 1950-2050.

A drawback of the aging process of the Dutch population is the concomitant rise in the number of chronically ill. In the Netherlands, cross-sectional prevalence estimates of chronic conditions are often estimated on the basis of general practitioners (GP) registrations. Demographic projections based on these GP registrations show an substantial increase in the prevalence figures of about 30-50% for most chronic conditions for the time period 2005-2025 (12-18). As a consequence of the increasing number of chronically ill, the health care burden will rise substantially in the coming decades, and will result in a large upward pressure on health care services and related health care costs in the future. The health care burden of chronic diseases will even be enlarged by the frequent occurrence of comorbidity (19-24). Comorbidity can be defined as the occurrence of one or more chronic conditions in the same person with an index-disease (25). It is estimated that 30% of the chronically ill have comorbidity (24). In this estimation psychiatric comorbidity is not even taken into account. Comorbidity has been shown to intensify health care utilization of the chronically ill and to increase health care costs (20;23;24;26-29).

Currently, most health care systems are insufficiently able to keep pace with the growing health care demands of the population (30). In order to sustain a high-quality health care system in the future, it becomes essential to find incentives that can curb the increasing health care burden of chronic diseases and to bridge the growing gap between demand and supply of health care.

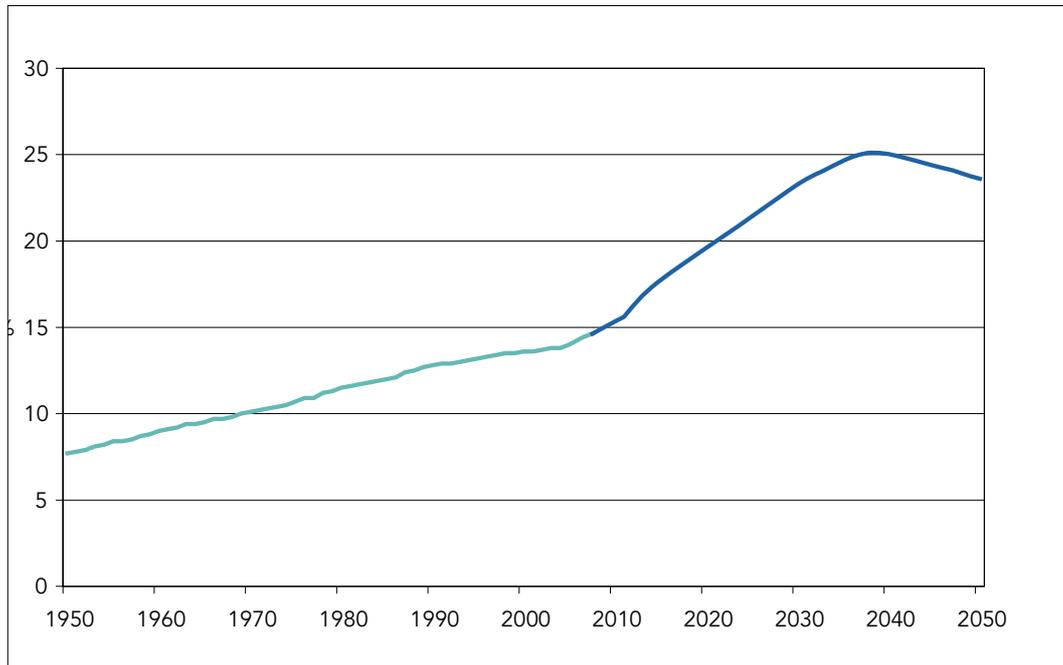


Figure 1.2: Percentage of persons over 65 years in the Dutch population 1950-2050 (7)

A strengthening of the primary prevention and a reorganization of chronic disease management in the health care system are proposed as potential solutions to curb the increasing health care burden of chronic diseases by the Ministry of Health, Welfare and Sports (31;32). The aim of prevention is to ensure that less individuals develop a chronic disease by promoting healthy life-styles, and to create awareness about the risk factors and consequences.

Organizational shifts in health care are needed to bridge the gap between demand and supply of care by improving the quality and continuity of care (33-35). Integrating services in so called disease management programs has the potential to improve the health system performance and to stimulate higher efficiency (36).

In this thesis we will assess the impact of prevention (e.g. changes in life-style) and the impact of organizational shifts in health care on the (future) health care burden of chronic diseases.

### Primary prevention

Life-style behavior of individuals plays an important role in the development of chronic diseases (30;37). During the last decades, the prevalence rates of major risk factors for chronic diseases like overweight, (in)activity and smoking show unfavorable patterns. For instance, the prevalence of moderate overweight (Body Mass Index (BMI) >25.0-30.0 kg/m<sup>2</sup>) in the Netherlands has increased substantially till 57% for men and 42% for women in the period 2005- 2006, and further increases are expected (38). Also the prevalence of obesity (BMI ≥ 30.0 kg/m<sup>2</sup>) has increased from 3% (men) and 6% (women) in 1981 till 12% for both men and women in 2006 (38;39). A further increase of about 50% in the prevalence of obesity is expected in the next 20 years (40). On top of that, an increasing trend is observed in the incidence of childhood overweight and obesity (41). Overweight and obesity in childhood are likely to persist resulting in increased risk for morbidity and mortality in adult life (42). Overweight and obesity will also result in the occurrence of chronic diseases earlier in life, for instance for diabetes (43).

The prevalence of physical inactivity in the Dutch population has also increased in the last decades, although a sharp decline in the prevalence of physical inactivity has been observed in the last few years (44). The Dutch guidelines of physical activity states that every adult should accumulate 30 minutes or more of moderate intense physical activity on most, preferably all days of the week (45). In 2006, about 56% of the Dutch population was active at the recommended levels of the guideline of physical activity, while in 2000 about 43% of the people adhered to the guideline of physical activity (44). Physical inactivity increases the likelihood to develop chronic diseases, for instance cardiovascular diseases or diabetes mellitus (46;47).

In contrast to the aforementioned risk factors, the prevalence of smoking declined, but only for men. The prevalence of smoking in men declined from 90% in 1958 till 31% in 2004 (48). For women the prevalence of smoking was stable during the last decades (about 28%).

The Dutch health care policy is strongly focusing on the prevention of chronic conditions and has stated that prevention has become a top-priority (31). To be able to develop and implement effective health policy, we need to gain more insight into the effects of these unfavorable trends in major risk factors on the future health care burden related to chronic diseases.

### **Organizational shifts in health care**

Chronically ill use a wide variety of health care services and providers simultaneously or in a tight sequence. Chronic care management faces some obstacles of which a lack of coordination is the most prominent (49-53). As a solution, new health care models, so called disease management programs, have been introduced since the 1990s to improve the continuity and simultaneously the quality of care for chronically ill (52;53). Several related concepts like integrated care, managed care and shared care are formulated in the literature (54-57). All concepts share a similarity in goals, namely to improve the quality and efficiency of care by the use of management instruments (58). The main features of disease management programs are a good coordination between the different health care providers, task reallocation and responsibilities and the implementation of protocols and guidelines (58).

Disease management programs exist at a limited scale in the Netherlands (51;59). Diabetes mellitus and stroke are front runner diseases with respect to the development and implementation of disease management programs in the Netherlands (51;59). The main features of diabetes disease management programs are the introduction of diabetes control schemes, diabetes consultation hours, the implementation of joined care protocols, multidisciplinary meetings and the presence of a specialized diabetes nurse (60). Diabetes disease management programs often include multiple health care providers like GPs, specialized nurses, dieticians and medical specialists. Diabetes disease management programs have been proven to be effective in improving the quality of care (33;60;61). Numerous studies have shown to improve process measures (like percentage of patients in which Hba1c is measured annually) and patient outcomes (like HbA1c and total cholesterol levels) (62-80). However, for other patient outcomes like blood pressure, overweight and cardiovascular complications, no improvements were found. Nevertheless, it is to be expected that diabetes disease management programs will become more widespread implemented in the Netherlands in the coming years. Stroke disease management programs are currently the only disease-specific disease management programs which are already more widespread implemented in the Netherlands (59). Stroke disease management programs are delivered by so called stroke services which include multiple health care providers like GPs, medical specialists, nurses, speech therapists, etc.. The main features of these stroke services are stroke units in the hospital, early discharge procedures in the

hospital, guaranteed accessibility to a nursing home, multidisciplinary meetings, specialized nurses and an integrated (electronic) medical record that is accessible to all health care providers (81). A Dutch experiment demonstrated that stroke care organized in stroke services can achieve better health effects with the same budget (49;50;61). A clearer understanding of the effect of a widespread implementation of disease management programs on the future health care burden is of particular interest for health care providers and policymakers.

## **1.2 Research questions**

The overall aim of this thesis is to assess the (future) health care burden related to chronic diseases in the Netherlands and to find incentives which can curb the expected increase in the health care burden of chronic diseases.

The overall aim can be subdivided into three research questions:

1. What is the impact of chronic diseases and comorbidity on the future health care burden?
2. What is the impact of trends in risk factors on the future burden of chronic diseases?
3. What is the impact of organizational shifts in health care on the future health care burden of chronic diseases?

In this thesis diabetes mellitus and stroke are used as illustrative examples. The prevalence of diabetes mellitus is estimated at 600,000 patients in the Netherlands in 2003, while 75,000 new patients are diagnosed annually (15). In 2003, about € 735 million were spent on diabetes mellitus (type 1 and 2), which corresponds to 1.3% of the Dutch health care budget (82). The cost estimates of diabetes are an underestimation, since complications of diabetes are not taken into account.

The prevalence and incidence of stroke in the Netherlands in 2000 are based on GP registrations and show a wide variety, from about 120,000 till 190,000 for stroke prevalence and from 34,000 till 41,000 for stroke incidence (14;83;84). Also the stroke cost estimates vary substantially from 2.5% till 4.3% of the Dutch health care costs (82;84).

The health care utilization of diabetes mellitus and stroke patients show different patterns. Health care utilization of diabetes patients concerns mainly the medical 'cure' sector, while stroke patients use the whole health care spectrum from cure and rehabilitation till nursing care. It is interesting to study whether these differences in health care utilization patterns lead to different outcomes and conclusions with respect to the impact of organizational shifts in health care on the future burden of chronic diseases.

## **1.3 Research methods**

To answer the research questions, we need to combine demographic and epidemiological data and data on the health care burden of chronic diseases. Demographic data were obtained from Statistics Netherlands (7), while the epidemiological data were derived from GP registrations (85-89). Data on the health care burden of chronic diseases comprise data on health care utilization and costs data.

To quantify multidisciplinary health care utilization we used medical record linkage techniques. In addition, we opted for a modeling approach in which all data from various sources were combined, which provided us the opportunity to estimate the chronic disease burden and related costs over time.

### **Medical record linkage techniques**

An efficient and relatively cheap manner to collect health care utilization data is to use existing health care registrations. However, the existing health care registrations were originally set up for administrative reasons rather than for a public health interest (90). As a consequence, the registrations in the Netherlands are event-oriented instead of patient-oriented and comprise data on single health care services (91). Therefore, current studies on health care utilization of chronically ill using existing health care registrations are confined to one health service and provide year-by-year analyses to monitor changes over time. No information is available about multidisciplinary health care utilization. Medical record linkage techniques enable us to reconstruct existing event-oriented registrations into patient-oriented registrations and to create longitudinal datasets needed for the quantification of longitudinal multidisciplinary health care utilization patterns of patients with chronic diseases.

### **Modeling approach**

One of our research questions is to investigate the health care burden of chronic diseases over time. Therefore, we constructed a dynamic model, which is equipped to deal with this time-dimension. A dynamic model is able to comprise multiple states (for instance different health states or smoking and non-smoking states) so that we can estimate the effect of demographic changes and epidemiological changes over time (92). By each step in time, incidence, survival and resulting prevalence are being calculated by taken into account changes in life-style. This modeling approach provides us the opportunity to estimate the future dynamics of chronic disease occurrence and related health care costs while taking into account demographic, epidemiological and organizational shifts in health care. Such models can be helpful in gaining insight into the future health care burden and therefore contribute to a more evidence-based decision making of policy makers (93).

## **1.4 Outline**

To answer the different research questions, we explore in **Chapter 2** the technical possibilities and the problems of linking data on GP referrals with data on hospital admissions and the usefulness of the linked data set for quantifying the health care utilization of patients with chronic conditions.

In chapter 3 and 4, we study the impact of comorbidity (research question 1) and organizational shifts in health care (research question 3) on the health care burden of diabetes mellitus.

In **Chapter 3** we estimate the impact of comorbidity on the use of GP care and hospital care in patients with diabetes mellitus, using medical record linkage techniques.

**Chapter 4** investigates the impact of organizational shifts in GP practices with respect to diabetes services. We aimed to identify organizational aspects of diabetes services that reduce medical care utilization of patients with diabetes. We focused on aspects that can be considered as important building blocks of diabetes disease management programs like the presence of a specialized nurse, the implementation of diabetes control schemes and diabetes consultation hours, and the participation of GPs in multidisciplinary meetings.

In chapter 5 till 7, we study all research questions (1-3) related to stroke.

In **Chapter 5**, a model is constructed to estimate the effects of demographic changes and the trends in major risk factors (hypertension and smoking) on the future dynamics of stroke in terms of incidence, prevalence and 'Potential Years of Life Lost' (PYLL).

In **Chapter 6**, a further elaboration of the stroke model is presented. We extended the model with costs estimates for current practice and for stroke disease management programs. The modeling approach will enable us to quantify the impact of a nationwide implementation of stroke services on future costs of stroke.

**Chapter 7** presents a review of stroke costs studies. In this review, we systematically compare stroke expenditures in different countries by means of a well-designed checklist. The purpose of this review is to validate the results of the model used in chapter 5 and 6. In this review, we also address the economic implications of changes caused by the rapid international spread of new innovative interventions and to interpret these implications at an international level. Finally, in **Chapter 8**, we give a summary of the findings and we discuss some methodological issues as well as the implications of our finding for research and policy.

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