



Journal of Medical Economics

ISSN: 1369-6998 (Print) 1941-837X (Online) Journal homepage: informahealthcare.com/journals/ijme20

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To cite this article: Peter J. Mallow, Bhavik Pandya, Ruslan Horblyuk & Harold S. Kaplan (2013) Prevalence and cost of hospital medical errors in the general and elderly United States populations, Journal of Medical Economics, 16:12, 1367-1378, DOI: <u>10.3111/13696998.2013.848210</u>

To link to this article: <u>https://doi.org/10.3111/13696998.2013.848210</u>

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Original article Prevalence and cost of hospital medical errors in the general and elderly United States populations

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Keywords:

Medical errors – Elderly – Cost of healthcare – Health reform – Premier Hospital Database – Public health

Accepted: 20 September 2013; published online: 16 October 2013 *Citation:* J Med Econ 2013; 16:1367–78

Abstract

Objective:

The primary objective of this study was to quantify the differences in the prevalence rate and costs of hospital medical errors between the general population and an elderly population aged ≥ 65 years.

Methods:

Methods from an actuarial study of medical errors were modified to identify medical errors in the Premier Hospital Database using data from 2009. Visits with more than four medical errors were removed from the population to avoid over-estimation of cost. Prevalence rates were calculated based on the total number of inpatient visits.

Results:

There were 3,466,596 total inpatient visits in 2009. Of these, 1,230,836 (36%) occurred in people aged \geq 65. The prevalence rate was 49 medical errors per 1000 inpatient visits in the general cohort and 79 medical errors per 1000 inpatient visits for the elderly cohort. The top 10 medical errors accounted for more than 80% of the total in the general cohort and the 65+ cohort. The most costly medical error for the general population was postoperative infection (\$569,287,000). Pressure ulcers were most costly (\$347,166,257) in the elderly population.

Limitations:

This study was conducted with a hospital administrative database, and assumptions were necessary to identify medical errors in the database. Further, there was no method to identify errors of omission or misdiagnoses within the database.

Conclusions:

This study indicates that prevalence of hospital medical errors for the elderly is greater than the general population and the associated cost of medical errors in the elderly population is quite substantial. Hospitals which further focus their attention on medical errors in the elderly population may see a significant reduction in costs due to medical errors as a disproportionate percentage of medical errors occur in this age group.

Introduction

The prevalence of medical errors places additional financial burden on hospitals in the US in a very direct way. In 2010, the Affordable Care Act established an array of financial incentives for quality care¹ and financial disincentives for preventable medical errors. This legislation followed on the heels of action taken by the Centers for Medicare & Medicaid Services to eliminate reimbursement for certain hospital-acquired infections.

Hospitals have been impacted by medical errors for decades^{2,3}, but it was *To Err Is Human: Building a Safer Health System*⁴, the 2000 seminal report from the Institute of Medicine, that led hospitals to become more pro-active in

addressing this issue. Despite the growing attention paid to medical errors, much of the discussion in the literature focuses on the prevalence and high cost of adverse events^{2,5–9} and unreimbursed hospital-acquired infections^{10,11}, rather than medical errors specifically.

To expand research on the subject of medical errors, the term must first be defined. According to the Institute of Medicine report, a medical error is 'the failure of a planned action to be completed as intended (error of execution) or the use of a wrong plan (error of planning) to achieve an aim' (p. 4)⁴. In other words, a medical error is preventable. It is differentiated from an adverse event, which refers to 'an injury caused by medical management rather than the underlying condition of the patient. Adverse events may or may not be preventable, but a sizeable portion of them result from medical error' (p. 28)⁴. A similar term, "medical injuries", may be defined as "any adverse events which occur due to medical intervention" (p. 5)¹².

Terminology is important because it is the underpinning of The Economic Measurement of Medical Errors, a pivotal study published in 2010 sponsored by the Society of Actuaries' Health Section and conducted by Milliman, Inc.^{12,13}. This study, which describes medical error as a sub-set of medical injury, used MarketScan[®], a large health insurance claims database, as well as the Medicare Supplemental and Coordination of Benefits claims database, to determine the economic burden of medical errors on society. However, this study did not look at hospitals' costs related to medical errors. The literature on the prevalence and cost of medical errors in the hospitalized Medicare population is minimal. A handful of studies sponsored by the US Department of Health and Human Services (HHS) looked at prevalence and cost of adverse events in Medicare beneficiaries^{14,15}, and there are annual studies on patient safety in the Medicare population from Health Grades, Inc. (Denver, CO), an independent healthcare ratings organization¹⁶.

Because the Milliman study noted that nearly half the expenditures of medical errors were linked to the age 65 and older demographic, and the literature identified the steep cost of adverse events in this group, gaining a more detailed understanding of medical errors in this population can offer insight into anticipated hospital costs that may not be reimbursed by Medicare. Also, it would be useful for hospitals to have data showing quantifiable differences in prevalence and type of medical error between the elderly and general populations, as this information will have cost implications and may signal the areas most in need of improvement.

The primary objective of this study was to determine the magnitude of the differences in the prevalence rate of medical errors between the general population and a population aged 65 and older. A secondary objective was to determine the magnitude of the differences in median costs of medical errors in these populations.

Methods

This study adapted the methodology developed by Milliman to identify medical injuries and estimate medical errors using the Premier Hospital Database. Once the medical errors were identified, the prevalence rates and estimated annual costs of the top 10 medical errors were calculated. Explanation of the data source, subjects, and further description of the specific methods follow below. The analyses were performed using SAS[®] software, version 9.2 (Cary, NC). Univariate *t*-tests and multivariable statistical techniques, including propensity matching, were utilized.

Subjects and database

For a hospital visit to qualify as an injury visit, at least one of the 97 injury groupings must have occurred at that specific visit (Appendix A). Visits with four or more unique injuries occurring at that visit were removed from analysis, and visits with more than one injury occurrence were only counted once in the general cost table to avoid over-estimation of cost. However, each injury was counted for the prevalence calculations. Hospital visits were identified from the clinical and billing data from the Premier hospital database^{17,18}. The time period of October 1, 2008 through March 31, 2010 was examined to identify injury visits and costs for the year 2009. The 2008 and 2010 data was used to understand if patients had prior or post visits related to their medical error.

The Premier hospital database contains clinical and utilization information from over 600 US facilities (~10% of US hospitals) 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 US.

Identifying injuries and errors

The Milliman study identified medical injuries by International Classification of Diseases, Ninth Revision (ICD-9) codes (Appendix A), and estimated how often each type of injury was likely to be associated with a medical error rather than a consequence of the underlying disease. These medical injuries were categorized into 97 injury groupings. Each grouping was classified based on the likelihood that they were associated with a medical error. The five classifications were: 0–10%; 10–35%; 35– 65%; 65–90%; and >90% (Appendix B). The mid-point of each range was applied to the frequency of each medical injury to establish the count of medical errors¹².

The current study applied the ranges and mid-points of medical errors established in the Milliman study to the data from the Premier database. All 97 injury groupings were re-verified by an outside medical coding group to ensure that no major changes had occurred since the Milliman list was developed.

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 mid-point of the error percentage category. For example, the occurrence of a pressure ulcer was determined at a greater than 90% probability of medical error. Using the mid-point of this range, we estimated that 95 out of 100 pressure ulcers were medical errors.

Prevalence calculation

The general and elderly population prevalence rates were calculated by dividing the estimated number of medical errors and the total number of inpatient hospital visits for the respective groups. Chi-square tests were performed to assess statistically significant differences in the prevalence rate. The top 10 medical errors for both the general and elderly groups were reported.

Cost analysis

For each injury visit, a matched non-injury control was chosen to compare the difference between direct medical costs to hospitals. Non-injury control groups were established by propensity score matching which reduces the bias of confounding variables not associated with the injury. The propensity score for each subject was estimated based on gender, age group, severity of illness, risk of mortality, admission type, major comorbidities, and hospital characteristics. After propensity matching, the differences between the injury and non-injury populations were removed. Visits incurring costs below \$300 or above \$300,000 were removed from the cost analysis as they were determined to be outside the normal range of inpatient costs. The cost per error was estimated as the difference in cost between the injury cohort and the non-injury control cohort. T-tests for statistically significant differences in direct cost were performed.

National cost projections

This study utilized a projection methodology developed by Premier and validated by the US Food and Drug Administration to estimate the US aggregate costs of medical errors in the general and elderly populations. Hospital-specific projection weights have been created using geographic region, bed size, teaching status, and urban/rural status. Based on these weights, the prevalence of inpatient discharges in the Premier database were projected to create a nationally representative number of inpatient discharges for the denominator. The Premier weights were then applied at the medical injury level and the projected counts of medical errors were estimated as described previously. Annual costs associated with an error from the propensity matched population were applied to the projected injury and error rates to estimate the cost of errors nationally.

Results

In the Premier database, there were 3,466,596 total inpatient visits in 2009. Of these, 1,230,836 (36%) occurred in people aged 65 and older. Of the injuries and errors in the general cohort, the elderly cohort accounted for 96,756 (57%) unique medical errors and 330,247 (50%) unique injuries. This amounted to a prevalence rate of 49 medical errors per 1000 inpatient visits in the general cohort and a prevalence rate of 79 medical errors per 1000 inpatient visits for the elderly cohort (Table 1).

Prior to propensity score matching, the patient and hospital characteristics of the general injury population were heterogeneous compared to the non-injury population (Appendix C). The general injury population was much more likely to be categorized as a major or extreme severity of illness (57.4% vs 25.1%) and be at a high risk (score of 3 or 4) of mortality (41% vs 14.9%). Consistent with the severity of illness and risk for mortality, the general injury population had a substantially higher percentage of patient visits who presented at the hospital with comorbidities. In particular, the percentage of heart-related comorbidities were much higher than in the non-injury population.

Similar to the general population, the elderly injury and non-injury population was heterogeneous prior to

Table 1. Prevalence rate of medical errors, 2009.

	Count of medical injuries* (<i>n</i>)	Count of medical errors** (n)	Count of inpatient visits (<i>n</i>)	Prevalence rate/1000 visits
Overall \geq Age 65	660,688	170,200	3,466,596	49
	330,247	96,756	1,230,836	79

*Medical injuries are determined by ICD-9 codes that indicate a medical injury during the hospital visit. Appendix A lists all ICD-9 codes used to identify a medical injury.

**Medical errors are as sub-set of medical injury. See Appendix B.

Table 2. Top 10 general population medical errors ranked by prevalence, 2009.

General population	Count of medical errors (<i>n</i>)	US extrapolated count of medical errors (<i>n</i>)	Prevalence rate/1000 visits	Median cost of medical error	Total cost of medical error (1000s)
Pressure Ulcer (Medicare Never Event)	63,335	470,447	18.3	\$1017 \$2006	\$478,501 \$560,286
Hypotension—iatrogenic	8913	64.370	2.6	\$1223	\$78.737
Substances causing adverse effects in therapeutic use	7587	55,250	2.2	\$764	\$42,191
Infection due to central venous catheter	7174	50,213	2.1	\$10,394	\$521,932
Accidental puncture or laceration during a procedure, NEC	6637	46,087	1.9	\$1974	\$90,990
Catheter-associated urinary tract infection (Medicare Never Event)	6089	43,540	1.8	\$2171	\$94,545
Hematoma complicating a procedure	5979	41,229	1.7	\$3083	\$127,088
Hemorrhage complicating a procedure	5822	41,096	1.7	\$2912	\$119,670
Abnormal reaction due to surgery without mentioning of misadventure	4028	28,960	1.2	\$1450	\$41,982

NEC, not elsewhere classified.

Table 3. Top 10 elderly population medical errors ranked by prevalence, 2009.

	Count of medical errors (<i>n</i>)	US extrapolated count of medical errors (<i>n</i>)	Prevalence rate/1000 visits	Median cost of medical error	Total cost of medical error (1000s)
Pressure Ulcer (Medicare Never Event)	46,004	346,691	37.4	\$1001	\$347,166
Post-operative infection	//1/	56,679	6.3	\$3819	\$216,464
Hypotension—iatrogenic	5269	38,708	4.3	\$1273	\$49,284
Catheter-associated urinary tract infection (Medicare Never Event)	4268	30,751	3.5	\$2408	\$74,050
Substances causing adverse effects in therapeutic use	4267	31,537	3.5	\$860	\$27,127
Hematoma complicating a procedure	3091	21,544	2.5	\$3298	\$71,055
Hemorrhage complicating a procedure	2869	20,322	2.3	\$3419	\$69,489
Accidental puncture or laceration during a procedure, NEC	2769	19,183	2.2	\$2717	\$52,119
Infection due to central venous catheter	2547	18,412	2.1	\$10795	\$198,749
Pneumothorax	1935	13,754	1.6	\$2925	\$40,235

NEC, not elsewhere classified.

the propensity matching (Appendix C). Over 66% of the elderly injury population had a severity of illness measure of major or extreme compared to 43% of the non-injury elderly population. Fifty-five percent of the elderly injury population was considered at high risk of mortality (score of 3 or 4) compared to 32% of the elderly non-injury population. However, there was little difference in the comorbidities between the two groups. Hypertension was higher in the elderly non-injury group compared to the elderly injury group (57% vs 51%), as was cardiac dysrhythmias (37% vs 30%).

After propensity matching, the top 10 medical errors accounted for more than 80% of the total number of medical errors in the general and the aged 65 and older cohorts. The top three medical errors—pressure ulcer, post-operative infection, and iatrogenic hypotension (inadvertent low blood pressure)—were equal in both the general and elderly cohorts. The fourth through ninth medical errors were the same in the two cohorts, but occurred in different orders. The tenth most common medical error was abnormal reaction due to surgery without mentioning of misadventure in the general cohort; but pneumothorax was number 10 in the elderly group. With the exception of infection due to central venous catheter, the prevalence rate of medical errors was substantially higher in the elderly group for the remaining medical errors (Tables 2 and 3).

The top 10 medical errors for both cohorts were extrapolated to the US population and their associated median costs were estimated (Tables 2 and 3). The median costs represent 2009 annual hospital incurred costs. The most costly medical error for the general population was postoperative infection (\$569,286,000), but pressure ulcers were most costly (\$347,166,000) in the elderly population. The median costs of injuries were similar between the two populations, with the exception of accidental puncture or laceration during a procedure, which was 38% higher in the elderly population (\$2717) than the general population (\$1974).

Discussion

This analysis found that the prevalence of medical errors occurring in the elderly population was substantially higher than the general population (79 medical errors per 1000 inpatient visits compared to 49 medical errors per 1000 inpatient visits). After propensity matching, the cost of the medical errors was found to be quite substantial. The most costly medical error in the general population was post-operative infections (\$569 million) and the most costly medical error in the elderly was pressure ulcers (\$347 million). The US Census forecasts the size of the elderly population as increasing from 13% today to 19% by 2030¹⁹. As the US population continues to age, the associated costs of these medical errors are likely to rise.

For comparison, the results of the Milliman study showed that, in 2008, 7% of inpatient admissions in the US led to some type of medical injury¹². The mean societal cost per error was calculated at \sim \$13,000, resulting in a total annual cost to the US economy of \$19.5 billion. Direct costs of medical errors were estimated at \$17.1 billion.

Other studies that examined medical errors found qualitatively similar results to this study. A 2010, North Carolina study determined the rate of error to be 30 per 1000 inpatient admissions⁷. Another study examining adult hospitalizations in New York determined that 37 per 1000 of all hospitalizations were associated with adverse events and negligence⁵. A 2005 study of patients seen by the Veterans Health Administration found 20 per 1000 of hospitalization resulted in a patient safety event as defined by the Agency for Healthcare Research Quality's Patient Safety Indicators²⁰. These studies have different study designs and populations, making a direct comparison difficult, but they provide context that the problem of medical errors is a significant burden on hospitals.

Medicare has recently restricted reimbursement for the treatment of 'never events', which are defined as events that should never occur in a hospital. Four of the top 10 medical errors in the general and elderly population can be linked to the list of never events²¹. Pressure ulcers and catheter-associated urinary tract infections are directly listed. Accidental puncture or laceration and substances causing adverse effects in therapeutic use can be linked to Medicare never events depending on the specific circumstances. This study has found that pressure ulcers and catheter-associated urinary tract infections accounted for over \$570 million in hospital costs in 2009, of which over \$400 million occurred in the elderly population. The recent focus on patient outcomes through regulatory efforts and

the legislative efforts of the Affordable Care Act of 2010 have demonstrated that hospitals must continue to analyze the causes of medical errors and seek new ways to reduce their occurrence.

This study suggests that substantial progress in reducing the hospital's cost of medical errors can be made through increased attention to programs that specifically target an elderly population. While the elderly accounted for only 36% of inpatient hospitalizations, more than half of the injuries and errors occurred in this population. Although reasons for the higher rate of errors among the elderly cannot be ascertained from this database, one contributing factor may be the longer mean length of stay in this cohort (7.7 days compared to 7.0 days; data not shown). However, the longer length of stay may have been due to the underlying cause of the visit rather than resulting from the injury. An additional contributing factor may include the increased likelihood of comorbid conditions among the elderly. Finally, younger individuals may not present adverse outcomes of a medical error, thus medical errors may go unreported at higher rate compared to the elderly.

Study limitations

This study had several limitations. First, the data used to identify medical errors came from a hospital system administrative database, rather than a database expressly designed to track medical injuries and errors. Therefore, the hospital claims data may lack the clinical detail necessary to definitively define a medical error. This study relied on hospital coding data, which may introduce measurement error due to different coding practices of hospitals. This analysis only contained data from inpatient hospital facilities; therefore, injuries and costs that occurred in other levels of care were not captured. Furthermore, the direct cost of medical errors to hospitals in this study was likely a conservative estimate. Visits that contained four or more unique injuries per visit or had costs exceeding \$300,000 per visit were excluded from the analysis. The cost of injuries may also have been under-estimated, as only unique injuries per visit were included in the analysis. Other costs, such as lost work time, were not considered. Finally, the method employed in this study did not account for a misdiagnosis or negligence on behalf of the hospital (errors of omission).

Conclusions

This study provides important insights into the epidemiology of medical errors in the general and, in particular, elderly populations hospitalized in a US inpatient setting. The impact of medical errors on hospitals is large and continues to rise. The associated cost of medical errors in the elderly population is quite substantial. Hospitals which further focus their attention on medical errors in the elderly population may see a significant reduction in costs due to medical errors, as a disproportionate percentage of medical errors occur in this age group.

Transparency

Declaration of funding

This study was funded by GE Healthcare. The publication of study results was not contingent on the sponsor's approval or censorship of the manuscript.

Declaration of financial/other relationships

Peter Mallow is an employee of S^2 Statistical Solutions, Inc., which is the paid consultant to GE Healthcare. Bhavik Pandya and Ruslan Horblyuk were employees of GE Healthcare, the study sponsor at the time the study was conducted. Harold Kaplan has been sponsored by and is a consultant/advisor to GE Healthcare. JME Peer Reviewers on this manuscript have no relevant financial relationships to disclose.

Acknowledgments

No assistance in the preparation of this article is to be declared.

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Appendix A. ICD-9 codes for injuries associated with an error

Table A1. ICD-9 codes for injuries associated with an error.

Injury type	ICD-9 code list
Abnormal reaction due to other procedures without mentioning of misadventure	E879.0, E879.1, E879.2, E879.3, E879.4, E879.5, E879.6, E879.7, E879.8, E879.9
Abnormal reaction due to surgery without mentioning of misadventure	E878.0, E878.1, E878.2, E878.3, E878.4, E878.5, E878.6, E878.8, E878.9
Accidental cut, puncture, perforation, or hemorrhage	E870.1, E870.3, E870.4, E870.5, E870.6, E870.8, E870.9
Accidental puncture or laceration during a procedure, NEC	998.2
procedure	330.7
Air Embolism (Medicare Never Event)	999.1
Amputation stump complication	997.60, 997.69
Blind loop syndrome Bland Twas Incompatibility (Medicare Never Event)	
Cataract fragments in eve following cataract surgery	939.0, 939.7, E070.0 998.82
Catheter-associated urinary tract infection (Medicare Never Event)	996.64
Colostomy and enterostomy complications	569.60, 569.69
Colostomy and enterostomy complications–Infection	569.61
Complication of prostnetic joint Complications affecting other specified body systems, not elsewhere classified	990.41, 990.42, 990.43, 990.44, 990.47 997.91
Complications affecting specified body systems, not elsewhere classified	997.00, 997.01, 997.09, 997.1, 997.2, 997.39, 997.4, 997.5, 997.99
Complications of labor and delivery	669.40, 669.41, 669.42, 669.43, 669.44
Complications of medical care, not elsewhere classified	999.2, 999.9
Complications of the administration of anesthetic or other sedation in	990.90, 990.91, 990.92, 990.93, 990.94, 990.95, 990.90, 990.99 668 00 668 01 668 02 668 03 668 04 668 10 668 11 668 12 668 13
labor and delivery	668.14, 668.20, 668.21, 668.22, 668.23, 668.24, 668.80, 668.81,
	668.82, 668.83, 668.84, 668.90, 668.91, 668.92, 668.93, 668.94
Complications of the Puerperium (670–677)	674.10, 674.12, 674.14, 674.20, 674.22, 674.24, 674.30, 674.32, 674.34
Complications of transplatied organ	990.00, 990.01, 990.02, 990.03, 990.04, 990.03, 990.00, 990.07, 990.09 996 45 996 46
Contact dermatitis and other eczema	692.3
Contaminated transfusion, injection, drug	E875.0, E875.1, E875.2, E875.8, E875.9
Dermatitis due to substances taken internally	693.0 959.7
Discruction of operation wound	203.7 008 3 008 30 008 31 008 32 008 33
Dosage failure in shock therapy	E873.4
Emphysema (subcutaneous) (surgical) resulting from procedure	998.81
Encephalitis, myelitis, and encephalomyelitis	323.5, 323.51, 323.52
Failure in suture and ligature during surgical operation Failure of sterile precautions during procedure	E070.2 E872 0 E872 1 E872 3 E872 4 E872 6 E872 8 E872 9
Failure to introduce or remove other tube or instrument	E876.4
Gastrostomy complications	536.40, 536.49
Gastrostomy complications—Infection	536.41
Generalized vaccinia as a complication of medical care	536.42 999 N
Hematoma complicating a procedure	998.12
Hemorrhage complicating a procedure	998.11
Hypotension—latrogenic	458.2, 458.21, 458.29
lanogenic cerebrovascular inflatculor of hemorinage	997.02 F873.5
Incorrect amount or dilution of fluid during transfusion or infusion	E873.0
Infection and inflammatory reaction due to internal prosthetic device, implant, and graft	996.60, 996.61, 996.62, 996.63, 996.65, 996.66, 996.67, 996.68, 996.69
Infection due to central venous catheter	999.31
Intection following other infusion, injection, transfusion, or	999.39
vaccination Infection of amputation stump	997 62
Infusion or transfusion reaction	999.8, 999.81, 999.82, 999.88, 999.89
Late effects of other and unspecified external causes	909.0, 909.2, 909.3, 909.5
Malignant Hyperthermia	995.86

Table A1. Continued.

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Injury type	ICD-9 code list
Mechanical complication of cardiac device, implant, and graft Mechanical complication of device, implant, or graft Mechanical complication of genitourinary device, implant, and graft Mechanical complication of other specified prosthetic device, implant and graft	996.00, 996.01, 996.02, 996.03, 996.04, 996.09 996.1, 996.2, 996.40, 996.49 996.30, 996.31, 996.32, 996.39 996.51, 996.52, 996.53, 996.54, 996.55, 996.56, 996.57, 996.59
Mechanical failure of instrument or apparatus Neuroma of amputation stump Non-administration of necessary drug or medicinal substance Non-healing surgical wound	E874.0, E874.1, E874.4, E874.5, E874.8, E874.9 997.61 E873.6 998.83 457.0
Noxious influences affecting fetus or newborn via placenta or breast milk	760.72, 760.76
Noxious influences affecting fetus or newborn via placenta or breast milk—anti-infectives	760.74
Object left in body (Medicare Never Event)	998.4, E871.0, E871.1, E871.2, E871.3, E871.5, E871.6, E871.7, E871.8, E871.9 240.0, 240.1
Other and unspecified extrapyramidal diseases and abnormal movement disorders	333.92
Other and unspecified non-infectious gastroenteritis and colitis Other complications of internal (biological) (synthetic) prosthetic	558.1 996.70, 996.71, 996.72, 996.73, 996.74, 996.75, 996.76, 996.77, 996.78,
Other complications or adverse effects not elsewhere classified Other failure in dosage	990.79 995.89, 998.89, 998.9 E873.8, E873.9
Other specified types of cystitis Overdose or inadvertent exposure to radiation	595.82 E873.2, E873.3
Preumothorax	998.0 512.1 960.0 960.1 960.2 960.3 960.4 960.5 960.6 960.7 960.8 960.9 961.0
Poisoning—Anesthetics Post-cholecystectomy syndrome	960.0, 960.1, 960.2, 960.3, 960.4, 960.5, 960.6, 960.7, 960.8, 960.9, 961.0, 961.1, 961.2, 961.3, 961.4, 961.5, 961.6, 961.7, 961.8, 961.9, 962.0, 962.1, 962.2, 962.3, 962.4, 962.5, 962.6, 962.7, 962.8, 962.9, 963.0, 963.1, 963.2, 963.3, 963.4, 963.5, 963.8, 963.9, 964.0, 964.1, 964.2, 964.3, 964.4, 964.5, 964.6, 964.7, 964.8, 964.9, 965.00, 965.02, 965.09, 965.1, 965.4, 965.5, 965.61, 965.69, 965.7, 965.8, 965.9, 966.0, 966.1, 966.2, 966.3, 966.4, 967.0, 967.1, 967.2, 967.3, 967.4, 967.5, 967.6, 967.8, 967.9, 968.0, 968.1, 969.0, 969.1, 969.2, 969.3, 969.4, 969.5, 969.7, 969.8, 969.9, 970.0, 970.1, 970.8, 970.9, 971.0, 971.1, 971.2, 971.3, 971.9, 972.0, 972.1, 972.2, 972.3, 972.4, 972.5, 972.6, 972.7, 972.8, 972.9, 973.0, 973.1, 973.2, 973.3, 973.4, 973.5, 973.6, 973.8, 973.9, 974.0, 974.1, 974.2, 974.3, 974.4, 974.5, 974.6, 974.7, 975.0, 975.1, 975.3, 975.4, 975.5, 975.6, 975.7, 975.8, 976.0, 976.1, 976.2, 976.3, 976.4, 976.5, 976.6, 976.7, 976.8, 976.9, 977.0, 977.1, 977.2, 977.3, 977.4, 977.8, 977.9, 978.0, 978.1, 978.2, 978.3, 978.4, 978.5, 978.6, 978.8, 978.9, 979.0, 979.1, 979.2, 979.3, 979.4, 979.5, 979.6, 979.7, 979.9, E850.1, E850.2, E850.3, E850.4, E850.6, E850.7, E850.8, E850.9, E851, E852.2, E852.4, E852.8, E852.9, E853.0, E853.1, E853.1, E853.2, E853.3, E855.4, E855.5, E855.6, E855.8, E855.9, E856, E857, E858.0, E851.1, E852.2, E852.4, E852.8, E852.9, E853.0, E853.1, E855.1, E855.2, E855.3, E855.4, E855.5, E855.6, E855.8, E855.9, E856, E857, E858.0, E851.1, E858.2, E858.3, E858.4, E858.5, E855.8, E858.7, E858.8, E858.9, E950.0, E950.1, E950.2, E950.3, E950.4, E950.5, E962.0, E980.0, E980.1, E980.2, E980.3, E980.4, E980.5 968.2, 968.3, 968.4, 968.5, 968.6, 968.7, 968.9 576.0
Post-gastric surgery syndrome Post-laminectomy syndrome Post-operative infection Post-operative Shock	564.2 722.80, 722.81, 722.82, 722.83 998.51, 998.59 998.0
Pressure Ulcer (Medicare Never Event)	707.0, 707.00, 707.01, 707.02, 707.03, 707.04, 707.05, 707.06, 707.07, 707.09, 707.20, 707.22, 707.23, 707.24
Radiation Kyphosis or scoliosis Respiratory conditions due to other and unspecified external agents Seroma complicating a procedure Serum reaction Shock due to anesthesia	737.11, 737.33 508.0, 508.1 998.13 999.4, 999.5 995.4

Table A1. Continued.

Injury type	ICD-9 code list			
Substances causing adverse effects in therapeutic use	357.6, E930.0, E930.1, E930.2, E930.3, E930.4, E930.5, E930.6, E930.7, E930.8, E930.9, E931.0, E931.1, E931.2, E931.3, E931.4, E931.5, E931.6, E931.7, E931.8, E931.9, E932.0, E932.1, E932.2, E932.3, E932.4, E932.5, E932.6, E932.7, E932.8, E932.9, E933.0, E933.1, E933.2, E933.3, E933.4, E933.5, E933.6, E933.7, E933.8, E933.9, E934.0, E934.1, E934.2, E934.3, E934.4, E934.5, E934.6, E934.7, E934.8, E934.9, E935.1, E935.2, E935.3, E935.4, E935.5, E935.6, E935.7, E935.8, E935.9, E936.0, E936.1, E936.3, E936.4, E937.0, E937.1, E937.2, E937.4, E937.6, E937.8, E937.9, E938.0, E938.1, E938.2, E938.3, E938.4, E938.5, E938.6, E938.7, E938.8, E939.0, E939.1, E939.2, E939.3, E939.4, E939.5, E939.7, E939.8, E939.9, E940.1, E940.8, E940.9, E941.0, E941.1, E941.2, E941.3, E941.9, E942.0, E942.1, E942.2, E942.3, E942.4, E942.5, E942.6, E942.7, E942.8, E943.8, E943.9, E944.0, E944.1, E944.2, E944.3, E944.4, E944.5, E944.6, E944.7, E945.0, E945.1, E945.2, E945.3, E945.4, E945.5, E945.6, E945.7, E945.8, E946.0, E946.1, E946.2, E946.3, E946.4, E946.5, E946.6, E946.7, E946.8, E946.9, E947.0, E947.1, E947.2, E947.3, E947.4, E947.8, E947.9, E948.0, E948.1, E948.3, E948.4, E948.5, E948.6, E948.8, E948.9, E949.0, E949.1, E948.3, E948.4, E946.5, E946.6, E946.7, E946.8, E946.9, E947.0, E947.1, E947.2, E947.3, E947.4, E947.8, E947.9, E948.0, E948.1, E948.3, E948.4, E946.5, E946.6, E946.7, E946.8, E946.9, E947.0, E947.1, E947.2, E947.3, E947.4, E947.8, E947.9, E948.0, E948.1, E948.3, E948.4, E946.5, E946.6, E946.7, E946.8, E946.9, E947.0, E947.1, E947.2, E947.3, E947.4, E947.8, E947.9, E948.0, E948.1, E948.3, E948.4, E948.5, E948.6, E948.8, E948.9, E949.0, E949.1, E948.3, E948.4, E946.5, E946.6, E946.7, E946.8, E948.9, E949.0, E949.1, E948.3, E948.4, E948.5, E948.6, E948.8, E948.9, E949.0, E949.1, E948.3, E948.4, E946.5, E946.6, E946.7, E946.8, E948.9, E949.0, E949.1, E948.3, E948.4, E948.5, E948.6, E948.8, E948.9, E949.0, E949.1, E948.3, E948.4, E948.5, E948.6, E948.8, E948.9, E949.0, E949.1, E948.3, E948.4, E948.5, E948.6, E948.8, E948.9,			
Surgery on the wrong limb/person (Medicare Never Event) Surgical complication of the respiratory system Thyroiditis Tracheostomy complications Tracheostomy complications—Infection	E876.5 997.3 245.4 519.00, 519.02, 519.09 519.01			
Unspecified adverse effect of drug medicinal and biological substance not elsewhere classified Urethral stricture Ventilator associated pneumonia Ventral hernia without mention of obstruction or gangrene Wrong fluid in transfusion	995.2, 995.20, 995.21, 995.22, 995.23, 995.24, 995.27, 995.29 598.2 997.31 553.21 E876.1			

NEC, not elsewhere classified.

Appendix B. Percentage of occurrences with error

Table A2. Percentage of occurrences with error.

Error type	Percentage of occurrences with error	Mid-point for frequency calculation
Abnormal reaction due to other procedures without mentioning of misadventure Abnormal reaction due to surgery without mentioning of misadventure Accidental cut, puncture, perforation, or hemorrhage Accidental puncture or laceration during a procedure, NEC Acute reaction to foreign substance accidentally left in during procedure Air Embolism (Medicare Never Event) Amputation stump complication Blind loop syndrome Blood-Type Incompatibility (Medicare Never Event) Cataract fragments in eye following cataract surgery Catheter-associated urinary tract infection (Medicare Never Event) Colostomy and enterostomy complications Colostomy and enterostomy complications—Infection Complication of prosthetic joint Complications affecting other specified body systems, not elsewhere classified Complications affecting specified body systems, not elsewhere classified	<10 <10 >90 >90 >90 <10 <10 <10 >90 >90 <10 >90 <10 >90 10-35 <10 <10	0.05 0.05 0.95 0.95 0.95 0.95 0.95 0.95

Table A2. Continued.

Error type	Percentage of occurrences	Mid-point for frequency
	with error	calculation
Complications of labor and delivery	<10	0.05
Complications of medical care, not elsewhere classified	<10	0.05
Complications of reattached extremity or body part	<10	0.05
Complications of the administration of anesthetic or other sedation in labor and delivery	<10	0.05
Complications of the Puerperium (670–677)	<10	0.05
Complications of transplanted organ	<10	0.05
Complications peculiar to certain specified procedures	<10	0.05
Contact definialities and other eczenia	<10	0.05
Dermatitis due to substances taken internally	~90 ~10	0.95
Disorders of the nituitary gland and its hypothalamic control	65-90	0.03
Disruntion of operation wound	10-35	0.225
Dosage failure in shock therapy	>90	0.95
Emphysema (subcutaneous) (surgical) resulting from procedure	10-35	0.225
Encephalitis, myelitis, and encephalomyelitis	<10	0.05
Failure in suture and ligature during surgical operation	>90	0.95
Failure of sterile precautions during procedure	>90	0.95
Failure to introduce or remove other tube or instrument	>90	0.95
Gastrostomy complications	<10	0.05
Gastrostomy complications—Infection	>90	0.95
Gastrostomy complications—Mechanical	10-35	0.225
Generalized vaccinia as a complication of medical care	10-35	0.225
Hematoma complicating a procedure	35-65	0.5
Hemorinage complicating a procedure	30-00	0.5
Nypolension—nalloyenic Introgenic cerebrovescular infarction or hemorrhage	30−05 < 00	0.0
Inangronriate temperature in local application and packing	>90	0.95
Incorrect amount or dilution of fluid during transfusion or infusion	>90	0.95
Infection and inflammatory reaction due to internal prosthetic device, implant, and graft	<10	0.05
Infection due to central venous catheter	>90	0.95
Infection following other infusion, injection, transfusion, or vaccination	>90	0.95
Infection of amputation stump	>90	0.95
Infusion or transfusion reaction	10–35	0.225
Late effects of other and unspecified external causes	<10	0.05
Malignant Hyperthermia	<10	0.05
Mechanical complication of cardiac device, implant, and graft	10-35	0.225
Mechanical complication of device, implant, or graft	10-35	0.225
Mechanical complication of genitourinary device, implant, and graft	10-35	0.225
Mechanical failure of instrument or apparatus	<10	0.05
Neuroma of amplitation stump	≥90 10–35	0.95
Non-administration of necessary drug or medicinal substance	>90	0.95
Non-healing surgical wound	<10	0.05
Non-infectious disorders of lymphatic channels	<10	0.05
Noxious influences affecting fetus or newborn via placenta or breast milk	10–35	0.225
Noxious influences affecting fetus or newborn via placenta or breast milk-anti-infectives	<10	0.05
Object left in body (Medicare Never Event)	>90	0.95
Other and unspecified disorders of the nervous system	<10	0.05
Other and unspecified extrapyramidal diseases and abnormal movement disorders	<10	0.05
Other and unspecified non-infectious gastroenteritis and colitis	<10	0.05
Other complications of internal (biological) (synthetic) prosthetic device, implant, and graft	<10	0.05
Uther complications or adverse effects not elsewhere classified	<10	0.05
Other specified types of cystitic	~90 ~10	0.95
Overdose or inadvertent exposure to radiation	<10 _90	0.05
Persistent nost-onerative fistula NEC	<10	0.05
Pneumothorax	35-65	0.5
Poisoning	<10	0.05
Poisoning—Anesthetics	10–35	0.225
Post-cholecystectomy syndrome	10–35	0.225
Post-gastric surgery syndrome	10–35	0.225
Post-laminectomy syndrome	10–35	0.225
Post-operative infection	>90	0.95
Post-operative Shock	10-35	0.225
Pressure Uicer (Medicare Never Event)	>90	0.95

Table A2. Continued.

Error type	Percentage of occurrences with error	Mid-point for frequency calculation
Radiation Kyphosis or scoliosis Respiratory conditions due to other and unspecified external agents Seroma complicating a procedure Serum reaction Shock due to anesthesia Substances causing adverse effects in therapeutic use Surgery on the wrong limb/person (Medicare Never Event) Surgical complication of the respiratory system Thyroiditis Tracheostomy complications Tracheostomy complications—Infection Unspecified adverse effect of drug medicinal and biological substance not elsewhere classified Urethral stricture Ventilator associated pneumonia Ventral hernia without mention of obstruction or gangrene	$\begin{array}{c} <10\\ <10\\ 10-35\\ 10-35\\ 10-35\\ <10\\ >90\\ 10-35\\ 10-35\\ <10\\ 10-35\\ <10\\ 10-35\\ <10\\ 10-35\\ >90\\ 10-35\\ >90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ <90\\ 10-35\\ $	$\begin{array}{c} 0.05\\ 0.05\\ 0.225\\ 0.225\\ 0.225\\ 0.05\\ 0.95\\ 0.225\\ 0.225\\ 0.225\\ 0.05\\ 0.225\\ 0.05\\ 0.225\\ 0.05\\ 0.225\\ 0.95\\ 0.225\\ 0.95\\ 0.225\\ 0.95\\ 0.225\\ 0.95\\ 0.225\\ 0.95\\ 0.225\\ 0.95\\ 0.225\\ 0.95\\ 0.225\\ 0.95\\ 0$

NEC, not elsewhere classified.

Appendix C. Injury and no injury population prior to propensity matching

Table A3. Injury and no injury population prior to propensity matching.

			Overall					Elderly		
Category	Injury		No injury		<i>p</i> -Value	Injury		No injury		<i>p</i> -Value
Patients	470,561		2,986,019			238,853		987014		
Age group at diagnosis										
<65	231,708	49.2%	1,999,005	66.9%		NA		NA		
65+	238,853	50.8%	987,014	33.1%		238,853		987014		
Gender					‡					‡
Male	214,221	45.5%	1,222,002	40.9%		106,976	44.8%	418,829	42.4%	
Female	256,335	54.5%	1,763,890	59.1%		131,874	55.2%	568,178	57.6%	
Unknown	5	0.0%	127	0.0%		3	0.0%	7	0.0%	
Race					‡					‡
White	307,879	65.4%	1,784,609	59.8%		165,671	69.4%	683,743	69.3%	
Black	64,400	13.7%	426,787	14.3%		24,131	10.1%	92,370	9.4%	
Hispanic	21,594	4.6%	207,934	7.0%		9,119	3.8%	41,042	4.2%	
Other/unknown	76,688	16.3%	566,689	19.0%		39,932	16.7%	169,859	17.2%	
Insurance Product Type					‡					‡
Medicare	268,754	57.1%	1,086,592	36.4%		216,382	90.6%	888,687	90.0%	
Medicaid	49,008	10.4%	616,243	20.6%		2,791	1.2%	11,900	1.2%	
Commercial	117,724	25.0%	999,492	33.5%		14,351	6.0%	64,002	6.5%	
Self-pay/Indigent	18,464	3.9%	167,297	5.6%		735	0.3%	3,837	0.4%	
Any other payor	16,611	3.5%	116,395	3.9%		4,594	1.9%	18,588	1.9%	
Admission Type					‡					‡
Emergency	272,400	57.9%	1,369,037	45.8%		143,826	60.2%	605,557	61.4%	
Urgent	76,141	16.2%	491,731	16.5%		37,324	15.6%	150,577	15.3%	
Elective	118,130	25.1%	758,995	25.4%		56,584	23.7%	224,307	22.7%	
Trauma center	1,023	0.2%	10,614	0.4%		398	0.2%	2,417	0.2%	
Other/unknown	2,867	0.6%	355,642	11.9%		721	0.3%	4,156	0.4%	
APR-DRG Severity of Illness					‡					‡
1 = Minor	53,677	11.4%	1,155,065	38.7%		15,830	6.6%	165,720	16.8%	
2 = Moderate	146,747	31.2%	1,082,007	36.2%		63,989	26.8%	396,476	40.2%	
3 = Major	178,959	38.0%	600,333	20.1%		104,261	43.7%	335,793	34.0%	
4 = Extreme	91,177	19.4%	148,489	5.0%		54,773	22.9%	89,023	9.0%	
Unknown	1	0.0%	125	0.0%		0	0.0%	2	0.0%	

Table A3. Continued.

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			Overall					Elderly		
Category	Injury		No injury		<i>p</i> -Value	Injury		No injury		<i>p</i> -Value
APR-DRG Risk of Mortality 1 = Minor 2 = Moderate 3 = Major 4 = Extreme Unknown Competibilities	142,851 132,597 130,349 64,763 1	30.4% 28.2% 27.7% 13.8% 0.0%	1,900,542 638,682 329,548 117,122 125	63.6% 21.4% 11.0% 3.9% 0.0%	‡	33,827 72,965 85,190 46,871 0	14.2% 30.5% 35.7% 19.6% 0.0%	268,761 397,833 233,672 86,746 2	27.2% 40.3% 23.7% 8.8%	‡
Comorbidities Depressive Disorders Diverticulitis Asthma Cardiac Dysrhythmias Chronic Bronchitis Colon Cancer COPD Coronary Artery Disease Crohn's Disease Diabetes Emphysema Gastric Ulcer Gastritis Heart Failure Hyperlipidemia Hypertension Hypothyroidism Irritable Bowel Disease Lumbar Disk Disease Lumbar Disk Disease Lumbar Disk Disease Lumbar Disk Disease Storders Osteoarthritis Osteoporosis Parkinson's disease Rheumatoid Arthritis Skin Cancer Stroke Ulcerative Colitis	75,869 4142 35,390 119,761 23,589 4822 69,844 122,666 3281 145,039 4853 4815 13,833 85,924 110,385 200,800 59,703 4466 7416 11,456 46,294 3,521 30,452 52,888 23,377 6315 9546 1082 9860 1989	$\begin{array}{c} 16.1\% \\ 0.9\% \\ 7.5\% \\ 5.0\% \\ 1.0\% \\ 14.8\% \\ 26.1\% \\ 0.7\% \\ 30.8\% \\ 1.0\% \\ 1.0\% \\ 2.9\% \\ 18.3\% \\ 23.5\% \\ 42.7\% \\ 12.7\% \\ 0.9\% \\ 1.6\% \\ 2.4\% \\ 9.8\% \\ 0.7\% \\ 6.5\% \\ 11.2\% \\ 5.0\% \\ 1.3\% \\ 2.0\% \\ 0.2\% \\ 2.1\% \\ 0.4\% \end{array}$	337,189 25,925 197,852 397,879 107,133 12,266 266,460 507,125 13,954 576,838 18,295 14,033 60,108 315,509 511,634 988,436 254,642 23,531 39,095 29,868 187,815 9,252 153,791 272,107 96,308 23,111 34,992 3,117 62,070 7,717	$\begin{array}{c} 11.3\%\\ 0.9\%\\ 6.6\%\\ 13.3\%\\ 3.6\%\\ 0.4\%\\ 8.9\%\\ 17.0\%\\ 0.5\%\\ 19.3\%\\ 0.6\%\\ 0.5\%\\ 2.0\%\\ 10.6\%\\ 17.1\%\\ 33.1\%\\ 8.5\%\\ 1.3\%\\ 1.3\%\\ 1.3\%\\ 1.3\%\\ 1.3\%\\ 1.3\%\\ 1.3\%\\ 0.8\%\\ 1.3\%\\ 0.8\%\\ 1.2\%\\ 0.1\%\\ 2.1\%\\ 0.1\%\\ 2.1\%\\ 0.3\%\end{array}$	0.4095 + + + + + + + + + + + + +	$\begin{array}{c} 30,139\\ 2,319\\ 13,157\\ 89,340\\ 16,051\\ 3,147\\ 46,403\\ 88,774\\ 913\\ 85,755\\ 3,233\\ 2,829\\ 7,990\\ 64,882\\ 71,957\\ 122,329\\ 40,434\\ 1,934\\ 3,335\\ 7,479\\ 30,898\\ 916\\ 11,961\\ 37,742\\ 19,181\\ 5559\\ 6001\\ 686\\ 6411\\ 858\end{array}$	$\begin{array}{c} 12.6\%\\ 1.0\%\\ 5.5\%\\ 37.4\%\\ 6.7\%\\ 1.3\%\\ 19.4\%\\ 37.2\%\\ 0.4\%\\ 35.9\%\\ 1.4\%\\ 1.2\%\\ 3.3\%\\ 27.2\%\\ 30.1\%\\ 51.2\%\\ 16.9\%\\ 0.8\%\\ 1.4\%\\ 3.1\%\\ 12.9\%\\ 0.4\%\\ 5.0\%\\ 15.8\%\\ 8.0\%\\ 2.3\%\\ 2.5\%\\ 0.3\%\\ 2.7\%\\ 0.4\%\end{array}$	$\begin{array}{c} 115,520\\ 11,676\\ 55,162\\ 294,903\\ 69,997\\ 7,620\\ 172,543\\ 355,709\\ 3,262\\ 313,726\\ 11,775\\ 7,903\\ 28,798\\ 235,496\\ 315,683\\ 563,975\\ 164,005\\ 9,227\\ 14,170\\ 19,394\\ 120,786\\ 1,902\\ 51,856\\ 180,317\\ 82,302\\ 20,558\\ 21,145\\ 2,099\\ 40,951\\ 2,674\\ \end{array}$	$\begin{array}{c} 11.7\%\\ 1.2\%\\ 5.6\%\\ 29.9\%\\ 7.1\%\\ 0.8\%\\ 17.5\%\\ 36.0\%\\ 0.3\%\\ 31.8\%\\ 1.2\%\\ 0.8\%\\ 2.9\%\\ 23.9\%\\ 32.0\%\\ 57.1\%\\ 16.6\%\\ 0.9\%\\ 1.4\%\\ 2.0\%\\ 12.2\%\\ 0.2\%\\ 5.3\%\\ 18.3\%\\ 8.3\%\\ 8.3\%\\ 2.1\%\\ 2.1\%\\ 0.2\%\\ 4.1\%\\ 0.3\%\end{array}$	0.1245
Provider Area Northeast Midwest South West Population Served Urban Rural Teaching Status Teaching Non-Teaching Hospital Size 000–099 100–199 200–299 300–399 400–499 500+	87,279 110,101 188,420 84,761 413,107 57,454 182,639 287,922 14,775 46,800 82,446 97,344 81,635 147,561	18.5% 23.4% 40.0% 18.0% 87.8% 12.2% 38.8% 61.2% 3.1% 9.9% 17.5% 20.7% 17.3% 31.4%	$\begin{array}{c} 536,306\\ 660,583\\ 1,236,972\\ 552,158\\ 2,579,181\\ 406,838\\ 1,029,839\\ 1,956,180\\ 118,146\\ 328,159\\ 539,254\\ 666,974\\ 525,638\\ 807,848\\ \end{array}$	18.0% 22.1% 41.4% 18.5% 86.4% 13.6% 34.5% 65.5% 4.0% 11.0% 18.1% 22.3% 17.6% 27.1%	‡ ‡ ‡	46,692 58,142 90,357 43,662 208,833 30,020 86,931 151,922 7,492 24,250 43,673 51,414 41,116 70,908	19.5% 24.3% 37.8% 18.3% 87.4% 12.6% 36.4% 63.6% 3.1% 10.2% 18.3% 21.5% 17.2% 29.7%	188,830 228,933 399,064 170,187 838,982 148,032 318,890 668,124 36,133 113,605 191,326 210,137 174,090 261,723	19.1% 23.2% 40.4% 17.2% 85.0% 15.0% 32.3% 67.7% 3.7% 11.5% 19.4% 21.3% 17.6% 26.5%	+ + +

‡*p*-Value < 0.0001.