

## Research Article

# The Effect of Patient Safety Events on Elective Surgical Patients at US Academic Medical Centers

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**Abstract****Objective:** To determine the extent of the impact of a patient safety event on outcomes for elective surgical admissions at US academic medical centers.**Methods:** The study design was a retrospective cohort analysis. The UHC Clinical Database was used to evaluate inpatients from 106 US academic medical centers. The system was queried for the development of a cohort in which patients admitted for elective surgical procedure did not experience a surgical patient safety event and a cohort in which the patients did experience a surgical patient safety event during their inpatient stay. Outcomes for each cohort were length of stay, costs, 30 day readmissions and inpatient mortality. The UHC risk-adjustment methodology was used to compare observed rates to expected rates of resource utilization and mortality outcomes.**Results:** Over 500,000 cases were analyzed. 13,733 cases were found that had experienced a surgical patient safety event during their inpatient stay. The incidence rate of a patient safety event occurring was 26.1/1,000 discharges [2.6%].

The mortality rate, mean length of stay, mean cost and 30 day readmission rate for those patients in the cohort without a post surgery patient safety event occurring was 0.32%, 4.43 days, \$17,197 and 8.06%, respectively. The LOS and mortality rates were lower at a 0.01 level of statistical significance than expected. Costs were higher than expected at a 0.01 level of significance.

The mortality rate, mean length of stay, mean cost and 30 day readmission rate for those patients in the cohort with a patient safety event occurring was 9.31%, 15.25 days, \$51,500 and 16.24%, respectively. The mean LOS, mean cost and mortality rate were higher at a .01 level of statistical significance than expected.

**Conclusion:** Higher mortality rates, 30 day readmission rates, mean LOS and cost are associated with the occurrence of a patient safety event among surgical inpatients admitted electively to academic medical centers.**Introduction**

Patient safety contributes considerably to resource utilization and mortality in the United States. It has been estimated that adverse events occur in 49 out of 100 patient admissions which amounts to over 18 million patient safety events annually [1]. This costs Americans over 17 billion dollars per year [2]. The death toll from patient safety events has been reported by the Institute of Medicine as up to 98,000 per year [3]. Recent estimates report the death toll may be over four times as high [4].

The academic medical center offers patients innovative medical care for some of the most difficult to treat diseases known to man. Many centers focus on referrals from community physicians for complex medical and surgical problems best solved in the multi-disciplinary environs with our nation's medical school faculty. At these centers we train the physicians of tomorrow as well as the nurses and allied health professionals for the next generation.

This retrospective cohort analysis seeks to determine the outcomes of inpatients at academic medical centers across the US

who are admitted for elective surgical procedures and experience a surgical patient safety event (post-surgical or intraoperatively) during the course of their treatment.

**Methods**

The study design deployed was a retrospective cohort analysis.

The University HealthSystem Consortium's Clinical Database/Resource Manager v. 1.5.0.10 [UHC CDB/CRM] employing the 2012 UHC risk model was used to analyze information related to patients discharged from 106 US academic medical centers that are part of the Clinical Resource Manager program.

The database was used to review discharges age 18 – 100 years old, (adults) from US academic medical centers in calendar year 2012. Elective inpatient admissions which were assigned a surgical MS-DRG were selected for the analysis. Obstetrical surgeries were excluded from the analysis.

The statistical methods used by UHC for statistical risk modeling to set expected values are logistic regression for mortality and log

transformed linear regression for LOS and cost. Outliers at the 99th percentile are excluded from model generation. Models are built on a rolling 2 years of data [5].

The 2012 UHC risk models were built using 114 academic medical center’s inpatient discharge administrative data for Q3 2010 to Q2 2012 as the model population. The data set contains patient-level, ICD-9 diagnosis and procedure codes, patient demographics, charge data and other data elements that are evaluated during the risk modeling for mortality, length of stay and direct cost. UHC technical specifications note that the modeling incorporates the co-morbid conditions that are present at the time of admission so as to minimize the impact of iatrogenic conditions on the risk model generations [5].

A patient safety event was defined as a case which met the profile for AHRQ Patient Safety Indicators [PSI] that capture surgical outcomes: 8, 9, 10, 11, 12, 13, 14, 15. The inpatient mean length of stay, mean cost, 30 day readmission rates and mortality rates were then analyzed and compared to those cases in which a PSI was not assigned.

Cohort 1, Non-PSI, included cases in which no surgical patient safety event occurred.

Cohort 2, PSI, included cases in which a surgical patient safety event occurred.

The incidence per thousand discharges and mortality rates for PSI 8-15, were reported.

The technical specifications for the AHRQ PSI can be found at [http://qualityindicators.ahrq.gov/Modules/PSI\\_TechSpec.aspx](http://qualityindicators.ahrq.gov/Modules/PSI_TechSpec.aspx)

Note: The information contained in this article was based in part on the Clinical Database/Resource Manager (CDB/RM) maintained by the University HealthSystem Consortium (UHC).

## Results

526,594 cases discharged from academic medical centers in calendar year 2012 were elective admissions with a surgical procedure. The mean length of stay was 4.71 days, the mean cost was \$18,093, 30 day readmission rate was 8.25% and the inpatient mortality rate was 0.55%

Table 1 lists the cases with a surgical patient safety event, the incidence rates and inpatient mortality rates. PSI 11, Postoperative Respiratory Failure had the highest occurrence rate and Postoperative Hip Fracture the lowest occurrence rate, 0.02 per 1,000 cases.

Table 2 contains data for all patients, the PSI cohort and Non PSI cohort.

The Non PSI cohort contained 512,861 cases. The mean length of stay (LOS) was 4.38 days, the mean cost was \$17,197, the 30 day readmission rate was 8.25% and the inpatient mortality rate was 0.55%.

The PSI cohort contained 13,733 cases. The incidence rate of a patient safety event was 21.6 cases per 1,000 discharges. The mean length of stay for this cohort was 15.25 days, the mean cost was \$51,500, the 30 day readmission rate was 7.16% and the inpatient mortality rate was 9.31% [1,278 deaths].

**Table 1:** AHRQ Patient Safety Indicators and Incidence Rates

AHRQ Safety Indicator	Observed Rate Per 1000 Cases	Inpatient Elective Surgical Mortality Rate [%]*
PSI08 postoperative hip fracture	0.02	0.00
PSI09 postoperative hemorrhage or hematoma	3.36	6.69
PSI10 postoperative physiologic metabolic derangement	1.21	41.64
PSI11 postoperative respiratory failure	12.25	14.74
PSI12 postoperative pe or dvt	5.49	7.35
PSI13 postoperative sepsis	11.03	22.34
PSI14 postoperative wound dehiscence	1.32	7.46
PSI15 accidental puncture or laceration	8.44	3.76

\*More than one PSI may be assigned to an inpatient admission.

**Table 2:** Cohorts and Outcomes

Cohort	Cases	Mean Length of Stay [days]	Mean Direct Costs (\$)	Inpatient Mortality Rate [%]	Readmission Rate [%]
All Elective Surgical Admissions	526,594	4.71	18,093	0.55	8.25
1 Patients who did not experience a patient safety event	512,861	4.43++	17,197**	0.32++	8.06
2 Patients with a patient safety event	13,733	15.25**	51,500**	9.31**	16.24

\*\* Higher than expected at the 0.01 level of statistical significance  
 ++ Lower than expected at the 0.01 level of statistical significance

The mean LOS of the PSI cohort was higher than the expected LOS, while the Non PSI cohort mean LOS was lower than expected at the 0.01 level of significance. The PSI cohort also incurred more resource-intensive care: a larger percent stayed in an ICU and had a higher mean ICU LOS than the Non PSI cohort. Sixty-seven percent of the PSI cohort experienced an ICU stay with a mean ICU LOS of 10.29 days, compared to 21.6% of the Non PSI cohort with an ICU stay and a mean ICU LOS of 3.30 days.

The mean cost for both cohorts was higher than expected at the 0.01 level of significance.

The PSI cohort mortality rate was higher than expected, while the Non PSI cohort’s mortality rate was lower than expected at the 0.01 level of significance.

## Discussion

Though much has been written about the AHRQ Patient Safety Indicators and their use in public reporting of hospital outcomes, the fact that we continue to lose lives in America’s hospitals due to preventable harm is undisputable. A recent research report places the patient safety death toll at over 400,000 annually [4].

This study demonstrates that inpatients admitted electively to an academic medical center for a surgical procedure who experience a surgical patient safety event incur higher mortality rates and ac-

count for higher resource utilization both during the inpatient stay and post-discharge with higher 30 day readmission rates compared to those inpatients without a PSI event. The occurrence of a surgical PSI was associated with a higher mortality rate, 9% vs less than 1% for elective surgical admissions without a PSI. Those inpatients with a PSI had a mean LOS 3.5 times higher and a mean cost 3 times higher than counterparts without a PSI. Their inpatient stay was also more likely to require utilization of ICUs, with the ICU utilization rate and ICU LOS both three times higher than comparable ICU rate and LOS for patients without a PSI. Finally, re-hospitalization is more likely to follow, with a 30 day readmission rate nearly twice as high for patients with a PSI compared to those without.

Patients that experienced a patient safety event in this cohort study were much more likely to die during their hospital stay than those that did not. Although in-hospital mortality is not the end all be all of quality assessment, it is a very discernible outcome that is clearly interpreted by all. It is not within the scope of this study to determine if the patient safety events and associated mortalities were preventable.

The length of time a patient spends as an inpatient is commonly thought to be a corollary of the quality of care they receive. All things being equal, a patient with a longer length of stay is thought to have had some complication of care that may have contributed to the outcome. In these days of shrinking reimbursements and higher costs, the length of stay is concentrated on as a modifiable outcome by hospital performance improvement teams. This study suggests that preventing patient safety events may have a significant impact on reducing length of stay in the academic medical center.

Readmissions are a major focus of hospital quality improvement teams. This study demonstrates a nationwide 30 day readmission rate of 8.25% for elective surgical admission to our academic medical centers. If a patient safety event occurs during the first admission, not only does the time the affected person spends in the hospital significantly increase, but the likelihood of readmission is significantly higher. A study that reviewed Veterans Health Administration patients found that the odds of readmission were 23% higher if a patient safety event occurred [6].

Government agencies have taken to publicly reporting the PSIs' incidence data as a means of comparing hospitals' patient safety records. This was never intended to be their use. A team of researchers concluded in 2009 that the government should proceed cautiously in using PSIs for comparing hospitals to each other. They report that the positive predicted values for the PSIs are in the range of 22 to 74 percent [7]. Researchers concluded in 2011 that some PSIs, especially the one dealing with venous thromboembolism, would be improved by using the present on admission flags now enabled in the AHRQ algorithms [8].

One of the most important drawbacks of the patient safety indicators is the lack of substantive risk adjustment related to co-morbidities. For instance, the post-operative sepsis PSI does eliminate immunocompromised patients from the denominator but does not take diabetes mellitus, alcoholism, alcoholic hepatitis or cirrhosis into consideration. It also treats all patients over the age of 18 years the same. There is no consideration for geriatric issues that may elevate the risk of developing a complication.

Assignment to a Patient Safety Indicator relies on administrative billing data and varies for each PSI, but may include ICD-9 CM diagnoses codes, age, gender, admission source, and admission status. Other methodologies have been developed by insurers and other public reporting organizations, such as Leapfrog, to identify complications using administrative data. To make a determination whether a medical error resulted in a complication or patient safety event requires more intensive case-specific investigation deploying chart review and root cause analysis, which is a systematic analysis used by quality improvement professionals to uncover the root cause and contributory factors to a patient safety event within a structured framework including input from team members.

This study re-emphasizes the need for substantial change in our hospitals to protect patients from harm. The mortality rate of the inpatients who experienced a patient safety event was more than 29 times that of patients who did not experience a patient safety event. Further research is needed to elucidate processes that can prevent such harm from occurring.

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