

Administrative data accurately identified intensive care unit admissions in Ontario

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Accepted 27 November 2005

Abstract

Background and Objectives: To evaluate the accuracy of Ontario administrative health data for identifying intensive care unit (ICU) patients.

Materials and Methods: Records from the Critical Care Research Network patient registry (CCR-Net) were linked to the Ontario Health Insurance Program (OHIP) database and the Canadian Institute for Health Information (CIHI) database. The CCR-Net was considered the criterion standard for assessing the accuracy of different OHIP or CIHI codes for identifying ICU admission.

Results: The highest positive predictive value (PPV) for ICU admission (91%) was obtained using a CIHI special care unit (SCU) code, but its sensitivity was poor (26%). A strategy based on a combination of CIHI SCU codes yielded a lower PPV (84%) but a higher sensitivity (92%). A strategy based purely on OHIP claims yielded further reductions in PPV (73%), gains in specificity (99%), and moderate sensitivity (56%). The highest sensitivity (100%) was obtained using a combination of CIHI and OHIP codes in exchange for poor PPV (32%).

Conclusions: Administrative databases can be used to identify ICU patients, but no single strategy simultaneously provided high sensitivity, specificity, and PPV. Researchers should consider the study purpose when selecting a strategy for health services research on ICU patients. © 2006 Elsevier Inc. All rights reserved.

Keywords: Claims analysis; Critical care; Databases; Health services research; Predictive value of tests; Sensitivity and specificity

1. Introduction

Administrative databases are used in health services research because they offer large and comprehensive sample size, systematic and coordinated data collection, and population-based information free of referral bias. We evaluated the accuracy of the Canadian Institute of Health Information database (which contains demographic, administrative, and clinical data for all hospital discharges and day surgeries in Canada), and the Ontario Health Insurance Program database (which contains all fee-for-service claims paid for services provided to Ontario residents) for identifying intensive care unit admissions.

Admission to the Critical Care Research Network (CCR-Net) database was our criterion standard. The CCR-Net is a collaboration including 33 Ontario hospitals that maintains a patient registry of the activities of critical care facilities [1–3]. The minimal dataset of admissions is systematically collected by participating hospitals and includes patient demographics, data to calculate a score on the Acute Physiology and Chronic Health Evaluation II (APACHE II) system [4], and information about ICU and hospital length of stay. The CCR-Net data has good interobserver reliability and strong face validity [5–7].

2. Methods

2.1. Selection of hospitals and patients

We considered all admissions (according to date of arrival) to nine Ontario acute care hospitals (including

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one teaching hospital) participating in the CCR-Net and appearing in the Canadian Institute of Health Information (CIHI) database during January 1, 2001 to December 31, 2002. The specific hospitals were selected based on the rates of successful linkage (>90% agreement) between the CIHI and CCR-Net databases (Appendix 1).

2.2. Handling of duplicate records

The patient admission to CIHI containing the most recent discharge date was retained when multiple records had the same healthcare number, admission date, and date of birth. For duplicate entries having different ages, the admission corresponding to the oldest age was selected for analysis. If duplicate records were identical for health care number, age, hospital number, admission, and discharge dates, one of the records was randomly deleted.

2.3. Linkage protocol

The resulting dataset was linked to records in the CCR-Net database using institution number, admission date, and the patient's chart number. Chart numbers were not available in CCR-Net for one hospital, and records were instead linked using institution number, admission date, and date of birth. If CIHI records could be linked to multiple CCR-Net entries indicating ICU readmissions during the same hospital admission, only the most recent CCR-Net admission was retained.

2.4. Specific identifier codes

Descriptions of the programming codes that were analyzed are listed in Appendix 2. The CIHI database contains special care unit (SCU) codes and two procedure codes for mechanical ventilation [Canadian Classification of Health Interventions (CCI) codes replaced Canadian Classification of Diagnostic, Therapeutic, and Surgical Procedures (CCP) codes in April 2002]. Reporting of SCU codes was standardized and made mandatory for all Ontario hospitals in April 2002. Trained abstractors working in hospitals' health records department and using standardized procedures perform coding of CIHI data [8]. The OHIP database contains several per diem codes applicable to adult intensive care. The accuracy of these two databases for distinguishing intensive care unit (ICU) patients requiring mechanical ventilation could not be assessed because CCR-Net does not contain information about this procedure.

2.5. Statistical analysis

Frequency tables were constructed for each programming code using the concomitant entry in the CCR-Net database as the criterion standard. Sensitivity, specificity, and positive and negative predictive values were calculated and a summary receiver operator curve was constructed [9].

A false positive was an ICU admission identified using these codes that did not appear in CCR-Net. A false negative was an ICU admission appearing in CCR-Net but not identified using these codes. Based on the analysis of false positives and false negatives the strategies for identifying ICU admission were refined. In all cases the patient was the unit of analysis.

The codes with highest specificity while maintaining sensitivity greater than 80% were used to classify false positive and false negative admissions. For the preferred strategies, characteristics of resulting ICU cohorts were compared using the Student's *t*-test for normally distributed continuous variables, the Wilcoxon rank-sum test for non-parametric continuous variables, and the chi-square test for categorical or binary variables. The agreement between CIHI versus OHIP codes for identifying mechanical ventilation was measured as percent agreement and using the kappa statistic.

3. Results

During the 2-year study interval a total of 329,284 admissions to CIHI with valid health care numbers occurred at the nine hospitals. After deleting 203 duplicate records, 329,081 admissions were available for analysis. During the same time period, 19,876 records appeared in CCR-Net and successful linkage to CIHI was possible for 18,637 (94%). After removing 936 records in CCR-Net representing readmissions to ICU during the same hospital admission, 17,701 ICU admissions served as the criterion standard (Fig. 1).

CIHI and OHIP codes could be combined in different ways to identify ICU admissions (Table 1). The CIHI procedure codes for mechanical ventilation (CCI) had high specificity (100%), reasonable positive predictive value (61%), yet very poor sensitivity (12%). OHIP and SCU codes for ICU admission had high specificity (96 and 90%, respectively) and sensitivity (84 and 96%, respectively). We created a stringent definition of ICU admission by requiring that both OHIP and SCU codes be present, which increased specificity marginally and decreased sensitivity substantially. The highest sensitivity (99%) was obtained by considering OHIP or SCU codes together, whereas further selection based on CIHI procedure codes did not further increase sensitivity. The receiver operator curve of OHIP and CIHI showed no significant anomalies (Fig. 2).

To check that our results were consistent across centers, we calculated the sensitivity and specificity of OHIP codes for identifying ICU admissions at each of the nine hospitals. Specificity remained greater than 95% for eight of the nine hospitals (range 92 to 99%). However, considerable variability was observed across centers for sensitivity (median 82%, range 31–98%). The hospital that performed worst on specificity was not the same hospital that performed worst on sensitivity.

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