



Healthcare-Associated Infections-Community Interface (HAIC): Emerging Infections Program (EIP) Network Report Invasive *Staphylococcus aureus*, 2017

Last Updated: September 5, 2024

Erratum: The rates among people on dialysis were corrected. The previous version of this report used an incorrect denominator for calculating these rates.

HAIC 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 metro Twin City counties); New York (1 Rochester county); Tennessee (1 Nashville county).

Methicillin-sensitive *Staphylococcus aureus* (MSSA): California (3 county San Francisco Bay area); Connecticut (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).

Note: The population under surveillance for MSSA increased in 2017 with the addition of Baltimore City and County, Maryland and New Haven County, Connecticut.

HAIC Population

The MRSA surveillance areas represent 16,064,290 persons. The MSSA surveillance areas represent 10,279,849 persons.

Source: National Center for Health Statistics bridged-race vintage 2017 postcensal file.

HAIC Case Definition

Invasive *Staphylococcus aureus* (SA) disease: isolation of SA from a normally sterile site in a resident of the surveillance area in 2017. Cases of disease 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 fourth calendar day of hospitalization, where admission is hospital day 1;
- healthcare-associated community-onset (HACO) if the culture was obtained in an outpatient setting or before the fourth 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 MRSA 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.

HAIC Methodology

EIP personnel routinely contacted microbiology laboratories serving healthcare facilities in their area to identify cases. Standardized case report forms that include information on demographic characteristics, clinical syndrome, and outcome of illness were completed for each identified case.

Convenience samples of MRSA isolates were collected and sent to CDC for routine testing, including antimicrobial susceptibility testing using reference broth microdilution, detection of toxin genes, *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 routine laboratory testing. Through 2016, PFGE type was 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 single-nucleotide polymorphism (SNP) assay³. Currently, whole genome sequencing and analysis is used to determine MLST clonal complexes, with PFGE types assigned based on phylogenetic relatedness and molecular characteristics of the isolates. In 2017, isolates were only collected in three sites (Georgia, Minnesota, and Tennessee). Regular laboratory audits were performed at all sites to ensure completeness of case detection.

In 2017, some sites collected limited data from most MRSA hospital-onset cases, with full case report form data collected only for a random sample of 7–59% 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 disease among all patients were calculated using population estimates for 2017. Cases with unknown race were assigned race based on distribution of known age, race, and sex by EIP site.

Rates of invasive SA disease among patients who were undergoing chronic dialysis treatment were calculated using the December 31, 2016, point prevalent counts of patients on dialysis from the [United States Renal Data System \(USRDS\)](https://www.niddk.nih.gov/about-niddk/strategic-plans-reports/usrds) (<https://www.niddk.nih.gov/about-niddk/strategic-plans-reports/usrds>). The figures depicting the overall invasive MRSA incidence by epidemiologic class and incidence of invasive HACO MRSA among persons on dialysis, 2009–2017, are restricted to the continuous catchment area (California [3 county San Francisco Bay area]; Connecticut; Georgia [8 county Atlanta area]; Minnesota [2 county Minneapolis – Saint Paul area]; New York [1 Rochester county]; and Tennessee [1 Nashville county]) for comparison of trends over time.

¹ [Use of an Inferred PFGE Algorithm, Emerging Infections Program/Active Bacterial Core \(ABCs\) Surveillance Invasive MRSA Project](https://archive.cdc.gov/#/details?url=https://www.cdc.gov/hai/settings/lab/inferred-pfge-algorithm.html)

(<https://archive.cdc.gov/#/details?url=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://archive.cdc.gov/#/details?url=https://www.cdc.gov/hai/settings/lab/ccalgorithm.html)

(<https://archive.cdc.gov/#/details?url=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)

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HAIC Results

MSSA and MRSA Cases by Race

Race	MSSA No. (Rate ^a)	MRSA No. (Rate ^a)
White	2254 (35.2)	1960 (19.3)
Black	858 (38.7)	1161 (30.3)
Other	314 (19.0)	198 (9.5)
TOTAL	3426 (33.3)	3319 (20.7)

Unknown race (n= 301 MSSA, N=333 MRSA) distributed amongst known

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

MSSA and MRSA Case and Death Rate by Epidemiological Classification

Class	MSSA Cases No. (Rate ^a)	MSSA Deaths No. (Rate)	MRSA Cases No. (Rate)	MRSA Deaths No. (Rate)
CA	1255 (12.2)	87 (0.9)	774 (4.8)	68 (0.4)
HCA ^b	2126 (20.7)	228 (2.2)	2509 (15.6)	345 (1.9)
HCA - HO ^c	404 (3.9)	75 (0.7)	446 (2.8)	72 (0.5)
HCA - HACO	1722 (16.8)	153 (1.5)	2063 (12.8)	273 (1.7)
Unknown	45 (0.4)	5 (0.5)	36 (0.2)	5 (0.03)

^a Cases per 100,000 population for EIP areas (crude rates) calculated using 2017 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.

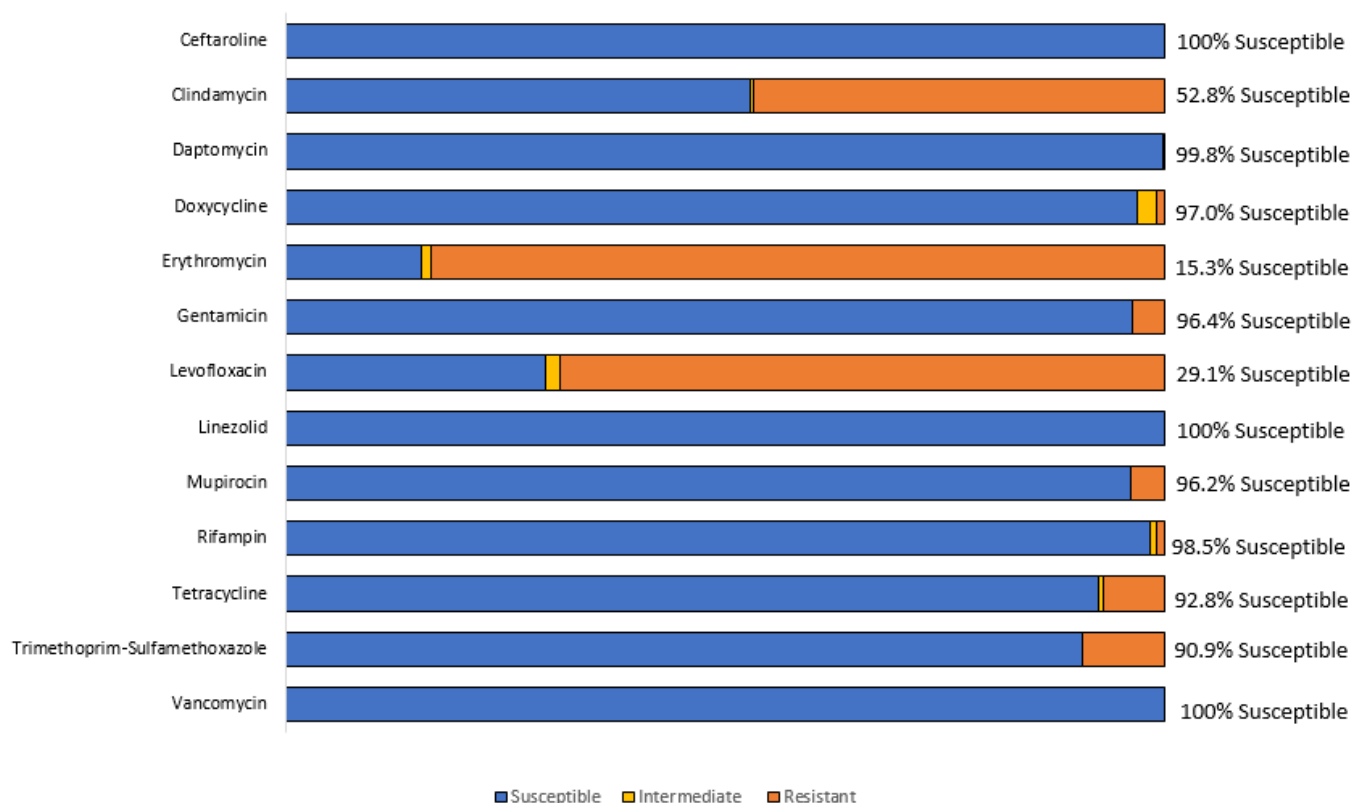
MRSA Inferred PFGE Type by Epidemiological Classification, Isolates Tested at CDC

Class	Total	CC5 USA100 No. (%)	Other CC5 No. (%)	CC8 USA300 No. (%)	Other CC8 No. (%)	Other (not CC5 or CC8) No. (%)
CA	103	20 (19.4)	6 (5.8)	56 (54.4)	15 (14.6)	6 (5.8)
HCA ^a	366	136 (37.2)	20 (5.5)	140 (38.3)	43 (11.7)	27 (7.4)
HCA - HO	60	18 (30.0)	5 (8.3)	20 (33.3)	11 (18.3)	6 (10.0)
HCA - HACO	306	118 (38.6)	15 (4.9)	120 (39.2)	32 (10.5)	21 (6.9)
Total ^b	470	157 (33.4)	26 (5.5)	196 (41.7)	58 (12.3)	33 (7.0)

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

^b Results for all isolates, including those with an unknown epidemiologic category (n=1), are included in the totals.

MRSA Antimicrobial Susceptibility Testing Results by Agent^{a,b,c} (n=470 isolates tested at CDC)



^a High level mupirocin resistance depicted in the figure as resistant; non-high level mupirocin resistance shown as susceptible.

^b Daptomycin non-susceptible isolates are depicted in the figure as resistant.

^c Isolates with inducible resistance to clindamycin are considered resistant

Reported MSSA (n=337) and MRSA (n=491) Cases on Chronic Dialysis

Type of Dialysis and Access Type	MSSA No. (%)	MRSA No. (%)
Peritoneal	18 (5.3)	18 (3.7)
Hemodialysis ^a	317 (94.1)	473 (96.3)
Hemodialysis - AV Fistula/Graft	172 (54.3)	221 (46.7)
Hemodialysis - CVC	143 (45.1)	241 (50.9)
Hemodialysis - Unknown	3 (0.9)	14 (2.9)
Unknown	2 (0.5)	0 (0.0)

^a One MSSA and 4 MRSA patients had AV Fistula/Graft and CVC

Reported MSSA and MRSA Clinical Syndrome by Epidemiological Class, 2017

Syndrome^a	CA MSSA (n=1255) No. (%)	CA MRSA (n=774) No. (%)	HACO MSSA (n=1722) No. (%)	HACO MRSA (n=2063) No. (%)	HO MSSA (n=404) No. (%)	HO MRSA (n=165)^b No. (%)
Bloodstream Infection ^c with Other Syndrome	688 (54.8)	510 (65.9)	872 (50.6)	1164 (56.4)	127 (31.4)	59 (35.8)
Bloodstream Infection with No Other Syndrome	262 (20.9)	146 (18.9)	543 (31.5)	666 (32.3)	186 (46.0)	62 (37.6)
Pneumonia	125 (9.9)	129 (16.7)	169 (9.8)	287 (13.9)	48 (11.9)	24 (14.6)
Osteomyelitis	200 (15.9)	104 (13.4)	247 (14.3)	327 (15.9)	40 (9.9)	18 (10.9)
Endocarditis	129 (10.3)	94 (12.1)	106 (6.2)	158 (7.7)	18 (4.5)	11 (6.7)
Cellulitis	204 (16.3)	161 (20.8)	146 (8.5)	202 (9.8)	27 (6.7)	11 (6.7)
Surgical Wounds ^d	11 (0.9)	9 (1.2)	122 (7.1)	110 (5.3)	15 (3.7)	7 (4.2)
Decubitus/Pressure Ulcers	6 (0.5)	11 (1.4)	23 (1.3)	58 (2.8)	4 (1.0)	4 (2.4)
Skin Abscesses ^e	64 (5.1)	71 (9.2)	55 (3.2)	78 (3.8)	9 (2.2)	5 (3.0)
Other Wounds ^f	42 (3.4)	32 (4.1)	61 (3.5)	97 (4.7)	8 (1.9)	2 (1.2)
Traumatic Wounds	10 (0.8)	4 (0.5)	6 (0.4)	10 (0.5)	1 (0.3)	2 (1.2)

^a Some case patients had more than one syndrome.

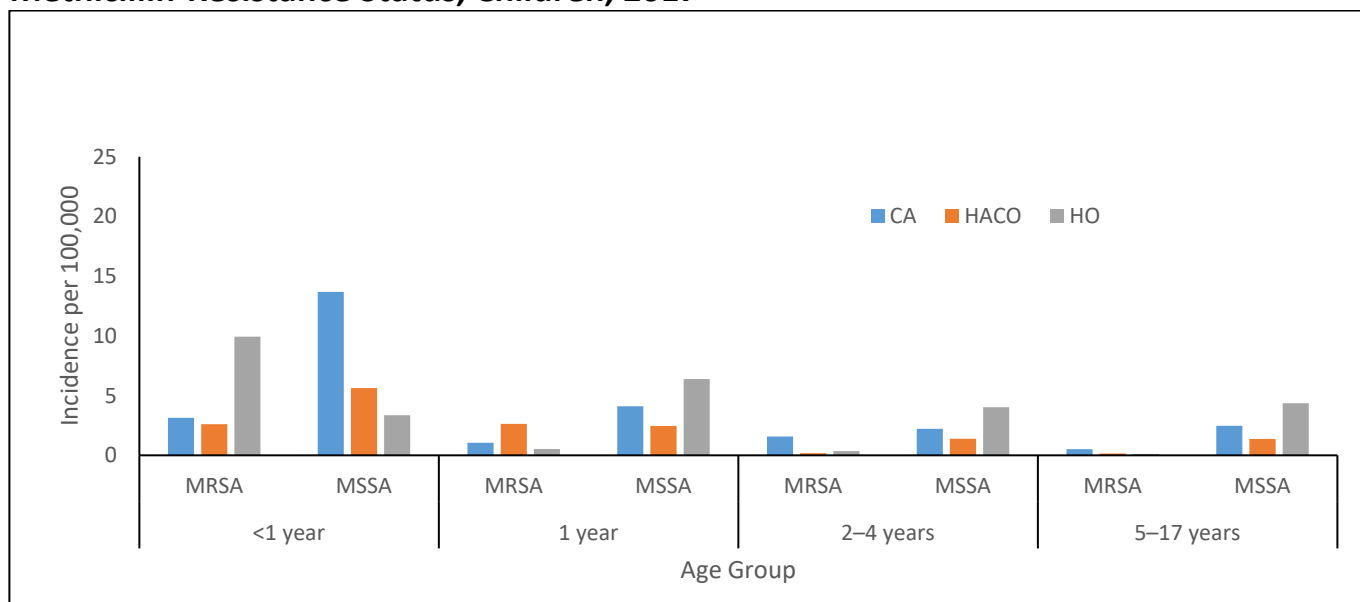
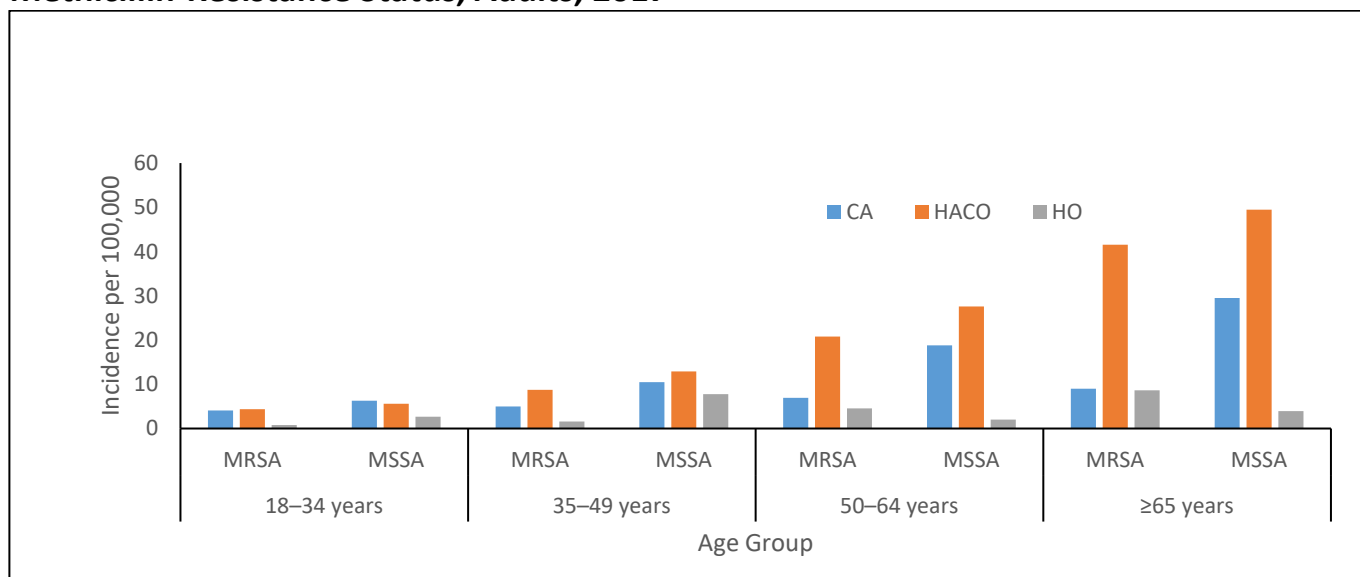
^b Represents a subset of HO MRSA cases due to sampling

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

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

^e Category includes skin abscess, necrotizing fasciitis, gangrene.

^f Category includes non-traumatic and other chronic wound infections.

Incidence^a of Invasive *Staphylococcus aureus*, by Epidemiologic Class, Age Group, and Methicillin-Resistance Status, Children, 2017**Incidence^a of Invasive *Staphylococcus aureus*, by Epidemiologic Class, Age Group, and Methicillin-Resistance Status, Adults, 2017**

^a Incidence (no. per 100,000 population per year) calculated using 2017 U.S. Census Data

Number and Incidence Rates of Invasive MRSA and MSSA Infections by Dialysis Status and Epidemiologic Category, 2017

Epidemiologic Category	MSSA Dialysis Patients No. (Rate) ^a	MRSA Dialysis Patients No. (Rate) ^a	MSSA Non-Dialysis Patients No. (Rate) ^b	MRSA Non-Dialysis Patients No. (Rate) ^b	MSSA Total No. (Rate)	MRSA Total No. (Rate)
CA	0 (0)	0 (0)	1255 (12.2)	774 (4.8)	1225 (11.9)	774 (4.8)
HCA ^c	450 (2507.1)	551 (2023.9)	1676 (16.3)	1958 (12.2)	2126 (20.7)	2509 (15.6)
HCA - HO ^d	30 (167.1)	75 (275.5)	374 (3.6)	371 (2.3)	404 (3.9)	446 (2.8)
HCA - HACO	420 (2340.0)	476 (1748.4)	1302 (12.7)	1587 (9.9)	1722 (16.8)	2063 (12.8)
Overall	450 (2507.1)	551 (2023.9)	2976 (29.0)	2768 (17.3)	3426 (33.3)	3319 (20.7)

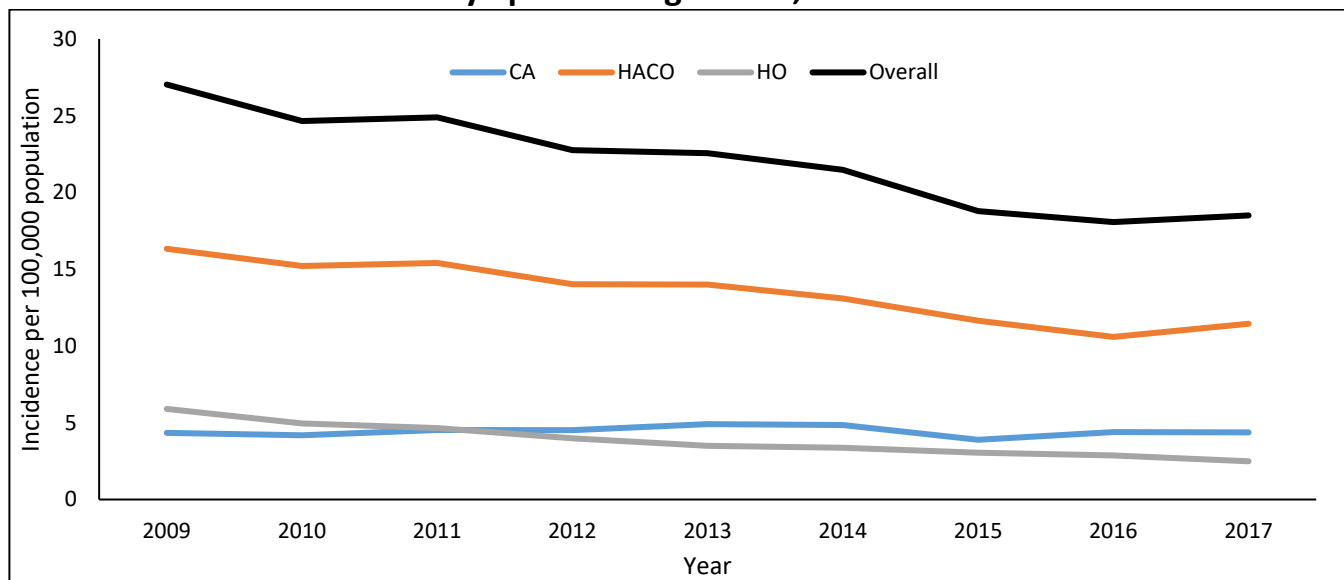
^a Incidence (no. per 100,000 dialysis patients per year) for dialysis patients calculated using 2016 USRDS point prevalence data

^b Incidence (no. per 100,000 population per year) calculated using 2017 U.S. Census Data

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

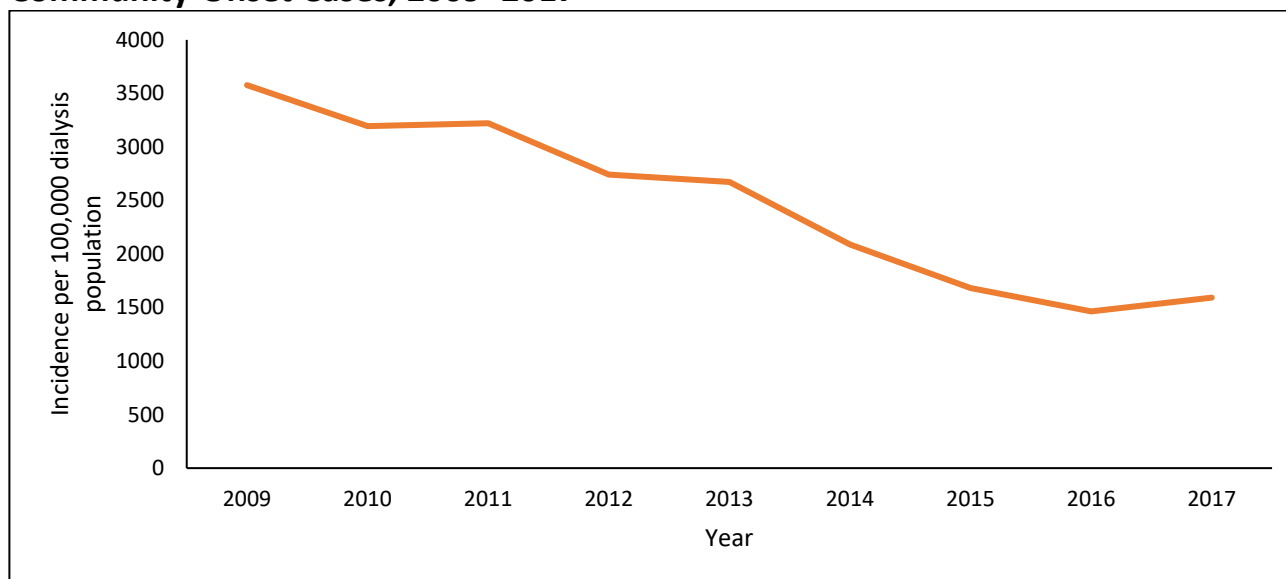
^d Dialysis and non-dialysis estimated number and incidence based on data from a sample of HO MRSA cases.

Incidence of Invasive MRSA by Epidemiologic Class, 2009–2017^a



^a Restricted to the continuous catchment area (California [3 county San Francisco Bay area]; Connecticut; Georgia [8 county Atlanta area]; Minnesota [2 county Minneapolis – Saint Paul area]; New York [1 Rochester county]; and Tennessee [1 Nashville county]) for comparison of trends over time.

Incidence of Invasive MRSA among Persons on Dialysis, Healthcare-Associated Community-Onset Cases, 2009–2017^a



^a Restricted to the continuous catchment area (California [3 county San Francisco Bay area]; Connecticut; Georgia [8 county Atlanta area]; Minnesota [2 county Minneapolis – Saint Paul area]; New York [1 Rochester county]; and Tennessee [1 Nashville county]) for comparison of trends over time.

Brief Summary

Surveillance data from 2017 represent the thirteenth full year of population-based surveillance for invasive MRSA infections through the Emerging Infections Program, and the second for MSSA. 2017 is the first year that USA300 is the most common strain type for isolates received in every epidemiologic classification. Incidence of invasive HO MRSA has decreased since 2009. The incidence of invasive HACO MRSA decreased from 2009–2016 but increased slightly in 2017, both overall and among persons on dialysis.

Reported invasive MSSA incidence was greater than invasive MRSA incidence for every age group, race category, and epidemiologic classification except for invasive HO infections in persons 50 years and older.

Citation

1. Centers for Disease Control and Prevention. 2020. Healthcare-Associated Infections – Community Interface Surveillance Report, Emerging Infections Program Network, Methicillin-Resistant *Staphylococcus aureus*, 2017. Available via the Internet: <https://www.cdc.gov/healthcare-associated-infections/media/pdfs/2017-MRSA-Report-508.pdf>

For more information, visit our web sites:

- [Invasive *Staphylococcus aureus* \(MRSA/MSSA\) Infection Tracking](https://www.cdc.gov/healthcare-associated-infections/php/haic-eip/invasive-staphylococcus.html)
(<https://www.cdc.gov/healthcare-associated-infections/php/haic-eip/invasive-staphylococcus.html>)

- [Methicillin-resistant *Staphylococcus aureus* \(MRSA\)](https://www.cdc.gov/mrsa/about/index.html)
(<https://www.cdc.gov/mrsa/about/index.html>)