The future health (care) burden of chronic diseases in the Netherlands
Struijs, J.N.

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Summary
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. Chronic diseases have become a major public health problem as a consequence of the ongoing aging of the population. The drawback of this aging process is the increasing prevalence of chronic conditions and the concomitant rise in comorbidity, resulting in a large upward pressure on health care services and related health care costs. In order to sustain a high-quality health care system, it becomes essential to find incentives that bridge the occurring gap between demand and supply of health care. Mainly two solutions are proposed in health care policy to bridge the occurring gap between demand and supply of health care, namely a strengthening of primary prevention by promoting a healthy life-style and a reorganization of health care by means of disease management programs.

This thesis focusses on two diseases i.e. diabetes and stroke: diseases with a large health (care) impact and front runner diseases with respect to the development and implementation of disease management programs.

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?

To assess the future health care burden, we need demographic, epidemiological and data about the multidisciplinary health care utilization data. To obtain multidisciplinary health care utilization data, we used medical record linkage techniques. These techniques are an efficient and cheap manner to collect multidisciplinary health care utilization data by using existing health care registrations. At the time of the start of this thesis medical record linkage techniques were scantly used. Therefore, we first performed a pilot-study (chapter 2) in which the technical (im)possibilities of medical record linkage techniques are explored in order to obtain multidisciplinary health care utilization data of patients with chronic diseases. Chapter 2 describes the principles, methodology of medical record linkage techniques and presents data about multidisciplinary health care utilization for four selected chronic diseases, namely Chronic Obstructive Pulmonary Disease (COPD), coronary heart disease, asthma and diabetes mellitus. We were able to link 78% of the patients referred by the GP to hospital registration data. Based on our experiences in the pilot-study, recommendations were given to improve the future linkages with respect to this specific goal. Our pilot study revealed that medical record linkage is a valid tool to quantify multidisciplinary health care utilization of patients with chronic conditions.

Chapter 3 studies the impact of comorbidity on the medical care utilization of patients with diabetes mellitus. By linking general practice data with hospital based registration data, data on comorbidity and multidisciplinary health care utilization of diabetes patients (n=7,499) were obtained. Comorbidity was defined as vascular-related (heart disease, stroke, nephropathy and diabetic foot) and non-vascular related comorbidity (depression, neurological diseases, musculoskeletal diseases and cancer). About 43% of the patients with diabetes had contacted their GP for coexisting comorbidities. More than half of the health care utilization was related to comorbidity. No differences were found between patients with vascular comorbidity or non-vascular related comorbidity, meaning...
that non-vascular related comorbidity is an equally important utilization driver as vascular related comorbidity. Based on these results, we conclude that current single disease approach of disease management programs should be extended with additional care modules, which must be generic and include multiple chronic diseases in order to meet the complex health care demands of patients with diabetes in the future.

**Chapter 4** investigates the impact of organizational shifts in health care on the health care burden of diabetes mellitus. The aim was to identify organizational aspects with respect to diabetes care which strongly reduce the medical care utilization of diabetes patients. We focussed on organizational aspects of GP practices which can be seen as important building blocks for disease management programs, like the presence of a specialized nurse, the implementation of diabetes control schemes, the implementation of diabetes consultation hours and the participation of the GPs in multidisciplinary meetings with other health care providers. None of these diabetes services characteristics influenced the medical care utilization of diabetes patients, with the exception of the presence of a specialized nurse. The presence of a specialized nurse led to less pharmaceuticals prescribed. None of the policy reasons to develop disease management programs, besides improving the quality and the continuity of diabetes care, was to curb the increasing demands of health care. Based on our results, we found no evidence that the implementation of diabetes disease management programs will achieve that goal. However, more comprehensive data on the diabetes services provided, like the performed tasks and responsibilities of the specialised nurses, are needed to fully understand the impact of disease management programs on the use of health care services related to diabetes mellitus.

**Chapter 5** presents a dynamic multi-state lifetable which is equipped to estimate the future number of stroke incidence, prevalence and mortality in the Dutch population for the time period 2000-2020. The stroke model calculates the yearly number of new stroke patients by age and gender by using incidence rates, specified by age and gender, and presence of major risk factors (hypertension and smoking). The dynamic multi-state lifetable showed that the stroke prevalence will rise continuously in the time-period 2000-2020 (24% per 1,000 for women and 7% per 1,000 for men). The increase in incidence was higher for men (28% per 1,000) than for women (12% per 1,000). A large part of this increase is a consequence of the aging process of the Dutch population. For the medium term, the increase in prevalence is marginally explained by expected changes in hypertension prevalence and changes in smoking behaviour. A reduction of the prevalence of these risk factors in the population will substantially reduce the prevalence of stroke in the long run.

Based on the epidemiological outcomes of the dynamic multi-state lifetable, we estimated the future burden of stroke in the Netherlands in terms of health care costs (chapter 6). The total health care costs are calculated by multiplying the average health care costs per patient specified by age, gender, and health care sector with the total number of stroke patients specified by age and gender. We focussed on the economic consequences of a nationwide implementation of stroke services on total stroke costs. Special attention was given to the substitution of costs between institutional care and non-institutional care. The total health care costs in the Netherlands for stroke amounted €1.62 billion (2000). This amount is approximately 4.3% of the total national health care budget. Projections of the total health care costs of stroke based on current practice, taking into account the effects of demographic changes and trends in risk factors, result in an increase of 28% (€2.08 billion) in the time-period 2000-2020. A nationwide implementation of stroke services in 2020 will result in a sub-
stantial reduction of the costs of stroke (€1.81 billion: 13 percent cost reduction). compared with the ‘regular care’ scenario. We conclude that a broad-scale implementation of stroke services is a strong policy tool for cost containment of stroke care.

Chapter 7 aims to systematically compare how the costs of stroke in different countries are affected by cross-national differences. We conducted a literature search from January 1966 to July 2003. By developing a quality checklist, all studies and articles were screened for design and costs aspects. We compared the national and per capita expenditures of the costs of stroke. After assessing the quality of the studies on the basis of the well-designed checklist, we have selected 25 studies for the analysis. Although the selected costs of illness studies used different methodologies (e.g. incidence-based vs. prevalence-based, top-down vs. bottom-up, etc), the estimated expenditures for stroke are approximately similar. The proportion of national care expenditures in the studies is unequivocal for the more recent studies, i.e. about 3.3% of the total health care expenditures. Our stroke cost estimates based on our stroke model appeared to be higher (4.3% of the total national health care expenditures) than stroke cost estimates found in the literature.

These differences in costs can partly be explained by the more detailed patient-based cost data in our study in comparison with more aggregated cost data in the review, by the introduction of more expensive medical technologies in the recent years like CT-scans and thrombolysis, and an increasing percentage of stroke patients admitted to a hospital. Moreover, most included cost studies did not perform a sensitivity analysis and did not present 95%-confidence intervals. Therefore, the uncertainty ranges around the presented point estimates are lacking, which hinder a good comparison between the different cost estimates.

In chapter 8, we first summarized the most important findings of our research. Subsequently, some methodological issues were addressed, i.e. medical record linkage and modeling approaches. Furthermore, recommendations for health (care) policy and future research were discussed. Prevention and disease management programs should receive higher priority in research and policy, in order to reduce the future health (care) burden of chronic diseases.