Chapter 21
A Theoretical Framework for Research on Readmission Risk Prediction

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ABSTRACT

On the one hand, predictive analytics is an important field of research in information systems; however, research on predictive analytics in healthcare is still scarce in IS literature. One area where predictive analytics can be of great benefit is with regard to unplanned readmissions. While a number of studies on readmission prediction already exists in related research areas, there are few guidelines to date on how to conduct such analytics projects. To address this gap the chapter presents the general process to develop empirical models by Shmueli and Koppius and extends this to the specific requirements of readmission risk prediction. Based on a systematic literature review, the resulting process defines important aspects of readmission prediction. It also structures relevant questions and tasks that need to be taken care of in this context. This extension of the guidelines by Shmueli and Koppius provides a best practice as well as a template that can be used in future studies on readmission risk prediction, thus allowing for more comparable results across various research fields.

DOI: 10.4018/978-1-7998-1371-2.ch021

INTRODUCTION

Hospital readmissions, especially unplanned readmissions are an important quality measure in healthcare, as they can indicate issues around treatments, rehabilitation and/or discharge management. Moreover, readmissions are often associated with increased costs resulting from penalties and regulations enforced by policy makers and insurers. At the same time, the increasing availability of healthcare data leads to an uptake in predictive analytics research conducted in the healthcare sector. The identification of patients at high risk of readmission is a significant issue in this context. The main motivation behind this research area is to identify patterns that can help to unravel high-risk patients to allow for timely interventions. The starting point of these interventions lies in the screening of individuals at high risk of discharge failure (Scott, 2010). By identifying high-risk patients, hospital resources can be allocated accordingly and interventions and discharge planning can be adapted. Multiple factors associated with a higher risk of readmission have been identified in research, including health factors (e.g., co-morbidities (Kumar et al., 2017; van Walraven, Bennett, Jennings, Austin, & Forster, 2011), social factors (e.g., marital status (Hasan et al., 2010)), clinical factors (e.g., hospital utilization (Shadmi et al., 2015)), length of stay (Heggestad, 2002)) or effective discharge management (Ohta, Mola, Rosenfeld, & Ford, 2016).

Determining the risk of readmission is an imperative and highly complicated task, relying on different risk factors for various health conditions. While some studies propose general risk scores (Donzé, Aujesky, Williams, & Schnipper, 2013; van Walraven et al., 2010) applicable for all kinds of diseases, research shows significant variation in risk factors for different health conditions. Thus, to be able to accurately predict patients at high risk of readmission, individual prediction models for different health conditions should be preferred. Even though there are a number of studies dealing with this phenomenon, currently no theoretical framework exists to guide these kinds of research projects. This leads to the issue that studies on readmission risk prediction often disregard key characteristics for this prediction task. Also, results from different studies are often difficult to compare and thus unsuitable to generalize best practices. This study proposes a theoretical framework to guide studies on readmission risk prediction by providing a structured overview of relevant definitions, tasks and questions that need to be taken care of in this context. To identify these steps previous studies are analysed to identify project characteristics specifically for hospital readmission prediction.

Background

Hospital Readmissions

While there is no standard definition for readmissions available, they can be broadly described as "a second admission to a hospital within a specified period after a primary or index admission" (Kristensen, Bech, & Quentin, 2015, p. 265). For each healthcare system, criteria concerning the index admission and the second admission to account as a readmission as well as the considered time frame, have to be defined. These criteria can include clinical characteristics (e.g., diagnosis), demographics (e.g., patient age), type of the admission (e.g., elective or emergency) or the treatment facility (Kristensen et al., 2015). To determine the applicable time frame, readmission days are counted from the discharge date of the index admission until the admission date of the second admission. Consequently, a readmission is defined by the relation between two admissions and the time frame in between. There is no international consensus