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Improved prediction of medical expenditures and health care utilization using an updated chronic disease score and claims data

Carola A. Huber[a,*], Sebastian Schneeweiss[b], Andri Signorell[a], Oliver Reich[a,c]

[a]*Department of Health Sciences, Helsana Insurance Group, P.O. Box, 8081 Zürich, Switzerland*

[b]*Division of Pharmacoepidemiology and Pharmacoeconomics, Department of Medicine, Brigham & Women's Hospital, Harvard Medical School, 1620 Tremont Street, Suite 3030, Boston, MA 02120, USA*

[c]*Institute of Public Health, Medical Decision Making and HTA, Department of Public Health and Health Technology Assessment, UMIT—University for Health Sciences, Medical Informatics and Technology, Eduard Wallnöfer Center 1, 6060 Hall i.T., Austria*

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Abstract

Objective: To predict future medical expenditures, health care utilization, and mortality in Switzerland using an updated chronic disease score (CDS), a chronic morbidity measure based on pharmacy data.

Study Design and Setting: We performed a cohort study using medical claims data from insured persons enrolled in 2009 and 2010. Patient's characteristics, chronic conditions, and health care costs from baseline were used to calculate each patient's disease score. Two-part regression models were fit to predict health care expenditures, utilization, and mortality during the following year using the score's baseline values. We calculated the proportion of explained variation for each regression model to assess their performance.

Results: The CDS model, controlled for sociodemographics and health insurance plan, showed a significant improvement in explained variance of health care costs, outpatient costs, and outpatient visits in 2010. Future outpatient visits were predicted best with an R^2 of 29.2% (age group: 18−65 years) and 22.9% (>65 years), and models predicted future mortality with a *c*-statistic of 0.8.

Conclusion: The CDS showed reasonable predictive validity of future health care utilization and medical expenditure based on pharmacy dispensing data, which may support health care decision makers in the planning delivery systems and resource allocation.

Keywords: Predictive models; Chronic diseases; Claims data; Health care costs; Utilization; Mortality

1. Background

The global burden of chronic diseases has increased dramatically. In 2008, the World Health Organization (WHO) reported that approximately 60% of deaths worldwide were caused by chronic diseases; and by 2020, this figure is projected to rise to almost 75% [1]. Because chronic morbidity increases medical expenses and reduces the productivity of labor, the economic burden of chronic diseases is immense. In the United States, chronic conditions account for more than 75% of the total health care expenditures [2]. Estimates of the current and future costs of chronic diseases are helpful in health policy debates and decision making on resource allocation. Furthermore, they improve our understanding of the importance of prevention and early intervention.

There are various approaches to evaluating the health status of a population and the associated medical costs, including population-based health surveys, monitoring studies, and analyses of disease registers. However, because reliable data on chronic conditions are scarce in many countries, an accurate assessment of the prevalence and cost of chronic diseases is challenging. In Switzerland, no population-based data on clinical diagnoses (International Classification of Diseases [ICDs]), health care use, or its associated costs are available to estimate the prevalence and economic burden of chronic diseases. Therefore, administrative data may be the only reliable source of information on morbidity and cost of care. The potential of using such data in epidemiological and health services research is increasingly recognized [3−6]. They are consistently available, comprehensive, reliable, inexpensive, and cover large populations [7,8].

Because diagnoses are currently missing from such administrative data, pharmacy-based cost groups (PCGs), a morbidity measure based on prescribed drug data, have often been used as a proxy for clinical diagnoses. For example, Dutch and Swiss studies of risk adjustment in health insurance

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* Corresponding author. Tel.: +41-43-340-6341; fax: +41-43-340-0434.

E-mail address: carola.huber@helsana.ch (C.A. Huber).

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What is new?

Key findings

- This study provides an updated, pharmacy-based measure of chronic diseases, which is reliable, valid, and easy to use.
- The chronic disease score model showed a significant improvement in the explained variance of health care costs, outpatient costs, and outpatient visits.

What this adds to what was known?

- Currently, there are no empirical weights tailored to various outcomes and patient characteristics. This study provides empirically derived weights for different age groups and for each prediction model: cost/utilization and mortality.

What is the implication and what should change now?

- Pharmacy-based morbidity measures should be seen as a valid method for predicting future medical expenditures, and widely evaluated and used in different health service delivery systems.

applied PCGs and showed an improvement in predictive accuracy by adding these pharmacy-based diagnoses to the demographics-based model [9–12]. In addition to PCGs, several more comprehensive, administrative-based morbidity measures have been developed as tools to predict health care costs, utilization, and mortality [13–16]. One of the most widely used and validated prescription-based methods to measure morbidity is the chronic disease score (CDS). It is a well-validated, repeatedly revised, and weighted index of chronic morbidity derived from a patient's use of prescription medications. Previous research has shown that several modified versions of the CDS (e.g., RxRisk) are good predictors for health care utilization, medical expenditures, and mortality, and it is comparable with other morbidity measures [17–20]. However, these results may be not be transferable to countries with different populations and health care systems. Therefore, the aim of our study was to predict medical expenditures, health care utilization, and mortality in Switzerland from a health insurance perspective, using an updated CDS, a measure of chronic morbidity based on pharmacy data.

2. Methods

2.1. Data and study population

This study used medical claims data from the leading health and accident insurance company in Switzerland (Helsana Group), which covers approximately 1.4 million Swiss citizens with mandatory health insurance. Population characteristics included age, sex, regional variables (e.g., language area), and the type of health insurance plan. The health insurance plan was characterized by the choice of a managed care model, the chosen deductible class, and the choice of additional coverage for accidents. As managed care models, we considered health plans with capitation, family doctor models, or telemedicine models. Deductibles are obligatory for all Swiss residents and range from 300 to 2,500 Swiss Francs (SFr) per year. The standard deductible is 300 SFr, but the insured persons can choose a higher deductible (500; 1,500; 2,000; and 2,500 SFr) in exchange for reduced premiums. The database also contains information on health care utilization and its associated expenditures as well as mortality. These data are highly reliable because the collected insurance claims cover almost all health care invoices. We performed a cohort study of Helsana enrollees aged 18 years or older from 2009 through 2010.

2.2. Empirical modeling of the (updated) CDS

2.2.1. Identification of chronic diseases

In our database, all prescription drug items are coded based on the WHO Anatomical Therapeutic Chemical (ATC) classification system [21]. According to the pharmacy-based cost group (PCG) model [22], ATC codes were assigned to different chronic diseases. This mapping allows a direct measure of treated diseases and was frequently used to identify persons with chronic conditions [9,22,23]. There is strong evidence that prescription data are a valid proxy measure for prevalence. For example, Cossman et al. [24] could show that prescribed drug rates are an useful proxy for "disease-specific diagnoses prevalence." In our analyses, we included 22 chronic conditions. Table 1 summarizes the chronic conditions and the assigned medication classes.

2.2.2. Calculating the CDS

The CDS was calculated according to the method of Von Korff et al. [15]. The CDS is a comprehensive measure of chronic disease status and overall disease severity [15,25,26]. Because the CDS is based on prescription drug data, it was calculated using the above-defined chronic conditions.

Using the approach of Fishman et al. [26], we assumed that health care costs are a function of each patient's age, sex, health insurance plan, and chronic conditions. Thereby, "health insurance plan" comprised the dummy variables "managed care (0/1)," "accident coverage (0/1)," and "deductible class over 500 SFr (0/1)." Equation (1) describes the model used for developing weights for each chronic condition in the baseline year (2009):

$$\text{Total health care costs} = f(\text{sex, age, language area, managed care, deductible, accident coverage, chronic conditions}) \quad (1)$$

Based on Equation (1), we constructed two-part regression models. In the first part, logistic regression was used to