

Overview of Methicillin-Resistant *Staphylococcus aureus* (MRSA)-Related Adult Inpatient Stays, 2016–2021

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Introduction

Methicillin-resistant *Staphylococcus aureus* (MRSA) is resistant to almost all antibiotics in the beta-lactam class, including penicillin, methicillin, amoxicillin, and oxacillin. Due to MRSA's resistance, MRSA infections can be very difficult to treat. *S.aureus*, with or without methicillin resistance, is a common bacterium found in both healthcare settings and the community. MRSA infections can especially affect hospitalized patients, particularly those who have undergone surgery or have weakened immune systems, but they also increasingly affect healthy individuals who have not been hospitalized.^{1,2}

Data from the Centers for Disease Control and Prevention's National Healthcare Safety Network (NHSN) show that the incidence of healthcare-associated MRSA bacteremia increased following the onset of the COVID-19 pandemic.^{2,3}

This HCUP Statistical Brief presents statistics on adult inpatient stays involving MRSA in non-Federal acute care hospitals, excluding rehabilitation and long-term acute care facilities, in 38 states¹ included in the HCUP State Inpatient Databases (SID) between 2016 and 2021. MRSA-related inpatient stays are presented in three categories: inpatient stays with MRSA infections that were present on admission (POA), inpatient stays with MRSA infections that were *not* present on admission (Not POA), and all inpatient stays with any MRSA infection (All). The statistics presented in this Statistical Brief include the number of MRSA-related inpatient stays, the rate of MRSA-related inpatient stays per 10,000 inpatient stays, and the percentage of MRSA-related stays by present on admission status. For years 2019 and 2021, outcomes are stratified by patient characteristics, including age group, sex, race and ethnicity, state of residence, urban/rural location of the patient's county of residence, expected payer, and social vulnerability of the patient's county. In addition, the ten most common diagnosis categories are reported for stays with a MRSA diagnosis, based on categorization by the Clinical Classifications Software Refined (CCSR)⁴ assigned for the principal diagnosis. Additional information on the clinical coding criteria for identifying MRSA and state-specific rates are included in the Methods and Appendix A.

Because the sample of HCUP SID discharges is large, small differences can be statistically significant but not clinically important. Thus, only differences greater than or equal to 10 percent are discussed in the text.

Highlights

- From 2016 to 2021, the rates of adult inpatient stays with MRSA infections declined by 10.9 percent.
- Rates of inpatient stays with MRSA infections that were present on admission decreased from 2016 to 2021. Rates of MRSA infections that were not present on admission decreased from 2016 to 2019 and then increased from 2019 to 2021.
- Patients from the most vulnerable communities and from rural areas had higher rates of inpatient stays with MRSA infections, whether they were present on admission or not, compared with patients from the least vulnerable and large metropolitan communities, respectively, in 2019 and 2021.
- Among 38 states with reliable diagnosis information on present on admission status, infection rates in 2019 ranged from 56.5 per 10,000 stays in Minnesota to 177.7 in West Virginia for MRSA present on admission and from 2.7 per 10,000 stays in Utah to 15.1 in Arkansas for MRSA not present on admission. The ranges were similar in 2021.
- Septicemia was the most common principal diagnosis category for inpatient stays with MRSA infections that were present on admission, accounting for almost one-third of stays with these infections (29.2 percent in 2019 and 32.0 percent in 2021).

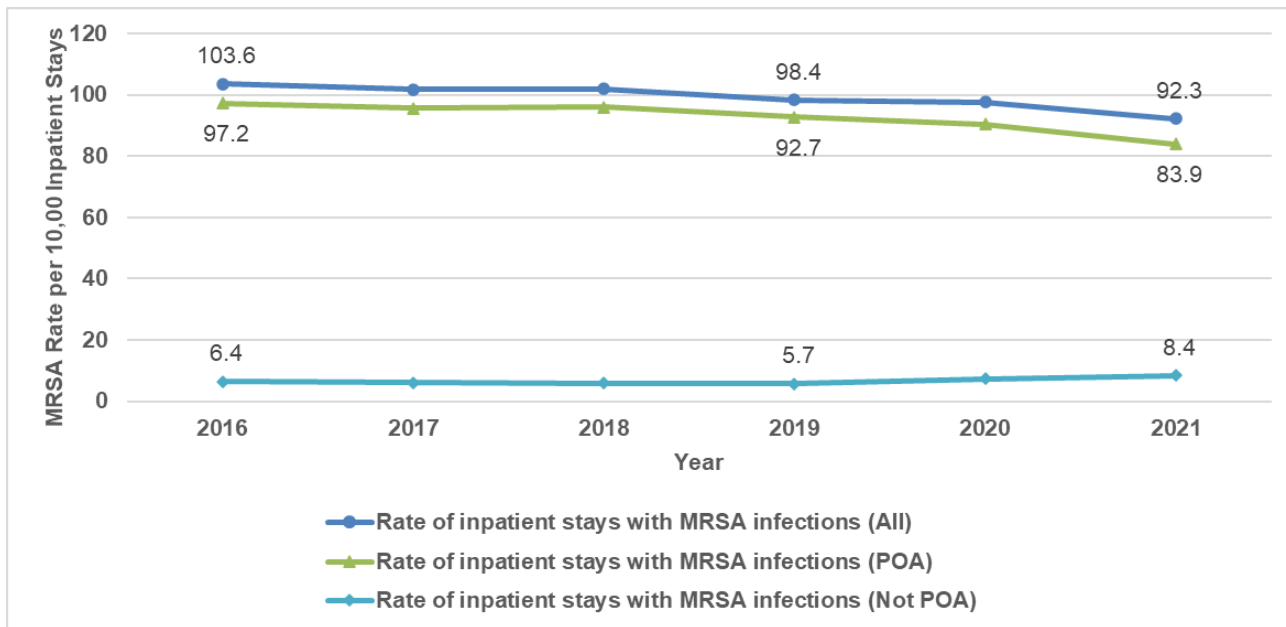
¹ The 38 states were selected based on reliable information on whether the diagnoses were present on admission (POA): Arizona, Arkansas, California, Florida, Georgia, Hawaii, Illinois, Indiana, Kansas, Kentucky, Louisiana, Massachusetts, Maine, Maryland, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, North Carolina, North Dakota, New Jersey, New Mexico, New York, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Utah, Virginia, Washington, West Virginia, and Wisconsin.

Findings

Trends in the Rate of Adult Inpatient Stays with Methicillin-Resistant *Staphylococcus aureus* (MRSA) Infections

Figure 1 presents trends from 2016 to 2021 across 38 states for rates of all adult inpatient stays with any MRSA infections, MRSA infections that were present on admission (POA) and MRSA infections that were *not* present on admission (Not POA).

Figure 1. Trends in the rate of MRSA-related inpatient stays per 10,000 adult inpatient stays, by present on admission status (whether the infections were present at the time of admission to the hospital), 2016–2021



Abbreviations: MRSA, methicillin-resistant *Staphylococcus aureus*; POA, present on admission.

Notes: Additional details are available in the Methods section. Appendix Table A.2 presents detailed rates.

Source: Agency for Healthcare Research and Quality (AHRQ), Healthcare Cost and Utilization Project (HCUP), State Inpatient Databases (SID), 2016–2021, 38 States.

- From 2016 to 2021, the rate of inpatient stays with MRSA infections declined by 10.8 percent overall, from 103.6 per 10,000 stays in 2016 to 92.3 in 2021.
- The change in the rate of inpatient stays with MRSA infections between 2016 and 2021 varied by whether MRSA was present on admission. The rate of inpatient stays with MRSA infections decreased by 13.7 percent for MRSA infections that were present on admission, from 97.2 per 10,000 stays in 2016 to 83.9 in 2021. However, the rate of MRSA infections that were *not* present on admission decreased by 10.9 percent, from 6.4 to 5.7 per 10,000 inpatient stays between 2016 and 2019 and then increased by 47.4 percent to 8.4 per 10,000 stays from 2019 to 2021.

Methicillin-Resistant Staphylococcus aureus (MRSA)-Related Adult Inpatient Stays by Patient Characteristics, 2019 and 2021

Table 1 presents the number and rate per 10,000 adult inpatient stays of MRSA infections, categorized by present on admission status (whether the infections were present at the time of admission to the hospital) and patient demographic characteristics, for 2019 and 2021 across 38 states. Patient characteristics include age group, sex, race and ethnicity, patient residence, social vulnerability of the patient's community, and expected payer.

Table 1. Number and rate of MRSA-related adult inpatient stays, by patient characteristics and present on admission status (whether the infections were present at the time of admission to the hospital), 2019 and 2021

Outcome and patient characteristics	Inpatient stays with MRSA infections (POA)					Inpatient stays with MRSA infections (Not POA)				
	Number of stays		Rate per 10,000 stays			Number of stays		Rate per 10,000 stays		
	2019	2021	2019	2021	Percent change	2019	2021	2019	2021	Percent change
Total stays										
	255,415	217,660	92.7	83.9	-9.5%	15,774	21,806	5.7	8.4	47.4%
Age, in years										
18-44	58,124	48,769	76.4	65.5	-14.3%	2,586	3,837	3.4	5.1	50.0%
45-64	91,928	80,452	119.4	112.8	-5.5%	5,654	8,465	7.3	11.9	63.0%
65-79	68,289	60,757	88.8	83.9	-5.5%	5,223	7,162	6.8	9.9	45.6%
80+	37,074	27,682	81.3	67.3	-17.2%	2,311	2,342	5.1	5.7	11.8%
Sex										
Female	107,857	88,462	68.6	60.8	-11.4%	6,542	8,671	4.2	6.0	42.9%
Male	147,536	129,158	124.6	113.5	-8.9%	9,228	13,129	7.8	11.5	47.4%
Race and ethnicity										
Asian, Pacific-Islander NH	4,243	3,665	54.2	48.1	-11.3%	300	481	3.8	6.3	65.8%
Black NH	35,332	30,580	84.0	75.9	-9.6%	2,772	3,835	6.6	9.5	43.9%
Hispanic	22,924	21,095	74.6	65.7	-11.9%	1,242	2,371	4.0	7.4	85.0%
White NH	179,451	150,552	100.3	92.2	-8.1%	10,458	13,596	5.8	8.3	43.1%
Other NH ¹	8,131	6,821	83.6	73.8	-11.7%	530	840	5.4	9.1	68.5%
Patient residence										
Large metropolitan	126,734	106,349	84.1	74.5	-11.4%	7,700	10,804	5.1	7.6	49.0%
Medium and small metropolitan	79,959	69,118	98.6	90.8	-7.9%	5,091	6,894	6.3	9.1	44.4%
Micropolitan	26,470	22,523	108.5	100.8	-7.1%	1,441	2,177	5.9	9.7	64.4%
Rural	18,678	15,504	105.7	97.0	-8.2%	1,403	1,710	7.9	10.7	35.4%
Community social vulnerability²										

Outcome and patient characteristics	Inpatient stays with MRSA infections (POA)					Inpatient stays with MRSA infections (Not POA)				
	Number of stays		Rate per 10,000 stays			Number of stays		Rate per 10,000 stays		
	2019	2021	2019	2021	Percent change	2019	2021	2019	2021	Percent change
Most vulnerable (top 25 percent)	66,972	54,226	97.4	83.4	-14.4%	4,537	6,141	6.6	9.4	42.4%
Somewhat vulnerable	133,676	113,793	97.3	88.8	-8.7%	7,879	11,094	5.7	8.7	52.6%
Least vulnerable (bottom 25 percent)	54,179	47,656	78.7	73.3	-6.9%	3,321	4,447	4.8	6.8	41.7%
Expected primary payer										
Medicare	133,957	109,453	101.2	92.0	-9.1%	8,856	10,746	6.7	9.0	34.3%
Medicaid	56,791	53,158	114.3	107.0	-6.4%	3,167	4,729	6.4	9.5	48.4%
Private	40,372	34,624	55.8	49.4	-11.5%	2,514	4,541	3.5	6.5	85.7%
Self-pay / no charge ³	16,790	13,266	130.1	114.1	-12.3%	631	911	4.9	7.8	59.2%
Other	7,226	6,837	90.3	81.0	-10.3%	577	846	7.2	10.0	38.9%

Abbreviations: MRSA, methicillin-resistant *Staphylococcus aureus*; POA, present on admission; NH, non-Hispanic.

Notes: ¹Other NH race and ethnicity category includes both non-Hispanic American Indian and Alaska Native and individuals from other non-Hispanic groups. ²The CDC/ATSDR Social Vulnerability Index 2018 was used to classify MRSA-related inpatient stays in 2019, and the CDC/ATSDR Social Vulnerability Index 2020 was used to classify MRSA-related inpatient stays in 2020, based on patients' county level data. ³Self-pay / no charge includes self-pay, no charge, charity, and no expected payment. The sum of discharges for each category may not equal the total number of stays due to missing information. Additional details are available in the Methods section.

Source: Agency for Healthcare Research and Quality (AHRQ), Healthcare Cost and Utilization Project (HCUP), State Inpatient Databases (SID), 2019 and 2021, 38 states.

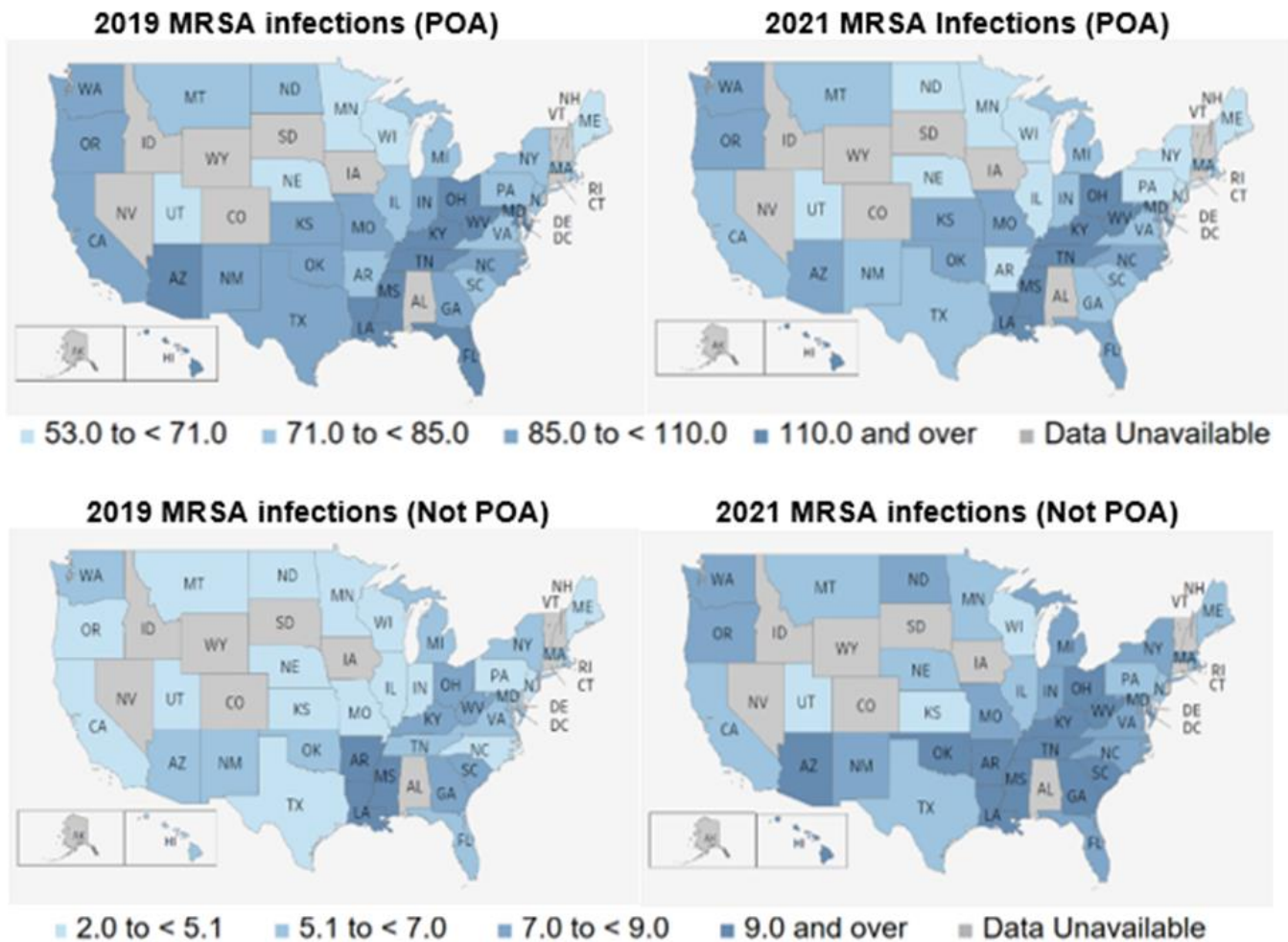
- Patients aged 45–64 years had the highest rate of inpatient stays with MRSA infections that were present on admission in 2019 and 2021 compared with patients in all other age groups (119.4 vs. 76.4 to 88.8 per 10,000 stays in 2019 and 112.8 vs. 65.5 to 83.9 in 2021). Patients aged 45–64 years followed by those aged 65–79 years had the highest rates of inpatient stays with MRSA infections that were *not* present on admission, compared with patients in other age groups (7.3 and 6.8 compared with 3.4 and 5.1 per 10,000 stays in 2019, 11.9 and 9.9 compared with 5.1 and 5.7 in 2021).
- In 2019 and 2021, male patients were 1.8 times as likely as female patients to have MRSA infections that were present on admission (124.6 per 10,000 stays in 2019 and 113.5 in 2021 vs. 68.6 and 60.8, respectively) and *not* present on admission (7.8 per 10,000 stays in 2019 and 11.5 in 2021 vs. 4.2 and 6.0, respectively).
- While the highest rate of inpatient stays with MRSA infections that were present on admission occurred among White Non-Hispanic patients (100.3 per 10,000 stays in 2019; 92.2 in 2021) compared with all other racial and ethnic groups, the highest rate of inpatient stays with MRSA infections that were *not* present on admission occurred among Black Non-Hispanic patients (6.6 per 10,000 stays in 2019 and 9.5 in 2021).
- The rate of inpatient stays with MRSA infections that were *not* present on admission increased among all racial and ethnic groups between 2019 and 2021, with the largest increase, by 85.0 percent, for Hispanic patients.
- In 2019 and 2021, patients from rural areas had higher rates of inpatient stays with MRSA infections, regardless of present on admission status, compared with patients from large metropolitan areas.
 - For MRSA infections that were present on admission, the rate among patients was 105.7 per 10,000 stays in rural areas vs. 84.1 in the large metropolitan areas in 2019, and 97.0 in rural areas vs. 74.5 in the large metropolitan areas in 2021.
 - For MRSA infections *not* present on admission, the rate among patients was 7.9 per 10,000 stays in rural areas vs. 5.1 in the large metropolitan areas in 2019 and 10.7 in rural areas vs. 7.6 in the large metropolitan areas in 2021.

- In 2019 and 2021, patients from the most vulnerable communities had higher rates of inpatient stays with MRSA infections, regardless of present on admission status, compared with patients from the least vulnerable communities (for POA: 97.4 per 10,000 stays vs. 78.7 in 2019 and 83.4 vs. 73.3 in 2021; and for *not* POA: 6.6 per 10,000 stays vs. 4.8 in 2019 and 9.4 vs. 6.8 in 2021).
- In 2019 and 2021, stays billed as self-pay or no charge (130.1 per 10,000 stays in 2019 and 114.1 in 2021) had the highest rate of MRSA infections that were present on admission, followed by patients with stays billed to Medicaid (114.3 per 10,000 stays in 2019 and 107.0 in 2021). Rates of stays with MRSA infections that were present on admission billed as self-pay or no charge and Medicaid were more than double the rate of stays billed to private insurance (55.8 per 10,000 stays in 2019 and 49.4 in 2021).

Geographic Variation in the Rate of Methicillin-Resistant *Staphylococcus aureus* (MRSA)-Related Adult Inpatient Stays, 2019 and 2021

Figure 2 presents the rate of MRSA infections per 10,000 adult inpatient stays across 38 states, categorized by present on admission status (whether the infections were present at the time of admission to the hospital), for 2019 and 2021. Rates are presented using gradient color coding based on quartiles of rates across both years of data, with light blue indicating lower rates and dark blue indicating higher rates. States with unavailable data are shaded in grey. Additional details on state-specific rates can be obtained from Appendix Table A.3.

Figure 2. Rate of MRSA-related inpatient stays per 10,000 adult inpatient stays, by state and present on admission status (whether the infections were present at the time of admission to the hospital), 2019 and 2021



Abbreviations: MRSA, methicillin-resistant *Staphylococcus aureus*; POA, present on admission.

Notes: States' rates are presented using gradient color coding. Light blue indicates lower rates, and dark blue indicates higher rates. Rates for 2019 and 2021 are divided into approximate quartiles based on the combined distribution for the two years. Additional details are available in the Methods section. Appendix Table A.3 presents state-specific rates.

Source: Agency for Healthcare Research and Quality (AHRQ), Healthcare Cost and Utilization Project (HCUP), State Inpatient Databases (SID), 2019 and 2021, 38 states.

- State-specific rates of inpatient stays with MRSA infections that were present on admission ranged from 56.5 per 10,000 stays in Minnesota to 177.7 in West Virginia in 2019, and from 53.5 in Utah to 179.5 in West Virginia in 2021.
- For inpatient stays with MRSA infections that were *not* present on admission, state-specific rates ranged from 2.7 per 10,000 stays in Utah to 15.1 in Arkansas in 2019, and from 4.3 in Wisconsin to 19.4 in Arkansas in 2021.

Leading Reasons for Methicillin-Resistant *Staphylococcus aureus* (MRSA)-Related Adult Inpatient Stays, 2019 and 2021

Table 2a and Table 2b present the ten most common principal diagnoses for adult inpatient stays with MRSA infections in 2019 and 2021. Table 2a includes stays in which the principal diagnosis is MRSA. The number and percentage of inpatient stays are shown, categorized by present on admission status (whether the infections were present at the time of admission to the hospital). These tables include the ranks of the leading principal diagnoses, allowing for a comparison of their prevalence and the changes in inpatient stays with MRSA infections between 2019 and 2021.

Table 2a. Most common principal diagnoses for adult inpatient stays with MRSA infections present on admission, 2019 and 2021

Top ten principal diagnoses (CCSR)	Inpatient stays with MRSA infections (POA)					
	2019			2021		
	Rank	Number of stays	Percentage of stays	Rank	Number of stays	Percentage of stays
Total stays		255,415			217,660	
Septicemia (INF002) ¹	1	74,520	29.2%	1	69,663	32.0%
Skin and subcutaneous infections (SKN001)	2	36,015	14.1%	2	25,495	11.7%
Complication of other surgical or medical care, injury, initial encounter (INJ037)	3	21,409	8.4%	3	19,114	8.8%
Diabetes mellitus with complication (END003)	4	18,149	7.1%	4	15,761	7.2%
Pneumonia (except that caused by tuberculosis) (RSP002) ²	5	10,454	4.1%	6	6,158	2.8%
Complication of internal orthopedic device or implant, initial encounter (INJ035)	6	7,307	2.9%	5	6,506	3.0%
Complication of cardiovascular device, implant or graft, initial encounter (INJ033)	7	6,711	2.6%	7	5,034	2.3%
Osteomyelitis (MUS002)	8	5,394	2.1%	10	4,629	2.1%
Complication of genitourinary device, implant or graft, initial encounter (INJ034)	9	5,183	2.0%	8	4,942	2.3%
Respiratory failure; insufficiency; arrest (RSP012)	10	3,759	1.5%			
Coronavirus disease - 2019 (COVID-19) (INF012)				9	4,759	2.2%
Total stays with one of the top ten principal diagnoses		188,901	74.0%		162,061	74.5%

Abbreviations: CCSR, Clinical Classification Software Refined; MRSA, methicillin-resistant *Staphylococcus aureus*; POA, present on admission.

Notes: The top ten principal diagnoses were analyzed based on the default CCSR for the principal diagnosis from v2023.1. ¹The CCSR for septicemia includes all sepsis infection codes and does not include the criterion of organ dysfunction. It includes 41,033 discharges with a principal diagnosis of sepsis due to MRSA (ICD-10-CM code: A4102) in 2019 and 40,630 in 2021. ² Includes 7,032 discharges with a principal diagnosis of pneumonia due to MRSA (ICD-10-CM code: J15212) in 2019 and 4,217 in 2021. Additional details are available in the Methods section.

Source: Agency for Healthcare Research and Quality (AHRQ), Healthcare Cost and Utilization Project (HCUP), State Inpatient Databases (SID), 2019 and 2021, 38 states.

- In both 2019 and 2021, the top 10 principal diagnoses accounted for approximately 74.0 to 74.5 percent of inpatient stays with MRSA infections that were present on admission.
- Septicemia was the most common principal diagnosis for inpatient stays with MRSA infections that were present on admission, accounting for almost one-third of these stays (29.2 percent in 2019 and 32.0 percent in 2021). Sepsis due to MRSA was the principal diagnosis for 55.1 percent of the septicemia stays in 2019 and 58.3 percent in 2021.
- Skin and subcutaneous infections was the second most common principal diagnosis for stays with MRSA infections that were present on admission as a comorbidity or complication, accounting for 14.1 percent of stays in 2019 and 11.7 percent in 2021.
- Following the onset of the pandemic in 2020, Coronavirus disease (COVID-19) was one of the top ten principal diagnoses in 2021 for adult inpatient stays with MRSA infections, accounting for 2.2 percent of stays.

Table 2b. Most common principal diagnoses for adult inpatient stays with MRSA infections not present on admission, 2019 and 2021

Top ten principal diagnoses (CCSR)	Inpatient stays with MRSA infections (Not POA)					
	2019			2021		
	Rank	Number of stays	Percentage of stays	Rank	Number of stays	Percentage of stays
Total stays¹		15,774			21,806	
Septicemia (INF002)	1	1,350	8.6%	2	3,373	15.5%
Respiratory failure; insufficiency; arrest (RSP012)	2	817	5.2%	3	730	3.3%
Heart failure (CIR019)	3	710	4.5%	5	680	3.1%
Traumatic brain injury (TBI); concussion (INJ008)	4	581	3.7%	4	702	3.2%
Acute hemorrhagic cerebrovascular disease (CIR021)	5	528	3.3%	6	579	2.7%
Diabetes mellitus with complication (END003)	6	460	2.9%	8	466	2.1%
Cerebral infarction (CIR020)	7	454	2.9%	7	542	2.5%
Skin and subcutaneous infections (SKN001)	8	428	2.7%			
Acute myocardial infarction (CIR009)	9	407	2.6%	9	369	1.7%
Acute and unspecified renal failure (GEN002)	10	367	2.3%			
Coronavirus disease - 2019 (COVID-19) (INF012)				1	4,281	19.6%
Complication of other surgical or medical care, injury, initial encounter (INJ037)				10	342	1.6%
Total stays with one of the top ten principal diagnoses		6,102	38.7%		12,064	55.3%

Abbreviations: CCSR, Clinical Classification Software Refined; MRSA, methicillin-resistant *Staphylococcus aureus*; POA, present on admission.

Notes: The top ten principal diagnoses were analyzed based on the default CCSR for the principal diagnosis from v2023.1. Additional details are available in the Methods section.

Source: Agency for Healthcare Research and Quality (AHRQ), Healthcare Cost and Utilization Project (HCUP), State Inpatient Databases (SID), 2019 and 2021, 38 states

- In 2019, similar to stays with MRSA infections that were present on admission, septicemia was the most frequently occurring principal diagnosis for MRSA infections that were *not* present on admission (8.6 percent). By definition, none of these stays had a principal diagnosis of sepsis due to MRSA infection, although they may have had a secondary diagnosis of sepsis due to MRSA infection (not POA).
- In 2021, COVID-19 was the most frequently occurring principal diagnosis for stays with MRSA that were *not* present on admission (19.6 percent).

References

¹Elixhauser A. (AHRQ); Steiner C. (AHRQ). Infections with Methicillin-Resistant *Staphylococcus aureus* (MRSA) in U.S. Hospitals, 1993–2005. HCUP Statistical Brief #35. July 2007. Agency for Healthcare Research and Quality, Rockville, MD. <http://www.hcup-us.ahrq.gov/reports/statbriefs/sb35.pdf>. Accessed August 24, 2024

²Weiner-Lastinger LM, Pattabiraman V, Konnor RY, et al. The impact of coronavirus disease 2019 (COVID-19) on healthcare-associated infections in 2020: A summary of data reported to the National Healthcare Safety Network. *Infection Control & Hospital Epidemiology*. 2022;43(1):12-25. doi:10.1017/ice.2021.36 ³Lastinger LM, Alvarez CR, Kofman A, et al. Continued increases in the incidence of healthcare-associated infection (HAI) during the second year of the coronavirus disease 2019 (COVID-19) pandemic. *Infection Control & Hospital Epidemiology*. 2023;44(6):997-1001. doi:10.1017/ice.2022.116

⁴Clinical Classifications Software Refined (CCSR). Agency for Healthcare Research and Quality, Rockville, MD. www.hcup-us.ahrq.gov/toolsoftware/ccsr/ccs_refined.jsp. Accessed August 24, 2024

Data Source

This Statistical Brief uses data from the HCUP 2016–2021 State Inpatient Databases (SID) from the following 38 states with reliable information on whether the diagnoses were present on admission (POA): Arizona, Arkansas, California, Florida, Georgia, Hawaii, Illinois, Indiana, Kansas, Kentucky, Louisiana, Massachusetts, Maine, Maryland, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, North Carolina, North Dakota, New Jersey, New Mexico, New York, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Utah, Virginia, Washington, West Virginia, and Wisconsin. For more information about the HCUP SID, see: <https://hcup-us.ahrq.gov/sidoverview.jsp>.

These states were selected because their SID contained reliable information on whether diagnoses were present on admission. These SID contain valid POA data for at least 90 percent of stays for every year in the period of analysis. Limiting the data to these states results in excluding between 5.4 to 6.3 percent of stays from the available SID data for each year.

Number and types of hospitals included in HCUP SID

This analysis used data from approximately 2,800 (slight variation by year) non-Federal acute care hospitals in the 38 states with valid information on the status of present on admission. Non-Federal acute care hospitals include academic medical centers, tertiary care hospitals, suburban community hospitals, short-term community hospitals, obstetrics and gynecology, otolaryngology, orthopedic, cancer, pediatric, public, and critical access hospitals. They exclude hospital units of other institutions (e.g., prisons), Department of Veterans Administration hospitals, Indian Health Service hospitals, Department of Defense facilities, rehabilitation and long-term care facilities, specialty psychiatric facilities and substance use disorder treatment facilities.

Population Studied

The Statistical Brief focuses on inpatient stays of adults with any listed ICD-10-CM diagnosis of Methicillin-resistant *Staphylococcus aureus* (MRSA). This analysis used up to 40 diagnoses, as available in the data for each year. Inpatient stays with missing or invalid data on patient characteristics, including sex, race and ethnicity, patient county, and expected payer, were excluded from the corresponding stratified analysis.

Additionally, this Statistical Brief includes inpatient stays for adults aged 18 and older. The analysis includes over 90 percent of inpatient stays for adults aged 18 and older for each year from the HCUP 2016–2021 SID (Table 3).

Table 3. Number of adult inpatient stays included in this Statistical Brief, 2016-2021

Year	HCUP 2016–2021 NIS	HCUP 2016–2021 SID from 38 states	
	Weighted number of adult inpatient stays (aged 18+)	Number of adult inpatient stays (aged 18+) included	Coverage of adult inpatient stays (aged 18+) in SID from 38 states
2016	30,188,612	27,453,302	91%
2017	30,420,907	27,610,597	91%
2018	30,259,863	27,567,965	91%
2019	30,218,268	27,560,911	91%
2020	27,667,387	25,213,013	91%
2021	28,441,739	25,930,670	91%

Abbreviations: NIS, National Inpatient Sample; SID, State Inpatient Databases.

Source: Agency for Healthcare Research and Quality (AHRQ), Healthcare Cost and Utilization Project (HCUP), National Inpatient Sample (NIS), 2016–2021, and State Inpatient Databases (SID), 2016–2021, 38 states

The unit of analysis is the hospital discharge (i.e., the inpatient stay), not the person or patient. This means that if a person is admitted to the hospital multiple times within a given year, each discharge will be counted as a separate discharge.

Case definition of Methicillin-Resistant *Staphylococcus aureus* (MRSA)-related inpatient stays

Inpatient stays with MRSA infections were identified using ICD-10-CM diagnosis codes, as listed in Appendix A, Table A.1. Inpatient stays with MRSA infections (All) include stays with any MRSA infection, regardless of POA status, in any diagnosis position. Inpatient stays with MRSA infections (POA) include inpatient stays for which MRSA is listed as the principal diagnosis or as a secondary diagnosis, with the infection present on admission (POA). Inpatient stays with MRSA infections (Not POA) include inpatient stays for which MRSA is listed as a secondary diagnosis, and the infection was not present on admission (Not POA). Although sensitivity and specificity of ICD-10-CM diagnosis codes for detection of MRSA may differ from those of other surveillance and detection methods, the availability of additional data elements allows the HCUP SID to provide complementary information to that provided by existing surveillance programs.

Present on admission (POA)

There are eight POA indicator options and definitions: Y- Yes (present on admission); N- No (not present on admission); W- Clinically undetermined; U- Documentation is insufficient to determine if condition is present on admission, E, 1, or X- Exempt from POA reporting; and Blank-Missing information on nonexempt diagnoses. A MRSA infection was considered POA if any MRSA diagnosis code had a POA indicator of Y or W or any MRSA diagnosis was on the POA-exempt list. If the principal diagnosis was MRSA, it was also considered POA. If no secondary MRSA diagnosis code was POA, the MRSA infection was classified as Not POA.

Definitions

Diagnoses

The *principal diagnosis* is that condition established after study to be chiefly responsible for the patient's admission to the hospital. *Secondary diagnoses* are conditions that are observed during the hospital stay and that require or affect patient care treatment or management.

ICD-10-CM Coding System

ICD-10-CM is the *International Classification of Diseases, Tenth Revision, Clinical Modification*. There are over 70,000 ICD-10-CM diagnosis codes. In October 2015 (Fiscal Year 2016), ICD-10-CM replaced the *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) diagnosis coding system for use with medical records.

Clinical Classifications Software Refined (CCSR) for ICD-10-CM Diagnoses

The CCSR aggregates more than 73,000 ICD-10-CM diagnosis codes into over 530 clinically meaningful categories across 22 body systems. The CCSR capitalizes on the specificity of the ICD-10-CM coding scheme and allows ICD-10-CM codes to be classified in more than one category. For this Statistical Brief, the principal diagnosis code is assigned to a single default CCSR based on clinical coding guidelines, etiology and pathology of diseases, and standards set by other Federal agencies. For this Statistical Brief, v2023.1 of the CCSR was used. For more information on the CCSR, see https://hcup-us.ahrq.gov/toolssoftware/ccsr/ccs_refined.jsp.

The top ten principal diagnoses were selected based on the frequency of the default CCSR category assigned to the principal diagnosis from CCSR v2023.1. Frequencies were calculated for each CCSR, and based on these frequencies, the CCSRs were ranked in descending order. The top ten most frequently occurring CCSRs were then selected. These top ten diagnoses were identified separately for each category of MRSA-related inpatient stays: inpatient stays with inpatient stays with MRSA infections (POA), inpatient stays with MRSA infections (Not POA) and MRSA infections (All), as well as for the years 2019 and 2021 separately. This Statistical Brief used the top ten principal diagnoses for inpatient stays with MRSA infections (POA) and inpatient stays with MRSA infections (Not POA).

For reference, the top ten CCSR codes for all stays with MRSA infections regardless of POA status are presented in the following table:

Table 5. Top ten principal diagnoses for MRSA-related inpatient stays, 2019 and 2021

Rank	2019		2021	
	CCSR category	Number of Inpatient Stays	CCSR category	Number of Inpatient Stays
1	Septicemia (INF002) ¹	75,870	Septicemia (INF002) ¹	73,036
2	Skin and subcutaneous tissue infections (SKN001)	36,443	Skin and subcutaneous tissue infections (SKN001)	25,749
3	Complication of other surgical or medical care, injury, initial encounter (INJ037)	21,745	Complication of other surgical or medical care, injury, initial encounter (INJ037)	19,456
4	Diabetes mellitus with complication (END003)	18,609	Diabetes mellitus with complication (END003)	16,227
5	Pneumonia (except that caused by tuberculosis) (RSP002) ²	10,623	Coronavirus disease 2019 (COVID-19) (INF012)	9,040
6	Complication of internal orthopedic device or implant, initial encounter (INJ035)	7,425	Complication of internal orthopedic device or implant, initial encounter (INJ035)	6,626
7	Complication of cardiovascular device, implant or graft, initial encounter (INJ033)	6,906	Pneumonia (except that caused by tuberculosis) (RSP002) ²	6,303
8	Osteomyelitis (MUS002)	5,490	Complication of cardiovascular device, implant or graft, initial encounter (INJ033)	5,218
9	Complication of genitourinary device, implant or graft, initial encounter (INJ034)	5,295	Complication of genitourinary device, implant or graft, initial encounter (INJ034)	5,066
10	Respiratory failure; insufficiency; arrest (RSP012)	4,576	Osteomyelitis (MUS002)	4,715

Abbreviations: CCSR, Clinical Classification Software Refined; *MRSA*, methicillin-resistant *Staphylococcus aureus*; POA, present on admission.

Notes: The top ten principal diagnoses were analyzed based on the default CCSR for the principal diagnosis from v2023.1. ¹The CCSR for septicemia includes all sepsis infection codes and does not include the criterion of organ dysfunction. It includes 41,033 discharges with a principal diagnosis of sepsis due to MRSA (ICD-10-CM code: A4102) in 2019 and 40,630 in 2021. ² Includes 7,032 discharges with a principal diagnosis of pneumonia due to MRSA (ICD-10-CM code: J15212) in 2019 and 4,217 in 2021.

Source: Agency for Healthcare Research and Quality (AHRQ), Healthcare Cost and Utilization Project (HCUP), State Inpatient Databases (SID), 2016–2021, 38 states

Patient race and ethnicity

Data on Hispanic ethnicity are collected differently among the states and also can differ from the census methodology of collecting information on race (White, Black, Asian and Pacific Islander, American Indian and Alaska Native, Other [including mixed race]) separately from ethnicity (Hispanic, non-Hispanic). Most state data organizations collect Hispanic ethnicity as one of several categories that include race. Therefore, for multistate analyses, HCUP creates the combined categorization of race and ethnicity for data from states that report ethnicity separately. When a state data organization collects Hispanic ethnicity separately from race, HCUP uses Hispanic ethnicity to override any other race category to create a Hispanic category for the uniformly coded race and ethnicity data element, while also retaining the original race and ethnicity data. This Statistical Brief reports race and ethnicity for the following categories: Asian and Pacific Islander non-Hispanic, Black non-Hispanic, Hispanic, and White non-Hispanic, and Other non-Hispanic that includes both American Indian and Alaska Native non-Hispanic and Other non-Hispanic.

Location of patient residence

Place of residence is based on the urban-rural classification scheme for U.S. counties developed by the National Center for Health Statistics (NCHS) and based on the Office of Management and Budget (OMB) definition of a metropolitan service area as including a city and a population of at least 50,000 residents. This analysis used the following four categories after grouping the NCHS's definitions:

- Large metropolitan:
 - Large Central Metropolitan: Counties in a metropolitan area with 1 million or more residents that satisfy at least one of the following criteria: (1) containing the entire population of the largest principal city of the metropolitan statistical area (MSA), (2) having their entire population contained within the largest principal city of the MSA, or (3) containing at least 250,000 residents of any principal city in the MSA
 - Large Fringe Metropolitan: Counties in a metropolitan area with 1 million or more residents that do not qualify as large central metropolitan counties
- Medium and small metropolitan:
 - Medium Metropolitan: Counties in a metropolitan area of 250,000–999,999 residents
 - Small Metropolitan: Counties in a metropolitan area of 50,000–249,999 residents
- Micropolitan:
 - Micropolitan: Counties in a nonmetropolitan area of 10,000–49,999 residents
- Rural:
 - Noncore: Counties in a nonmetropolitan and non-micropolitan area

Social Vulnerability Index

Social Vulnerability refers to the demographic and socioeconomic factors (such as poverty, lack of access to transportation, and crowded housing) that adversely affect communities that encounter hazards and other community-level stressors. These stressors can include natural or human-caused disasters (such as tornadoes or chemical spills) or disease outbreaks (such as COVID-19). This Statistical Brief used the Centers for Disease Control and Prevention (CDC) Social Vulnerability Index (CDC/ATSDR SVI) for counties. CDC/ATSDR SVI is a place-based index, database, and mapping application designed to identify and quantify communities experiencing social vulnerability. CDC/ATSDR SVI indicates the relative vulnerability of every U.S. County. SVI ranks the counties on 15 social factors (2018) and 16 social factors (2020), and further groups them into four related themes. Thus, each county receives a ranking for each social factor variable and for each of the four themes as well as an overall ranking. This Statistical Brief used an overall ranking for the analysis of social vulnerability. For more information on the CDC/ATSDR SVI, see <https://www.atsdr.cdc.gov/placeandhealth/svi/index.html>

Primary expected payer

To make coding uniform across all HCUP data sources, the primary expected payer combines detailed categories into general groups:

- Medicare: includes fee-for-service and managed care Medicare
- Medicaid: includes fee-for-service and managed care Medicaid
- Private insurance: includes commercial nongovernmental payers, regardless of the type of plan (e.g., private health maintenance organizations [HMOs], preferred provider organizations [PPOs])
- Self-pay/No charge: includes self-pay, no charge, charity, and no expected payment
- Other payers: includes other Federal and local government programs (e.g., TRICARE, CHAMPVA, Indian Health Service, Black Lung, Title V) and Workers' Compensation

Calculations

Rate of adult inpatient stays with MRSA infections

The rate of inpatient stays with MRSA infections per 10,000 adult inpatient stays was calculated using the number of adult hospital discharges with MRSA infections in a given year in the numerator and the total number of adult hospital discharges included in this Statistical Brief in a given year in the denominator. The rate of adult inpatient stays with MRSA infections was calculated using the following formula.

$$\text{Rate of inpatient stays with MRSA infections} = \left(\frac{\text{Number of hospital discharges with MRSA infections in a given year}}{\text{Total number of hospital discharges in a given year}} \right) \times 10,000$$

Percentage change

The percentage change between groups was calculated using the following formula:

$$\text{Percentage change} = \left(\frac{\text{Group 1 value} - \text{Group 2 value}}{\text{Group 2 value}} \right) \times 100$$

Percentage of inpatient stays

The percentage of inpatient stays in a given inpatient stay category was calculated for each year using the following formula:

$$\text{Percentage of stays} = \left(\frac{\text{Number of hospital discharges that meet the criteria in a given inpatient stay category and year}}{\text{Total number of hospital discharges in a given inpatient stay category and year}} \right) \times 100$$

About HCUP

The Healthcare Cost and Utilization Project (HCUP) is a family of healthcare databases and related software tools and products developed through a Federal-State-Industry partnership and sponsored by the Agency for Healthcare Research and Quality (AHRQ). HCUP databases bring together the data collection efforts of state data organizations, hospital associations, and private data organizations (HCUP Partners) and the Federal government to create a national information resource of encounter-level healthcare data. HCUP includes the largest collection of longitudinal hospital care data in the United States, with all-payer, encounter-level information beginning in 1988. These databases enable research on a broad range of health policy issues, including cost and quality of health services, medical practice patterns, access to healthcare programs, and outcomes of treatments at the national, state, and local market levels. For more information about HCUP, see: <https://hcup-us.ahrq.gov/>

HCUP would not be possible without the contributions of the following data collection Partners from across the United States:

Alaska Department of Health	Nebraska Hospital Association
Alaska Hospital and Healthcare Association	Nevada Department of Health and Human Services
Arizona Department of Health Services	New Hampshire Department of Health & Human Services
Arkansas Department of Health	New Jersey Department of Health
California Department of Health Care Access and Information	New Mexico Department of Health
Colorado Hospital Association	New York State Department of Health
Connecticut Hospital Association	North Carolina Department of Health and Human Services
Delaware Division of Public Health	North Dakota (data provided by the Minnesota Hospital Association)
District of Columbia Hospital Association	Ohio Hospital Association
Florida Agency for Health Care Administration	Oklahoma State Department of Health
Georgia Hospital Association	Oregon Association of Hospitals and Health Systems
Hawaii Laulima Data Alliance	Oregon Health Authority
Hawaii University of Hawai'i at Hilo	Pennsylvania Health Care Cost Containment Council
Illinois Department of Public Health	Rhode Island Department of Health
Indiana Hospital Association	South Carolina Revenue and Fiscal Affairs Office
Iowa Hospital Association	South Dakota Association of Healthcare Organizations
Kansas Hospital Association	Tennessee Hospital Association
Kentucky Cabinet for Health and Family Services	Texas Department of State Health Services
Louisiana Department of Health	Utah Department of Health
Maine Health Data Organization	Vermont Association of Hospitals and Health Systems
Maryland Health Services Cost Review Commission	Virginia Health Information
Massachusetts Center for Health Information and Analysis	Washington State Department of Health
Michigan Health & Hospital Association	West Virginia Department of Health and Human Resources
Minnesota Hospital Association	Wisconsin Department of Health Services
Mississippi State Department of Health	Wyoming Hospital Association
Missouri Hospital Industry Data Institute	
Montana Hospital Association	

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For More Information

For more information on this and other topics, please visit our HCUP Statistical Briefs topic area page located at www.hcup-us.ahrq.gov/reports/statbriefs/sbtopic.jsp.

For additional HCUP statistics, visit:

- HCUP Fast Stats at <https://datatools.ahrq.gov/hcup-fast-stats> for easy access to the latest HCUP-based statistics for healthcare information topics
- HCUPnet, HCUP's interactive query system, at <https://datatools.ahrq.gov/hcupnet>
- HCUP Summary Trend Tables at www.hcup-us.ahrq.gov/reports/trendtables/summarytrendtables.jsp for monthly information on hospital utilization

AHRQ welcomes questions and comments from readers of this publication who are interested in obtaining more information about access, cost, use, financing, and quality of healthcare in the United States. We also invite you to tell us how you are using this Statistical Brief and other HCUP data and tools, and to share suggestions on how HCUP products might be enhanced to further meet your needs. Please email us at hcup@ahrq.gov or send a letter to the address below:

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