

# Adverse Events Among In-Hospital Medicare Patients in 2021 and 2022



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# Adverse Events Among In-Hospital Medicare Patients in 2021 and 2022

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## I. Summary

Understanding the frequency of adverse events (AEs) among hospitalized patients is a prerequisite to ultimately improving the quality and safety of care patients receive in this setting. In collaboration with the Centers for Medicare & Medicaid Services (CMS), the Agency for Healthcare Research and Quality (AHRQ) provides this report of analyses on AEs experienced by Medicare patients hospitalized in 2021 and 2022.

To arrive at these findings, trained abstractors reviewed more than 22,000 inpatient hospitalization records for each year using AHRQ's Quality and Safety Review System (QSRS). Data about 41 types of AEs as well as composite AE measures are presented in detail below. For each year, comparative analyses were also conducted by sex and age group (patients ages 18 to 64 and those 65 and older).

### Highlighted Findings

- For 2021, the weighted percentage of Medicare patients experiencing at least one AE per hospital stay is 7.1%, and the rate was 83.6 AEs per 1,000 discharges. In 2022, these rates were lower, with 6.2% of patients experiencing at least one AE per hospital stay and 71.1 AEs per 1,000 discharges.
- For AEs where the population at risk numbered at least 100, the highest rates for both 2021 and 2022 were worsening pressure injuries that were present on admission (2021: 4.9%, 2022: 6.0%), hypoglycemic events (4.7% for both years) and AEs related to intravenous unfractionated heparin (2021: 4.2%, 2022: 3.0%).
- For both years, overall AE rates were significantly lower for females compared with males. In 2021, the composite AE rates were 14.5% lower (5.9% vs. 6.9%) for the rate of experiencing at least one AE during the inpatient stay and 17.0% lower (67.5 vs. 81.3) for AEs per 1,000 discharges. In 2022, the rate of AEs per 1,000 discharges was 13.5% lower (62.0 vs. 71.7) for females compared with males. The rates of experiencing at least one AE during the inpatient stay in 2022 were not significantly different for males versus females.

## II. Background

This report reflects the evolution of combined efforts of AHRQ and CMS since 2001 to monitor inpatient hospital AEs through retrospective chart review. For the first time, QSRS was used to conduct the underlying chart abstractions to determine whether specific AEs occurred in the inpatient hospital setting. Important distinctions between QSRS and its predecessor system, the Medicare Patient Safety Monitoring System (MPSMS), are described below.

### A. QSRS

The QSRS was designed to identify the occurrence of specified AEs to better understand patient safety in the hospital setting. At present, it captures 80 outcomes grouped here into 43 AE types that are organized into 11 modules (topic areas). It also is used to track information about approximately 14 other “occurrences to be monitored,” which includes AE measures in development or other information of interest that does not reflect an AE (e.g., indicators of possible AEs). Appendix 1 includes tables that list, by module, all the AEs and occurrences to be monitored that QSRS captures.

QSRS data are collected through retrospective manual abstraction of inpatient records. Human abstractors answer questions related to objective information from the medical record. Algorithms are coded into QSRS that use the answers to these questions to identify whether an AE occurred during a particular hospital stay. QSRS uses standardized definitions and algorithms consistent with the AHRQ Common Formats for Surveillance.<sup>i</sup> These standardized specifications ensure adverse events are reliably identified across all hospitals.

### B. Historical Background: Medicare Patient Safety Monitoring System

The extent of medical errors in U.S. hospitals was revealed in 2000 when the Institute of Medicine (now the National Academy of Medicine) published *To Err Is Human*, estimating that up to 98,000 deaths occurred each year due to medical errors. In response to this challenge, in 2001, CMS created the MPSMS in coordination with AHRQ, the Centers for Disease Control and Prevention, the Food and Drug Administration, and the Department of Veterans Affairs. Originally designed to monitor and track in-hospital AEs among Medicare patients through retrospective chart review, MPSMS established a baseline for assessing the impact of national patient safety initiatives.

In 2009, primary coordination for MPSMS was transferred from CMS to AHRQ. For almost 20 years, MPSMS was used to collect data to determine national rates for specific adverse events.<sup>ii</sup> MPSMS data were last collected for calendar year 2019. In 2020, MPSMS reached the end of its service life and was replaced by the QSRS.

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<sup>i</sup> [https://www.psoppc.org/psoppc\\_web/publicpages/surveillancecommonformats](https://www.psoppc.org/psoppc_web/publicpages/surveillancecommonformats).

<sup>ii</sup> For a full list of hospital-acquired conditions (HACs) tracked by MPSMS, see: <https://www.ahrq.gov/sites/default/files/wysiwyg/professionals/quality-patient-safety/pfp/hacreport-2019.pdf>.



MPSMS data were used to produce the AHRQ National Scorecard on Hospital-Acquired Conditions.<sup>iii</sup> Using MPSMS data, AHRQ determined that national efforts to reduce hospital-acquired conditions such as adverse drug events and injuries from falls helped prevent 20,700 deaths and saved \$7.7 billion between 2014 and 2017.<sup>iv</sup> In addition, MPSMS data from 2010 to 2019 showed decreases from 31-39% in the number of in-hospital AEs for major surgery patients and those with a principal diagnosis of acute myocardial infarction, congestive heart failure, or pneumonia.<sup>v</sup>

### C. Differences Between MPSMS and QSRs

While the systems have similar purposes, AE rates produced from MPSMS data and QSRs data are not directly comparable. MPSMS included 21 types of AEs, and QSRs currently includes 43. QSRs also expanded on some existing MPSMS events and updated some of the MPSMS measures based on newer evidence. Unlike MPSMS, QSRs also has the capacity to add, remove, or revise measures.

In addition, beginning in 2020, which coincides with the introduction of QSRs, CMS changed its sampling methodology. In 2009, CMS expanded from a Medicare-only to an all-payer sample. This all-payer sample was used through 2019. In 2020, the sample of patients transitioned back to a Medicare-only sample.

From 2010 to 2014, MPSMS divided patient charts into four groups: those with a principal diagnosis of acute myocardial infarction, congestive heart failure, or pneumonia, and major surgery patients. Beginning in 2014, the new methodology added to these four groups patient charts for most other conditions treated in acute care hospitals.<sup>vi</sup> Starting in 2020, the sample became an all-Medicare sample among patients age 18 years and older.<sup>vii</sup>

The sample for 2020 and 2021 contains hospitals from five strata (also called cohorts): Medicare Rural Acute Care Hospitals (“RURAL”) participating in the Inpatient Prospective Payment System (IPPS), Medicare Targeted Urban Acute Care Hospitals (“TARGETED URBAN”) participating in IPPS<sup>viii</sup>, Medicare Other Acute Care Hospitals (“OTHER”) participating in IPPS, Critical Access Hospitals<sup>ix</sup> (CRITICAL ACCESS), and Indian Health Service<sup>x</sup> (IHS) hospitals.

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<sup>iii</sup> Previous reports and related information are available at <https://www.ahrq.gov/hai/pfp/index.html>.

<sup>iv</sup> [https://www.ahrq.gov/data/infographics/hac-rates\\_2019.html](https://www.ahrq.gov/data/infographics/hac-rates_2019.html).

<sup>v</sup> Eldridge N, Wang Y, Metersky M, et al. Trends in adverse event rates in hospitalized patients, 2010-2019. JAMA. 2022;328(2):173–183. doi:10.1001/jama.2022.9600.

<sup>vi</sup> <https://www.ahrq.gov/sites/default/files/wysiwyg/professionals/quality-patient-safety/pfp/Updated-hacreportFinal2017data.pdf>.

<sup>vii</sup> Because of the COVID-19 pandemic, CMS waived inpatient data collection from January through August 2020.

<sup>viii</sup> Targeted Urban Acute Care Hospitals are hospitals targeted in urban areas that represented a significant share of their healthcare market. These hospitals also had identified areas of improvement over a period of time. They were targeted by the CMS [Hospital Quality Improvement Contractors program](#) consistent with the program’s priorities for quality and safety.

<sup>ix</sup> More information on critical access hospitals is available at <https://www.cms.gov/medicare/health-safety-standards/certification-compliance/critical-access-hospitals>.

<sup>x</sup> More information about IHS health services is available at [www.ihs.gov/sites/newsroom/themes/responsive2017/display\\_objects/documents/factsheets/QuickLook.pdf](http://www.ihs.gov/sites/newsroom/themes/responsive2017/display_objects/documents/factsheets/QuickLook.pdf).

### III. Methods

#### A. Data Collection

As part of the Quality Improvement Organization (QIO) Program,<sup>xi</sup> CMS obtains medical records to inform efforts to improve quality of care for beneficiaries. The CMS sample of records from 2021 and 2022 is designed to focus on acute care inpatient facilities receiving technical assistance from the CMS Quality Innovation Network QIOs under the 12<sup>th</sup> Statement of Work. The CMS QIO 12<sup>th</sup> Statement of Work's mission is to improve the performance of the healthcare system by increasing the quality of healthcare delivered and reducing burden. It was awarded for a 5-year period that began in fiscal year 2020.<sup>xii</sup>

The CMS sample was taken from the five hospital cohorts noted above: RURAL, TARGETED URBAN, OTHER, CRITICAL ACCESS, and IHS. For the RURAL, TARGETED URBAN, OTHER, and CRITICAL ACCESS cohorts, CMS sampling was multistage, performed at the hospital level and randomly at the patient level for all patients 18 years and older insured by Medicare. Each month, a predetermined number of records was requested from randomly selected hospitals in the four cohorts. Because IHS hospitals are sampled differently than the hospitals in all other cohorts, records from these hospitals are not included in the analyses presented in this report.

Further information about CMS's sampling methodology can be found in Appendix 2. A total of 22,678 records from 2021 and 26,291 records from 2022 inpatient hospitalizations were obtained and abstracted, excluding IHS records.

**Table 1. 2021 and 2022 Sample Distribution by Hospital Cohorts**

Cohort	Number of Records, 2021	Percentage of Records in Sample	Number of Records, 2022	Percentage of Records in Sample
OTHER	8289	36.6%	8427	32.1%
RURAL	4997	22.0%	5246	20.0%
TARGETED URBAN	4922	21.7%	7331	27.9%
CRITICAL ACCESS	4470	19.7%	5287	20.1%
<i>Total</i>	<i>22678</i>		<i>26291</i>	

More than 3,600 more records were abstracted in 2022 than in 2021. While more records were abstracted from each cohort, most of the additional records came from the TARGETED URBAN and CRITICAL ACCESS cohorts.

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<sup>xi</sup> The QIO Program, one of the largest federal programs dedicated to improving health quality for Medicare beneficiaries, is an integral part of the U.S. Department of Health and Human Services' National Quality Strategy for providing better care and better health at lower cost. By law, the mission of the QIO Program is to improve the effectiveness, efficiency, economy, and quality of services delivered to Medicare beneficiaries.

<https://www.cms.gov/medicare/quality-initiatives-patient-assessment-instruments/qualityimprovementorgs>.

<sup>xii</sup> <https://www.cms.gov/files/document/report-congress-fy-2020-qio-program.pdf>.

These medical records were abstracted by the Clinical Data Abstraction Center using the QSRs tool. Based on these abstractions, the QSRs determines whether any of the specified adverse events occurred during that particular hospital stay. Within a given AE, such as a fall, abstractors are instructed to only report the highest severity AE, such as the most severe fall. As such, while QSRs may show that multiple, different AEs occurred during a single hospital stay (e.g., a fall and hospital-acquired pneumonia), it would not show two or more of the same AE for the same patient during a single hospitalization (e.g., two or more falls).

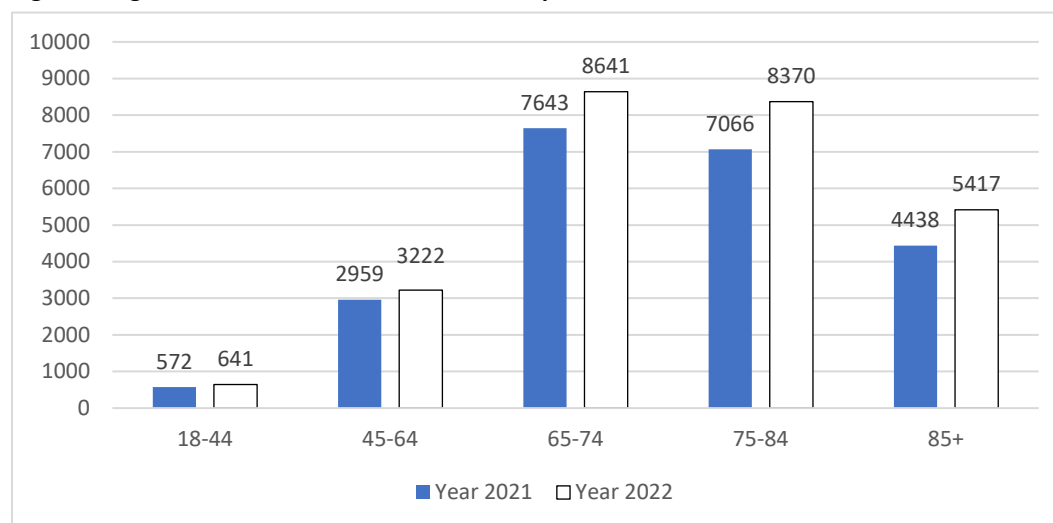
Exports of QSRs data for 2021 and 2022 were prepared and provided to a data analytics team. The data analytics team provided a quality check of QSRs by performing the same analyses outside the system as occur within the system for the observed data, as well as some additional analyses of some of the observed data. In addition, the data analytics team weighted the data (according to the method described below) and calculated the weighted AE rates presented here. These weighted rates provide national estimates for the occurrence of the specified in-hospital AEs among the Medicare population.

## B. Sample Characteristics

References below to the “QSRs sample” refer to the 22,678 records from 2021 and the 26,291 records from 2022 in the following four cohorts: CRITICAL ACCESS, RURAL, TARGETED URBAN, and OTHER.

The QSRs sample is *disproportionately distributed with respect to age*.

**Figure 1. Age Identified for Patient Records Sampled in 2021 and 2022**



Patients between 18 and 64 years old represent only 15.6% of the 2021 sample and 14.7% of the 2022 sample. These patients likely reflect dually eligible beneficiaries:

...people enrolled in both Medicare and Medicaid who are eligible by virtue of their age or disability and low incomes. This is a diverse population that includes people with multiple chronic conditions, physical disabilities, mental illness, and cognitive impairments such as dementia and developmental disabilities. It also includes individuals who are relatively healthy.<sup>xiii</sup>

<sup>xiii</sup> <https://www.macpac.gov/topics/dually-eligible-beneficiaries/>.

The remaining approximately 85% of the patients in the QSRs sample are 65 years old or over. The sample does not include any patients under the age of 18 years. The following table compares the age distribution of the 2021 and 2022 QSRs samples of inpatient hospital records with the overall Medicare population in these years. The percentage of patients aged 18 to 64 is higher (approximately 15-16% vs. 12.6%) and the percentage of patients 65 years of age and older is lower (approximately 84%-85% vs. 87%) in the QSRs samples for 2021 and 2022 than in the overall Medicare population from 2021.

**Table 2. QSRs Sample Age Comparison With Overall Medicare Population**

Age range	2021 Records	Percentage of 2021 QSRs Sample	2022 Records	Percentage of 2022 QSRs Sample	Percentage of 2021 Medicare Population <sup>xiv</sup>
18-64	3531	15.6%	3863	14.7%	12.6%
65 and older	19147	84.4%	22428	85.3%	87.4%
<i>Total</i>	<i>22678</i>		<i>26291</i>		

As to patient sex in the QSRs sample, there are more records from female patients than male patients in both 2021 and 2022. The following table compares the sex distribution of the 2021 and 2022 QSRs samples of inpatient hospital records with the overall Medicare population in 2021. The percentage of males (approximately 46%) and females (approximately 54%) is very similar between the QSRs samples for both years and the overall Medicare population in 2021.

**Table 3. QSRs Sample Sex Comparison With Overall Medicare Population**

Sex	2021 Records	Percentage of 2021 QSRs Sample	2022 Records	Percentage of 2022 QSRs Sample	Percentage of 2021 Medicare Population <sup>xv</sup>
Female	12307	54.3%	14221	54.1%	54.4%
Male	10371	45.7%	12070	45.9%	45.6%
<i>Total</i>	<i>22678</i>		<i>26291</i>		

Combining these patient demographics, the tables below show for each year the sample by sex and age group.

**Table 4. QSRs 2021 Sample Joint Distribution of Age and Sex**

Age (Years)	Male	Female	Total
18-64	1733	1798	3531
65 and older	8638	10509	19147
<i>Total</i>	<i>10371</i>	<i>12307</i>	<i>22678</i>

**Table 5. QSRs 2022 Sample Joint Distribution of Age and Sex**

Age (Years)	Male	Female	Total
18-64	1966	1897	3863
65 and older	10104	12324	22428
<i>Total</i>	<i>12070</i>	<i>14221</i>	<i>26291</i>

<sup>xiv</sup> <https://data.cms.gov/summary-statistics-on-beneficiary-enrollment/medicare-and-medicare-reports/cms-program-statistics-medicare-total-enrollment>. Data for 2022 not yet available.

<sup>xv</sup> <https://data.cms.gov/summary-statistics-on-beneficiary-enrollment/medicare-and-medicare-reports/cms-program-statistics-medicare-total-enrollment>. Data for 2022 not yet available.

Sections IV.A. and IV.B. and Appendix 4 below provide further data on the AEs disaggregated by sex and age groups.

The following table compares the race and ethnicity distribution of the 2021 and 2022 QSRs samples of inpatient hospital records with the overall Medicare population in 2021.

**Table 6. QSRs Sample Race and Ethnicity Comparison With Overall Medicare Population**

Race/Ethnicity	2021 Records	Percentage of 2021 QSRs Sample	2022 Records	Percentage of 2022 QSRs Sample	Percentage of Overall 2021 Medicare Population
Non-Hispanic White	17575	77.5%	20173	76.7%	72.8%
Black (or African American)	2624	11.6%	3027	11.5%	10.5%
Hispanic	1447	6.4%	1971	7.5%	9.7%
Asian/Pacific Islander	380	1.7%	432	1.6%	3.7%
American Indian/Alaska Native	271	1.2%	216	0.8%	0.4%
Other	138	0.6%	178	0.7%	0.9%
Unknown	243	1.1%	294	1.1%	2.0%

**Source:** Table provided by CMS Center for Clinical Standards and Quality. Overall Medical population data available at <https://data.cms.gov/summary-statistics-on-beneficiary-enrollment/medicare-and-medicaid-reports/cms-program-statistics-medicare-total-enrollment>.

**Note:** Percentages may not add to 100 due to rounding.

The percentages of non-Hispanic White, Black (or African American), and American Indian/Alaska Native identified in the QSRs sample were greater than in the overall Medicare population for 2021.

Conversely, a smaller percentage of Hispanic, Asian/Pacific Islander, Other, and Unknown were identified in the QSRs sample compared with the overall Medicare population for 2021.

## C. Determining Adverse Event Rates

The “AE rate” for individual AEs is the number of hospital stays where that AE occurred divided by the “population at risk,” meaning the number of patients at risk for that AE. For some AEs, such as falls, every patient is considered at risk. However, for others, only certain patients, a subset of the sample, are considered at risk. For example, the Birth – Maternal AE rate is calculated by dividing the total number of hospitalizations where a specified maternal AE occurred by the total number of patients who gave birth during their inpatient hospital stay.<sup>xvi</sup> The “AE rate per 1,000 discharges” is the number of stays where the specific AE occurred divided by the total number of discharges for that year’s sample (i.e., for 2021, 22,678) multiplied by 1,000.

<sup>xvi</sup> For further information on the numerator and denominator for each adverse event in QSRs, see section 2.1 of the [Event Description \(ED\) Overview and Application Guide: AHRQ Common Formats for Surveillance – Hospital Version 1.0](#).

This report also includes two composite rates. The first is the rate of patients experiencing at least one AE identified by QSRs during their stay. This rate is calculated by taking the number of hospitalizations with at least one AE, dividing it by the total number of discharges, and multiplying that by 100. The second is the total number of AEs per 1,000 discharges. This rate is calculated by taking the total number of identified AEs, dividing by the total number of discharges, and multiplying this number by 1,000. These composite rates are provided both as observed and weighted rates.

## D. Weighting Methodology

CMS's current sampling plan for the hospital cohorts does not reflect the true percentage of these hospital cohorts in the United States. For the reported AE rates to be more nationally representative based on hospital type, a weighting strategy was developed to account for the over- or underrepresentation of the hospital cohorts included in the sample. By using this strategy and weighting each case to be more representative of the overall national hospital composition, we have included all abstracted records from the four cohorts described above in the composite AE calculations.

Ideally, within each cohort, each medical record from different hospitals has the same probability of being sampled. However, this sampling scheme and associated weights are not compatible with the current sampling plan for the following reasons:

1. The total number of discharges for each hospital varies over time, which is anticipated,
2. The number of hospitals sampled could be different from planned because hospitals experience natural disasters or other emergency waiver or CMS changes their priorities or has budgetary considerations, and
3. The monthly number of samples per hospitals varies, which is also anticipated.

Therefore, the total number of sampled records may vary from the expected total number in each month. A weighting methodology, described further in Appendix 3, addresses these challenges.

## IV. Findings

### A. 2021 Findings

Overall, 6.4% of the patients in the 2021 QSRs sample experienced at least one AE during their stay. Among the four cohorts, the TARGETED URBAN cohort had the highest AE rate (8.1%) and the CRITICAL ACCESS cohort had the lowest AE rate (3.3%). The rate of AEs per 1,000 discharges followed the same pattern, and, overall, 1,674 AEs were identified, which resulted in a rate of 73.8 AE per 1,000 discharges.

**Table 7. 2021 Composite AE Rates – Observed**

Cohorts	Total Discharges	Patients With At Least One AE During Hospitalization			AEs Per 1,000 Discharges		
		Hospitalizations With AEs	Rate (%)	95% Confidence Interval (CI)	Total Number AEs (N)	N per 1,000 Discharges	95% CI
TARGETED URBAN	4922	398	8.1	7.4 – 8.9	474	96.3	88 – 105.4
OTHER	8289	588	7.1	6.6 – 7.7	686	82.8	76.8 – 89.2
RURAL	4997	308	6.2	5.5 – 6.9	350	70.0	63.1 – 77.8
CRITICAL ACCESS	4470	149	3.3	2.8 – 3.9	164	36.7	31.5 – 42.8
<i>Total</i>	<i>22678</i>	<i>1443</i>	<i>6.4</i>	<i>6.1 – 6.7</i>	<i>1674</i>	<i>73.8</i>	<i>70.4 – 77.4</i>

The methodology described above was applied to derive the weighted versions of these same rates. The order of the rates by hospital cohort was the same for the weighted and observed data. However, the overall weighted rates were higher compared with the observed rates, with the weighted percentage of patients experiencing at least one AE per stay of 7.1% and the rate of 83.6 AE per 1,000 discharges.

**Table 8. 2021 Composite AE Rates – Weighted**

Cohorts	Total Discharges	Patients With At Least One AE During Hospitalization		AEs Per 1,000 Discharges	
		Rate (%)	95% CI	N per 1,000 Discharges	95% CI
TARGETED URBAN	4922	8.5	7.2 – 9.7	104.2	86.1 – 122.2
OTHER	8289	7.1	6.5 – 7.7	83.0	75.6 – 90.4
RURAL	4997	6.2	5.5 – 6.9	70.3	62.3 – 78.2
CRITICAL ACCESS	4467	3.4	2.7 – 4	36.9	29.9 – 44.0
<i>Total</i>	<i>22675</i>	<i>7.1</i>	<i>6.6 – 7.6</i>	<i>83.6</i>	<i>77.5 – 89.8</i>

**Note:** Information needed to apply weighting was missing for three discharges from the Critical Access Hospitals cohort, so these hospitalizations were not included in the table.

In some cases, more than one AE type was identified during a single hospital stay for a patient. Table 9 provides more information on the number of AEs per stay. The rate was calculated by dividing the number of hospital stays where the AEs were identified by the total number of hospital stays in 2021 (22,678).

**Table 9. 2021 Hospital Stays With One or More Adverse Events**

	Number of Hospitalizations	Rate (%)	95% CI
<b>Stay with one or more AE type</b>	1443	6.4	6.1 – 6.7
<b>Stay with 1 AE type</b>	1248	5.5	5.2 – 5.8
<b>Stay with 2 AE type</b>	167	0.7	0.6 – 0.9
<b>Stay with 3 AE type</b>	24	0.1	0.1 – 0.2
<b>Stay with 4 or more AE type</b>	4	0.0	0.0 – 0.1

The next two tables show specific AE rates for the 2021 sample. These tables show the combined observed data across all four hospital cohorts. The sample did not include any neonatal or pediatric patients, so while QSRS can capture such events, Birth – Neonatal events and pediatric seizures were excluded. Table 1A in Appendix 1 outlines all the AEs identified in QSRS, and the [Common Formats for Surveillance – Hospitals](#) includes further information on how each event is defined.

Table 10 highlights the five highest AE rates. Table 11 includes analyses of all 41 AE rates by module (topic area). For Table 11, where a module contains multiple AEs and the population at risk for all AEs within that module is the same, AE rates are also reported at the module level.

**Table 10. Five Highest AE Rates for 2021**

<b>Adverse Event</b>	<b>Hospitalizations With AE</b>	<b>Population At Risk</b>	<b>AE Rate (%)</b>	<b>95% CI</b>
<i>Birth – Maternal</i>	1	20	5.0	0.9 - 23.6
<i>Advancing Pressure Injury (PI) or complication in PI Present on Admission</i>	96	1949	4.9	4.1 – 6.0
<i>Hypoglycemic Events</i>	346	7384	4.7	4.2 – 5.2
<i>Intravenous unfractionated heparin Event</i>	68	1638	4.2	3.3 – 5.2
<i>New PI</i>	406	22678	1.8	1.6 – 2.0

**Table 11. AE Rates for 2021**

<b>Adverse Event</b>	<b>Hospitalizations With AE</b>	<b>Population At Risk</b>	<b>AE Rate (%)</b>	<b>95% CI</b>
<b>Birth – Maternal</b>	1	20	5.0	0.9 - 23.6
<b>Blood or Blood Product</b>	37	2603	1.4	1.0 – 2.0
<b>Fall</b>	124	22678	0.5	0.5 – 0.7
<i>Unassisted Fall</i>	105	22678	0.5	0.4 – 0.6
<i>Assisted Fall</i>	19	22678	0.1	0.1 – 0.1
<b>Hospital-Acquired Infections</b>				
<i>Catheter-associated urinary tract Infection</i>	17	5493	0.3	0.2 – 0.5
<i>Clostridioides difficile Infection</i>	45	20132	0.2	0.2 – 0.3
<i>Central line-associated bloodstream infection</i>	37	2373	1.6	1.1 – 2.1
<i>Hospital-Acquired COVID-19</i>	8	1474	0.5	0.3 – 1.1
<i>Hospital-Acquired Pneumonia (HAP)</i>	188	19429	1.0	0.8 – 1.1
<i>Surgical Site Infection</i>	7	3971	0.2	0.1 – 0.4
<i>Urinary Tract Infections</i>	15	20132	0.1	0.0 – 0.1
<b>Medication</b>				
<i>Anticoagulant Events</i>	122	12364	1.0	0.8 – 1.2
<i>Intravenous unfractionated heparin Event</i>	68	1638	4.2	3.3 – 5.2
<i>Warfarin Event</i>	9	900	1.0	0.5 – 1.9
<i>Low molecular weight heparin, thrombin inhibitor, or factor Xa inhibitor</i>	45	11007	0.4	0.3 – 0.5
<i>Hypoglycemic Events</i>	346	7384	4.7	4.2 – 5.2
<i>Opioid Events</i>	40	12110	0.3	0.2 – 0.4
<i>Anaphylaxis</i>	2	22678	0.0	0.0 – 0.0
<i>Potential overdoses</i>	1	22678	0.0	0.0 – 0.0
<b>Pressure Injury/Ulcer (PI)</b>				
<i>New PI</i>	406	22678	1.8	1.6 – 2.0
<i>Advancing PI or complication in PI Present on Admission</i>	96	1949	4.9	4.1 – 6.0
<b>Surgery or Anesthesia AE</b>	79	8333	0.9	0.8 – 1.2
<b>Venous Thromboembolism (VTE)</b>	65	21649	0.30	0.2 – 0.4
<i>Deep vein thrombosis (DVT) without pulmonary embolism (PE)</i>	42	21649	0.2	0.1 – 0.3
<i>Pulmonary embolism without DVT</i>	20	21649	0.1	0.1 – 0.1



<b>Adverse Event</b>	<b>Hospitalizations With AE</b>	<b>Population At Risk</b>	<b>AE Rate (%)</b>	<b>95% CI</b>
<i>Both DVT and PE developed during stay</i>	3	21649	0.0	0.0 – 0.0
<b>Other AEs</b>				
<i>AE attributed to failure to communicate laboratory, pathology, imaging, and physiologic test results</i>	0	22678	0.0	0.0 – 0.0
<i>AE due to the receipt of wrong, contaminated, or no anesthesia gas</i>	0	22678	0.0	0.0 – 0.0
<i>AE related to a radiologic or imaging study</i>	1	22678	0.0	0.0 – 0.0
<i>Incorrect non-OR procedure</i>	0	22678	0.0	0.0 – 0.0
<i>Intravascular air embolism during stay</i>	1	22678	0.0	0.0 – 0.0
<i>Irretrievable loss of irreplaceable biologic specimen</i>	2	22678	0.0	0.0 – 0.0
<i>Laceration or unintended puncture</i>	2	22678	0.0	0.0 – 0.0
<i>Mechanical AE associated with central venous catheter</i>	7	2944	0.2	0.1 – 0.5
<i>Non-OR related burn or electric shock events</i>	1	22678	0.0	0.0 – 0.0
<i>Patient attempted suicide</i>	1	22678	0.0	0.0 – 0.0
<i>Patient elopement</i>	5	22678	0.0	0.0 – 0.1
<i>Patient harmed from accident associated with bedrails (other than fall)</i>	1	22678	0.0	0.0 – 0.0
<i>Patient harmed from use of physical restraint (other than bedrails)</i>	0	22678	0.0	0.0 – 0.0
<i>Unintended arterial puncture</i>	16	2388	0.7	0.4 – 1.1
<i>Unintended iatrogenic pneumothorax</i>	1	22678	0.0	0.0 – 0.0

Comparative analyses were then conducted by age group and sex. Results were considered statistically significant if the confidence intervals did not overlap. The Medicare population, by the nature of the program, is composed mostly of people 65 years and older. Thus, the sample is disproportionately distributed between two age groups: (1) patients between 18 and 64 years, and (2) patients 65 years or older.

When the composite AE rates were compared by age, no statistically significant differences were identified. When the individual AE rates were compared by age, the only significant difference was that the rate of advancing pressure injuries or complications of pressure injuries present on admission (POA) was significantly higher (8.4% vs. 4.4%) for the younger age group.

When compared by sex, the composite AE rates were significantly lower for females than males: 14.5% lower (5.9% vs. 6.9%) for the rate of experiencing at least one AE during the inpatient stay and 17.0% lower (67.5 vs. 81.3) for the rate of AEs per 1,000 discharges. When the individual AE rates were compared by sex, there were no statistically significant differences. Further findings from these comparative analyses are presented in Appendix 4.

**Table 12. 2021 Composite AE Rates by Sex**

Sex	Total Discharges	Hospitalizations With At Least One AE			AEs Per 1,000 Discharges		
		Hospitalizations With AEs	Rate (%)	95% CI	Total Number AEs (N)	N per 1,000 Discharges	95% CI
Female	12307	727	5.9	5.5 – 6.3	831	67.5	63.1 – 72.3
Male	10371	716	6.9	6.4 – 7.4	843	81.3	76.0 – 87.0
<i>Total</i>	22678	1443	6.4	6.1 – 6.7	1674	73.8	70.4 – 77.4

The following tables provide information on length of stay and patients who died during their hospitalization. Of note, the death during stay information is derived from the discharge status for the records in the sample. This information is not connected to whether the patient was determined to have an AE during their hospitalization. In 2021, the CRITICAL ACCESS cohort had both the shortest length of stay (mean and median) and the lowest death rate.

**Table 13. Length of Stay 2021**

Cohort	Mean Length of Stay (Days)	Standard Deviation	Median Length of Stay (Days)	25 <sup>th</sup> Percentile, 75 <sup>th</sup> Percentile
TARGETED URBAN	6.3	6.6	4.0	3.0, 8.0
OTHER	5.9	6.0	4.0	2.0, 7.0
RURAL	5.2	4.9	4.0	2.0, 6.0
CRITICAL ACCESS	3.8	3.0	3.0	2.0, 5.0
<i>All Above</i>	5.4	5.5	4.0	2.0, 6.0

**Table 14. 2021 Deaths During Stay**

Cohort	N Deaths	N Records	Rate (%)	95% CI	Deaths per 1,000 Discharges
RURAL	247	4997	4.9	4.4 – 5.6	49.4
TARGETED URBAN	225	4922	4.6	4.0 – 5.2	45.7
OTHER	341	8289	4.1	3.7 – 4.6	41.1
CRITICAL ACCESS	179	4470	4.0	3.5 – 4.6	40.0
<i>Total</i>	992	22678	4.4	4.2 – 4.7	43.7

## B. 2022 Findings

Overall, 5.7% of the patients in the 2022 QSRs sample experienced at least one AE during their stay. Among the four cohorts, the TARGETED URBAN cohort had the highest AE rate (7.2%) and the CRITICAL ACCESS cohort had the lowest AE rate (3.2%). The rate of AEs per 1,000 discharges followed the same pattern, and, overall, 1,747 AEs were identified, which resulted in 66.4 AEs per 1,000 discharges.

**Table 15. 2022 Composite AE Rates – Observed**

		Patients With At Least One AE During Hospitalization			AEs Per 1,000 Discharges		
Cohorts	Total Discharges	Hospitalizations With AEs	Rate (%)	95% CI	Total Number AEs (N)	N per 1,000 Discharges	95% CI
TARGETED URBAN	7331	528	7.2	6.6 – 7.8	638	87.0	80.5 – 94.1
OTHER	8427	531	6.3	5.8 – 6.8	603	71.6	66.1 – 77.5
RURAL	5246	277	5.3	4.7 – 5.9	321	61.2	54.8 – 68.3
CRITICAL ACCESS	5287	169	3.2	2.8 – 3.7	185	35.0	30.3 – 40.4
<i>Total</i>	<i>26291</i>	<i>1505</i>	<i>5.7</i>	<i>5.4 – 6.0</i>	<i>1747</i>	<i>66.4</i>	<i>63.4 – 69.6</i>

The same weighting methodology described above was applied to the 2022 data. The order of the rates by hospital cohort was the same for the weighted and observed data in 2022. However, the overall weighted rates increased in comparison to the observed rates, with the weighted percentage of patients experiencing at least one AE per stay of 6.2% and 71.1 AEs per 1,000 discharges.

**Table 16. 2022 Composite AE Rates – Weighted**

		Patients With At Least One AE During Hospitalization		AEs Per 1,000 Discharges	
Cohorts	Total Discharges	Rate (%)	95% CI	N per 1,000 Discharges	95% CI
TARGETED URBAN	7329	7.2	6.6 – 7.9	87.6	79.3 – 96.0
OTHER	8427	6.3	5.7 – 6.8	71.2	64.8 – 77.7
RURAL	5246	5.3	4.7 – 5.9	61.3	53.9 – 68.8
CRITICAL ACCESS	5287	3.1	2.7 – 3.6	34.4	28.8 – 40.0
<i>Total</i>	<i>26289</i>	<i>6.2</i>	<i>5.8 – 6.6</i>	<i>71.1</i>	<i>65.9 – 76.3</i>

**Note:** Information needed to apply weighting was missing for two discharges from hospitals in the URBAN cohort, so these hospitalizations were not included in the table.

Table 17 provides further information on the number of AEs identified during a single hospital stay. The rate was calculated by dividing the number of hospital stays where the specified number of AEs was identified by the total number of hospital stays in 2022 (26,291).

**Table 17. 2022 Hospital Stays With One or More Events**

	Number of Events	Rate (%)	95% CI
Stay with one or more AE type	1505	5.7	5.5 – 6.0
Stay with 1 AE type	1305	5.0	4.7 – 5.2
Stay with 2 AE type	164	0.6	0.5 – 0.7
Stay with 3 AE type	31	0.1	0.1 – 0.2
Stay with 4 or more AE type	5	0.0	0.0 – 0.0

The next two tables show specific AE rates for the 2022 QSRs sample. These tables show the combined observed data across all four hospital cohorts. As with 2021, the 2022 sample did not include any neonatal or pediatric patients, so while QSRs can capture such events, Birth – Neonatal events and pediatric seizures were excluded. Table 18 highlights the five highest AE rates; Table 19 includes analyses of all 41 AE rates by module.

**Table 18. 5 Highest AE Rates for 2022**

<b>Adverse Event</b>	<b>Hospitalizations With AE</b>	<b>Population At Risk</b>	<b>AE Rate (%)</b>	<b>95% CI</b>
<i>Advancing Pressure Injury (PI) or complication in PI Present on Admission</i>	124	2062	6.0	5.1 – 7.1
<i>Hypoglycemic Events</i>	399	8438	4.7	4.3 – 5.2
<i>Intravenous unfractionated heparin Event</i>	55	1859	3.0	2.3 – 3.8
<i>New PI</i>	434	26291	1.7	1.5 – 1.8
<i>Central line-associated bloodstream infection</i>	36	2306	1.6	1.1 – 2.2

**Table 19. AE Rates for 2022**

<b>Adverse Event</b>	<b>Hospitalizations With AE</b>	<b>Population At Risk</b>	<b>AE Rate (%)</b>	<b>95% CI</b>
<b>Birth – Maternal</b>	0	20	0.0	0.0 – 16.1
<b>Blood or Blood Product</b>	15	2683	0.6	0.3 – 0.9
<b>Fall</b>	132	26291	0.5	0.4 – 0.6
<i>Unassisted Fall</i>	117	26291	0.5	0.4 – 0.5
<i>Assisted Fall</i>	15	26291	0.1	0.0 – 0.1
<b>Hospital-Acquired Infections</b>				
<i>Catheter-associated urinary tract Infection</i>	10	4211	0.2	0.1 – 0.4
<i>Clostridioides difficile Infection</i>	59	23323	0.3	0.2 – 0.3
<i>Central line-associated bloodstream infection</i>	36	2306	1.6	1.1 – 2.2
<i>Hospital-Acquired COVID-19</i>	15	1709	0.9	0.5 – 1.4
<i>Hospital-Acquired Pneumonia (HAP)</i>	162	22883	0.7	0.6 – 0.8
<i>Surgical Site Infection</i>	9	4674	0.2	0.1 – 0.4
<i>Urinary Tract Infections</i>	28	23323	0.1	0.1 – 0.2
<b>Medication</b>				
<i>Anticoagulant Events</i>	103	14143	0.7	0.6 – 0.9
<i>Intravenous unfractionated heparin Event</i>	55	1859	3.0	2.3 – 3.8
<i>Warfarin Event</i>	7	857	0.8	0.4 – 1.7
<i>Low molecular weight heparin, thrombin inhibitor, or factor Xa inhibitor</i>	41	12697	0.3	0.2 – 0.4
<i>Hypoglycemic Events</i>	399	8438	4.7	4.3 – 5.2
<i>Opioid Events</i>	40	13576	0.3	0.2 – 0.4
<i>Anaphylaxis</i>	1	26291	0.0	0.0 – 0.0
<i>Potential overdoses</i>	0	26291	0.0	0.0 – 0.1
<b>Pressure Injuries/Ulcers (PI)</b>				
<i>New PI</i>	434	26291	1.7	1.5 – 1.8
<i>Advancing PI or complication in PI Present on Admission</i>	124	2062	6.0	5.1 – 7.1
<b>Surgery or Anesthesia AE</b>	77	9351	0.8	0.7 – 1.0
<b>Venous Thromboembolism (VTE)</b>	69	25389	0.3	0.7 – 1.0
<i>Deep vein thrombosis (DVT) without pulmonary embolism (PE)</i>	49	25389	0.2	0.1 – 0.3
<i>Pulmonary embolism without DVT</i>	16	25389	0.1	0.0 – 0.1
<i>Both DVT and PE developed during stay</i>	4	25389	0.0	0.0 – 0.0

Adverse Event	Hospitalizations With AE	Population At Risk	AE Rate (%)	95% CI
<b>Other AEs</b>				
<i>AE attributed to failure to communicate laboratory, pathology, imaging, and physiologic test results</i>	1	26291	0.0	0.0 – 0.0
<i>AE due to the receipt of wrong, contaminated, or no anesthesia gas</i>	1	26291	0.0	0.0 – 0.0
<i>AE related to a radiologic or imaging study</i>	0	26291	0.0	0.0 – 0.0
<i>Incorrect non-OR procedure</i>	1	26291	0.0	0.0 – 0.0
<i>Intravascular air embolism during stay</i>	1	26291	0.0	0.0 – 0.0
<i>Irretrievable loss of irreplaceable biologic specimen</i>	0	26291	0.0	0.0 – 0.0
<i>Laceration or unintended puncture</i>	1	26291	0.0	0.0 – 0.0
<i>Mechanical AE associated with central venous catheter</i>	7	2868	0.2	0.1 – 0.5
<i>Non-OR related burn or electric shock events</i>	0	26291	0.0	0.0 – 0.0
<i>Patient attempted suicide</i>	0	26291	0.0	0.0 – 0.0
<i>Patient elopement</i>	8	26291	0.0	0.0 – 0.0
<i>Patient harmed from accident associated with bedrails (other than fall)</i>	2	26291	0.0	0.0 – 0.0
<i>Patient harmed from use of physical restraint (other than bedrails)</i>	1	26291	0.0	0.0 – 0.0
<i>Unintended arterial puncture</i>	13	2486	0.5	0.3 – 0.9
<i>Unintended iatrogenic pneumothorax</i>	3	26291	0.0	0.0 – 0.0

Comparative analysis of the 2022 data was also performed by age group and sex. The table below reflects the composite AE rates for the 18-64 and 65 and older age groups. The rate of AEs per 1,000 discharges was significantly higher for the younger age group (80.5 vs. 64.0).

**Table 20. 2022 Composite AE Rates by Age Groups**

Age Groups	Total Discharges	Hospitalizations With At Least One AE			AEs Per 1,000 Discharges		
		Hospitalizations With AEs	Rate (%)	95% CI	Total Number AEs (N)	N per 1,000 Discharges	95% CI
18 – 64	3,863	258	6.7	5.9 – 7.5	311	80.5	72.0 – 90.0
65 and older	22,428	1247	5.6	5.3 – 5.9	1436	64.0	60.8 – 67.4
<i>Total</i>	<i>26291</i>	<i>1505</i>	<i>5.7</i>	<i>5.4 – 6.0</i>	<i>1747</i>	<i>66.4</i>	<i>63.4 – 69.6</i>

When the individual AE rates were analyzed by age, only two AE rates were significantly higher for the 18-64 group than for the 65 and older group: advancing pressure injuries or complications of pressure injuries present on admission (13.4% vs. 4.7%) and catheter-associated urinary tract infections (0.9% vs. 0.1%).

When compared by sex, the rate of AEs per 1,000 discharges is 13.5% lower (62.0 vs. 71.7) for females compared with males. When the individual AE rates were analyzed by sex, the AE rate for advancing pressure injuries or complications of pressure injuries POA was significantly higher for males than females (7.2% vs. 4.9%). No other statistically significant differences were identified.

**Table 21. 2022 Composite AE Rates by Sex**

		Hospitalizations With At Least One AE			AEs Per 1,000 Discharges		
Sex	Total Discharges	Hospitalizations With AEs	Rate (%)	95% CI	Total Number AEs (N)	N per 1,000 Discharges	95% CI
Female	14221	766	5.4	5.0 – 5.8	882	62.0	58.1 – 66.3
Male	12070	739	6.1	5.7 – 6.6	865	71.7	67.0 – 76.6
Total	26291	1505	5.7	5.4 – 6.0	1747	66.4	63.4 – 69.6

The following tables provide information on the length of stay and patients who died during their hospitalization from the 2022 data. As noted above, the death during stay information is not connected to whether the patient was determined to have an AE during their hospitalization. In 2022, the TARGETED URBAN cohort had the longest length of stay and highest death rate whereas the CRITICAL ACCESS cohort had the shortest length of stay and lowest death rate.

**Table 22. Length of Stay 2022**

Cohort	Mean Length of Stay (Days)	Standard Deviation	Median Length of Stay (Days)	25 <sup>th</sup> Percentile, 75 <sup>th</sup> Percentile
TARGETED URBAN	6.3	6.8	4.0	2.0, 8.0
OTHER	6.0	6.5	4.0	2.0, 7.0
RURAL	5.1	4.9	4.0	2.0, 6.0
CRITICAL ACCESS	3.9	3.4	3.0	2.0, 5.0
All Above	5.5	5.8	4.0	2.0, 6.0

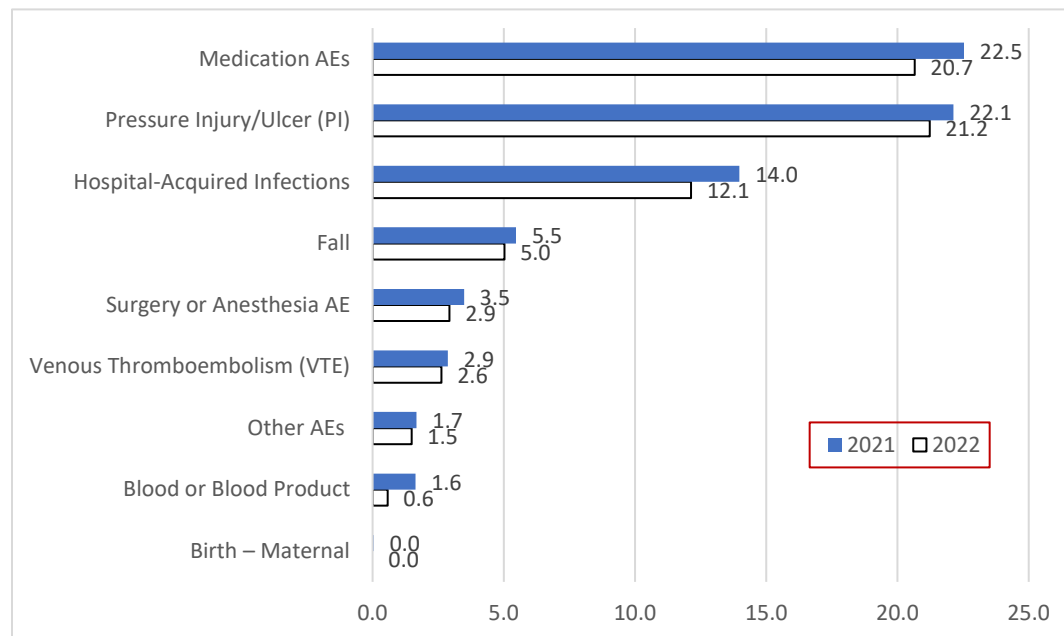
**Table 23. 2022 Deaths During Stay**

Cohort	N Deaths	N Records	Rate (%)	95% CI	Deaths per 1,000 discharges
TARGETED URBAN	365	7331	5.0	4.5 – 5.5	49.8
RURAL	215	5246	4.1	3.6 – 4.7	41.0
OTHER	313	8427	3.7	3.3 – 4.1	37.1
CRITICAL ACCESS	173	5287	3.3	2.8 – 3.8	32.7
All Above	1066	26291	4.1	3.8 – 4.3	40.5

## C. 2021 and 2022 Comparisons

Figure 2 compares the number of AEs per 1,000 discharges by category (QSRS topic-area module) between 2021 and 2022. In all categories (except Birth – Maternal, where both years had 0.0 AEs per 1,000 discharges), the number of AEs per 1,000 discharges was lower in 2022 compared with 2021. For each category, the number of AEs was divided by the total number of discharges in each year.

**Figure 2. Number of Adverse Events per 1000 Discharges by Category in 2021 and 2022**



For both the observed and weighted data, Table 24 shows that the composite rates for 2022 are generally significantly lower than the 2021 rates. (Negative numbers in the “Change” row mean the 2022 rate is lower than the 2021 rate.) For example, the 2022 weighted rate of AEs per 1,000 discharges is 15.0% lower (71.1 vs. 83.6) for 2022 than for 2021.

**Table 24. Comparison of 2021 and 2022 Overall Composite AE Rates, Observed and Weighted Data**

	Observed – Patients With At Least One AE During Hospitalization		Weighted – Patients With At Least One AE During Hospitalization		Observed N AEs Per 1,000 Discharges		Weighted – N AEs Per 1,000 Discharges	
	Rate (%)	95% CI	Rate (%)	95% CI	N per 1,000 Discharges	95% CI	N per 1,000 Discharges	95% CI
2021	6.4	6.1 – 6.7	7.1	6.6 – 7.6	73.8	70.4 – 77.4	83.6	77.5 – 89.8
2022	5.7	5.4 – 6.0	6.2	5.8 – 6.6	66.4	63.4 – 69.6	71.1	65.9 – 76.3
Change	-0.7		-0.9		-7.4		-12.5	

This year-to-year comparison was also conducted by hospital cohort; however, while the rates were lower for 2022 than for 2021, these differences were not statistically significant. A year-to-year comparison was also conducted by individual AE rates. Two AE rates were significantly lower in 2022 than in 2021, intravenous unfractionated heparin events (4.2% vs. 3.0%) and blood or blood product events (1.4% vs. 0.6%).

The length of stay data for 2021 and 2022 were similar (e.g., 5.4 vs. 5.5 days as mean length of stay for 2021 compared with 2022). There were no statistically significant differences between years for deaths during hospital stays. Further findings from these analyses are in Appendix 4.

## **V. Discussion**

### **A. AE Rates Among Medicare Patients, 2021 and 2022**

Encouragingly, the above findings show that the composite AE rates for 2022 are lower than those for 2021. For example, the 2022 weighted rate of AEs per 1,000 discharges is 15.0% lower (71.1 vs. 83.6) for 2022 than for 2021. This difference appears to be due to modest decreases in rates across multiple AEs, with limited statistically significant decreases at the individual AE level.

When the AE rates were broken down by sex, in 2022, the female group had a lower rate of AEs per 1,000 discharges than the male group. Again, this difference appears to be related to small decreases in rates across multiple AEs.

Interestingly, for the analyses by age, in 2022 the younger group had a higher rate of AEs per 1,000 discharges than the older group. As noted above, the 18-64 age group in the QSRS sample likely represents “dually eligible” patients, a cohort not representative of the 18-64 population nationally. Reexamining these rates after further risk adjustment (see *Limitations*) would be of particular interest.

When examined by hospital cohort, for both 2021 and 2022 data, the composite rates were highest for the TARGETED URBAN cohort, followed by OTHER and RURAL, with the CRITICAL ACCESS cohort having the lowest rates.

### **B. Limitations**

These findings may not be representative of, and should not be extrapolated to, the entire population of patients hospitalized in the United States in 2021 or 2022. Per the sampling methodology for the inpatient hospitalization records as defined by CMS, selection of records was limited to those patients insured by Medicare. The occurrence of the AEs specified in QSRS may be different among patients with other insurance types.

In addition, no records were obtained from patients under 18, who also may experience AEs differently than the adult Medicare population. While demographic information about the patient population is presented above, the findings in this report have not been adjusted to reflect patient characteristics (other than the analyses disaggregated by age and sex) or other potential confounding variables. AHRQ is exploring the feasibility of providing risk-adjusted data in the future.

While QSRS was designed to capture the vast majority of AEs occurring during inpatient hospitalizations, these findings should not be interpreted as reflecting all possible AEs that may have occurred during the reviewed hospital stays. The QSRS primarily is used to identify the specific events listed in Appendix 1. Additional possible AEs may not be accounted for in the system, such as those that are not compatible with the abstraction method used in QSRS and those that would not be discernible from review of the inpatient hospitalization record (e.g., those that manifested after the patient was discharged).



## Appendix 1.

Table 1A further describes the information within QSRS and how it is organized. Like AEs are grouped together by topic area (module). Many AEs reflect a single outcome (e.g., hospital-acquired pneumonia) whereas other AEs combine several outcomes into one AE type. The AE column in the table shows where multiple outcomes have been combined into one AE. Where the AE column is blank, the outcome and the AE are the same.

**Table 1A. QSRS adverse events by module**

Module	Adverse Event (AE)	Outcome
1. Birth – Maternal	Reflected as one Birth – Maternal AE including all 8 outcomes	Antibiotic administration more than 24 hours following term vaginal birth
		Eclampsia
		Fetal death after admission: related to labor and delivery and not expected
		Hemorrhage requiring transfusion
		Infection not present on admission (Chorioamnionitis or Endometritis)
		Injury to other body part or organ during labor or birth
		Maternal death
		Third or fourth degree perineal laceration
2. Birth – Neonatal*	Reflected as one Birth – Neonatal AE including all 10 outcomes	Abduction of neonate
		Anoxic or hypoxic-ischemic encephalopathy
		Five-minute Apgar <7 when birthweight > 2,500 grams
		Injury to brachial plexus, including Erb's or Klumpke's paralysis
		Infection
		Massive aspiration syndrome or meconium aspiration syndrome
		Neonate death: related to labor and delivery and not expected
		Seizures
		Severe hyperbilirubinemia
		Subdural or cerebral hemorrhage
3. Blood or Blood Product	Reflected as one Blood or Blood Product AE including all 3 outcomes	Administration of incompatible ABO type
		Transfusion reaction coded
		Transfusion reaction notated
4. Fall		Assisted Fall
		Unassisted Fall
5. Hospital Acquired Infection (HAI)		Catheter-associated urinary tract infection (CAUTI)
		Central line-associated bloodstream Infections (CLABSI)
		Clostridioides difficile Infection (CDI)
		Coronavirus (COVID-19)
		Pneumonia
		Surgical site infection (SSI) following operating room procedures
		Urinary tract infection (UTI); not catheter-associated
6. Medication		Anticoagulant event – Intravenous unfractionated heparin event

Module	Adverse Event (AE)	Outcome
		Anticoagulant event – Warfarin event
		Anticoagulant event – Low molecular weight heparin, thrombin inhibitor, or factor Xa inhibitor
		AE associated with hypoglycemic agent
		AE within 24 hours following opioid administration
		Anaphylaxis
		Potential Overdose
7. Other		AE attributed to failure to communicate laboratory, pathology, imaging, and physiologic test results
		AE due to the receipt of wrong, contaminated, or no anesthesia gas
		AE involving invasive, non-OR procedure – Incorrect non-OR procedure
		AE involving invasive, non-OR procedure – Laceration or unintended puncture
		AE involving invasive, non-OR procedure – Unintended iatrogenic pneumothorax
		AE related to a radiologic or imaging study including radiation overdose, imaging procedure on wrong person or wrong body region, event related to introduction of inappropriate metallic object in MRI room, and other
		Intravascular air embolism during stay
		Irretrievable loss of irreplaceable biologic specimen
		Mechanical AE associated with central venous catheter
		Non-OR related burn and electric shock events
		Patient attempted suicide
		Patient elopement
		Patient harmed from accident associated with bedrails (other than fall)
		Patient harmed from use of physical restraint (other than bedrails)
		Pediatric seizure*
		Unintended arterial puncture
8. Pressure Injury/Ulcer (PI)		Advancing PI or Secondary Comorbidity in PI Present on Admission
		New PI
9. Surgery or Anesthesia	Reflected as one AE including all 22 outcomes	Air or other gas embolus
		Burn or Electric Shock
		Cardiac or circulatory event during or within 48 hours of OR procedure or administration of anesthesia
		Central nervous system event (e.g., CVA, seizures, coma)
		Death during or shortly after anesthesia in ASA Class 1 patient
		Dehiscence, flap or wound failure or disruption, or graft failure
		Dental injury

Module	Adverse Event (AE)	Outcome
		High spinal requiring intubation and/or assisted ventilation
		Incorrect OR procedure
		Injury to peripheral or cranial nerve or spinal cord; Malignant hyperthermia
		Ocular injury
		Peri-operative injury
		Post-dural puncture headache
		Respiratory failure indicated by unplanned respiratory support within 24 hours of OR procedure or administration of anesthesia
		Retained object(s)
		Unintended awareness (during general anesthesia)
		Unintended blockage, obstruction, or ligation
		Unintended iatrogenic pneumothorax
		Unintended laceration or puncture
		Unplanned conversion to general anesthesia
		Unplanned removal of normal organ
		Unplanned return to operating room
10. Venous Thromboembolism (VTE)		Deep vein thrombosis (DVT) without pulmonary embolism (PE)
		PE without DVT
		Both DVT and PE developed during stay

\*Not included in this report given sample limitations.

**Table 2A. Occurrences To Be Monitored in QSRS – Not Treated as AEs**

Module	Occurrences To Be Monitored
1. Birth – Maternal	Patients with other maternal outcome(s) during stay
2. Birth – Neonatal	Other birth injury
3. Blood or Blood Product	Treatment suggestive of transfusion reaction
4. Device	Stay during which one or more occurrences associated with the use of a device occurred
5. Hospital Acquired Infection (HAI)	Stay with other HAI
6. Medication	Other medication event identified by abstractor
7. Other	Other occurrences
	Renal failure
	Unplanned transfer
	Ventilator support (non-OR)
8. Surgery or Anesthesia	Other anesthesia events
	Other complications manifested post-op
	Other major complications associated with either surgery or anesthesia
	Other unplanned returned to OR

**Note:** Not every module has occurrences to be monitored; those modules without any have been omitted from Table 2A. At this time, the Device module only includes occurrences to be monitored and does not appear in Table 1A.

## Appendix 2. CMS Sampling Methodology

The CMS sampling method uses probability proportional to size sampling to select hospitals. All hospitals are chosen in October of each year, then randomly assigned to months 1, 2, and 3, equally. Hospitals chosen for months 1, 2, and 3 will define the master list of hospitals used in the following quarters, with October samples pulled from hospitals assigned to month 1, November samples pulled from hospitals assigned to month 2, December samples pulled from hospitals assigned to month 3, January samples pulled from the October master list containing all hospitals sampled for October, and so on.

During 2021 and 2022, if a monthly sample fell short by more than 10 claims, additional hospitals were sampled from groups and added to the monthly hospital list. During the year, some hospitals may receive a Federal Emergency Management Agency (FEMA) waiver or may close. In such cases, the groups that those hospitals belonged to will fall short of the monthly claims goal and will be replaced.

One of the reasons October is used as month 1 is that its pull date corresponds with the Inpatient Quality Reporting (IQR) Program<sup>xvii</sup> validation list, which is released in January of each year. The IQR validation list contains approximately 500 hospitals excluded from the QSRS universe for the year. By setting October to month 1, the likelihood of the need for resampling due to IQR validation exclusions is reduced. This approach increases the likelihood of having a consistent hospital sample group across the year.

The sampling process begins with the exclusion of ineligible hospitals. Excluded hospitals include those that are closed, were selected for IQR validation, have a FEMA exclusion, or were not designated as Prospective Payment System.<sup>xviii</sup> Criteria are then used to further identify those eligible for sampling. Demographic data are combined with stays at eligible hospitals, keeping only claims with a stay less than 120 days for patients over 18. Duplicate claims are removed, and hospitals are identified for probability proportion sampling by cohort.

In the first quarter, sampled hospitals are selected for the first time in three month-groups (as described above). The hospitals are selected to obtain the goal number of hospitals per quarter for the CRITICAL ACCESS, RURAL, TARGETED URBAN, and OTHER cohorts. For the second, third, and fourth quarters, hospitals are reselected in the respective month per quarter, such as the second month of each quarter.

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<sup>xvii</sup> <https://www.cms.gov/medicare/quality/initiatives/hospital-quality-initiative/inpatient-reporting-program>.

<sup>xviii</sup> <https://www.cms.gov/medicare/payment/prospective-payment-systems>.

### Appendix 3. Weighting Methodology

The following algorithms were applied to calculate the weight associated with each inpatient hospitalization record.

#### 1. Sample record weight calculation for month $m$ and cohort $k$ :

Denote  $N_{mk}$  as the total number of claims that can be sampled from, and  $n_{hmk}$  is the number of sampled records from hospital  $h$ .

Calculate a monthly cohort-specific weight  $s_{mk}$  and set as  $w_{hmk}$ , where  $w_{hmk}=s_{mk}=N_{mk}/n_{mk}$  where  $n_{mk}$  is number of sampled records.

#### 2. Calculate the monthly and yearly numerators, denominators, and rate for a given AE $j$ .

**Monthly** calculation for denominator  $Den_{jmk}$ , numerator  $Num_{jmk}$  and AE rate  $r_{jmk}$  can be defined as:

$$Num_{jmk}=\sum(a_{ijhmk}*w_{hmk}), Den_{jmk}=\sum(c_{ijhmk}*w_{hmk}) \text{ and } r_{jmk}=Num_{jmk}/Den_{jmk}$$

While  $a_{ijhmk}=1$  if AE  $j$  is present else  $a_{ijhmk}=0$ ;  $c_{ijhmk}=1$  if the claim is eligible for evaluating the presence of AE  $j$  else  $c_{ijhmk}=0$ . For example, maternal-related AE can only be evaluated in a subset of all the sampled claims, while fall and pressure ulcer can be evaluated from all claims.

**Yearly** calculation for denominator  $Den_j$ , numerator  $Num_j$  and AE rate  $r_j$  can be defined as:

$$Num_j=\sum_{over m} \sum_{over k} Num_{jmk}, Den_j=\sum_{over m} \sum_{over k} Den_{jmk}, \text{ and } r_j=Num_j/Den_j$$

The weighting methodology considers the exact probability of a given hospital and associated number of cases that were selected and available for a given month. Monthly weighted rates are combined to provide an annual weighted rate.

## Appendix 4. Additional Analyses

Results were considered statistically significant if the confidence intervals did not overlap; these results are highlighted in color.

**Table 3A. 2021 Composite AE Rates by Age Groups**

Age Groups	Total Discharges	Hospitalizations With At Least One AE			AEs Per 1,000 Discharges		
		Hospitalizations With AEs	Rate (%)	95% CI	Total Number AEs (N)	N per 1,000 Discharges	95% CI
18-64	3531	234	6.6	5.9 – 7.5	270	76.5	67.9 – 86.2
65 and older	19147	1209	6.3	6.0 – 6.7	1404	73.3	69.6 – 77.3
<i>Total</i>	22678	1443	6.4	6.1 – 6.7	1674	73.8	70.4 – 77.4

**Table 4A. 2021 Adverse Events by Age Groups**

Adverse Event	18-64				65 and Older			
	Hospitalizations With AE	Pop. At Risk	AE Rate (%)	95% CI	Hospitalizations With AE	Pop. At Risk	AE Rate (%)	95% CI
<b>Birth – Maternal</b>	1	20	5.0	0.9 – 23.6	-	-	-	-
<b>Blood or Blood Product</b>	2	393	0.5	0.1-1.8	35	2210	1.6	1.1-2.2
<b>Fall</b>	18	3531	0.5	0.3 – 0.8	106	19147	0.6	0.5-0.7
<i>Unassisted Fall</i>	16	3531	0.5	0.3 – 0.7	82	19147	0.4	0.3 – 0.5
<i>Assisted Fall</i>	2	3531	0.1	0.0 – 0.2	24	19147	0.1	0.1 – 0.2
<b>Hospital-Acquired Infections</b>								
<i>Catheter-associated urinary tract Infection</i>	6	717	0.8	0.4 – 1.8	11	4776	0.2	0.1 – 0.4
<i>Clostridioides difficile Infection</i>	5	3135	0.2	0.1 – 0.4	40	16997	0.2	0.2 – 0.3
<i>Central line-associated bloodstream infection</i>	10	542	1.8	1.0 – 3.4	27	1831	1.5	1.0 – 2.1
<i>Hospital-Acquired COVID-19</i>	2	299	0.7	0.2 – 2.4	6	1175	0.5	0.2 – 1.1
<i>Hospital-Acquired Pneumonia (HAP)</i>	31	3047	1.0	0.7 – 1.4	158	16382	1.0	0.8 – 1.1
<i>Surgical Site Infection</i>	4	601	0.7	0.3 – 1.7	3	3370	0.1	0.0 – 0.3
<i>Urinary Tract Infections</i>	3	3135	0.1	0.0 – 0.3	12	16997	0.1	0.0 – 0.1
<b>Medication AEs</b>								
<i>Anticoagulant Events</i>	22	1744	1.3	0.8 – 1.9	100	10620	0.9	0.8 – 1.2

	18-64				65 and Older			
<b>Adverse Event</b>	<b>Hospitalizations With AE</b>	<b>Pop. At Risk</b>	<b>AE Rate (%)</b>	<b>95% CI</b>	<b>Hospitalizations With AE</b>	<b>Pop. At Risk</b>	<b>AE Rate (%)</b>	<b>95% CI</b>
<i>Intravenous unfractionated heparin Event</i>	10	232	4.3	2.4 – 7.8	58	1406	4.1	3.2 – 5.3
<i>Warfarin Event</i>	1	92	1.1	0.2 – 5.9	8	808	1.0	0.5 – 1.9
<i>Low molecular weight heparin, thrombin inhibitor, or factor Xa inhibitor</i>	11	1573	0.7	0.4 – 1.2	34	9434	0.4	0.3 – 0.5
<i>Hypoglycemic Events</i>	67	1406	4.8	3.8 – 6.0	279	5978	4.7	4.2 – 5.2
<i>Opioid Events</i>	6	2204	0.3	0.1 – 0.6	34	9906	0.3	0.2 – 0.5
<i>Anaphylaxis</i>	0	3531	0.0	0.0 – 0.1	2	19147	0.0	0.0 – 0.0
<i>Potential overdoses</i>	1	3531	0.0	0.0 – 0.2	0	19147	0.0	0.0 – 0.0
<b>Pressure Injury/Ulcer (PI)</b>								
<i>New PI</i>	49	3531	1.4	1.1 – 1.8	357	19147	1.9	1.7 – 2.1
<i>Advancing PI or complication in PI Present on Admission</i>	22	261	8.4	5.6 – 12.4	74	1688	4.4	3.5 – 5.5
<b>Surgery or Anesthesia AE</b>	10	1330	0.8	0.4 – 1.4	69	7003	1.0	0.8 – 1.2
<b>Venous Thromboembolism (VTE)</b>	7	3373	0.2	0.1 – 0.4	58	18276	0.3	0.3 – 0.4
<i>Deep vein thrombosis (DVT) without pulmonary embolism (PE)</i>	5	3373	0.2	0.1 – 0.4	37	18276	0.2	0.2 – 0.3
<i>Pulmonary embolism without DVT</i>	1	3373	0.0	0.0 – 0.2	19	18276	0.1	0.1 – 0.2
<i>Both DVT and PE developed during stay</i>	1	3373	0.0	0.0 – 0.2	2	18276	0.0	0.0 – 0.0
<b>Other AEs</b>								
<i>AE attributed to failure to communicate laboratory, pathology, imaging, and physiologic test results</i>	0	3531	0.0	0.0 – 0.1	0	19147	0.0	0.0 – 0.0
<i>AE due to the receipt of wrong, contaminated, or no anesthesia gas</i>	0	3531	0.0	0.0 – 0.1	0	19147	0.0	0.0 – 0.0

	18-64				65 and Older			
<b>Adverse Event</b>	<b>Hospitalizations With AE</b>	<b>Pop. At Risk</b>	<b>AE Rate (%)</b>	<b>95% CI</b>	<b>Hospitalizations With AE</b>	<b>Pop. At Risk</b>	<b>AE Rate (%)</b>	<b>95% CI</b>
<i>AE related to a radiologic or imaging study</i>	0	3531	0.0	0.0 – 0.1	1	19147	0.0	0.0 – 0.0
<i>Intravascular air embolism during stay</i>	0	3531	0.0	0.0 – 0.1	1	19147	0.0	0.0 – 0.0
<i>Incorrect non-OR procedure</i>	0	3531	0.0	0.0 – 0.1	0	19147	0.0	0.0 – 0.0
<i>Irretrievable loss of irreplaceable biologic specimen</i>	0	3531	0.0	0.0 – 0.1	2	19147	0.0	0.0 – 0.0
<i>Laceration or unintended puncture</i>	0	3531	0.0	0.0 – 0.0	2	19147	0.0	0.0 – 0.0
<i>Mechanical AE associated with central venous catheter</i>	1	644	0.2	0.0 – 0.9	6	2300	0.3	0.1 – 0.6
<i>Non-OR related burn or electric shock events</i>	1	3531	0.0	0.0 – 0.2	0	19147	0.0	0.0 – 0.0
<i>Patient attempted suicide</i>	0	3531	0.0	0.0 – 0.1	1	19147	0.0	0.0 – 0.0
<i>Patient elopement</i>	1	3531	0.0	0.0 – 0.2	4	19147	0.0	0.0 – 0.1
<i>Patient harmed from accident associated with bedrails (other than fall)</i>	0	3531	0.0	0.0 – 0.1	1	19147	0.0	0.0 – 0.0
<i>Patient harmed from use of physical restraint (other than bedrails)</i>	0	3531	0.0	0.0 – 0.1	0	19147	0.0	0.0 – 0.0
<i>Unintended arterial puncture</i>	2	403	0.5	0.1 – 1.8	14	1985	0.7	0.4 – 1.2
<i>Unintended iatrogenic pneumothorax</i>	0	3531	0.0	0.0 – 0.0	1	19147	0.0	0.0 – 0.0

**Table 5A. 2021 Adverse Events by Sex**

	Female				Male			
<b>Adverse Event</b>	<b>Hospitalizations With AE</b>	<b>Pop. At Risk</b>	<b>AE Rate (%)</b>	<b>95% CI</b>	<b>Hospitalizations With AE</b>	<b>Pop. At Risk</b>	<b>AE Rate (%)</b>	<b>95% CI</b>
<b>Birth – Maternal</b>	1	20	5.0	0.9 – 23.6	-	-	-	-
<b>Blood or Blood Product</b>	20	1375	1.5	0.9 – 2.2	17	1228	1.4	0.9 – 2.2
<b>Fall</b>	54	12307	0.4	0.3 – 0.6	70	10371	0.7	0.5 – 0.9
<i>Unassisted Fall</i>	46	12307	0.4	0.3 – 0.5	59	10371	0.6	0.4 – 0.7
<i>Assisted Fall</i>	8	12307	0.1	0.0 – 0.1	11	10371	0.1	0.1 – 0.2



	Female				Male			
Adverse Event	Hospitaliza- tions With AE	Pop. At Risk	AE Rate (%)	95% CI	Hospitaliza- tions With AE	Pop. At Risk	AE Rate (%)	95% CI
<b>Hospital-Acquired Infections</b>								
<i>Catheter-associated urinary tract Infection</i>	11	2891	0.4	0.2 – 0.7	6	2602	0.2	0.1 – 0.5
<i>Clostridioides difficile Infection</i>	21	11015	0.2	0.1 – 0.3	24	9117	0.3	0.2 – 0.4
<i>Central line-associated bloodstream infection</i>	21	1181	1.8	1.2 – 2.7	16	1192	1.3	0.8 – 2.2
<i>Hospital-Acquired COVID-19</i>	6	718	0.8	0.4 – 1.8	2	756	0.3	0.1 – 1.0
<i>Hospital-Acquired Pneumonia (HAP)</i>	94	10874	0.9	0.7 – 1.0	94	8555	1.1	0.9 – 1.3
<i>Surgical Site Infection</i>	6	2208	0.3	0.1 – 0.6	1	1763	0.1	0.0 – 0.3
<i>Urinary Tract Infections</i>	12	11015	0.1	0.1 – 0.2	3	9117	0.0	0.0 – 0.1
<b>Medication AEs</b>								
<i>Anticoagulant Events</i>	57	6712	0.8	0.7 – 1.1	65	1.2	5652	0.9 – 1.5
<i>Intravenous unfractionated heparin Event</i>	29	795	3.6	2.6 – 5.2	39	843	4.6	3.4 – 6.3
<i>Warfarin Event</i>	3	428	0.7	0.2 – 2.0	6	472	1.3	0.6 – 2.7
<i>Low molecular weight heparin, thrombin inhibitor, or factor Xa inhibitor</i>	25	6094	0.4	0.3 – 0.6	20	4913	0.4	0.3 – 0.6
<i>Hypoglycemic Events</i>	169	3680	4.6	4.0 – 5.3	177	3704	4.8	4.1 – 5.5
<i>Opioid Events</i>	18	6746	0.3	0.2 – 0.4	22	5364	0.4	0.3 – 0.6
<i>Anaphylaxis</i>	1	12307	0.0	0.0 – 0.0	1	10371	0.0	0.0 – 0.1
<i>Potential overdoses</i>	1	12307	0.0	0.0 – 0.0	0	10371	0.0	0.0 – 0.0
<b>Pressure Injury/Ulcer (PI)</b>								
<i>New PI</i>	199	12307	1.6	1.4 – 1.9	207	10371	2.0	1.7 – 2.3
<i>Advancing PI or complication in PI Present on Admission</i>	46	1009	4.6	3.4 – 6.0	50	940	5.3	4.1 – 6.9
<b>Surgery or Anesthesia AE</b>	42	4382	1.0	0.7 – 1.3	37	3951	0.9	0.7 – 1.3

	Female				Male			
Adverse Event	Hospitalizations With AE	Pop. At Risk	AE Rate (%)	95% CI	Hospitalizations With AE	Pop. At Risk	AE Rate (%)	95% CI
<b>Venous Thromboembolism (VTE)</b>	29	11746	0.3	0.2 – 0.4	36	9903	0.4	0.3 – 0.5
<i>Deep vein thrombosis (DVT) without pulmonary embolism (PE)</i>	21	11746	0.2	0.1 – 0.3	21	9903	0.2	0.1 – 0.3
<i>Pulmonary embolism without DVT</i>	7	11746	0.1	0.0 – 0.1	13	9903	0.1	0.1 – 0.2
<i>Both DVT and PE developed during stay</i>	1	11746	0.0	0.0 – 0.0	2	9903	0.0	0.0 – 0.1
<b>Other AEs</b>								
<i>AE attributed to failure to communicate laboratory, pathology, imaging, and physiologic test results</i>	0	12307	0.0	0.0 – 0.0	0	10371	0.0	0.0 – 0.0
<i>AE due to the receipt of wrong, contaminated, or no anesthesia gas</i>	0	12307	0.0	0.0 – 0.0	0	10371	0.0	0.0 – 0.0
<i>AE related to a radiologic or imaging study</i>	1	12307	0.0	0.0 – 0.0	0	10371	0.0	0.0 – 0.0
<i>Incorrect non-OR procedure</i>	0	12307	0.0	0.0 – 0.0	0	10371	0.0	0.0 – 0.0
<i>Intravascular air embolism during stay</i>	0	12307	0.0	0.0 – 0.0	1	10371	0.0	0.0 – 0.1
<i>Irretrievable loss of irreplaceable biologic specimen</i>	2	12307	0.0	0.0 – 0.1	0	10371	0.0	0.0 – 0.0
<i>Laceration or unintended puncture</i>	1	12307	0.0	0.0 – 0.1	1	10371	0.0	0.0 – 0.1
<i>Mechanical AE associated with central venous catheter</i>	5	1469	0.3	0.1 – 0.8	2	1475	0.1	0.0 – 0.5
<i>Non-OR related burn or electric shock events</i>	1	12307	0.0	0.0 – 0.0	0	10371	0.0	0.0 – 0.0

	Female				Male			
Adverse Event	Hospitalizations With AE	Pop. At Risk	AE Rate (%)	95% CI	Hospitalizations With AE	Pop. At Risk	AE Rate (%)	95% CI
<i>Patient attempted suicide</i>	1	12307	0.0	0.0 – 0.0	0	10371	0.0	0.0 – 0.0
<i>Patient elopement</i>	2	12307	0.0	0.0 – 0.1	3	10371	0.0	0.0 – 0.1
<i>Patient harmed from accident associated with bedrails (other than fall)</i>	1	12307	0.0	0.0 – 0.0	0	10371	0.0	0.0 – 0.0
<i>Patient harmed from use of physical restraint (other than bedrails)</i>	0	12307	0.0	0.0 – 0.0	0	10371	0.0	0.0 – 0.0
<i>Unintended arterial puncture</i>	9	1113	0.8	0.4 – 1.5	7	1275	0.5	0.3 – 1.1
<i>Unintended iatrogenic pneumothorax</i>	0	12307	0.0	0.0 – 0.0	1	10371	0.0	0.0 – 0.1

**Table 6A. 2022 Adverse Events by Age Groups**

Adverse Event	18-64				65 and Older			
	Hospitalizations With AE	Pop. At Risk	AE Rate (%)	95% CI	Hospitalizations With AE	Pop. At Risk	AE Rate (%)	95% CI
<b>Birth – Maternal</b>	0	20	0.0	0.0 – 16.1	-	-	-	-
<b>Blood or Blood Product</b>	2	379	0.5	0.1 – 1.9	13	2304	0.6	0.3 – 1.0
<b>Fall</b>	15	3863	0.4	0.2 – 0.6	117	22428	0.5	0.4 – 0.6
<i>Unassisted Fall</i>	14	3863	0.4	0.2 – 0.6	103	22428	0.5	0.4 – 0.6
<i>Assisted Fall</i>	1	3863	0.0	0.0 – 0.1	14	22428	0.1	0.0 – 0.1
<b>Hospital-Acquired Infections</b>								
<i>Catheter-associated urinary tract Infection</i>	5	549	0.9	0.4 – 2.1	5	3662	0.1	0.1 – 0.3
<i>Clostridioides difficile Infection</i>	12	3442	0.3	0.2 – 0.6	47	19881	0.2	0.2 – 0.3
<i>Central line-associated bloodstream infection</i>	11	499	2.2	1.2 – 3.9	25	1807	1.4	0.9 – 2.0
<i>Hospital-Acquired COVID-19</i>	0	355	0.0	0.0 – 1.1	15	1354	1.1	0.7 – 1.8

Adverse Event	18-64				65 and Older			
	Hospitalizations With AE	Pop. At Risk	AE Rate (%)	95% CI	Hospitalizations With AE	Pop. At Risk	AE Rate (%)	95% CI
<i>Hospital-Acquired Pneumonia (HAP)</i>	24	3487	0.7	0.4 – 1.0	138	19396	0.7	0.6 – 0.8
<i>Surgical Site Infection</i>	2	709	0.3	0.1 – 1.0	7	3965	0.2	0.1 – 0.4
<i>Urinary Tract Infections</i>	4	3442	0.1	0.0 – 0.3	24	19881	0.1	0.1 – 0.2
<b>Medication AEs</b>								
<i>Anticoagulant Events</i>	11	1897	0.6	0.3 – 1.1	92	12246	0.8	0.6 – 0.9
<i>Intravenous unfractionated heparin Event</i>	6	252	2.4	1.1 – 5.1	49	1607	3.0	2.3 – 4.0
<i>Warfarin Event</i>	1	99	1.0	0.2 – 5.5	6	758	0.8	0.4 – 1.7
<i>Low molecular weight heparin, thrombin inhibitor, or factor Xa inhibitor</i>	4	1729	0.2	0.1 – 0.6	37	10968	0.3	0.2 – 0.5
<i>Hypoglycemic Events</i>	80	1518	5.3	4.3 – 6.5	319	6920	4.6	4.1 – 5.1
<i>Opioid Events</i>	8	2375	0.3	0.2 – 0.7	32	11201	0.3	0.2 – 0.4
<i>Anaphylaxis</i>	1	3863	0.0	0.0 – 0.1	0	22428	0.0	0.0 – 0.0
<i>Potential overdoses</i>	0	3863	0.0	0.0 – 0.1	0	22428	0.0	0.0 – 0.0
<b>Pressure Injury/Ulcer (PI)</b>								
<i>New PI</i>	61	3863	1.6	1.2 – 2.2	373	22428	1.7	1.5 – 1.8
<i>Advancing PI or complication in PI Present on Admission</i>	42	313	13.4	10.1 – 17.6	82	1749	4.7	3.8 – 5.8
<b>Surgery or Anesthesia AE</b>	16	1432	1.1	0.7 – 1.8	61	7919	0.8	0.6 – 1.0
<b>Venous Thromboembolism (VTE)</b>	14	3719	0.4	0.2 – 0.6	55	21670	0.3	0.2 – 0.3
<i>Deep vein thrombosis (DVT) without pulmonary embolism (PE)</i>	8	3719	0.2	0.1 – 0.4	41	21670	0.2	0.1 – 0.3
<i>Pulmonary embolism without DVT</i>	6	3719	0.2	0.1 – 0.3	10	21670	0.1	0.0 – 0.1

Adverse Event	18-64				65 and Older			
	Hospitalizations With AE	Pop. At Risk	AE Rate (%)	95% CI	Hospitalizations With AE	Pop. At Risk	AE Rate (%)	95% CI
<i>Both DVT and PE developed during stay</i>	0	3719	0.0	0.0 – 0.1	4	21670	0.0	0.0 – 0.1
<b>Other AEs</b>								
<i>AE attributed to failure to communicate laboratory, pathology, imaging, and physiologic test results</i>	0	3863	0.0	0.0 – 0.1	1	22428	0.0	0.0 – 0.0
<i>AE due to the receipt of wrong, contaminated, or no anesthesia gas</i>	1	3863	0.0	0.0 – 0.1	0	22428	0.0	0.0 – 0.0
<i>AE related to a radiologic or imaging study</i>	0	3863	0.0	0.0 – 0.1	0	22428	0.0	0.0 – 0.0
<i>Incorrect non-OR procedure</i>	1	3863	0.0	0.0 – 0.2	0	22428	0.0	0.0 – 0.0
<i>Intravascular air embolism during stay</i>	0	3863	0.0	0.0 – 0.1	1	22428	0.0	0.0 – 0.0
<i>Irretrievable loss of irreplaceable biologic specimen</i>	0	3863	0.0	0.0 – 0.1	0	22428	0.0	0.0 – 0.0
<i>Laceration or unintended puncture</i>	0	3863	0.0	0.0 – 0.1	1	22428	0.0	0.0 – 0.0
<i>Mechanical AE associated with central venous catheter</i>	0	619	0.0	0.0 – 0.6	7	2249	0.3	0.2 – 0.6
<i>Non-OR related burn or electric shock events</i>	0	3863	0.0	0.0 – 0.1	0	22428	0.0	0.0 – 0.0
<i>Patient attempted suicide</i>	0	3863	0.0	0.0 – 0.1	0	22428	0.0	0.0 – 0.0
<i>Patient elopement</i>	3	3863	0.1	0.0 – 0.2	5	22428	0.0	0.0 – 0.1
<i>Patient harmed from accident associated with bedrails (other than fall)</i>	1	3863	0.0	0.0 – 0.1	1	22428	0.0	0.0 – 0.0

Adverse Event	18-64				65 and Older			
	Hospitalizations With AE	Pop. At Risk	AE Rate (%)	95% CI	Hospitalizations With AE	Pop. At Risk	AE Rate (%)	95% CI
<i>Patient harmed from use of physical restraint (other than bedrails)</i>	0	3863	0.0	0.0 – 0.1	1	22428	0.0	0.0 – 0.0
<i>Unintended arterial puncture</i>	1	413	0.2	0.0 – 1.4	12	2073	0.6	0.3 – 1.0
<i>Unintended iatrogenic pneumothorax</i>	0	3863	0.0	0.0 – 0.1	3	22428	0.0	0.0 – 0.0

**Table 7A. 2022 Adverse Events by Sex**

Adverse Event	Female				Male			
	Hospitalizations With AE	Pop. At Risk	AE Rate (%)	95% CI	Hospitalizations With AE	Pop. At Risk	AE Rate (%)	95% CI
<b>Birth – Maternal</b>	0	20	0.0	0.0 – 16.1	-	-	-	-
<b>Blood or Blood Product</b>	8	1450	0.6	0.3 – 1.1	7	1233	0.6	0.3 – 1.2
<b>Fall</b>	64	14221	0.5	0.4 – 0.6	68	12070	0.6	0.4 – 0.7
<i>Unassisted Fall</i>	58	14221	0.4	0.3 – 0.5	59	12070	0.5	0.4 – 0.6
<i>Assisted Fall</i>	6	14221	0.0	0.0 – 0.1	9	12070	0.1	0.0 – 0.1
<b>Hospital-Acquired Infections</b>								
<i>Catheter-associated urinary tract Infection</i>	8	2190	0.4	0.2 – 0.7	2	2021	0.1	0.0 – 0.4
<i>Clostridioides difficile Infection</i>	34	12683	0.3	0.2 – 0.4	25	10640	0.2	0.2 – 0.3
<i>Central line-associated bloodstream infection</i>	21	1187	1.8	1.2 – 2.7	15	1119	1.3	0.8 – 2.2
<i>Hospital-Acquired COVID-19</i>	6	834	0.7	0.3 – 1.6	9	875	1.0	0.5 – 1.9
<i>Hospital-Acquired Pneumonia (HAP)</i>	88	12467	0.7	0.6 – 0.9	74	10416	0.7	0.5 – 0.9
<i>Surgical Site Infection</i>	3	2447	0.1	0.0 – 0.4	6	2227	0.3	0.1 – 0.6
<i>Urinary Tract Infections</i>	17	12683	0.1	0.1 – 0.2	11	10640	0.1	0.1 – 0.2
<b>Medication AEs</b>								
<i>Anticoagulant Events</i>	55	7773	0.7	0.5 – 0.9	48	6370	0.8	0.6 – 1.0

	Female				Male			
Adverse Event	Hospitalizations With AE	Pop. At Risk	AE Rate (%)	95% CI	Hospitalizations With AE	Pop. At Risk	AE Rate (%)	95% CI
<i>Intravenous unfractionated heparin Event</i>	29	910	3.2	2.2 – 4.5	26	949	2.7	1.9 – 4.0
<i>Warfarin Event</i>	5	412	1.2	0.5 – 2.8	2	445	0.5	0.1 – 1.6
<i>Low molecular weight heparin, thrombin inhibitor, or factor Xa inhibitor</i>	21	7099	0.3	0.2 – 0.5	20	5598	0.4	0.2 – 0.6
<i>Hypoglycemic Events</i>	197	4183	4.7	4.1 – 5.4	202	4255	4.7	4.1 – 5.4
<i>Opioid Events</i>	21	7491	0.3	0.2 – 0.4	19	6085	0.3	0.2 – 0.5
<i>Anaphylaxis</i>	0	14221	0.0	0.0 – 0.0	1	12070	0.0	0.0 – 0.0
<i>Potential overdoses</i>	0	14221	0.0	0.0 – 0.0	0	12070	0.0	0.0 – 0.0
<b>Pressure Injury/Ulcer (PI)</b>								
<i>New PI</i>	222	14221	1.6	1.4 – 1.8	212	12070	1.8	1.5 – 2.0
<i>Advancing PI or complication in PI Present on Admission</i>	52	1066	4.9	3.7 – 6.3	72	996	7.2	5.8 – 9.0
<b>Surgery or Anesthesia AE</b>	34	4764	0.7	0.5 – 1.0	43	4587	0.9	0.7 – 1.3
<b>Venous Thromboembolism (VTE)</b>	40	13754	0.3	0.2 – 0.4	29	11635	0.3	0.2 – 0.4
<i>Deep vein thrombosis (DVT) without pulmonary embolism (PE)</i>	28	13754	0.2	0.1 – 0.3	21	11635	0.2	0.1 – 0.3
<i>Pulmonary embolism without DVT</i>	10	13754	0.1	0.0 – 0.1	6	11635	0.1	0.0 – 0.1
<i>Both DVT and PE developed during stay</i>	2	13754	0.0	0.0 – 0.1	2	11635	0.0	0.0 – 0.1
<b>Other AEs</b>								
<i>AE attributed to failure to communicate laboratory, pathology, imaging, and physiologic test results</i>	0	14221	0.0	0.0 – 0.0	1	12070	0.0	0.0 – 0.0

	Female				Male			
<b>Adverse Event</b>	<b>Hospitalizations With AE</b>	<b>Pop. At Risk</b>	<b>AE Rate (%)</b>	<b>95% CI</b>	<b>Hospitalizations With AE</b>	<b>Pop. At Risk</b>	<b>AE Rate (%)</b>	<b>95% CI</b>
<i>AE due to the receipt of wrong, contaminated, or no anesthesia gas</i>	1	14221	0.0	0.0 – 0.0	0	12070	0.0	0.0 – 0.0
<i>AE related to a radiologic or imaging study</i>	0	14221	0.0	0.0 – 0.0	0	12070	0.0	0.0 – 0.0
<i>Incorrect non-OR procedure</i>	1	14221	0.0	0.0 – 0.0	0	12070	0.0	0.0 – 0.0
<i>Intravascular air embolism during stay</i>	1	14221	0.0	0.0 – 0.0	0	12070	0.0	0.0 – 0.0
<i>Irretrievable loss of irreplaceable biologic specimen</i>	0	14221	0.0	0.0 – 0.0	0	12070	0.0	0.0 – 0.0
<i>Laceration or unintended puncture</i>	1	14221	0.0	0.0 – 0.0	0	12070	0.0	0.0 – 0.0
<i>Mechanical AE associated with central venous catheter</i>	4	1460	0.3	0.1 – 0.7	3	1408	0.2	0.1 – 0.6
<i>Non-OR related burn or electric shock events</i>	0	14221	0.0	0.0 – 0.0	0	12070	0.0	0.0 – 0.0
<i>Patient attempted suicide</i>	0	14221	0.0	0.0 – 0.0	0	12070	0.0	0.0 – 0.0
<i>Patient elopement</i>	0	14221	0.0	0.0 – 0.0	8	12070	0.1	0.0 – 0.1
<i>Patient harmed from accident associated with bedrails (other than fall)</i>	0	14221	0.0	0.0 – 0.0	2	12070	0.0	0.0 – 0.1
<i>Patient harmed from use of physical restraint (other than bedrails)</i>	0	14221	0.0	0.0 – 0.0	1	12070	0.0	0.0 – 0.0
<i>Unintended arterial puncture</i>	7	1187	0.6	0.3 – 1.2	6	1299	0.5	0.0 – 1.0
<i>Unintended iatrogenic pneumothorax</i>	2	14221	0.0	0.0 – 0.1	1	12070	0.0	0.0 – 0.1



**Table 8A. Comparison of 2021 and 2022 Critical Access Hospitals Composite AE Rates, Observed and Weighted Data**

	Observed – Patients With At Least One AE During Hospitalization		Weighted – Patients With At Least One AE During Hospitalization		Observed – N AEs Per 1,000 Discharges		Weighted – N AEs Per 1,000 Discharges	
	Rate (%)	95% CI	Rate (%)	95% CI	N per 1,000 Discharges	95% CI	N per 1,000 Discharges	95% CI
2021	3.3	2.8 – 3.9	3.4	2.7 – 4.0	36.7	31.5 – 42.8	36.9	29.9 – 44.0
2022	3.2	2.8 – 3.7	3.1	2.7 – 3.6	35.0	30.3 – 40.4	34.4	28.8 – 40.0
Change	-0.1		-0.3		-1.7		-2.5	

**Table 9A. Comparison of 2021 and 2022 Rural Hospitals Composite AE Rates, Observed and Weighted Data**

	Observed – Patients With At Least One AE During Hospitalization		Weighted – Patients With At Least One AE During Hospitalization		Observed – N AEs Per 1,000 Discharges		Weighted – N AEs Per 1,000 Discharges	
	Rate (%)	95% CI	Rate (%)	95% CI	N per 1,000 Discharges	95% CI	N per 1,000 Discharges	95% CI
2021	6.2	5.5 – 6.9	6.2	5.5 – 6.9	70.0	63.1 – 77.8	70.3	62.3 – 78.2
2022	5.3	4.7 – 5.9	5.3	4.7 – 5.9	61.2	54.8 – 68.3	61.3	53.9 – 68.8
Change	-0.9		-0.9		-8.8		-9.0	

**Table 10A. Comparison of 2021 and 2022 Targeted Urban Hospitals Composite AE Rates, Observed and Weighted Data**

	Observed – Patients With At Least One AE During Hospitalization		Weighted – Patients With At Least One AE During Hospitalization		Observed – N AEs Per 1,000 Discharges		Weighted – N AEs Per 1,000 Discharges	
	Rate (%)	95% CI	Rate (%)	95% CI	N per 1,000 Discharges	95% CI	N per 1,000 Discharges	95% CI
2021	8.1	7.4 – 8.9	8.5	7.2 – 9.7	96.3	88.0 – 105.4	104.2	86.1 – 122.2
2022	7.2	6.6 – 7.8	7.2	6.6 – 7.9	87.0	80.5 – 94.1	87.6	79.3 – 96.0
Change	-0.9		-1.3		-9.3		-16.6	

**Table 11A. Comparison of 2021 and 2022 Other Hospitals AE Rates, Observed and Weighted Data**

	Observed – Patients With At Least One AE During Hospitalization		Weighted – Patients With At Least One AE During Hospitalization		Observed – N AEs Per 1,000 Discharges		Weighted – N AEs Per 1,000 Discharges	
	Rate (%)	95% CI	Rate (%)	95% CI	N per 1,000 Discharges	95% CI	N per 1,000 Discharges	95% CI
2021	7.1	6.6 – 7.7	7.1	6.5 – 7.7	82.8	76.8 – 89.2	83.0	75.6 – 90.4
2022	6.3	5.8 – 6.8	6.3	5.7 – 6.8	71.6	66.1 – 77.5	71.2	64.8 – 77.7
Change	-0.8		-0.8		-11.2		-11.8	

**Table 12A. Comparison of AE Rates for 2021 and 2022**

Adverse Event	2021				2022				Change in Rates
	Hospitalizations With AE	Pop. At Risk	AE Rate (%)	95% CI	Hospitalizations With AE	Pop. At Risk	AE Rate (%)	95% CI	(%)
<b>Birth – Maternal</b>	1	20	5.0	0.9 – 23.6	0	20	0	0.0 – 16.1	-5.0
Blood or Blood Product	37	2603	1.4	1.0 – 2.0	15	2683	0.6	0.3 – 0.9	-0.8
<b>Fall</b>	124	22678	0.5	0.5 – 0.7	132	26291	0.5	0.4 – 0.6	0.0
Unassisted Fall	105	22678	0.5	0.4 – 0.6	117	26291	0.4	0.4 – 0.5	-0.1
Assisted Fall	19	22678	0.1	0.1 – 0.1	15	26291	0.1	0.0 – 0.1	0.0
<b>Hospital-Acquired Infections</b>									
Catheter- associated urinary tract Infection	17	5493	0.3	0.2 – 0.5	10	4211	0.2	0.1 – 0.4	-0.1
Clostridioides difficile Infection	45	20132	0.2	0.2 – 0.3	59	23323	0.3	0.2 – 0.3	0.1
Central line- associated bloodstream infection	37	2373	1.6	1.1 – 2.1	36	2306	1.6	1.1 – 1.2	0.0
Hospital-Acquired COVID-19	8	1474	0.5	0.3 – 1.1	15	1709	0.9	0.5 – 1.4	0.4
Hospital-Acquired Pneumonia (HAP)	188	19429	1.0	0.8 – 1.1	162	22883	0.7	0.6 – 0.8	-0.3
Surgical Site Infection	7	3971	0.2	0.1 – 0.4	9	4674	0.2	0.1 – 0.4	0.0
Urinary Tract Infections	15	20132	0.1	0.0 – 0.1	28	23323	0.1	0.1 – 0.2	0.0
<b>Medication AEs</b>									
Anticoagulant Events	122	12364	1.0	0.8 – 1.2	103	14143	0.7	0.6 – 0.9	-0.3
Intravenous unfractionated heparin Event	68	1638	4.2	3.3 – 5.2	55	1859	3.0	2.3 – 3.8	-1.2

	2021				2022				Change in Rates
Adverse Event	Hospi- taliza- tions With AE	Pop. At Risk	AE Rate (%)	95% CI	Hospi- taliza- tions With AE	Pop. At Risk	AE Rate (%)	95% CI	(%)
<i>Warfarin Event</i>	9	900	1.0	0.5 – 1.9	7	857	0.8	0.4 – 1.7	-0.2
<i>Low molecular weight heparin, thrombin inhibitor, or factor Xa inhibitor</i>	45	11007	0.4	0.3 – 0.5	41	12697	0.3	0.2 – 0.4	-0.1
<i>Hypoglycemic Events</i>	346	7384	4.7	4.2 – 5.2	399	8438	4.7	4.3 – 5.2	0.0
<i>Opioid Events</i>	40	12110	0.3	0.2 – 0.4	40	13576	0.3	0.2 – 0.4	0.0
<i>Anaphylaxis</i>	2	22678	0.0	0.0 – 0.0	1	26291	0.0	0.0 – 0.0	0.0
<i>Potential overdoses</i>	1	22678	0.0	0.0 – 0.0	0	26291	0.0	0.0 – 0.0	0.0
<b>Pressure Injury/Ulcer (PI)</b>									
<i>New PI</i>	406	22678	1.8	1.6 – 2.0	434	26291	1.7	1.5 – 1.8	-0.1
<i>Advancing PI or complication in PI Present on Admission</i>	96	1949	4.9	4.1 – 6.0	124	2062	6.0	5.1 – 7.1	1.1
<b>Surgery or Anesthesia AE</b>	79	8333	0.9	0.8 – 1.2	77	9351	0.8	0.7 – 1.0	0.1
<b>Venous Thromboembolism (VTE)</b>	65	21649	0.3	0.2 – 0.4	69	25389	0.3	0.2 – 0.4	0.0
<i>Deep vein thrombosis (DVT) without pulmonary embolism (PE)</i>	42	21649	0.2	0.1 – 0.3	49	25389	0.2	0.1 – 0.3	0.0
<i>Pulmonary embolism without DVT</i>	20	21649	0.1	0.1 – 0.1	16	25389	0.1	0.0 – 0.1	0.0
<i>Both DVT and PE developed during stay</i>	3	21649	0.0	0.0 – 0.0	4	25389	0.0	0.0 – 0.0	0.0
<b>Other AEs</b>									
<i>AE attributed to failure to communicate laboratory, pathology, imaging, and physiologic test results</i>	0	22678	0.0	0.0 – 0.0	1	26291	0.0	0.0 – 0.0	0.0

	2021				2022				Change in Rates
Adverse Event	Hospi- taliza- tions With AE	Pop. At Risk	AE Rate (%)	95% CI	Hospi- taliza- tions With AE	Pop. At Risk	AE Rate (%)	95% CI	(%)
<i>AE due to the receipt of wrong, contaminated, or no anesthesia gas</i>	0	22678	0.0	0.0 – 0.0	0	26291	0.0	0.0 – 0.0	0.0
<i>AE related to a radiologic or imaging study</i>	1	22678	0.0	0.0 – 0.0	0	26291	0.0	0.0 – 0.0	0.0
<i>Incorrect non-OR procedure</i>	0	22678	0.0	0.0 – 0.0	1	26291	0.0	0.0 – 0.0	0.0
<i>Intravascular air embolism during stay</i>	1	22678	0.0	0.0 – 0.0	1	26291	0.0	0.0 – 0.0	0.0
<i>Irretrievable loss of irreplaceable biologic specimen</i>	2	22678	0.0	0.0 – 0.0	0	26291	0.0	0.0 – 0.0	0.0
<i>Laceration or unintended puncture</i>	2	22678	0.0	0.0 – 0.0	1	26291	0.0	0.0 – 0.0	0.0
<i>Mechanical AE associated with central venous catheter</i>	7	2944	0.2	0.1 – 0.5	7	26291	0.2	0.1 – 0.5	0.0
<i>Non-OR related burn or electric shock events</i>	1	22678	0.0	0.0 – 0.0	0	26291	0.0	0.0 – 0.0	0.0
<i>Patient attempted suicide</i>	1	22678	0.0	0.0 – 0.0	0	26291	0.0	0.0 – 0.0	0.0
<i>Patient elopement</i>	5	22678	0.0	0.0 – 0.1	8	26291	0.0	0.0 – 0.1	0.0
<i>Patient harmed from accident associated with bedrails (other than fall)</i>	1	22678	0.0	0.0 – 0.0	2	26291	0.0	0.0 – 0.0	0.0
<i>Patient harmed from use of physical restraint (other than bedrails)</i>	0	22678	0.0	0.0 – 0.0	1	26291	0.0	0.0 – 0.0	0.0
<i>Unintended arterial puncture</i>	16	2388	0.7	0.4 – 1.1	13	2486	0.5	0.3 – 0.9	0.2
<i>Unintended iatrogenic pneumothorax</i>	1	22678	0.0	0.0 – 0.0	3	26291	0.0	0.0 – 0.0	0.0

**Table 13A. Death Rate 2021 and 2022**

<b>Cohort</b>	<b>2021 Death Rate (%)</b>	<b>95% CI</b>	<b>2022 Death Rate (%)</b>	<b>95% CI</b>	<b>Change</b>
TARGETED URBAN	4.9	4.4 – 5.6	5.0	4.5 – 5.5	0.1
RURAL	4.6	4.0 – 5.2	4.1	3.6 – 4.7	-0.5
OTHER	4.1	3.7 – 4.6	3.7	3.3 – 4.1	-0.4
CRITICAL ACCESS	4.0	3.5 – 4.6	3.3	2.8 – 3.8	-0.7
All Above	4.4	4.2 – 4.7	4.1	3.8 – 4.3	-0.3



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