



Emerging Infections Program Healthcare-Associated Infections Community Interface Report Invasive *Staphylococcus aureus*, 2020

Last Updated: September 16, 2022

Surveillance Catchment Areas

Methicillin-resistant *Staphylococcus aureus* (MRSA): California (3 county San Francisco Bay area); Connecticut (Fairfield, Hartford, and New Haven counties); Georgia (8 county Atlanta area); Maryland (Baltimore City and County); Minnesota (2 county Minneapolis–Saint Paul area); New York (1 Rochester county); Tennessee (1 Nashville county).

Methicillin-sensitive *Staphylococcus aureus* (MSSA): California (3 county San Francisco Bay area); Connecticut (1 New Haven county); Georgia (1 Atlanta county); Maryland (Baltimore City and County); Minnesota (2 county Minneapolis–Saint Paul area); New York (1 Rochester county); Tennessee (1 Nashville county).

Population

The MRSA surveillance areas represent 15,218,247 persons. The MSSA surveillance areas represent 10,274,147 persons.

Source: U.S. Census Bureau, Population Division, Vintage 2020 Special Tabulation

Case Definition

Invasive *Staphylococcus aureus* (SA) infection: isolation of SA from a normally sterile site in a resident of the surveillance area in 2020. Cases of infection are classified into one of three epidemiologic classifications.

A case is classified as

- hospital-onset (HO) if the SA culture was obtained on or after the third calendar day of hospitalization, where admission is hospital day 0¹;
- healthcare-associated community-onset (HACO) if the culture was obtained in an outpatient setting or before the third¹ calendar day of hospitalization and had one or more of the following:
 1. a history of hospitalization, surgery, dialysis, or residence in a long-term care facility in the previous year, or
 2. the presence of a central vascular catheter (CVC) within 2 days prior to SA culture;
- community-associated (CA) if none of the previously mentioned criteria are met.

Cases were classified as MRSA or MSSA based on results from local clinical microbiology laboratory testing.

¹ Compared to annual summaries from 2005–2017, this case definition represents an update in nomenclature (i.e., switching from “fourth” to “third” day before), but not a change to the case definition

Methods

Case finding was active, laboratory-based and population-based. Emerging Infections Program (EIP) personnel routinely contacted microbiology laboratories serving healthcare facilities in their area to identify cases. Laboratories serving the surveillance catchment areas were routinely audited to ensure complete case ascertainment.

A standardized case report form was completed for each incident case through review of medical records. Medical records were reviewed for information on demographic characteristics, clinical syndrome, and outcome of illness.

Convenience samples of MSSA and MRSA isolates were collected and sent to CDC for routine testing, including antimicrobial susceptibility testing using reference broth microdilution and, beginning with 2017 isolates, whole genome sequencing (WGS) to perform SCC*mec* typing, *spa* typing, multilocus sequence typing (MLST), clonal complex assignment, and inferred pulsed-field gel electrophoresis (PFGE) typing. Pulsed field type is inferred from WGS based on phylogenetic relatedness, MLST clonal complex, and molecular characteristics of the isolates¹. Isolates belonging to clonal complex 8 are sub-typed using a SNP assay that has been modified for use with WGS data, allowing confirmation of isolates identified as USA300². The use of PFGE for all isolates was discontinued in 2008; up until 2012, PFGE was inferred using a validated algorithm based on the following isolate microbiologic characteristics: SCC*mec* type, presence of Panton Valentine Leukocidin and Toxin Shock Syndrome Toxin genes, and antimicrobial susceptibility results³. From 2012-2016, *spa* typing was included in routine laboratory testing and MLST clonal complexes were inferred based on *spa* type, allowing for the identification of PFGE types based on MLST clonal complex and molecular characteristics of the isolates¹, with 2016 isolates identified as USA300 confirmed using a SNP assay³. In 2020, MRSA isolates were collected in five sites (California, Georgia, Minnesota, New York, and Tennessee) and MSSA isolates in three (Georgia, Minnesota, and New York). Characterization of 2020 isolates is in process as of the date of this report.

Rates of invasive SA infection among all patients were calculated using population estimates for 2020. Cases with unknown race were assigned race based on distribution of known age, race, and gender by EIP site.

Rates of invasive SA infection among patients who were undergoing chronic dialysis treatment were calculated using the December 31, 2019 point prevalent counts of patients on dialysis from the [United States Renal Data System \(USRDS\)](https://www.usrds.org/) (<https://www.usrds.org/>). The figures depicting the incidence of invasive MRSA among persons on dialysis and not on dialysis by epidemiologic classification, 2009–2020 are restricted to the continuous catchment area (California [3 county San Francisco Bay area]; Connecticut [Fairfield, Hartford, and New Haven counties]; Georgia [8 county Atlanta area]; Minnesota [1 county Minneapolis–Saint Paul area]; New York [1 Rochester county]; and Tennessee [1 Nashville county]) for comparison of trends over time.

Invasive SA surveillance data undergo regular data cleaning to ensure accuracy and completeness. Patients with complete case report form data as of September 5, 2022 were included in this analysis. Because data can be updated as needed, analyses of datasets generated on a different date may yield slightly different results.

¹ [Inferred Identification of Pulsed Field Types based on MLST clonal complex \(CC\)](https://www.cdc.gov/HAI/settings/lab/CCalgorithm.html)

(<https://www.cdc.gov/HAI/settings/lab/CCalgorithm.html>)

² [Improved Subtyping of *Staphylococcus aureus* Clonal Complex 8 Strains Based on Whole-Genome Phylogenetic Analysis \[PDF - 15 pages\]](https://msphere.asm.org/content/msph/3/3/e00464-17.full.pdf) (<https://msphere.asm.org/content/msph/3/3/e00464-17.full.pdf>)

³ [Use of an Inferred PFGE Algorithm, Emerging Infections Program/Active Bacterial Core \(ABCs\) Surveillance Invasive MRSA Project](https://www.cdc.gov/HAI/settings/lab/inferred-PFGE-algorithm.html) (<https://www.cdc.gov/HAI/settings/lab/inferred-PFGE-algorithm.html>)

Results

MSSA (N=3593) and MRSA (N=3051) Cases by Race, 2020

Race	MSSA No. (Rate ^a)	MRSA No. (Rate ^a)
White	2202 (35.9)	1688 (18.8)
Black	1012 (47.4)	1185 (31.8)
Other	379 (18.9)	178 (7.1)
TOTAL	3593 (35.0)	3051 (20.1)

Unknown race (n= 362 MSSA, n= 236 MRSA) was imputed using age, sex, and dialysis status

^a Cases per 100,000 population for EIP areas (crude rates)

MSSA (N=3593) and MRSA (N=3051) Case and Death Rate by Epidemiological Classification, 2020

Class	No. (Rate^a) MSSA Cases	No. (Rate) MSSA Deaths	No. (Rate) MRSA Cases	No. (Rate) MRSA Deaths
CA	1307 (12.7)	131 (1.3)	665 (4.4)	78 (0.5)
HCA ^b	2241 (21.8)	312 (3.0)	2361 (15.5)	414 (2.7)
HO	487 (4.7)	112 (1.1)	458 (3.0)	138 (0.9)
HACO	1754 (17.1)	200 (1.9)	1903 (12.5)	276 (1.8)
Unknown	45 (0.4)	1 (<0.01)	25 (0.2)	1 (<0.01)

^a Cases per 100,000 population for EIP areas (crude rates) calculated using 2020 U.S. Census Data

^b HCA: Healthcare-associated invasive SA infection; sum of patients that are classified as either the HO or HACO classes

MSSA (N=3593) and MRSA (N=3051) Cases by Race and Ethnicity, 2020

Race/Ethnicity	MSSA No. (%)	MRSA No. (%)
Hispanic, any race	315 (8.8)	208 (6.8)
Not known to be Hispanic ^a - White ^b	1906 (53.1)	1481 (48.5)
Not known to be Hispanic ^a - Black or African American ^c	885 (24.6)	1082 (35.5)
Not known to be Hispanic ^a - Asian ^d	242 (6.7)	99 (3.2)
Not known to be Hispanic ^a - Other or multiple races ^e	70 (1.9)	49 (1.6)
Not known to be Hispanic ^{a,f} - Unknown race	175 (4.9)	132 (4.3)

^a Records either indicated ethnicity was non-Hispanic, or ethnicity was not known

^b 129 MSSA cases and 100 MRSA cases with unknown ethnicity

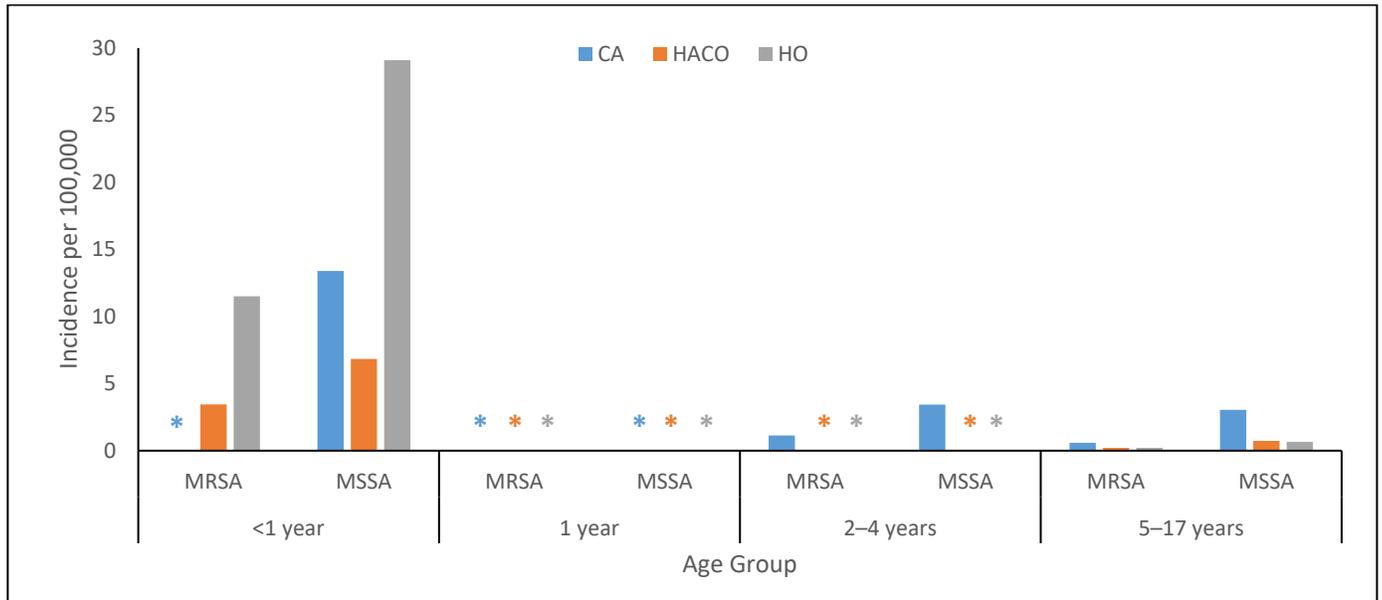
^c 48 MSSA cases and 62 MRSA cases with unknown ethnicity

^d 45 MSSA cases and 12 MRSA cases with unknown ethnicity

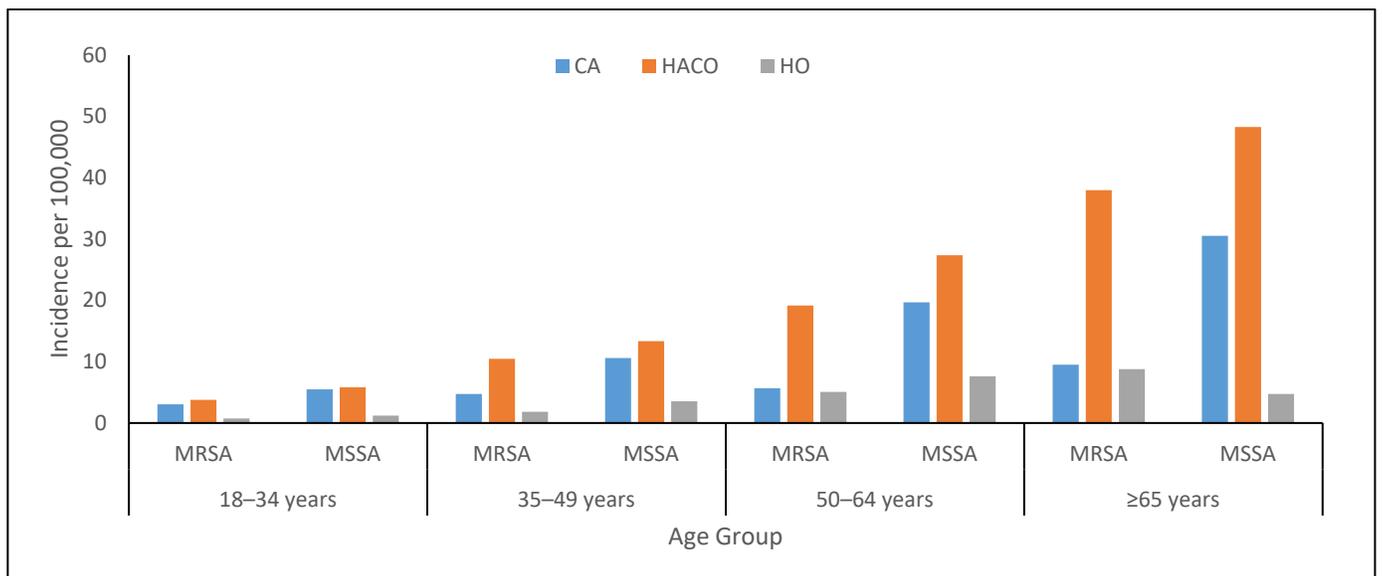
^e American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, or ≥2 races reported; 8 MSSA cases and 5 MRSA cases with unknown ethnicity

^f Of cases with unknown race, 102 MSSA and 75 MRSA cases had unknown ethnicity

Incidence^{a,b} of Invasive *Staphylococcus aureus*, by Epidemiologic Class, Pediatric Age Groups, and Methicillin-Resistance Status, 2020



Incidence^a of Invasive *Staphylococcus aureus*, by Epidemiologic Class, Adult Age Groups, and Methicillin-Resistance Status, 2020



^a Incidence (no. per 100,000 population per year) calculated using 2020 U.S. Census Data

^b An asterisk represents a case count of <5; rates for these instances have been suppressed

Location of Invasive MSSA (N=3593) and MRSA (N=3051) Cases Before Incident Specimen Collection, 2020

Location of patient before incident specimen collection ^a	MSSA No. (%)	MRSA No.(%)
Private residence	2691 (74.9)	1898 (62.2)
Long-term care facility	237 (6.6)	543 (17.8)
Acute-care hospital (inpatient)	419 (11.7)	389 (12.8)
Long-term acute care hospital	5 (0.1)	14 (0.5)
Homeless	273 (7.6)	235 (7.7)
Other	11 (0.3)	18 (0.6)
Unknown	52 (1.4)	34 (1.1)

^a Represents location of the patient three days before incident specimen collection, where date of initial culture is day 0

Location of Invasive MSSA (N=3593) and MRSA (N=3051) Cases at Time of Incident Specimen Collection, 2020

Location of incident specimen collection	MSSA No. (%)	MRSA No. (%)
Outpatient setting or emergency department	2507 (69.8)	2140 (70.1)
Acute care hospital	1012 (28.2)	858 (28.1)
Long-term care facility	10 (0.3)	22 (0.7)
Long-term acute care hospital	5 (0.1)	6 (0.2)
Other	20 (0.6)	3 (0.1)
Unknown	39 (1.1)	22 (0.7)

Selected Clinical Characteristics of Invasive MSSA (N=3548^a) and MRSA (N=3026^a) Cases by Epidemiological Class, 2020

Characteristics	CA, No. (%) MSSA (n=1307)	CA, No. (%) MRSA (n=665)	HACO, No. (%) MSSA (n=1754)	HACO, No. (%) MRSA (n=1903)	HO, No. (%) MSSA (n=487)	HO, No. (%) MRSA (n=458)
Charlson comorbidity index ^b - 0	453 (34.9)	222 (33.7)	249 (14.3)	204 (10.7)	123 (25.4)	90 (19.7)
Charlson comorbidity index ^b - 1	382 (29.4)	193 (29.3)	283 (16.2)	333 (17.6)	90 (18.6)	64 (14.0)
Charlson comorbidity index ^b - ≥2	464 (35.7)	244 (37.0)	1211 (69.5)	1359 (71.7)	271 (56.0)	303 (66.3)
Underlying conditions ^b - Burn/surgical wound	9 (0.7)	2 (0.3)	37 (2.1)	60 (3.2)	6 (1.2)	4 (0.9)
Underlying conditions ^b - Chronic pulmonary disease	189 (14.5)	126 (19.1)	314 (18.0)	464 (24.5)	100 (20.7)	116 (25.4)
Underlying conditions ^b - Chronic kidney disease	165 (12.7)	85 (12.9)	746 (42.8)	787 (41.5)	121 (25.0)	135 (29.5)
Underlying conditions ^b - Decubitus/pressure ulcer	36 (2.8)	21 (3.2)	100 (5.7)	232 (12.2)	17 (3.5)	32 (7.0)
Underlying conditions ^b - Diabetes mellitus	436 (33.6)	201 (30.5)	771 (44.2)	909 (47.9)	168 (34.7)	178 (39.0)
Underlying conditions ^b - Hemiplegia	3 (0.2)	4 (0.6)	19 (1.1)	36 (1.9)	5 (1.0)	2 (0.4)
Underlying conditions ^b - Injection drug use	169 (13.0)	161 (24.4)	121 (6.9)	171 (9.0)	14 (2.9)	24 (5.3)
Underlying conditions ^b - Obesity or morbid obesity	239 (18.4)	100 (15.2)	321 (18.4)	349 (18.4)	96 (19.8)	102 (22.3)
Underlying conditions ^b - Other chronic ulcer or chronic wound	126 (9.7)	70 (10.6)	209 (12.0)	314 (16.6)	22 (4.6)	43 (9.4)
Underlying conditions ^b - Paraplegia	6 (0.5)	10 (1.5)	11 (0.6)	63 (3.3)	1 (0.2)	7 (1.5)

Underlying conditions ^b - Pregnancy	2 (0.2)	1 (0.2)	6 (0.3)	2 (0.1)	0 (0.0)	0 (0.0)
Syndrome ^c - Bloodstream infection ^d with other syndrome	747 (57.1)	429 (64.5)	1011 (57.6)	1224 (64.3)	194 (39.8)	221 (48.3)
Syndrome ^c - Bloodstream infection with no other syndrome	315 (24.0)	137 (20.6)	528 (30.1)	507 (26.6)	219 (45.0)	159 (34.7)
Syndrome ^c - Pneumonia	123 (9.4)	105 (15.8)	172 (9.8)	266 (14.0)	86 (17.7)	106 (23.1)
Syndrome ^c - Osteomyelitis	185 (14.2)	90 (13.5)	215 (12.3)	296 (15.6)	29 (6.0)	46 (10.0)
Syndrome ^c - Endocarditis	120 (9.2)	82 (12.3)	152 (8.7)	183 (9.6)	25 (5.1)	33 (7.2)
Syndrome ^c - Cellulitis	232(17.8)	136 (20.5)	180 (10.3)	221 (11.6)	23 (4.7)	30 (6.6)
Syndrome ^c - Surgical wound ^e	16 (1.2)	5 (0.8)	106 (6.0)	87 (4.6)	14 (2.9)	17 (3.7)
Syndrome ^c - Decubitus/pressure ulcer	22 (1.7)	9 (1.4)	43 (2.5)	80 (4.2)	7 (1.4)	14 (3.1)
Syndrome ^c - Skin abscess ^f	101 (7.7)	66 (9.9)	93 (5.3)	104 (5.5)	16 (3.3)	18 (3.9)
Syndrome ^c - Other wound ^g	59 (4.5)	19 (2.9)	80 (4.6)	120 (6.3)	12 (2.5)	7 (1.5)
Syndrome ^c - Traumatic wound	23 (1.8)	10 (1.5)	18 (1.0)	11 (0.6)	5 (0.9)	14 (3.1)

^a Excludes 45 MSSA and 25 MRSA cases with unknown epidemiological class

^b Some case patients had more than one underlying condition. Excludes 8 CA MSSA, 6 CA MRSA, 11 HACO MSSA, 7 HACO MRSA, 3 HO MSSA, and 1 HO MRSA cases with unknown underlying conditions

^c Some case patients had more than one syndrome

^d Catheter site infection or AV fistula infection only are included in BSI with other syndrome

- ^e Combines deep tissue/organ infection and infection of a surgical wound, post-operatively
- ^f Category includes skin abscess, necrotizing fasciitis, gangrene
- ^g Category includes non-traumatic and other chronic wound infections

Selected Healthcare Exposures and Risk Factors for Invasive MSSA (N=3593) and MRSA (N=3051)

Exposures	MSSA No. (%)	MRSA No. (%)
Healthcare facility stay in the year before incident specimen collection	1656 (46.1)	2012 (66.0)
Acute care hospitalization	1573 (43.8)	1860 (61.0)
Long-term care facility residence	379 (10.5)	850 (27.9)
Long-term acute care hospitalization	10 (0.3)	33 (1.1)
Surgery in the year before the date of incident specimen collection	676 (18.8)	781 (25.6)
Chronic dialysis	489 (13.6)	506 (16.6)
Peritoneal ^a	30 (6.1)	15 (3.0)
Hemodialysis ^b	456 (93.3)	489 (96.6)
AV Fistula/Graft	226 (49.6)	180 (36.8)
CVC	232 (50.9)	306 (62.6)
Unknown	5 (1.1)	8 (1.6)
Unknown dialysis type	3 (0.6)	2 (0.4)
Central vascular catheter in place at any time in the 2 calendar days before incident specimen collection	534 (14.9)	612 (20.1)
Unknown	45 (1.3)	25 (0.8)

^a No cases were reported to receive both peritoneal dialysis and hemodialysis

^b 7 MSSA and 5 MRSA cases had both AV Fistula/Graft and CVC

Number and Incidence Rates of Invasive MSSA (N=3593) and MRSA (N=3051) Infections by Dialysis Status and Epidemiologic Class, 2020

Epidemiologic Class	Dialysis Patients ^a No. (Incidence Rate) MSSA	Dialysis Patients ^a No. (Incidence Rate) MRSA	Non-Dialysis Patients ^b No. (Incidence Rate) MSSA	Non-Dialysis Patients ^b No. (Incidence Rate) MRSA	Total No. (Incidence Rate) MSSA	Total No. (Incidence Rate) MRSA
CA	NA	NA	1307 (12.8)	665 (4.4)	1307 (12.7)	665 (4.4)
HCA ^c	489 (2130.7)	507 (1678.1)	1752 (17.1)	1854 (12.3)	2241 (21.8)	2361 (15.5)
HO	39 (169.9)	55 (181.7)	448 (4.4)	403 (2.7)	487 (4.7)	458 (3.0)
HACO	450 (1960.8)	452 (1496.4)	1304 (12.7)	1451 (9.6)	1754 (17.1)	1903 (12.5)
Overall ^d	494 (2152.5)	513 (1694.9)	3099 (30.2)	2538 (16.7)	3593 (35.0)	3051 (20.1)

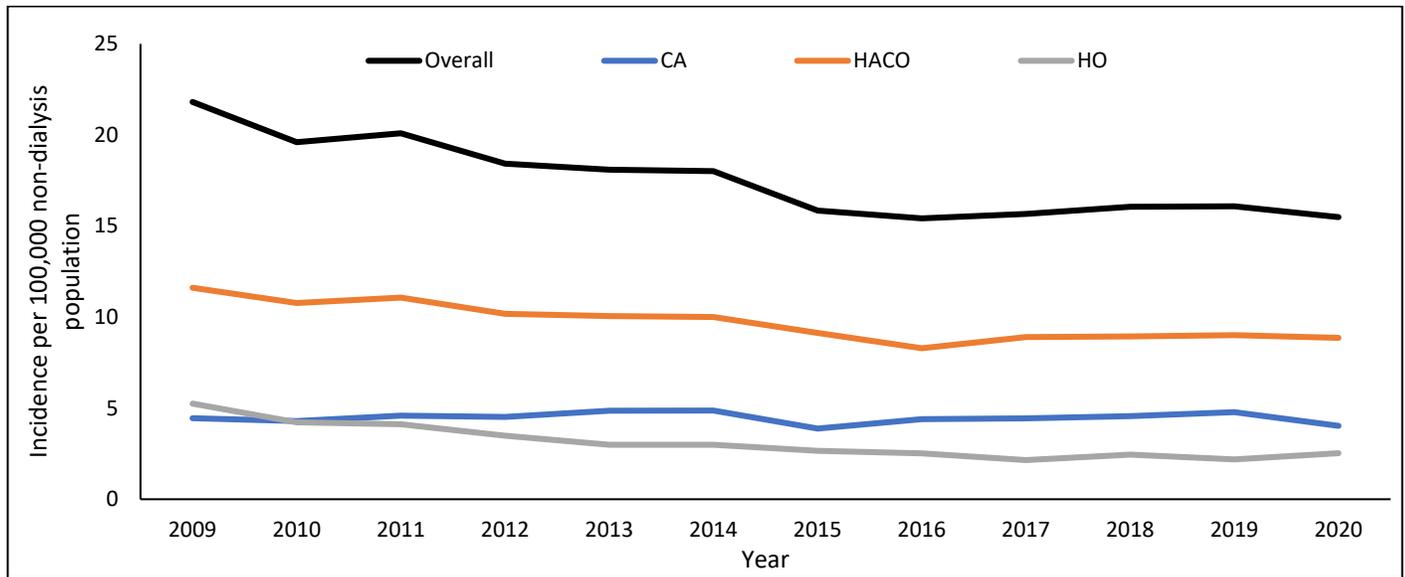
^a Incidence (no. per 100,000 dialysis patients per year) for dialysis patients calculated using 2019 USRDS point prevalence data

^b Incidence (no. per 100,000 population per year) calculated using 2020 U.S. Census Data

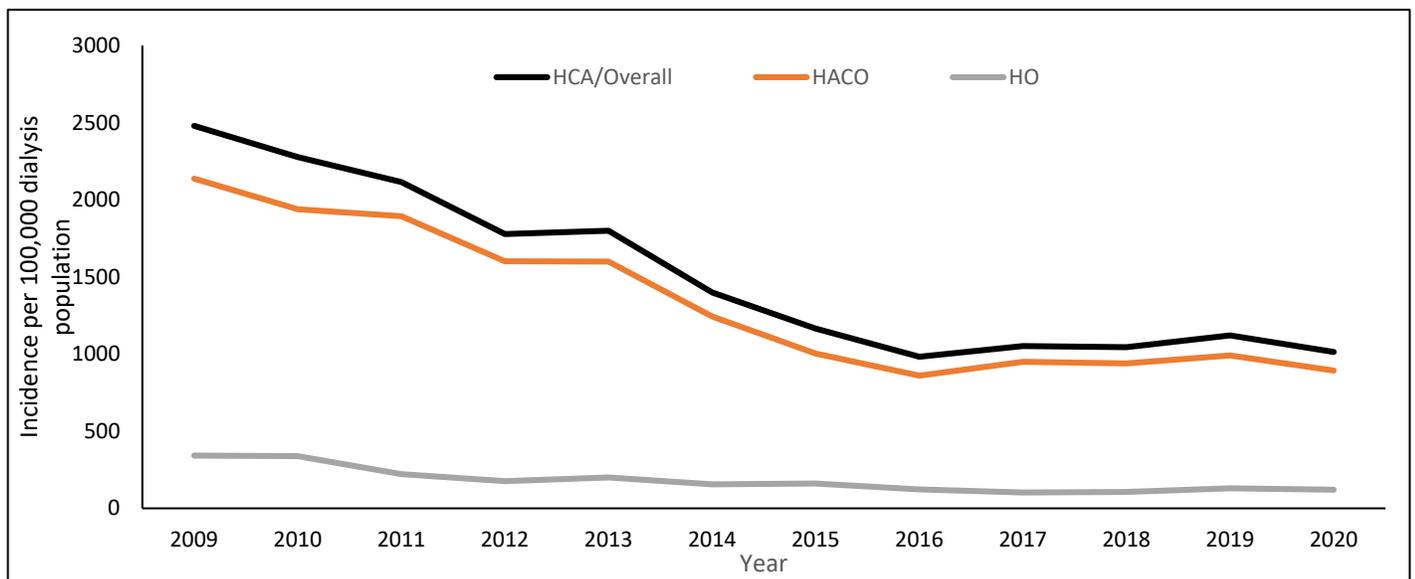
^c HCA: Healthcare-associated invasive MRSA infection; sum of patients that are classified as either the HO or HACO classes

^d The overall counts and rates include 45 MSSA and 25 MRSA cases with unknown epidemiological class

Incidence of Invasive MRSA Among Persons Not on Dialysis by Epidemiologic Class, 2009–2020^a



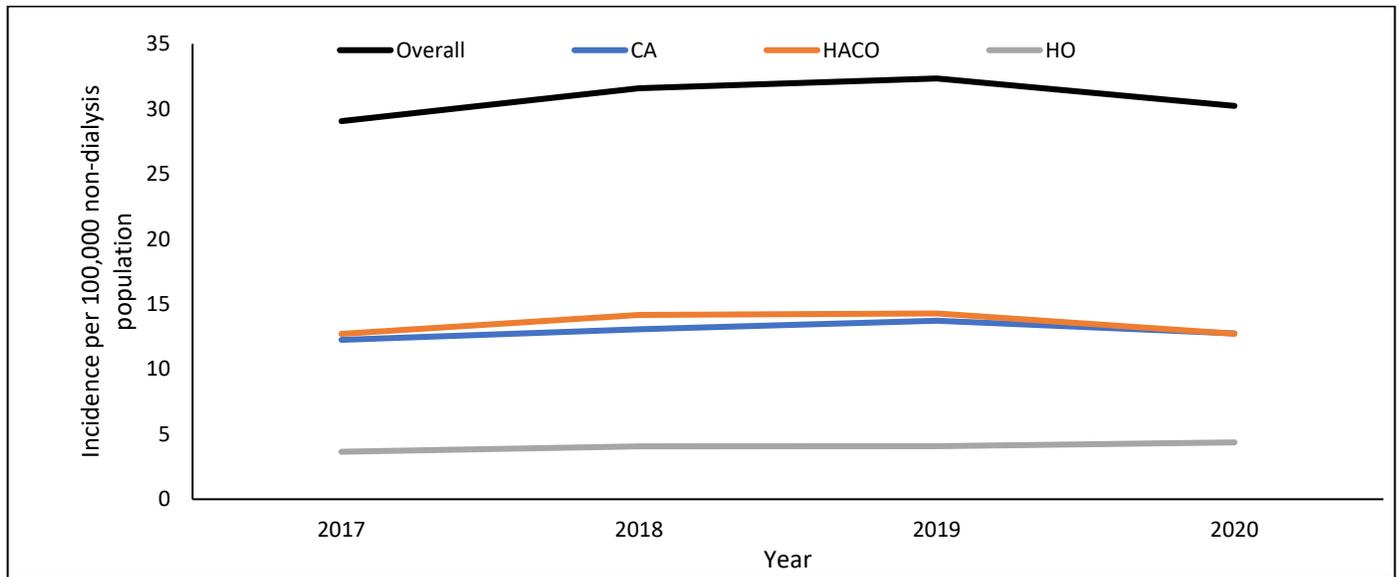
Incidence of Invasive MRSA among Persons on Dialysis by Epidemiologic Class, 2009–2020^{a,b}



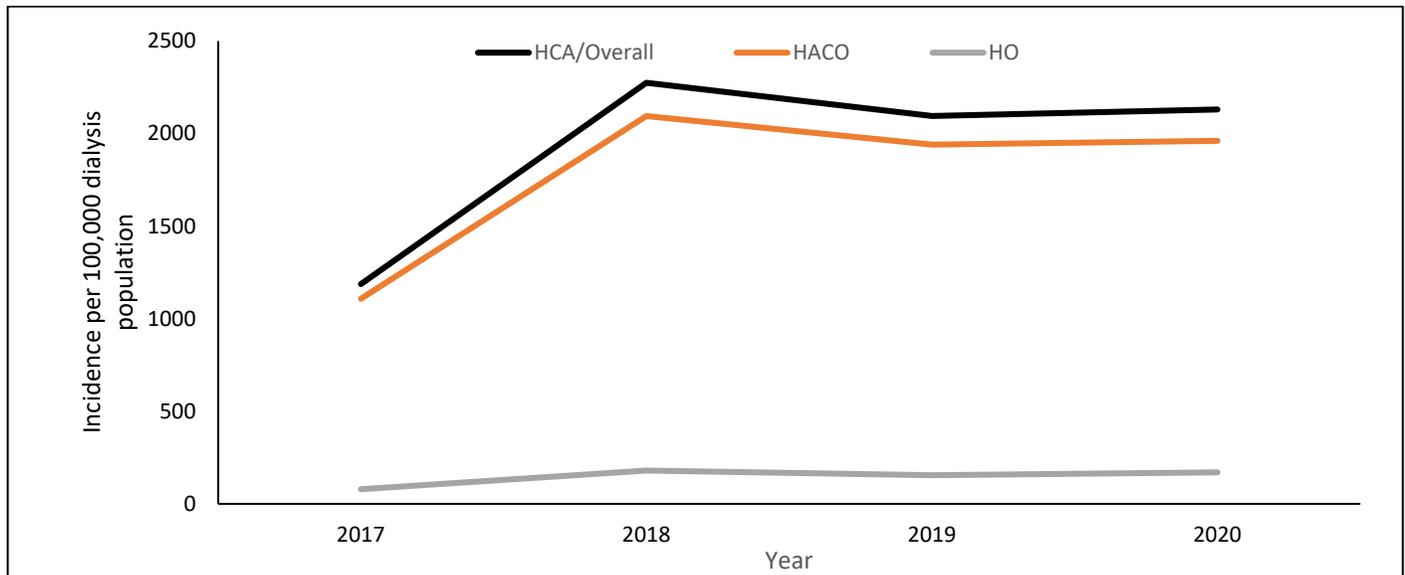
^a Restricted to the continuous catchment area (California [3 county San Francisco Bay area]; Connecticut [Fairfield, Hartford, and New Haven counties]; Georgia [8 county Atlanta area]; Minnesota [1 Saint Paul county]; New York [1 Rochester county]; and Tennessee [1 Nashville county]) for comparison of trends over time.

^b HCA: Healthcare-associated invasive SA infection; sum of patients that are classified as either the HO or HACO classes

Incidence of Invasive MSSA Among Persons Not on Dialysis by Epidemiologic Class, 2017–2020^a



Incidence of Invasive MSSA among Persons on Dialysis by Epidemiologic Class, 2017–2020^{a,b}



^a Restricted to the continuous catchment area (California [3 county San Francisco Bay area]; Connecticut [1 New Haven county]; Georgia [1 Atlanta area county]; Minnesota [2 county Minneapolis–Saint Paul area]; New York [1 Rochester county]; and Tennessee [1 Nashville county]) for comparison of trends over time.

^b HCA: Healthcare-associated invasive SA infection; sum of patients that are classified as either the HO or HACO classes

Outcomes of Invasive MSSA (N=3593^a) and MRSA (N=3051^a) Cases by Epidemiologic Class

Outcomes	CA, No. (%) MSSA (n=1307)	CA, No. (%) MRSA (n=665)	HACO, No. (%) MSSA (n=1754)	HACO, No. (%) MRSA (n=1903)	HO, No. (%) MSSA (n=487)	HO, No. (%) MRSA (n=458)
Died	131 (10.0)	78 (11.7)	200 (11.4)	276 (14.5)	112 (23.0)	138 (30.1)
Survived	1174 (89.8)	582 (87.5)	1547 (88.2)	1618 (85.0)	373 (76.6)	319 (69.7)
Discharge location after acute-care hospitalization among patients who survived ^b - Long-term care facility	325 (31.3)	148 (28.2)	479 (32.3)	666 (42.7)	131 (35.1)	122 (38.2)
Discharge location after acute-care hospitalization among patients who survived ^b - Long-term acute care hospital	15 (1.4)	14 (2.7)	20 (1.4)	29 (1.9)	17 (4.6)	14 (4.4)
Discharge location after acute-care hospitalization among patients who survived ^b - Other ^c	675 (64.9)	335 (64.5)	948 (63.9)	813 (52.1)	220 (59.0)	173 (54.2)
Discharge location after acute-care hospitalization among patients who survived ^b - Unknown	25 (2.4)	22 (4.2)	37 (2.5)	51 (3.3)	5 (1.3)	10 (3.1)
Unknown	2 (0.2)	5 (0.8)	7 (0.4)	9 (0.5)	2 (0.4)	1 (0.2)

^a Excludes 45 MSSA and 25 MRSA cases with unknown epidemiological class

^b Excludes 197 MSSA and 121 MRSA cases not admitted to acute-care hospital

^c Examples include private residence, correctional facility, homeless shelter, and drug rehabilitation program

Summary

Surveillance data from 2020 represent the sixteenth full year of population-based surveillance for invasive MRSA infections through the Emerging Infections Program, and the fifth for MSSA.

Incidence of HO MRSA among persons not on dialysis increased in 2020 compared to 2017-2019. Conversely, incidence of HACO and CA MRSA and HACO/HCA MRSA among dialysis patients decreased in 2020, interrupting the previous increases that had been noted since 2017. HACO and CA MSSA incidence among persons not on dialysis decreased compared to 2018 and 2019, but HO MSSA incidence among persons not on dialysis increased slightly and is the highest observed since 2017.

Citation

Centers for Disease Control and Prevention. 2022. Emerging Infections Program, Healthcare-Associated Infections – Community Interface Surveillance Report, Invasive *Staphylococcus aureus*, 2020. Available at: <https://www.cdc.gov/hai/eip/pdf/2020-MRSA-Report-508.pdf>

For more information, visit our web sites:

- [Invasive *Staphylococcus aureus* \(MRSA/MSSA\) Infection Tracking](https://www.cdc.gov/hai/eip/saureus.html) (<https://www.cdc.gov/hai/eip/saureus.html>)
- [Methicillin-resistant *Staphylococcus aureus* \(MRSA\)](http://www.cdc.gov/mrsa) (<http://www.cdc.gov/mrsa>)