Assessing Surgical Adverse Events Using Administrative Data

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Introduction: With the Institute of Medicine's 1999 landmark report, *To Err is Human*,[1] patient safety became a key component of health care quality. Patient safety is measured by monitoring preventable adverse events (PAE), which are injuries caused by medical management rather than by the underlying disease of the patient.[2] Numerous studies have shown an association between PAE and increased mortality, length of stay, and readmissions.[3, 4]

To monitor PAE in hospitals, the Agency for Healthcare Research and Quality (AHRQ), established a set of Patient Safety Indicators (PSIs) to identify populations at risk and potential cases using administrative inpatient databases. Patient safety indicators are based on ICD-9-CM and diagnosis-related groups (DRGs) codes. [6-8] As with PAEs, PSIs have been associated with increased inpatient length of stay, in-hospital mortality, and hospital charges. Using PSIs to screen for potentially preventable adverse events is a universally replicable method of identifying likely lapses in patient safety.[9, 10]

Surgery is an ideal discipline to study PSIs, as processes and outcomes are closely related temporally and there are over an estimated 234 million operations performed yearly.[13] Due to the volume of procedures, medical errors are not rare at the national level. Epidemiologic data on inpatient adverse events are essential for measuring and evaluating the safety and quality of healthcare delivery. The goal of this project is to assess in-hospital adverse events in different surgical specialties using PSIs on administrative data; here we focus on reconstructive plastic surgery. This group of patients represents a unique population because reconstruction often occurs after failure of other techniques. Thus these complex patients receive care from many different specialists and undergo multiple procedures. We aimed to describe adverse events in patients receiving reconstructive plastic surgery in the US and highlight areas where further research is needed to help identify causality of events.

Methods: Using the Nationwide Inpatient Sample (NIS) database, we identified adult discharge records for patients receiving an two common reconstructive plastic surgery procedures between 1998 and 2009. Patients were stratified by type of wound: pressure ulcer, orthopedic complication, post-operative infection, burns, and all others. AHRQ's Patient Safety Indicators were used to examine adverse events

Results: Of the 575,428 pedicle flap or graft procedures, 174,185 (30%) were coded as a principle procedure and 401,243 (70%) were secondary procedures. For principle procedures, orthopedic complications accounted for 24% of the patients, followed by pressure ulcers (22%) and post-operative infections (18%). In cases identified based on secondary procedures, orthopedic complications and post-operative infections each accounted for 23% of cases and pressure ulcers in 22%. Heterografts and homografts were dominated by burn patients, 53% and 54%, respectively. Average length of stay was 9.9 for principle procedures and 10.9 for secondary procedures ($p<.0001$) and average days to principle procedure was 2.1 and 3.0, respectively ($p<.0001$). Principle procedure patients had an average of 4.1 procedures compared to 3.9 for secondary procedure patients ($p<.0001$). The cohort with a principle reconstructive surgical procedure had an average in-hospital mortality rate of 1.36% compared to 1.19% for secondary procedure cohort ($p=0.0291$). Patient safety events were similar in the two groups of patients with few exceptions where principle procedure group had higher rates than secondary procedure: pressure ulcers (5.1 vs. 3.2; $p<.0001$), postoperative respiratory failure (1.6 vs. 1.3; $p=.0001$), and postoperative sepsis (2.1 vs. 1.6; 0.0252), respectively.

Limitations: For hospital adverse events, secondary diagnoses are esstential to properly indentify a true adverse event. In identifying adverse events using administrative data, we have to assume there are miscoded events and incomplete risk adjustment due to ICD-9 coding limitations and completeness for secondary diagnoses.[14, 15] Although principle diagnosis is frequently accurately coded in administrative data, secondary or comorbid diagnoses are often underreported. This therefore limits the positive predictive value of hospital adverse events using administrative data.

Another concern is over-reporting of in-hospital preventable adverse events due to the possibility of including present on admission (POA) conditions.[16] Using administrative data, we lack the temporal component of the adverse event. Timing of event is crucial for identifying a true adverse event caused by medical error, rather than those patients admitted with an existing event, certainly in our population of reconstructive plastic surgery patients. Certain adverse events captured are greatly influenced by the inclusion of POA information and the validity of these rates is questionable in the absence of POA codes.[17-19] These events need to be flagged and caution used when reported.

Conclusions: The identification and epidemiology of in-hospital adverse events is complex. Using administrative data patients have relatively high rates of adverse events compared to smaller chart extraction studies. Distinguishing between events present on admission and those acquired in-hospital is important and requires further data exploration using clinically rich temporal data. The tracking and monitoring of adverse events is essential in the identification of areas in need of quality improvement efforts. Our preliminary data indicate two statistically distinct plastic surgery cohorts, those receiving a plastic surgery procedure for wounds present on admission and those receiving one as a secondary procedure, possibly in response to an adverse event occurring during their hospital stay. Adverse events in the latter group need rich clinical data and time of event information; however these patients could reflect a new way to identify adverse events.

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