Emerging Infections Program
Healthcare-Associated Infections Community Interface Report
Invasive *Staphylococcus aureus*, 2019

Last Updated: January 4, 2022

Note: Other CDC reports[1] highlight a more recent increase in methicillin-resistant *S. aureus* infections that may be related to impacts of the COVID-19 pandemic on population health, antimicrobial resistance, and healthcare delivery.

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 16,105,493 persons. The MSSA surveillance areas represent 10,298,036 persons.

Source: National Center for Health Statistics bridged-race vintage 2019 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 2019. 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 0[2];
- healthcare-associated community-onset (HACO) if the culture was obtained in an outpatient setting or before the third[1] 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] 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.
(https://doi.org/10.1017/ice.2021.362)

[2] This 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. 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, 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 algorithm[1]. 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 isolates[2]. Isolates identified as USA300 were confirmed using a SNP assay[3]. In 2019, MRSA isolates were collected in five sites (California, Georgia, Minnesota, New York, and Tennessee) and MSSA isolates in two (Georgia and New York). Characterization of 2019 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 2019. 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, 2018 point prevalent counts of patients on dialysis from the United States Renal Data System (USRDS) (https://www.usrds.org/). The figures depicting the incidence of invasive MRSA among persons on dialysis and not on dialysis by epidemiologic classification, 2009–2019 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 December 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)

[2] Inferred Identification of Pulsed Field Types based on MLST clonal complex (CC) (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)

Results

MSSA (N=3800) and MRSA (N=3437) Cases by Race

Race	MSSA No. (Rate[a])	MRSA No. (Rate[a])
White	2396 (36.9)	2134 (21.2)
Black	984 (44.1)	1148 (29.5)
Other	420 (24.8)	155 (7.3)
TOTAL	3800 (36.9)	3437 (21.3)

Unknown race (n= 450 MSSA, n= 345 MRSA) distributed amongst known

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

MSSA (N=3800) and MRSA (N=3437) 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	1410 (13.7)	119 (1.2)	838 (5.2)	54 (0.3)
HCA[b]	2361 (22.9)	293 (2.8)	2576 (16.0)	406 (2.5)
HO	454 (4.4)	97 (0.9)	446 (2.8)	117 (0.7)
HACO	1907 (18.5)	196 (1.9)	2130 (13.2)	289 (1.8)
Unknown	29 (0.3)	0 (0.0)	23 (0.1)	1 (<0.01)

[a] Cases per 100,000 population for EIP areas (crude rates) calculated using 2019 U.S. Census Data

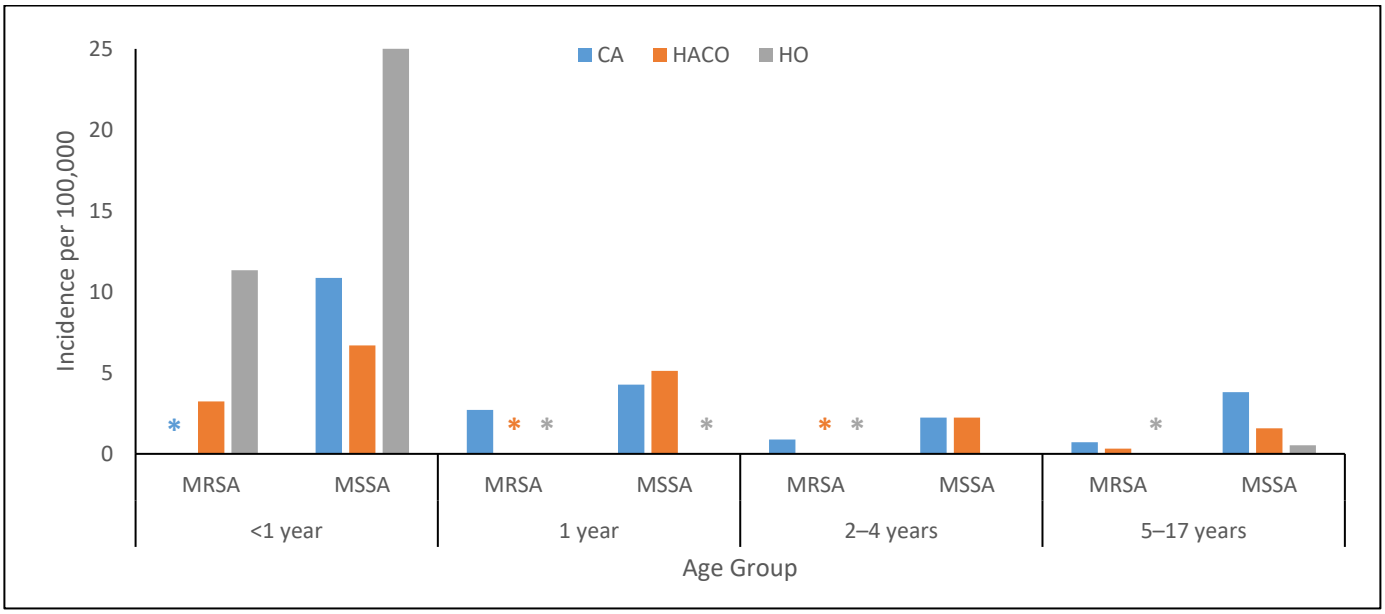
[b] HCA: Healthcare-associated invasive SA infection; sum of patients that are classified as either the HO or HACO classes

MSSA (N=3800) and MRSA (N=3437) Cases by Race and Ethnicity

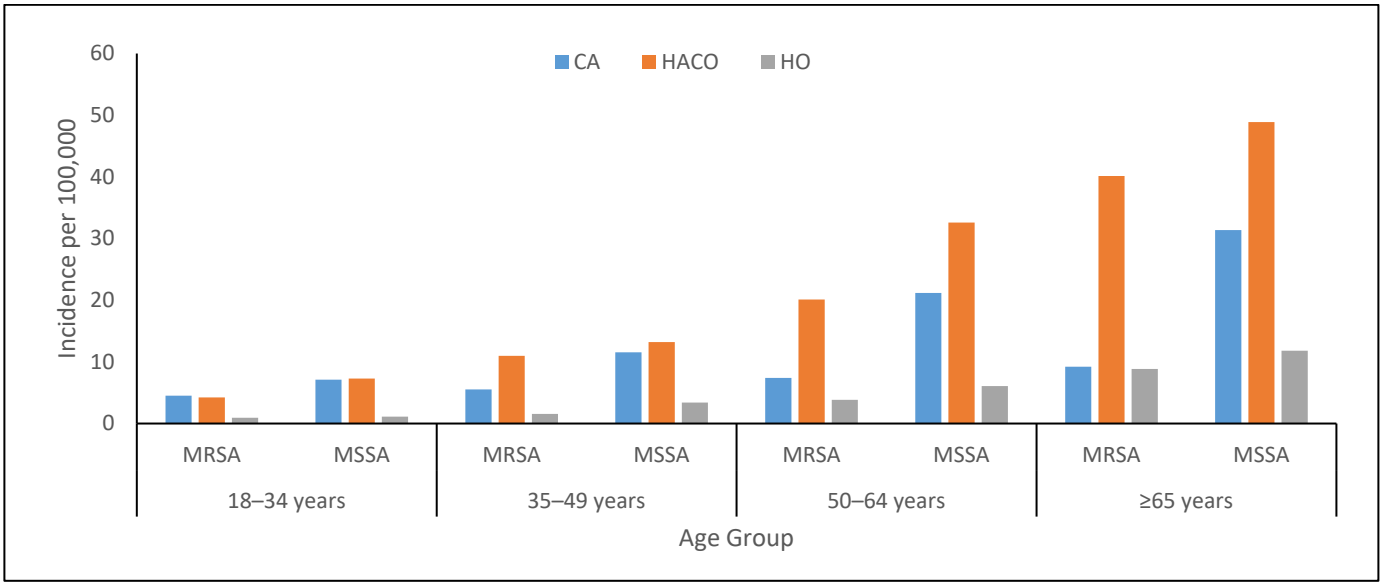
Race/Ethnicity	MSSA No. (%)	MRSA No. (%)
Hispanic, any race	360 (9.5)	231 (6.7)
Not known to be Hispanic[a] - White[b]	2027 (53.3)	1844 (53.7)
Not known to be Hispanic[a] - Black or African American[c]	880 (23.2)	1045 (30.4)
Not known to be Hispanic[a] - Asian[d]	266 (7.0)	84 (2.4)
Not known to be Hispanic[a] - Other or multiple races[e]	75 (2.0)	58 (1.7)
Not known to be Hispanic[a,f] - Unknown race	192 (5.1)	175 (5.1)

[a] Records either indicated ethnicity was non-Hispanic, or ethnicity was not known
[b] 217 MSSA cases and 172 MRSA cases with unknown ethnicity
[c] 78 MSSA cases and 78 MRSA cases with unknown ethnicity
[d] 59 MSSA cases and 10 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 33 MRSA cases with unknown ethnicity
[f] Of cases with unknown race, 113 MSSA and 135 MRSA cases had unknown ethnicity

Incidence[a,b] of Invasive *Staphylococcus aureus*, by Epidemiologic Class, Pediatric Age Groups, and Methicillin-Resistance Status, 2019



Incidence[a] of Invasive *Staphylococcus aureus*, by Epidemiologic Class, Adult Age Groups, and Methicillin-Resistance Status, 2019



[a] Incidence (no. per 100,000 population per year) calculated using 2019 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=3800) and MRSA (N=3437) Cases Before Incident Specimen Collection

Location of patient before incident specimen collection[a]	MSSA No. (%)	MRSA[a] No. (%)
Private residence	2930 (77.1)	2270 (66.0)
Long-term care facility	219 (5.8)	502 (14.6)
Acute-care hospital (inpatient)	442 (11.6)	415 (12.1)
Long-term acute care hospital	8 (0.2)	12 (0.3)
Homeless	157 (4.1)	177 (5.2)
Incarcerated	8 (0.2)	22 (0.6)
Other	8 (0.2)	5 (0.1)
Unknown	28 (0.7)	34 (0.99)

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

Location of Invasive MSSA (N=3800) and MRSA (N=3437) Cases At Time of Incident Specimen Collection

Location of incident specimen collection	MSSA No. (%)	MRSA[a] No. (%)
Outpatient setting or emergency department	2671 (70.3)	2426 (70.6)
Acute care hospital	1075 (28.3)	944 (27.5)
Long-term care facility	15 (0.4)	28 (0.8)
Long-term acute care hospital	3 (0.1)	5 (0.1)
Other	16 (0.4)	11 (0.3)
Unknown	20 (0.5)	23 (0.7)

Selected Clinical Characteristics of Invasive MSSA (N=3800[a]) and MRSA (N=3437[a]) Cases by Epidemiological Class, 2019

Characteristics	CA, No. (%) MSSA (n=1410)	CA, No. (%) MRSA (n=838)	HACO, No. (%) MSSA (n=1907)	HACO, No. (%) MRSA (n=2130)	HO, No. (%) MSSA (n=454)	HO, No. (%) MRSA (n=446)
Charlson comorbidity index[b] - 0	551 (39.3)	304 (36.6)	295 (15.6)	226 (10.7)	119 (26.2)	87 (19.5)
Charlson comorbidity index[b] - 1	407 (29.0)	281 (33.9)	347 (18.3)	372 (17.6)	78 (17.2)	64 (14.4)
Charlson comorbidity index[b] - ≥2	444 (31.7)	245 (29.5)	1255 (66.2)	1518 (71.7)	257 (56.6)	295 (66.1)
Underlying conditions[b] – Burn/surgical wound	5 (0.4)	4 (0.5)	27 (1.4)	51 (2.4)	3 (0.7)	9 (2.0)
Underlying conditions[b] - Chronic pulmonary disease	203 (14.4)	146 (17.4)	382 (20.0)	557 (26.2)	79 (17.4)	116 (26.0)
Underlying conditions[b] - Chronic kidney disease	154 (10.9)	77 (9.2)	729 (38.2)	873 (41.0)	135 (29.7)	150 (33.6)
Underlying conditions[b] - Decubitus/pressure ulcer	36 (2.6)	41 (4.9)	97 (5.1)	215 (10.1)	14 (3.1)	39 (8.7)
Underlying conditions[b] - Diabetes mellitus	410 (29.1)	227 (27.1)	788 (41.3)	997 (46.8)	155 (34.1)	164 (36.8)
Underlying conditions[b] - Hemiplegia	5 (0.4)	4 (0.5)	14 (0.7)	28 (1.3)	3 (0.7)	5 (1.1)
Underlying conditions[b] - Injection drug use	191 (13.5)	221 (26.4)	143 (7.5)	217 (10.2)	19 (4.2)	28 (6.3)
Underlying conditions[b] - Obesity or morbid obesity	200 (14.2)	93 (11.1)	360 (18.9)	336 (15.8)	62 (13.7)	72 (16.1)
Underlying conditions[b] - Other chronic ulcer or chronic wound	149 (10.6)	102 (12.2)	231 (12.1)	387 (18.2)	30 (6.6)	47 (10.5)
Underlying conditions[b] - Paraplegia	8 (0.6)	9 (1.1)	26 (1.4)	55 (2.6)	3 (0.7)	9 (2.0)

Underlying conditions[b] - Pregnancy	3 (0.2)	4 (0.5)	3 (0.2)	0 (0.0)	1 (0.2)	2 (0.4)
Syndrome[c] - Bloodstream infection[d] with other syndrome	712 (50.5)	548 (65.4)	935 (49.0)	1255 (58.9)	140 (30.8)	184 (41.3)
Syndrome[c] - Bloodstream infection with no other syndrome	370 (26.2)	158 (18.9)	676 (35.4)	657 (30.8)	234 (51.5)	166 (37.2)
Syndrome[c] - Pneumonia	116 (8.2)	106 (12.6)	161 (8.4)	239 (11.2)	47 (10.4)	72 (16.1)
Syndrome[c] - Osteomyelitis	185 (13.1)	125 (14.9)	214 (11.2)	322 (15.1)	33 (7.3)	40 (9.0)
Syndrome[c] - Endocarditis	122 (8.7)	97 (11.6)	141 (7.4)	219 (10.3)	22 (4.8)	34 (7.6)
Syndrome[c] - Cellulitis	221 (15.7)	185 (22.1)	191 (10.0)	249 (11.7)	29 (6.4)	43 (9.6)
Syndrome[c] - Surgical wound[e]	26 (1.8)	2 (0.2)	110 (5.8)	137 (6.4)	9 (2.0)	13 (2.9)
Syndrome[c] - Decubitus/pressure ulcer	10 (0.7)	7 (0.8)	27 (1.4)	50 (2.3)	4 (0.9)	3 (0.7)
Syndrome[c] - Skin abscess[f]	64 (4.5)	82 (9.8)	63 (3.3)	81 (3.8)	14 (3.1)	12 (2.7)
Syndrome[c] - Other wound[g]	44 (3.1)	21 (2.5)	64 (3.4)	93 (4.4)	6 (1.3)	7 (1.6)
Syndrome[c] - Traumatic wound	6 (0.4)	5 (0.6)	2 (0.1)	10 (0.5)	4 (0.9)	3 (0.7)

[a] Excludes 29 MSSA and 23 MRSA cases with unknown epidemiological class

[b] Some case patients had more than one underlying condition. Excludes 8 CA MSSA, 8 CA MRSA, 10 HACO MSSA, and 14 HACO 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=3800) and MRSA (N=3437)

Exposures	MSSA No. (%)	MRSA No. (%)
Healthcare facility stay in the year before incident specimen collection	1863 (49.0)	2242 (65.2)
Acute care hospitalization	1784 (46.9)	2131 (62.0)
Long-term care facility residence	392 (10.3)	880 (25.6)
Long-term acute care hospitalization	18 (0.5)	41 (1.2)
Surgery in the year before the date of incident specimen collection	778 (20.5)	1028 (29.9)
Chronic dialysis	475 (6.6)	589 (8.1)
Peritoneal[a]	31 (6.5)	19 (3.2)
Hemodialysis[b]	440 (92.6)	570 (96.8)
AV Fistula/Graft	245 (55.7)	256 (44.9)
CVC	191 (43.4)	315 (55.3)
Unknown	8 (1.8)	5 (0.9)
Unknown dialysis type	4 (0.8)	1 (0.2)
Central vascular catheter in place at any time in the 2 calendar days before incident specimen collection	462 (12.2)	617 (18.0)
Unknown	29 (0.8)	25 (0.7)

[a] 1 MRSA case was reported to receive both peritoneal dialysis and hemodialysis

[b] 4 MSSA and 6 MRSA cases had both AV Fistula/Graft and CVC

Number and Incidence Rates of Invasive MRSA and MSSA Infections by Dialysis Status and Epidemiologic Class, 2019

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	1410 (13.7)	838 (5.2)	1410 (13.7)	838 (5.2)
HCA[c]	475 (2094.7)	590 (1712.3)	1886 (18.4)	1986 (12.4)	2361 (22.9)	2576 (16.0)
HO	35 (154.4)	69 (200.2)	419 (4.1)	377 (2.4)	454 (4.4)	446 (2.8)
HACO	440 (1940.4)	521 (1512.1)	1467 (14.3)	1609 (10.0)	1907 (18.5)	2130 (13.2)
Overall[d]	477 (2103.6)	596 (1729.7)	3323 (32.3)	2841 (17.7)	3800 (36.9)	3437 (21.3)

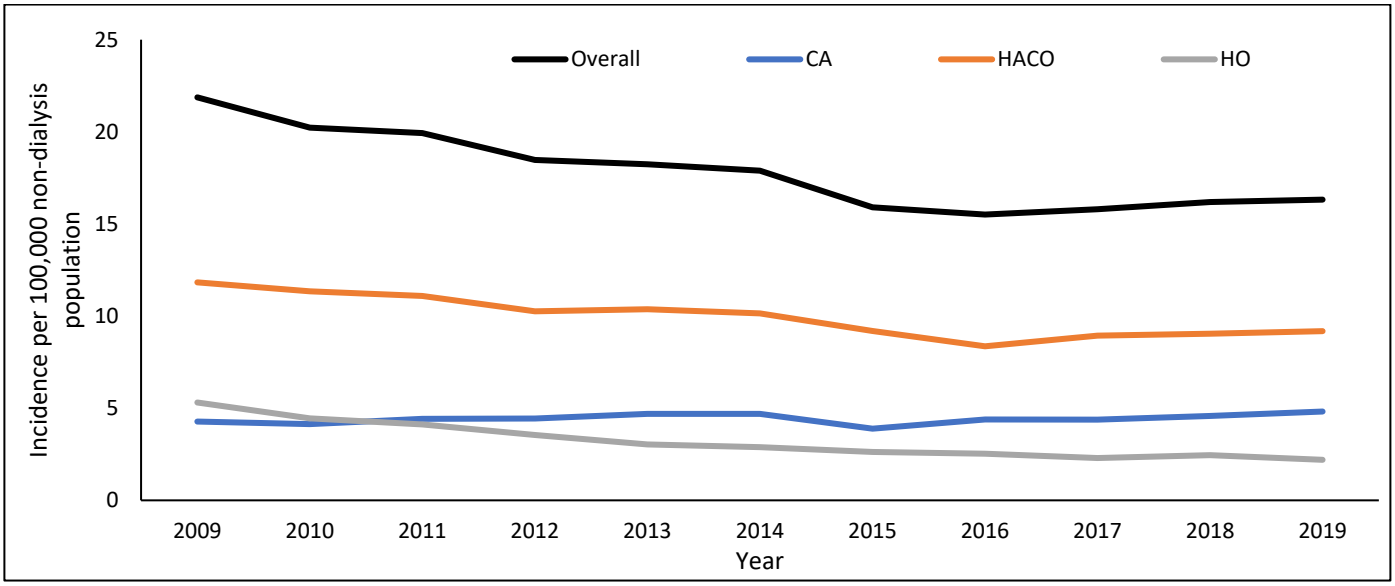
[a] Incidence (no. per 100,000 dialysis patients per year) for dialysis patients calculated using 2018 USRDS point prevalence data

[b] Incidence (no. per 100,000 population per year) calculated using 2019 U.S. Census Data

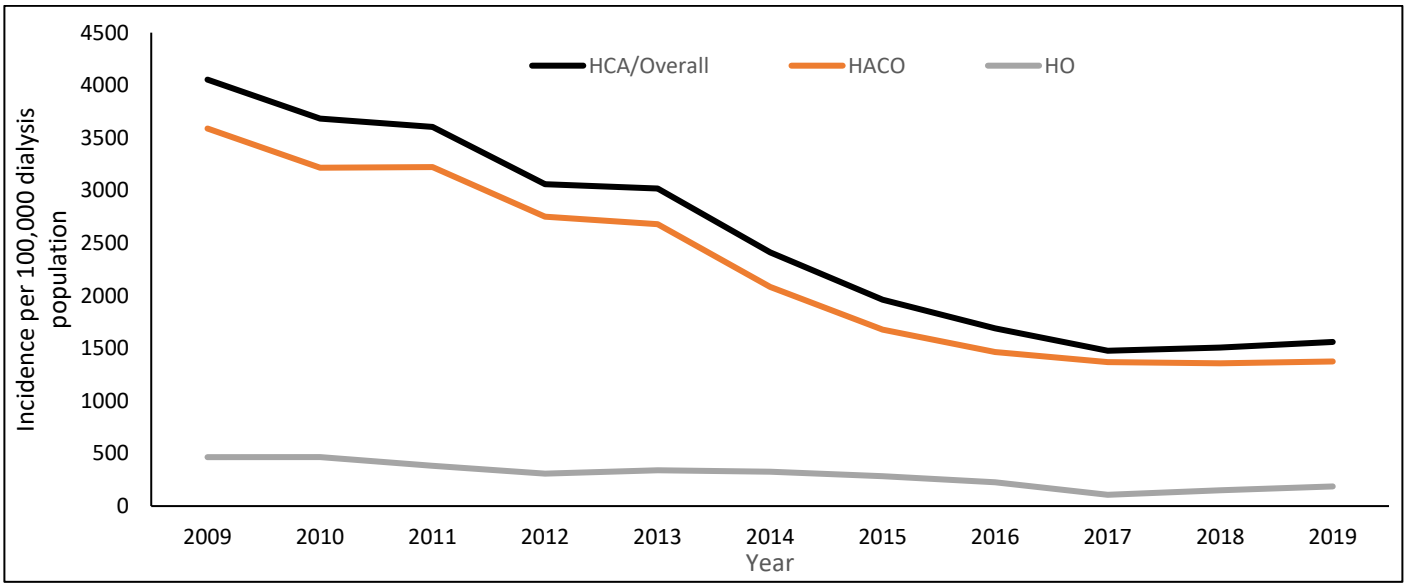
[c] HCA: Healthcare-associated invasive MRSA infection; sum of patients that are classified as either the HO or HACO classes

[d] The overall counts and rates include 29 MSSA and 23 MRSA cases with unknown epidemiological class

Incidence of Invasive MRSA Among Persons Not on Dialysis by Epidemiologic Class, 2009–2019[a]



Incidence of Invasive MRSA among Persons on Dialysis by Epidemiologic Class, 2009–2019[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=3800[a]) and MRSA (N=3437[a]) Cases by Epidemiologic Class

Outcomes	CA, No. (%) MSSA (n=1410)	CA, No. (%) MRSA (n=838)	HACO, No. (%) MSSA (n=1907)	HACO, No. (%) MRSA (n=2130)	HO, No. (%) MSSA (n=454)	HO, No. (%) MRSA (n=446)
Died	119 (8.4)	54 (6.4)	196 (10.3)	289 (13.6)	97 (21.4)	117 (26.2)
Survived	1278 (90.6)	781 (93.2)	1705 (89.4)	1823 (85.6)	356 (78.4)	329 (73.8)
Discharge location after acute-care hospitalization among patients who survived[b] - Long-term care facility	363 (28.4)	234 (30.0)	572 (33.5)	809 (44.4)	136 (38.2)	136 (41.3)
Discharge location after acute-care hospitalization among patients who survived[b] - Long-term acute care hospital	27 (2.1)	13 (1.7)	29 (1.7)	23 (1.3)	14 (3.9)	17 (5.2)
Discharge location after acute-care hospitalization among patients who survived[b] - Other[c]	852 (66.7)	503 (64.4)	1079 (63.3)	937 (51.4)	205 (57.6)	171 (52.0)
Discharge location after acute-care hospitalization among patients who survived[b] – Unknown	11 (0.9)	24 (3.1)	13 (0.8)	37 (2.0)	1 (0.3)	5 (1.5)
Unknown	13 (0.9)	3 (0.4)	6 (0.3)	18 (0.8)	1 (0.2)	0 (0.0)

[a] Excludes 29 MSSA and 23 MRSA cases with unknown epidemiological class

[b] Excludes 37 MSSA and 25 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 2019 represent the fifteenth full year of population-based surveillance for invasive MRSA infections through the Emerging Infections Program, and the fourth for MSSA. Incidence of invasive HO and HACO MRSA has decreased since 2009, but has increased for CA and HACO MRSA since 2017 among persons not on dialysis. CA MSSA incidence and total MSSA incidence increased for the second consecutive year.

Citation

Centers for Disease Control and Prevention. 2021. Emerging Infections Program, Healthcare-Associated Infections – Community Interface Surveillance Report, Invasive *Staphylococcus aureus*, 2019. Available at: https://www.cdc.gov/hai/eip/pdf/2019-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)
- Methicillin-resistant *Staphylococcus aureus* (MRSA) (http://www.cdc.gov/mrsa)