

Detection of Inpatient Health Care Associated Injuries: Comparing Two ICD-9-CM Code Classifications

Carol J. Masheter, Paul Houglan, Wu Xu

Abstract

This paper compares two complementary International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) code classifications for detection of adverse events (AEs) at the hospital, State, and national levels. The classifications are the Agency for Healthcare Research and Quality's Patient Safety Indicators 2003, June release, Version 2.1 (PS Indicators) and the Utah/Missouri Adverse Event Classification 2002, Version 1 (AE Classes). First, the paper describes similarities and differences between the two classifications, such as intended purpose, process of development, grouping of ICD-9-CM codes, specificity, and sensitivity. Second, it compares the ways each classification categorizes ICD-9-CM codes into indicators or classes of potential AEs. Third, the paper presents the number and percentage of Utah inpatient discharges (UTIDs) with any PS Indicator over 3 years (2000, 2001, and 2002) and compares the percentage of UTIDs by PS Indicator to published values derived from a national database, the Healthcare Cost and Utilization Project (HCUP) Nationwide Inpatient Sample 2000 (NIS). UTIDs have significantly higher values for five PS Indicators and significantly lower values for seven PS Indicators than NIS. Fourth, the paper presents the annual percentage of UTIDs with any AE Class code for 2000, 2001, and 2002, which shows a small but significant increase over this 3-year period. The AE Classes are more sensitive; they detect far more potential injuries due to medical care, or AEs, but may include more false positives than the PS Indicators. The PS Indicators are more specific; they detect fewer potential AEs but may include fewer false positives than the AE Classes.

Introduction

We expect miracles from modern medicine. In fact, advances in medicine have increased life expectancy and enhanced quality of life. People who would have died or been bedridden by cancer, diabetes, heart disease, or other diseases even a decade ago now survive, and even thrive, thanks to new medical devices, procedures, and medications. However, the very care that is intended to heal can also cause harm. Highly publicized cases, such as a teenage girl who died after lung transplant surgery due to a blood type error,¹ serve as tragic reminders. Unfortunately, these cases are only the tip of the iceberg. Frequently cited studies have estimated between 44,000 and 98,000 deaths per year due to medical management nationwide.² The Institute of Medicine has reported findings from approximately 30 works published in the 1990s substantiating "serious and

widespread errors in health care delivery that resulted in frequent avoidable injuries to patients.”³ Such incidents and publications have increased awareness of errors in, and injuries due to, medical management (AEs) rather than the patient’s underlying disease or condition.²

AE underreporting

AEs are underdetected and underreported, both within health care organizations and externally.² Interviews in 19 States, including Utah, indicated numerous reasons for underreporting, such as health care facilities lacking internal systems to identify events, uncertainty about reporting requirements, a culture of nonreporting, a lack of enforcement at the State level, bureaucratic burden, competition and market share, fear of publicity, fear of liability,⁴ and lack of a common AE taxonomy.⁵ These findings suggest that AE reporting systems may be most effective if they are easy to use, but not so simple that the information reported is of limited value.⁵

Use of ICD-9-CM codes in hospital discharge data for AE detection

In its call for improved understanding of patient safety epidemiology, the Agency for Healthcare Research and Quality (AHRQ) has identified hospital discharge data as one of six useful sources of information on AEs.⁵ Hospital discharge data are among the few forms of data used nationwide. Because the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) coding system is widely used in hospital discharge data, it can provide an accessible, low cost, and efficient means of detecting AEs in hospitals, State and nationwide.⁶⁻⁸ Because it is already in use, this system adds few new burdens on hospital and State resources.⁶ As retrospective surveillance and case-finding tools, ICD-9-CM codes in discharge data can complement other detection and reporting methods. Though hospital discharge data and ICD-9-CM codes have substantial limitations, the codes provide an attractive starting place to improve AE detection.^{6,7}

Hospitals already use ICD-9-CM codes in discharge data for their own patient safety surveillance systems. For example, at a large teaching hospital in Utah, ICD-9-CM codes related to medical device codes detected more medical device-related hazards and AEs than five other detection methods, including computer flag surveillance, online incident reporting, telemetry checklists, clinical engineering database, and a postdischarge patient survey. Also, ICD-9-CM codes related to medical devices detected different kinds of device-related hazards and AEs than the other detection methods. Review of a random-selection sample of patient records in a large teaching hospital in Utah with ICD-9-CM device codes (N = 141) revealed that 72 percent had a confirmed medical device AE.⁸ Other Utah teaching hospital researchers have investigated enhanced case findings based on ICD-9-CM codes, followed by retrospective chart review using explicit criteria to detect adverse drug events (ADEs), or adverse events related to medications. Initial results suggested that such methods can roughly double the

total number of ADEs detected relative to those found by computer flag surveillance.⁹ These studies give compelling evidence of the effectiveness of ICD-9-CM codes for AE detection. However, they are limited to specific teaching hospitals and specific kinds of AEs.

Several States also have developed methods based on ICD-9-CM codes for statewide surveillance of AEs and to assist hospitals with their own internal quality improvement of patient care. These classifications differ in purpose of AE detection as well as scope and kind of AEs they detect. For example, the Florida Agency for Health Care Administration released a one-time statewide study in 2000 on drug-caused illnesses, such as allergies and side effects, that was based on codes associated with these adverse drug effects.¹⁰ To date, the Utah Department of Health has sent five quarterly reports that contain statewide numbers and rates of inpatient discharges with at least one ADE or misadventure and related information to all acute care hospitals in Utah. The Department also has posted the reports on its Web site.¹¹ Additionally, all 40 Utah acute care hospitals received their own hospital level numbers and rates for ADEs and misadventures. The Department uses the term “misadventures” to include obvious errors of or injuries due to medical care, such as accidental punctures or lacerations and foreign bodies accidentally left in patient’s body during procedures, wrong surgery, etc.

Adverse event classes of ICD-9-CM codes

AHRQ-funded patient safety reporting demonstration projects in Missouri, New York, Utah, and Wisconsin have developed similar, but not identical, classifications for several categories of AEs.⁵ Wisconsin uses four categories of ICD-9-CM codes for AEs (drug, device, procedure, and radiation), including principal and secondary diagnosis codes among all Wisconsin general acute care hospitals.⁶ One of New York’s AHRQ-funded projects focuses on three specific kinds of AEs: new acute pulmonary embolism, acute myocardial infarction, and postoperative wound infection.⁵ Based on published research, research in progress, and input from a national expert panel, the Utah and Missouri studies expanded Rolfs and associates’ previous AE classification.¹² The expanded version, Utah/Missouri Adverse Event Classification, 2002 Version 1 (AE Classes),¹³ is being validated by medical chart reviews in Missouri and Utah (N = approximately 7,200 charts per State). All 40 Utah acute care hospitals are participating in the chart review. In Missouri, 36 study hospitals (a convenience sample of all 123 Missouri acute care hospitals) are participating in the chart review. (See Van Tuinen, Elder, Link, Li, Song, Pritchett, “Surveillance of Surgery-Related Adverse Events in Missouri: Using ICD-9-CM Codes,” in this volume for more details about the Missouri sample.) The Utah study emphasizes misadventures, a subset of two of the surgery-related AE Classes, (e.g., patient injuries likely to be due to medical care, such as foreign object accidentally left in patient’s body), and ADEs in the entire patient population; the Missouri study emphasizes a larger number of surgery-related AEs among surgery patients. The States have provided their statewide and hospital information on AEs to their hospitals. Based on this information, some Utah hospitals have requested

additional patient-level information for in-depth examination of AEs and changed or added programs to reduce risk to patients.

AHRQ patient safety indicators

AHRQ and Stanford University have developed 20 Patient Safety (PS) Indicators based on ICD-9-CM codes.¹⁴ These indicators are based on published research, input from a national expert panel, medical coding experts, and empirical results from analysis of Healthcare Cost and Utilization Project (HCUP) data. The intended purpose of the PS Indicators is to detect potential AEs, prioritize areas of action, or to provide a starting point for further analysis to reduce preventable errors through system or process changes. Users have reported that the PS Indicators have demonstrated high specificity and low sensitivity.¹⁵ In other words, the PS Indicators capture relatively few false positives (potential AEs that further inquiry showed were not caused by medical care,) but they probably miss a considerable portion of true positives, or actual AEs. In this paper, “potential AEs” are errors or injuries detected by selected ICD-9-CM codes that are more likely than not to be due to medical care, such as accidental puncture or laceration during a procedure (998.2).

Rationale for this study

In summary, several teaching hospitals, States, and a federal agency have developed ICD-9-CM code classifications as accessible, low cost, efficient methods for detection of potential AEs for State public health surveillance and to assist their hospitals with internal patient safety improvement. However, AHRQ and most of these States have developed their own ICD-9-CM code classifications. Their classifications differ in number of codes, ways the codes are categorized, ranges of AEs they detect, and the degree of verification for their ability to detect actual AEs. To date, no national findings are available for any of the state-developed classifications, and no State findings have been published on the PS Indicators. This paper addresses this gap. It compares one of the State classifications, the Utah/Missouri Adverse Event Classification, 2002 Version 1 (AE Classes),¹³ and the AHRQ Quality Indicators, Patient Safety Indicators 2003, Version 2.1 (PS Indicators).¹⁴

Methods

Data Sources

The national dataset is the HCUP National Inpatient Sample (NIS), which consists of approximately 36 million discharges from 986 nonfederal United States acute care hospitals in the year 2000. For this paper, the authors have used published values for number and percentage of NIS discharges by PS Indicator.¹⁶ The Utah dataset (Utah inpatient discharges or UTIDs) consists of approximately 710,000 inpatient discharges from all 40 nonfederal Utah acute care hospitals in 2000, 2001, and 2002.¹⁷

Analysis

First, this paper compares the features of the two classifications, the PS Indicators and the AE Classes. Second, it compares the ways each classification categorizes ICD-9-CM codes into indicators or classes of potential AEs. Third, the paper presents and compares the number and percentage of inpatient discharges by PS Indicator for UTIDs and NIS. Fourth, the paper presents the number and percentage of inpatient discharges by AE Class for UTIDs.

Similarities between PS Indicators and AE Classes

The two classifications have followed similar development processes and share several similarities. Both use ICD-9-CM codes in hospital inpatient discharge data to identify potential AEs. Input from national expert panels guided development of both classifications. Both exclude principal diagnosis codes from the numerator for each indicator or class to focus on in-hospital AEs, rather than AEs that originated before the patient's hospital stay. Both classifications restrict the denominator of some indicators or classes to at-risk patient populations (e.g., only surgery patients' discharges were included in the denominator for potential AEs related to surgical procedures).

Differences between the two classifications

Closer inspection reveals several differences (Table 1). First, each classification has a different emphasis. The PS Indicators, which target events with a high likelihood of representing errors in medical care, are intended primarily for institutional case-finding and patient safety improvement initiatives.¹⁴ The AE Classes are intended primarily for statewide public health surveillance, though hospitals have been encouraged to use State and hospital information based on the AE Classes for internal improvement of patient care. Second, the PS Indicator expert panel consists of physicians who reviewed PS Indicator codes prescreened by medical records coders,¹⁴ whereas the panel for the AE Classes includes pharmacists, nurses, medical records experts, as well as physicians, all of whom reviewed each AE Class code. Third, PS Indicators were developed based on previous findings.¹⁴ The development of the AE Classes included chart reviews, currently in progress, in Utah and Missouri (N = approximately 7,200 charts per State.)

Fourth, the classifications differ in scope. The PS Indicators consist of 143 ICD-9-CM diagnosis codes and codes for external causes of injury and poisoning (E-codes) in three categories: three obstetric or birth trauma indicators, eight medical indicators, and nine surgery-related indicators,¹⁴ but none specifically for ADEs. The AE Classes consist of 1,003 codes in 3 categories of 64 classes: 26 ADE classes, 22 medical classes, and 16 surgery-related classes (including two misadventure classes).¹³ The Utah study has emphasized the ADE classes, because the Harvard Study reported that they are the most frequent cause of iatrogenic injury.¹⁸