



Emerging Infections Program Healthcare-Associated Infections Community Interface Report *Invasive Staphylococcus aureus*, 2018

Last Updated: September 15, 2021

Emerging Infections Program (EIP) Surveillance Catchment Areas

Methicillin-resistant *Staphylococcus aureus* (MRSA): California (3 county San Francisco Bay area); Connecticut; 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 16,074,962 persons. The MSSA surveillance areas represent 10,283,632 persons.

Source: National Center for Health Statistics bridged-race vintage 2018 postcensal file.

Case Definition

Invasive *Staphylococcus aureus* (SA) infection: isolation of SA from a normally sterile site in a resident of the surveillance area in 2018. 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.

¹This case definition represents an update in nomenclature from previous years (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. 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 MRSA isolates were collected and sent to CDC for routine testing, including antimicrobial susceptibility testing using reference broth microdilution, toxin testing, *SCCmec* typing, and *spa* typing. Pulsed-field gel electrophoresis (PFGE) of all isolates was discontinued in 2008; up until 2012, PFGE was inferred based on a validated algorithm¹. Starting in 2012, *spa* typing was added to the routine laboratory testing. Pulsed field type is currently inferred based on *spa* type, inferred multilocus sequence typing (MLST) clonal complex and molecular characteristics of the isolates². Isolates identified as USA300 were confirmed using a SNP assay³. In 2018, isolates were collected in five sites (California, Georgia, Minnesota, New York, and Tennessee). Characterization of 2018 isolates is in process.

In 2018, some sites collected limited data from most MRSA hospital-onset cases, with full case report form data collected only for a random sample of 8–91% of hospital-onset cases. Data not collected because of sampling were estimated based on the distribution of collected data to calculate incidence. Detailed case data below only reflect data from full case report forms unless otherwise specified. Rates of invasive SA infection among all patients were calculated using population estimates for 2018. 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, 2017 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, 2009–2018 are restricted to the continuous catchment area (California [3 county San Francisco Bay area]; Connecticut; 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 June 5, 2021 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 [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>)

² [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>)

³ [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>)

Results

MSSA (N=3748) and MRSA (N=3391) Cases by Race

Race	MSSA No. (Rate ^a)		MRSA No. (Rate ^a)	
White	2344	(36.7)	2073	(20.5)
Black	1024	(46.0)	1170	(30.3)
Other	380	(22.7)	148	(7.1)
TOTAL	3748	(36.5)	3319	(21.1)

Unknown race (n= 358 MSSA, n=372 MRSA) distributed amongst known

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

MSSA (N=3748) and MRSA (N=3391) Case and Death Rate by Epidemiological Classification

Class	No. (Rate ^a) MSSA Cases	No. (Rate) MSSA Deaths	No. (Rate) MRSA Cases	No. (Rate) MRSA Deaths
CA	1340 (13.0)	116 (1.1)	790 (4.9)	72 (0.5)
HCA ^b	2378 (23.2)	271 (2.7)	2575 (16.0)	361 (2.2)
HO ^c	458 (4.5)	78 (0.8)	486 (3.0)	81 (0.5)
HACO	1920 (18.7)	193 (1.9)	2089 (13.0)	280 (1.7)
Unknown	30 (0.3)	7 (0.03)	26 (0.2)	4 (0.02)

^a Cases per 100,000 population for EIP areas (crude rates) calculated using 2018 U.S. Census Data

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

^c HO MRSA rate imputed from a sample of cases.

MSSA (N=3748) and MRSA (N=3391) Cases by Race/Ethnicity

Race/Ethnicity	MSSA No. (%)	MRSA No. (%)
Hispanic, any race	295 (7.9)	180 (5.3)
Not known to be Hispanic ^a - White ^b	2021 (53.9)	1701 (50.2)
Not known to be Hispanic ^a - Black or African American ^c	908 (24.2)	977 (28.8)
Not known to be Hispanic ^a - Asian ^d	236 (6.3)	92 (2.7)
Not known to be Hispanic ^a - Other or multiple races ^e	92 (2.5)	32 (0.9)
Not known to be Hispanic ^a - Unknown race, non-Hispanic	75 (2.0)	185 (5.5)
Unknown race and ethnicity	121 (3.2)	224 (6.6)

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

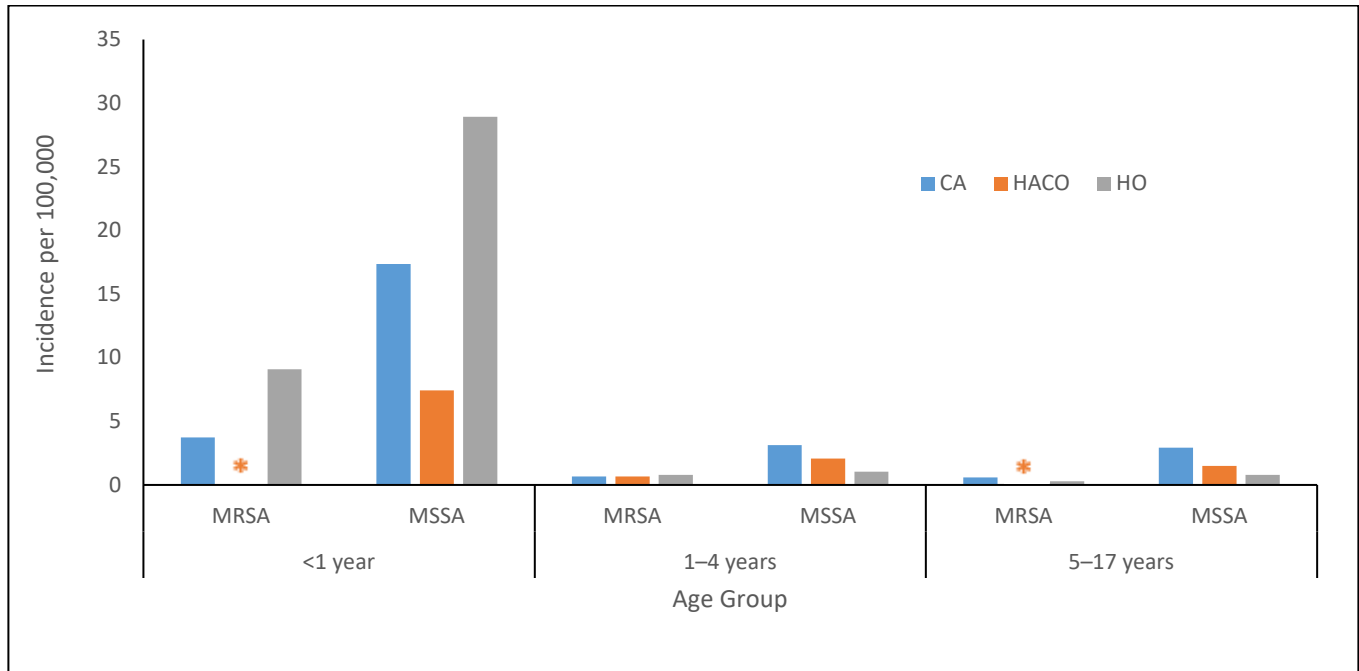
^b 254 MSSA cases and 159 MRSA cases with unknown ethnicity

^c 107 MSSA cases and 90 MRSA cases with unknown ethnicity

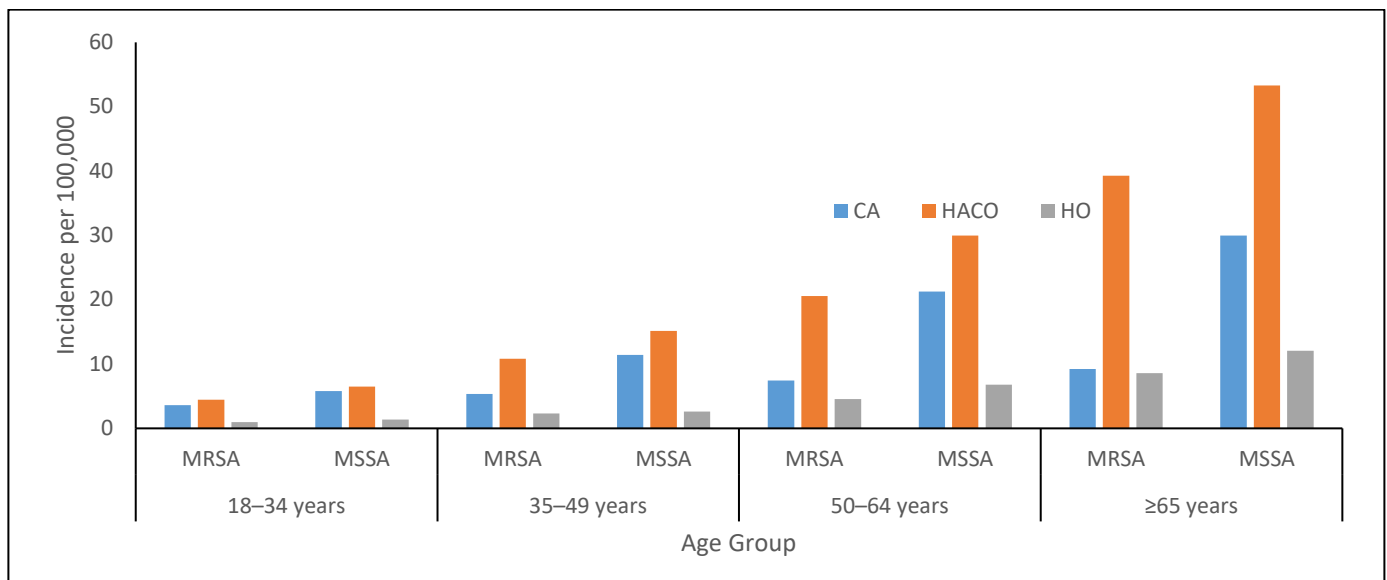
^d 56 MSSA cases and 16 MRSA cases with unknown ethnicity

^e American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, or ≥ 2 races reported; 17 MSSA cases and 4 MRSA cases with unknown ethnicity

Incidence^{a,b} of Invasive *Staphylococcus aureus*, by Epidemiologic Class, Pediatric Age Groups, and Methicillin-Resistance Status, 2018



Incidence^a of Invasive *Staphylococcus aureus*, by Epidemiologic Class, Adult Age Groups, and Methicillin-Resistance Status, 2018



^a Incidence (no. per 100,000 population per year) calculated using 2018 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=3748) and MRSA (N=3196^a) Cases Before Incident Specimen Collection

Location of patient before incident specimen collection ^b	MSSA No. (%)	MRSA ^a No. (%)
Private residence	2822 (75.3)	2139 (66.9)
Long-term care facility	232 (6.2)	514 (16.1)
Acute-care hospital (inpatient)	488 (13.0)	323 (10.1)
Long-term acute care hospital	0 (0.0)	18 (0.6)
Homeless	167 (4.5)	172 (5.4)
Incarcerated	11 (0.3)	14 (0.4)
Other	0 (0.0)	0 (0.0)
Unknown	28 (0.7)	16 (0.5)

^a Represents a subset of HO MRSA cases due to sampling

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

Location of Invasive MSSA (N=3748) and MRSA (N=3196^a) Cases At Incident Specimen Collection

Location of incident specimen collection	MSSA No. (%)	MRSA ^a No. (%)
Outpatient setting or emergency department	2659 (70.9)	2417 (75.6)
Acute care hospital	1030 (27.5)	706 (22.1)
Long-term care facility	12 (0.3)	40 (1.3)
Long-term acute care hospital	0 (0.0)	14 (0.4)
Other	29 (0.8)	7 (0.2)
Unknown	18 (0.5)	12 (0.4)

^a Represents a subset of HO MRSA cases due to sampling

Selected Clinical Characteristics of Invasive MSSA (N=3718^a) and MRSA (N=3170^{a,b}) Cases by Epidemiological Class, 2018

Characteristics	CA, No. (%) MSSA (n=1340)	CA, No. (%) MRSA (n=790)	HACO, No. (%) MSSA (n=1920)	HACO, No. (%) MRSA (n=2089)	HO, No. (%) MSSA (n=458)	HO, No. (%) MRSA ^b (n=291)
Underlying conditions ^c - Abscess/boil (recurrent)	10 (0.7)	16 (2.0)	19 (1.0)	28 (1.3)	0 (0.0)	2 (0.7)
Underlying conditions ^c - Chronic pulmonary disease	212 (15.9)	143 (18.1)	369 (19.3)	545 (26.2)	97 (21.2)	99 (34.3)
Underlying conditions ^c - Chronic kidney disease	155 (11.6)	84 (10.6)	732 (38.3)	832 (40.0)	114 (24.9)	81 (28.0)
Underlying conditions ^c - Chronic skin breakdown	208 (15.6)	107 (13.6)	275 (14.4)	412 (19.8)	40 (8.7)	33 (11.4)
Underlying conditions ^c - Decubitus/pressure ulcer	44 (3.3)	30 (3.8)	98 (5.1)	270 (13.0)	10 (2.2)	17 (5.9)
Underlying conditions ^c - Diabetes mellitus	385 (28.9)	234 (29.7)	758 (39.6)	984 (47.3)	132 (28.8)	109 (37.7)
Underlying conditions ^c - Hemiplegia/paraplegia	23 (1.7)	15 (1.9)	46 (2.4)	111 (5.3)	9 (2.0)	5 (1.7)
Underlying conditions ^c - Intravenous drug use	179 (13.4)	211 (26.7)	179 (9.4)	248 (11.9)	18 (3.9)	30 (10.4)
Underlying conditions ^c - Obesity or morbid obesity	185 (13.9)	92 (11.7)	327 (17.1)	300 (14.4)	69 (15.1)	47 (16.3)
Underlying conditions ^c - Pregnancy	6 (<0.01)	4 (<0.01)	1 (<0.01)	3 (<0.01)	0 (0.0)	0 (0.0)
Syndrome ^d - Bloodstream infection ^e with other syndrome	738 (55.1)	527 (66.7)	1007 (52.4)	1265 (60.6)	169 (36.9)	120 (41.2)

Syndrome ^d - Bloodstream infection with no other syndrome	312 (23.3)	146 (18.5)	642 (33.4)	626 (30.0)	185 (40.4)	96 (33.0)
Syndrome ^d - Pneumonia	136 (10.2)	132 (16.7)	219 (11.4)	270 (12.9)	77 (16.8)	50 (17.2)
Syndrome ^d - Osteomyelitis	187 (14.0)	99 (12.5)	216 (11.3)	301 (14.4)	39 (8.5)	31 (10.7)
Syndrome ^d - Endocarditis	114 (8.5)	117 (14.8)	158 (8.2)	225 (10.8)	11 (2.4)	21 (7.2)
Syndrome ^d - Cellulitis	230 (17.2)	168 (21.3)	181 (9.4)	222 (10.6)	36 (7.9)	25 (8.6)
Syndrome ^d - Surgical wound ^f	11 (0.8)	8 (1.0)	112 (5.8)	97 (4.6)	25 (5.5)	12 (4.1)
Syndrome ^d - Decubitus/pressure ulcer	17 (1.3)	5 (0.6)	34 (1.8)	68 (3.3)	5 (1.1)	2 (0.7)
Syndrome ^d - Skin abscess ^g	76 (5.7)	54 (6.8)	78 (4.1)	83 (4.0)	18 (3.9)	10 (3.4)
Syndrome ^d - Other wound ^h	59 (4.4)	18 (2.3)	95 (4.9)	102 (4.9)	12 (2.6)	7 (2.4)
Syndrome ^d - Traumatic wound	13 (1.0)	8 (1.0)	11 (0.6)	7 (0.3)	3 (0.7)	3 (1.0)

^a Excludes 30 MSSA and 26 MRSA cases with unknown epidemiological class

^b Represents a subset of HO MRSA cases due to sampling

^c Some case patients had more than one underlying condition. Excludes 6 CA MSSA, 1 CA MRSA, 7 HACO MSSA, 7 HACO MRSA, 0 HO MSSA, and 2 HO MRSA cases with unknown underlying conditions; Pregnancy status was unknown for 147 CA MSSA, 158 CA MRSA, 169 HACO MSSA, 355 HACO MRSA, 45 HO MSSA, and 70 HO MRSA cases

^d Some case patients had more than one syndrome

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

^f Combines deep tissue/organ infection and infection of a surgical wound, post-operatively

^g Category includes skin abscess, necrotizing fasciitis, gangrene

^h Category includes non-traumatic and other chronic wound infections

Selected Healthcare Exposures or Risk Factors for Invasive MSSA (N=3748) and MRSA (N=3196^a)

Exposures	MSSA No. (%)	MRSA ^a No. (%)
Healthcare facility stay in the year before incident specimen collection	1879 (50.1)	2114 (66.1)
Acute care hospitalization	1791 (47.8)	1974 (61.8)
Long-term care facility residence	400 (10.7)	791 (24.7)
Long-term acute care hospitalization	12 (0.3)	35 (1.1)
Surgery in the year before the date of incident specimen collection	701 (18.7)	861 (26.9)
Chronic dialysis	506 (13.5)	521 (16.3)
Peritoneal	31 (6.1)	15 (2.9)
Hemodialysis ^b	472 (93.3)	506 (97.1)
AV Fistula/Graft	240 (50.9)	237 (46.8)
CVC	229 (48.5)	253 (50.0)
Unknown	8 (1.7)	16 (3.2)
Unknown	3 (0.6)	0 (0.0)
Central vascular catheter in place at any time in the 2 calendar days incident specimen collection	453 (12.1)	469 (14.7)
Unknown	32 (0.9)	28 (0.9)

^a Represents a subset of HO MRSA cases due to sampling

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

Number and Incidence Rates of Invasive MRSA and MSSA Infections by Dialysis Status and Epidemiologic Class, 2018

Epidemiologic Class	Dialysis Patients ^a No. (Incidence Rate) MSSA	Dialysis Patients ^b No. (Incidence Rate) MRSA	Non-Dialysis Patients ^c No. (Incidence Rate) MSSA	Non-Dialysis Patients ^d No. (Incidence Rate) MRSA	Total No. (Incidence Rate) MSSA	Total No. (Incidence Rate) MRSA
CA	NA	NA	1340 (13.1)	790 (4.9)	1340 (13.0)	790 (4.9)
HCA ^e	506 (2332.2)	541 (1680.8)	1872 (18.3)	2034 (12.7)	2378 (23.2)	2575 (16.0)
HO ^f	40 (184.4)	57 (177.1)	418 (4.1)	429 (2.7)	458 (4.5)	486 (3.0)
HACO	466 (2147.9)	484 (1503.7)	1454 (14.2)	1605 (10.0)	1920 (18.7)	2089 (13.0)
Overall ^e	506 (2332.2)	541 (1680.8)	3242 (31.6)	2850 (17.8)	3748 (36.5)	3391 (21.1)

^a Incidence (no. per 100,000 dialysis patients per year) for dialysis patients calculated using 2017 USRDS point prevalence data

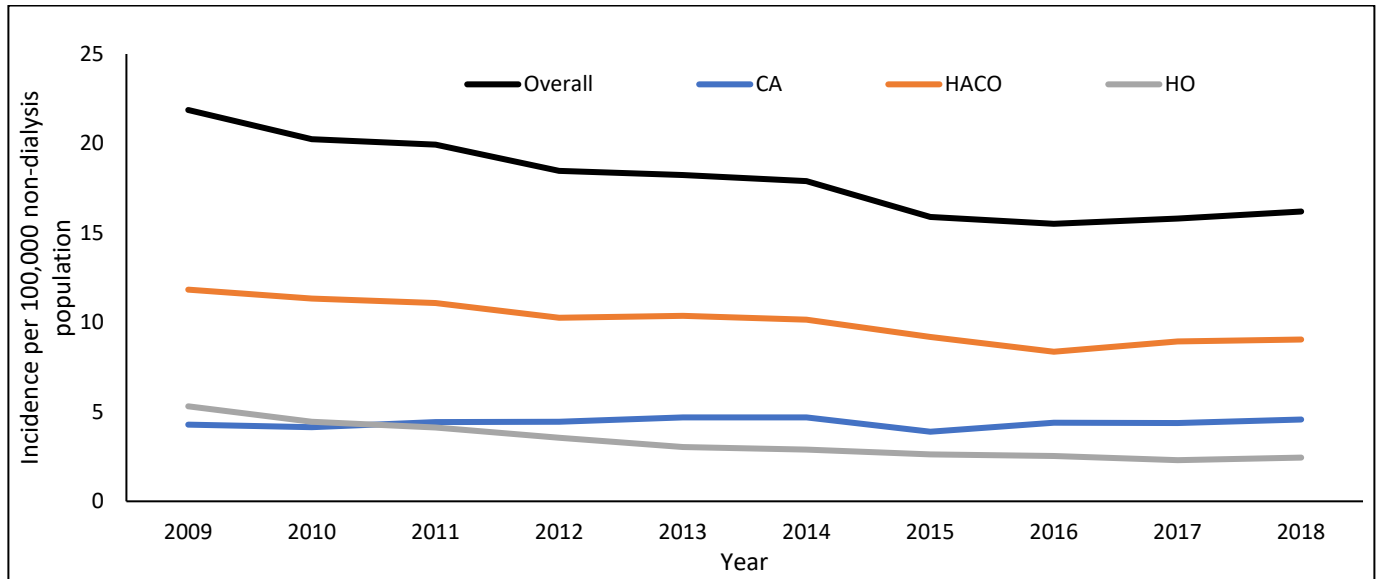
^b Incidence (no. per 100,000 population per year) calculated using 2018 U.S. Census Data

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

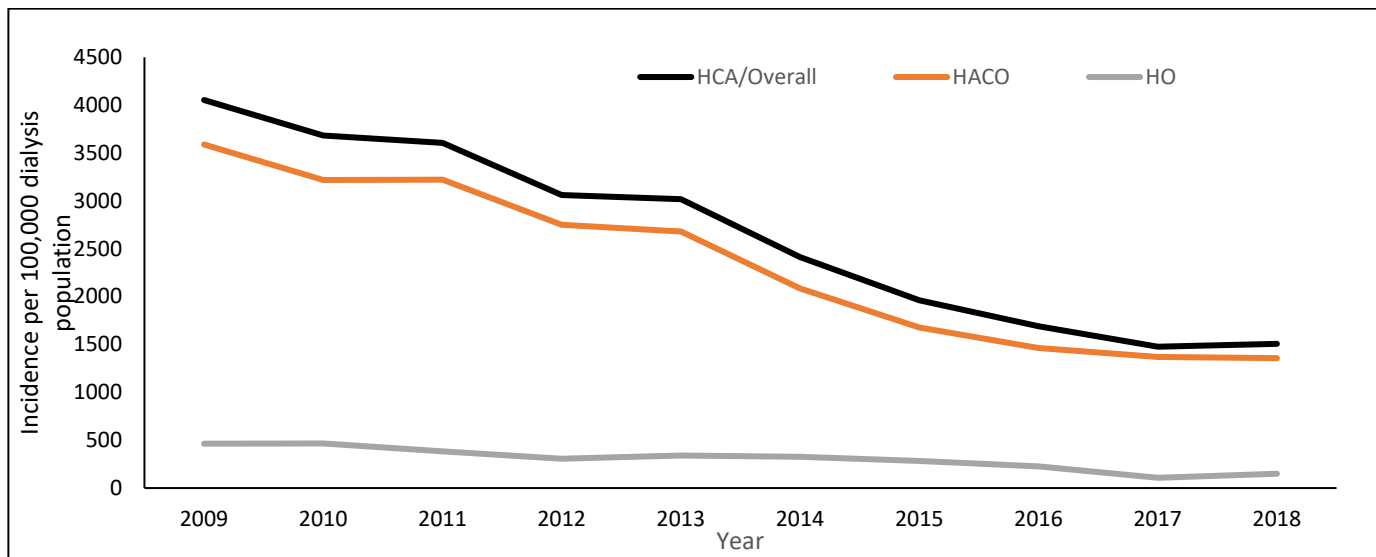
^d Dialysis and non-dialysis estimated number and incidence based on data from a sample of HO MRSA cases

^e The overall counts and rates include 30 MSSA and 26 MRSA cases with unknown epidemiological class

Incidence of Invasive MRSA Among Persons Not on Dialysis by Epidemiologic Class, 2009–2018^a



Incidence of Invasive MRSA among Persons on Dialysis by Epidemiologic Class, 2009–2018^{a,b}



^a Restricted to the continuous catchment area (California [3 county San Francisco Bay area]; Connecticut; 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

Outcomes of Invasive MSSA (N=3748^a) and MRSA (N=3196^{a,b}) Cases by Epidemiologic Class

Outcomes	CA, No. (%) MSSA (n=1340)	CA, No. (%) MRSA (n=790)	HACO, No. (%) MSSA (n=1920)	HACO, No. (%) MRSA (n=2089)	HO, No. (%) MSSA (n=458)	HO, No. (%) MRSA ^b (n=291)
Died	116 (8.6)	72 (9.1)	193 (10.1)	280 (13.4)	78 (17.0)	56 (19.2)
Survived	1223 (91.3)	717 (90.8)	1719 (89.5)	1804 (86.4)	379 (82.8)	235 (80.8)
Discharge location after acute-care hospitalization among patients who survived - Long-term care facility	354 (28.9)	216 (30.1)	602 (35.0)	818 (45.3)	148 (39.1)	108 (46.0)
Discharge location after acute-care hospitalization among patients who survived - Long-term acute care hospital	15 (1.2)	10 (1.4)	31 (1.8)	53 (2.9)	17 (4.5)	12 (5.1)
Discharge location after acute-care hospitalization among patients who survived - Other ^c	847 (69.2)	491 (68.5)	1084 (63.1)	929 (51.5)	214 (56.5)	115 (48.9)
Discharge location after acute-care hospitalization among patients who survived - Unknown	7 (0.6)	0 (0.0)	2 (0.1)	4 (0.2)	0 (0.0)	0 (0.0)
Unknown	1 (0.1)	1 (0.1)	8 (0.4)	5 (0.2)	1 (0.2)	0 (0.0)

^a Excludes 30 MSSA and 26 MRSA cases with unknown epidemiological class

^b Represents a subset of HO MRSA cases due to sampling

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

Summary

Surveillance data from 2018 represent the fourteenth full year of population-based surveillance for invasive MRSA infections through the Emerging Infections Program, and the third for MSSA. Incidence of invasive HO and HACO MRSA has decreased since 2009, but has increased for CA, HO, and HACO MRSA since 2017 among persons not on dialysis. MSSA incidence was greater in 2018 than in 2017 for every epidemiologic class.

Citation

1. Centers for Disease Control and Prevention. 2021. Emerging Infections Program, Healthcare-Associated Infections – Community Interface Surveillance Report, Invasive *Staphylococcus aureus*, 2018. Available at: <https://www.cdc.gov/hai/eip/pdf/2018-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>)