International Journal of Medical Informatics 92 (2016) 44–53

Contents lists available at ScienceDirect

International Journal of Medical Informatics

journal homepage: www.ijmijournal.com

Improving the informational continuity of care in diabetes mellitus treatment with a nationwide Shared EHR system: Estimates from Austrian claims data

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ARTICLE INFO

Article history:
Received 5 October 2015
Received in revised form 4 May 2016
Accepted 6 May 2016

Keywords:
Medical records
Medical records systems
Computerized
Continuity of patient care
Diabetes mellitus
Austria

ABSTRACT

Purpose: Shared Electronic Health Record (EHR) systems, which provide a health information exchange (HIE) within a community of care, were found to be a key enabler of informational continuity of diabetes mellitus (DM) care. Quantitative analyses of the actual contribution of Shared EHR systems to informational continuity of care are rare. The goal of this study was to quantitatively analyze (i) the degree of fragmentation of DM care in Austria as an indicator for the need for HIE, and (ii) the quantity of information (i.e. number of documents) from Austrian DM patients that would be made available by a nationwide Shared EHR system for HIE.

Methods: Our analyses are based on social security claims data of 7.9 million Austrians from 2006 and 2007. DM patients were identified through medication data and inpatient diagnoses. The degree of fragmentation was determined by the number of different healthcare providers per patient. The amount of information that would be made available by a nationwide Shared EHR system was estimated by the number of documents that would have been available to a healthcare provider if he had access to information on the patient's visits to any of the other healthcare providers. As a reference value we determined the number of locally available documents that would have originated from the patient's visits to the healthcare provider himself. We performed our analysis for two types of systems: (i) a "comprehensive" Shared EHR system (SEHRS), where each visit of a patient results in a single document (progress note), and (ii) the Austrian ELGA system, which allows four specific document types to be shared.

Results: 391,630 DM patients were identified, corresponding to 4.7% of the Austrian population. More than 90% of the patients received health services from more than one healthcare provider in one year. Both, the SEHRS as well as ELGA would have multiplied the available information during a patient visit in comparison to an isolated local EHR system; the median ratio of external to local medical documents was between 1:1 for a typical visit at a primary care provider (SEHRS as well as ELGA) and 39:1 (SEHRS) respectively 28:1 (ELGA) for a typical visit at a hospital.

Conclusions: Due to the high degree of care fragmentation, there is an obvious need for HIE for Austrian DM patients. Both, the SEHRS as well as ELGA could provide a substantial contribution to informational continuity of care in Austrian DM treatment. Hospitals and specialists would have gained the most amount of external information, primary care providers and pharmacies would have at least doubled their available information. Despite being the most important potential feeders of a national Shared EHR system according to our analysis, primary care providers will not tap their full corresponding potential under the current implementation scenario of ELGA.

1. Introduction

Electronic health records (EHRs) provide efficient access to relevant patient data for healthcare providers (HCPs). EHRs were found to be a key enabler of *informational continuity of care* [1]. According

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http://dx.doi.org/10.1016/j.ijmedinf.2016.05.001

to Haggerty et al., informational continuity of care represents one of three dimensions of continuity of care and is defined as the use of information on past events and personal circumstances to make current care appropriate for each individual [2].

Continuity of care implies the management of health information in two ways: (a) local information management about the subject of care at the site of care provision, and (b) information interchange between HCPs [3]. In this paper we concentrate on the second, i.e. we will analyze to what extent EHRs may contribute to inter-organizational informational continuity of care. In compliance with ISO TR 20514 we use the term *Shared EHR system* to denote a system for managing information in EHRs, which aims to facilitate integrated shared care within a community of care [4].

According to a recent study [5], HCPs confirm that Shared EHR systems can in fact achieve the goal of supporting inter-organizational patient care. There, seventy percent of the 3700 interviewed physicians say that Shared EHR systems improve coordination of care across care settings and 74% say that Shared EHR systems improve cross-organizational working processes. Similarly, Swedish HCPs report that complete medical records offered by Shared EHR systems allowed them to provide safer and better care [6]. The absence of Shared EHR systems was identified as one of five current organizational barriers to integrated care in the United Kingdom [7]. Reviewing the published outcomes of regional healthcare information systems, Mäenpää et al. found evidence for improved health information exchange (HIE) and communication and coordination between cooperating HCPs [8].

Continuity of care has a positive impact on the care of chronically ill patients [9]. Due to the longitudinal character of chronic disease treatment, which is typically distributed between different HCPs, the sharing of the fragmented information on a common patient becomes particularly significant. The importance of sharing diabetes mellitus (DM) data between different HCPs was identified in earlier work [10,11]. Widespread use of EHR systems among primary care practices was found to be correlated with fewer temporal gaps in the care of DM patients [12]. Similarly, MacPhail et al. reported that Shared EHR systems can provide sufficient informational continuity to prevent gaps and overlaps in DM treatment [1]. Branger et al. showed that DM patients can benefit from an increased communication between their HCPs and a higher availability of data for their HCPs through the application of Shared EHR systems [13]. Further, preliminary findings of a recent study indicate that Shared EHR systems may improve integrated care of patients suffering from chronic kidney failure [14].

Despite the perceived impact of Shared EHR systems in cooperative care settings, quantitative analyses of the actual contribution provided by Shared EHR systems to informational continuity of care are rare. Nationwide Shared EHR systems, which are aspired to by most industrial nations [15], will allow a particularly high contribution due to their broad coverage of patient information. An obvious way of analyzing the contribution of nationwide Shared EHR systems to informational continuity of care would be to measure the information that is actually transferred between the different users of the system [16]. At the moment, however, most national Shared EHR systems are still in the development phase. In Austria, the development of a national HIE infrastructure has been discussed for more than a decade [17]. This process culminated in the implementation of the Austrian Shared EHR system ELGA [18]. Even though ELGA has become operational in December 2015, the system is still in its early phase and does not provide sufficient data that would allow a meaningful analysis of information transfer.

In this paper we estimate the contribution to informational continuity of DM care that could be achieved by a nationwide Shared EHR system. We use pseudonymized claims data of the Main Association of Austrian Social Security Institutions. This includes data on outpatient (general practitioners and specialists) and inpatient care. Overall, the database contains medication data of 7.9 million persons from all age groups who received medical care that was paid for by one of the Social Security Institutions in Austria between 2006 and 2007. The mean Austrian population size in these years was 8.28 million [19]. The data covers about 95% of the entire population, the missing five percent are due to insurance carriers not covered by the database (e.g., municipalities and unemployment service), or due to insufficient data quality (e.g., missing age or gender). According to the Austrian data protection law, pseudonymized as well as anonymized health data that do not allow personal identification of the corresponding patient, may be legally used for research without requiring prior patient consent. The present study was approved by the ethics committee of the Medical University of Vienna.

2. Objectives

This paper aims to answer two questions:

1. To what extent is information fragmented between HCPs treating Austrian DM patients, and thus to what extent do these HCPs depend on information interchange? The answer to this question helps to clarify to what extent HIE technologies, such as Shared EHR systems, are relevant in the context of DM.
2. What amount of information (in terms of number of documents) from Austrian DM patients would be made available by a nationwide Shared EHR system for HIE? The corresponding analysis will be done for (i) a "comprehensive" Shared EHR system, where we assume data to be recorded for each patient visit to a HCP, and (ii) based on data in a format as will be recorded in the Austrian ELGA system.

3. Methods

3.1. Identification of diabetes mellitus patients

Pharmaceutically treated DM patients were identified if at least one type of diabetes-specific medication (see Table 1) was dispensed to them between 2006 and 2007. We did not require these patients to have a documented diagnosis of DM, as our database

Table 1
ATC codes of diabetes-specific medication according to Chini et al. [20].

ATC code	Description
A10AB	Insulins and analogues for injection, fast-acting
A10AC	Insulins and analogues for injection, intermediate-acting
A10AD	Insulins and analogues for injection, intermediate- or long-acting combined w. fast-acting
A10AE	Insulins and analogues for injection, long-acting
A10BA	Biguanides
A10BB	Sulfonamides, urea derivatives
A10BD	Combinations of oral blood glucose lowering drugs
A10BG	Thiazolidinediones
A10BX	Other blood glucose lowering drugs, excluding insulins