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Categorized diagnoses and procedure records in an administrative database improved mortality prediction

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Abstract

Objectives: Comorbidity measures are widely used in administrative databases to predict mortality. The Japanese Diagnosis Procedure Combination database is unique in that secondary diagnoses are recorded into subcategories, and procedures are precisely recorded. We investigated the influence of these features on the performance of mortality prediction models.

Study Design and Setting: We obtained data of adult patients with main diagnosis of acute myocardial infarction, congestive heart failure, acute cerebrovascular disease, gastrointestinal hemorrhage, pneumonia, or septicemia during a 1-year period. Multiple models were constructed representing different subcategories from which Charlson and Elixhauser comorbidities were extracted. Prevalence of comorbidities and C statistics of logistic regression models predicting in-hospital mortality was compared. Associations between four procedures (computed tomography, oxygen administration, urinary catheter, and vasopressors) and mortality were also evaluated.

Results: C statistics of the model using all secondary diagnoses (Charlson: 0.717; Elixhauser: 0.762) were greater than those using a limited subcategory to strictly specify comorbidities (Charlson: 0.708; Elixhauser: 0.744). However, misidentification of complications and main diagnoses as comorbidities was observed in the all-diagnosis model. The four procedures were associated with mortality.

Conclusion: Subcategorized diagnoses allowed correct identification of comorbidities and procedures predicted mortality. Incorporation of these two features should be considered for other administrative databases.

Keywords: Administrative data; Comorbidity; Severity; In-hospital mortality; Charlson; Elixhauser

1. Introduction

Defining comorbidities is important in epidemiologic and health service research using administrative data. Use of comorbidity indices, obtained by summarizing the number of diseases weighted by their prognostic importance, is one method for measuring comorbidity, and the Charlson Comorbidity Index [1] has been used widely. Based on the original method using information from medical records, coding algorithms using the International Classification of Diseases, 9th Revision (ICD-9), and its clinical modification (ICD-9-CM), were developed for application to administrative data [2−5]. Elixhauser et al. [6] introduced another method, designed for administrative data with ICD-9-CM codes. Algorithms have been developed and assessed for the use of the Charlson and Elixhauser methods with ICD-10 [7−10]. As a summarized index was not available in the original Elixhauser method, an index for the Elixhauser method was later developed and validated [11].

Using different administrative databases and patients, many studies have been conducted to evaluate the performance of the comorbidity measures [12]. Comparisons of the Charlson and Elixhauser methods have found the latter to be slightly superior in predicting in-hospital death in various groups of patients [13−17]. Other methods have also been tested [18,19]. In most administrative databases, however, there is no categorization within the secondary diagnoses, and complications during hospitalization can

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What is new?

Key findings

- When using more diagnosis categories for extraction of comorbidities, the prevalence of the comorbidities increased, and their use improved prediction of mortality.
- Four procedures (computed tomography scan, oxygen administration, urinary catheter insertion, and use of catecholamines or vasopressin) performed on the admission day were associated with in-hospital death.

What this adds to what was known?

- Without subcategorization of the secondary diagnoses, complications and severity of the main disease could be misidentified as comorbidities when using comorbidity measures in administrative data.
- Procedures could be used to describe the severity of a patient on admission and be included in the mortality prediction models.

What is the implication and what should change now?

- Improved modeling of disease burden of a patient may be possible when an administrative database records subcategorized secondary diagnoses and procedures performed.

be misclassified as comorbidities present on admission. This misclassification could lead to improved mortality predictability of comorbidities, as pointed out by studies using Canadian hospital discharge data, in which chronological information (on admission or during hospitalization) is added to each diagnosis by the "diagnosis-type indicator" [14,20].

In the Japanese Diagnosis Procedure Combination (DPC) database, there are six distinct categories of diagnosis: "main diagnosis" (DMain), "admission-precipitating diagnosis" (DAdm), "most resource-consuming diagnosis" (DRes1), "second most resource-consuming diagnosis" (DRes2), "comorbidities present at time of admission" (DCom), and "conditions arising after admission" (DPost). This allows selection of categories of diagnoses from which illnesses are extracted for comorbidity analysis. However, the effect of this selection on performances of comorbidity measures has not been evaluated. Also, procedures performed during hospitalization are recorded in the DPC database, but it is unknown whether the procedures can be used in mortality prediction models.

The purpose of this study was to compare the mortality-predicting ability of the Charlson and Elixhauser methods using different diagnosis categories in extraction of comorbidity data from the DPC database and to evaluate the associations between performed procedures and in-hospital death.

2. Methods

2.1. Data source

The DPC database is a national database of acute care in-patients containing administrative claims data and discharge information. In 2012, the number of participating hospitals was approximately 1,000, with data from approximately 7 million in-patients collected annually, representing approximately 50% of all acute in-patients in Japan. The database includes the following information: hospital identification code and type of hospital; patient information; admission and discharge status; diagnoses; and drugs and procedures used.

Up to 12 diagnoses for each admission are recorded in the DPC database and are coded using the ICD-10 classification. There are six categories of diagnosis, each with a limited number of recordable diseases. One diagnosis each is coded for DMain, DAdm, DRes1, and DRes2. A maximum of four diagnoses each is coded for DCom and DPost. Data are recorded according to the attending physician's decision. Report of DMain, DAdm, and DRes1 is mandatory, whereas recording of DRes2, DCom, DPost is voluntary. Suspected diagnoses are allowed, in which case they are designated as such. For this study, we termed DAdm, DCom, and DPost as secondary diagnoses.

Drugs and procedures are coded according to the Japanese fee schedule for reimbursement [21], and their dates of use during hospitalization are recorded. The daily quantities of each drug administered are also recorded.

2.2. Study population and outcomes

We included adult patients (≥18 years) with a confirmed diagnosis of acute myocardial infarction, congestive heart failure, acute cerebrovascular disease, gastrointestinal hemorrhage, pneumonia, or septicemia recorded in DMain who were discharged between April 1, 2012, and March 31, 2013. The identification of these six diseases was based on the Clinical Classifications Software (CCS) for ICD-10 developed by the Healthcare Cost and Utilization Project [22], and the following CCS categories were used for the six diseases, respectively: CCS 100, 108, 109, 153, 122, and 2. For congestive heart failure, we also included hypertensive heart disease with heart failure (ICD-10 codes: I11.0, I13.0, and I13.2). Each admission was considered as an independent patient. Those transferred to another hospital were excluded. The outcome of this study was in-hospital mortality.

Because of the anonymous nature of the data, the need for informed consent was waived. Study approval was