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Economic Measurement of Medical Errors Using a Hospital Claims Database

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ABSTRACT

Objective: The primary objective of this study was to estimate the occurrence and costs of medical errors from the hospital perspective. **Methods:** Methods from a recent actuarial study of medical errors were used to identify medical injuries. A visit qualified as an injury visit if at least 1 of 97 injury groupings occurred at that visit, and the percentage of injuries caused by medical error was estimated. Visits with more than four injuries were removed from the population to avoid overestimation of cost. Population estimates were extrapolated from the Premier hospital database to all US acute care hospitals. **Results:** There were an estimated 161,655 medical errors in 2008 and 170,201 medical errors in 2009. Extrapolated to the entire US population, there were more than 4 million unique injury visits containing more than 1 million unique medical errors each year. This analysis estimated that the total annual cost of measurable medical errors in the United States was $985 million in 2008 and just over $1 billion in 2009. The median cost per error to hospitals was $892 for 2008 and rose to $939 in 2009. Nearly one third of all medical injuries were due to error in each year. **Conclusions:** Medical errors directly impact patient outcomes and hospitals' profitability, especially since 2008 when Medicare stopped reimbursing hospitals for care related to certain preventable medical errors. Hospitals must rigorously analyze causes of medical errors and implement comprehensive preventative programs to reduce their occurrence as the financial burden of medical errors shifts to hospitals.

Keywords: direct hospital costs, medical error, medical injury.

Introduction

The current era of health care reform is bringing many changes to health care systems overall and hospitals in particular. Medicare has eliminated payments to hospitals for hospital-acquired conditions. Furthermore, the 2010 Affordable Care Act put into place financial incentives for quality care and financial disincentives for preventable medical errors. All these factors have led to a significant increase in the financial burden of medical errors, and much of that financial burden has been shifted to hospitals. In addition to the negative implications on patient care, medical errors now directly impact a hospital's profitability. This comes at a time when Medicare and commercial health insurance plans are reducing reimbursement to hospitals for procedures and shifting care to ambulatory sites of care as cost-saving measures. Because medical errors are preventable, hospitals must rigorously analyze the causes of medical errors and implement comprehensive preventative programs to reduce their occurrence.

An error was defined by the Institute of Medicine report titled *To Err Is Human: Building a Safer Health System* as "the failure of a planned action to be completed as intended or the use of a wrong plan to achieve an aim" [1]. Injuries that result from medical errors are the focus of this analysis. Preliminary research into the epidemiology of medical errors suggests that they occur more frequently than thought and pose a considerable economic and social burden, as well as serious patient harm [2]. Analyses have projected that in the United States, medical errors cause 44,000 to 98,000 injuries each year [3]. The Institute of Medicine report was published in 2000 and brought to light the fact that medical errors are increasingly likely as health care systems become more complex. The same report noted that reducing medical errors will require a systematic effort to build safety into the processes of care.

In 2010, Landrigan et al. [4] noted that interventions started after 2000 have not been implemented in a reliable manner. The authors retrospectively reviewed medical injuries in the state of North Carolina and quantified the rate of injury at approximately 3%. This rate was similar to that in an earlier study examining records of adult hospitalizations in New York state, which found that 3.7% of all hospitalizations were associated with medical injuries [3]. Naessens et al. [5] found that approximately 4% of hospital discharges had an associated adverse event and the majority (43%) involved skin integrity issues, while 23% were medication errors and 21% were falls.

An analysis of the cost and length of stay associated with voluntary adverse event reporting in hospital settings found that hospital stays with an event report were 17% more costly and 22%

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longer than hospital stays without an associated event report. Medication and treatment errors were the most common and expensive types of adverse events, accounting for 77% of all events and added costs [6]. A study of hospital reporting data from Maryland and California determined that potentially preventable complications added approximately 9.4% to 9.7% to hospital inpatient costs [7].

In 2010, a study sponsored by The Society of Actuaries Health Section and performed by Milliman, Inc., examined the economic measurement of medical errors to health plans and society [8,9]. The report estimated that 6.3 million measurable medical injuries occurred in the United States in 2008. In an inpatient setting, 7% of the admissions resulted in some type of medical injury. Of the 6.3 million injuries, 1.5 million were associated with a medical error. Total cost per error was calculated at approximately $13,000, resulting in a total cost of $19.5 billion to the US economy. In addition, these errors resulted in more than 2500 excess deaths and more than 10 million excess days missed from work because of short-term disability [8,9].

In 2008, Medicare eliminated payments to hospitals for hospital-acquired conditions that were deemed to be preventable if hospitals followed clinical practice guidelines. Among these conditions were certain events termed "never events", or events that should never occur in safe hospitals [10]. With these restrictions, and the 2010 Affordable Care Act that further incentivizes quality care and disincentivizes preventable medical errors [11,12], hospitals now bear most of the economic burden of medical errors.

The primary objective of this study was to estimate the costs and occurrence of medical errors from the hospital perspective by using data contained in the Premier hospital database and methodology developed by Milliman, Inc. The current study adds to the discussion by assessing the cost of medical errors from the hospital perspective, rather than from the perspective of managed care. The methodology developed by Milliman, Inc., to estimate the likeliness of an injury's association with a medical error was applied for the first time to the Premier hospital data set. In addition, extrapolation methodology developed by Premier in conjunction with the US Food and Drug Administration allowed for the estimation of the impact of medical errors on the nation's hospitals.

Methods

Milliman, Inc., Study

A 2010 study sponsored by The Society of Actuaries Health Section and performed by Milliman, Inc., examined the economic measurement of medical errors to health plans and society [8,9]. The Milliman study used health plan claims data from the MarketScan databases to assess medical injuries identified through *International Classification of Diseases, Ninth Edition*, codes for medical injuries. The Milliman study utilized an expert panel of clinicians and actuaries to estimate how often each type of injury was likely to be associated with a medical error rather than a consequence of the underlying disease. Injuries were classified into five groups on the basis of the likelihood that they were associated with a medical error, and the midpoint of each range of likelihood of medical error was applied to the frequency of each medical injury to establish the rate of medical error. The Milliman study compared both inpatient and outpatient injury visits to noninjury visits on the basis of a propensity-matching algorithm to estimate the costs associated with injuries.

Data Source

This study utilized clinical and billing data from the Premier hospital database [13]. This database contains clinical and utilization information from more than 600 US hospitals and ambulatory surgery centers and includes more than 45 million inpatient discharges and more than 210 million hospital outpatient visits from acute care facilities, ambulatory surgery centers, and clinics across the nation. The data used in this study included hospital discharge data from October 1, 2007, through September 30, 2010. The entire data set was used to identify inpatient injuries. Injury rates, error estimates, and cost-per-error estimates were developed from hospital billing data in 2008 and 2009.

Identifying Injuries and Errors

The current study utilized the ranges and midpoints of medical errors established in the Milliman study and applied them to the data from the Premier database. All 97 injury groupings identified in the Milliman study were reverified, with only minor modifications, by an outside coding group to ensure that no major changes had occurred since the Milliman list was developed.

For a visit to qualify as an injury visit, at least 1 of the 97 identified injury groupings must have occurred at that specific visit. Visits with four or more unique injuries occurring at that visit were removed from the population, and visits with more than one injury occurrence were counted only once in the overall cost table to avoid overestimation of cost. Visits with injuries were flagged for sensitivity analyses if the patient had a previous visit within an approximate 30-day window of the visit in which the injury occurred. After identifying visits for each type of injury, the likelihood that the specific injury was caused by a medical error was estimated. The final frequency of a specific type of medical error was estimated by multiplying the calculated frequency of the specified type of injury by the midpoint of the error percentage category.

Similarly to the Milliman study, this study established noninjury control groups by using propensity score matching. The propensity score for each subject was estimated on the basis of gender, age group, All Patient Refined Diagnosis Related Groups severity of illness and risk of mortality, admission type, major comorbidities, and hospital characteristics. The propensity score match was a 1:1 greedy match on nearest neighbor with a maximum caliper width of four digits.

Cost Analysis

For each injury visit, a matched noninjury control was chosen to compare the difference between direct medical costs to hospitals. Visits incurring costs below $300 or above $300,000 were removed from the cost analysis because these visits were determined to be outside the normal range of inpatient costs, and therefore not good indicators of the real cost to the hospital. Sensitivity analysis was preformed, which confirmed that removal did not affect the outcome. The cost per error was estimated as the difference in cost over the control for those who experienced a medical injury. *T* tests for statistically significant differences in direct cost were performed, and the injuries with the largest statistically significant differences are reported.

Extrapolation Methodology

This study utilized the extrapolation methodology, which was developed by Premier and validated by the US Food and Drug Administration, for producing nationally representative inpatient discharge data. The method is based on a stratified comparison of Premier's inpatient database to all US hospitals responding to