Healthcare-Associated Infections-Community Interface (HAIC): Emerging Infections Program (EIP) Network Report Invasive *Staphylococcus aureus*, 2016

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).
Note: The population under surveillance changed from 2015; it was increased by 2 Maryland counties.

Methicillin-sensitive *Staphylococcus aureus* (MSSA): California (3 county San Francisco Bay area); Georgia (1 Atlanta county); Minnesota (2 metro Twin City counties); New York (1 Rochester county); Tennessee (1 Nashville county).
Note: 2016 was the first year of MSSA surveillance.

HAIC Population

The MRSA surveillance areas represent 15,918,111 persons. The MSSA surveillance areas represent 7,809,686 persons.
Source: National Center for Health Statistics bridged-race vintage 2016 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 2016. 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; as 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; and as 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 all 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, 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 (http://www.cdc.gov/HAI/settings/lab/inferred-PFGE-algorithm.html). 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 (http://www.cdc.gov/HAI/settings/lab/CCalgorithm.html). Isolates identified as USA300 were confirmed using a SNP assay (https://msphere.asm.org/content/msph/3/3/e00464-17.full.pdf). In 2016, 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 2016, some sites collected limited data from most MRSA hospital-onset cases, with full case report form data collected only for a random sample of 12–32% 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 2016. One site started MSSA surveillance in March 2016. For rate calculations, case counts from this site were multiplied by 1.2 to approximate a full year of surveillance. Cases with unknown race were assigned race based on distribution of known age, race, and gender by EIP site.

Rates of invasive SA disease among patients who were undergoing chronic dialysis treatment were calculated using the December 31, 2015 point prevalent counts of patients on dialysis from the United States Renal Data System (USRDS) (http://www.usrds.org/adr.htm). The figures depicting the incidence of invasive MRSA among persons on dialysis and not on dialysis by epidemiologic classification, 2009–2016 are restricted to the continuous catchment area (California [3 county San Francisco Bay area]; Connecticut; Georgia [8 county Atlanta area]; Minnesota [1 metro Twin City county]; New York [1 Rochester county]; and Tennessee [1 Nashville county]) for comparison of trends over time.

HAIC Results

MSSA and MRSA Cases[a] By Race

Race	MSSA No. (Rate[b])	MRSA No. (Rate[b])
White	1551 (31.2)	1972 (19.5)
Black	584 (41.5)	1134 (30.3)
Other	311 (31.3)	108 (5.4)
TOTAL	2446 (31.3)	3214 (20.2)

Unknown race (n= 238 MSSA, N=197 MRSA) distributed amongst

known

[a]MSSA case counts multiplied by 1.2 for one site

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

MSSA[a] and MRSA Case and Death Rate by Epidemiological Classification

Class	No. (Rate[b]) MSSA Cases	No. (Rate) MSSA Deaths	No. (Rate) MRSA Cases	No. (Rate) MRSA Deaths
CA	910 (12.2)	74 (1.0)	746 (4.7)	65 (0.4)
HCA[c]	1495 (19.2)	175 (2.3)	2408 (15.1)	384 (2.4)
HO[d]	279 (3.6)	44 (0.6)	510 (3.2)	110 (0.7)
HACO	1216 (15.6)	131 (1.7)	1898 (11.9)	274 (1.7)
Unknown	41 (0.5)	8 (0.1)	60 (0.4)	10 (0.06)

[a] MSSA case counts multiplied by 1.2 for one site

[b] Cases per 100,000 population for EIP areas (crude rates) calculated using 2016 U.S. Census Data

[c] HCA: Healthcare-associated invasive SA infection; sum of patients that are classified as either the HO or HACO classes
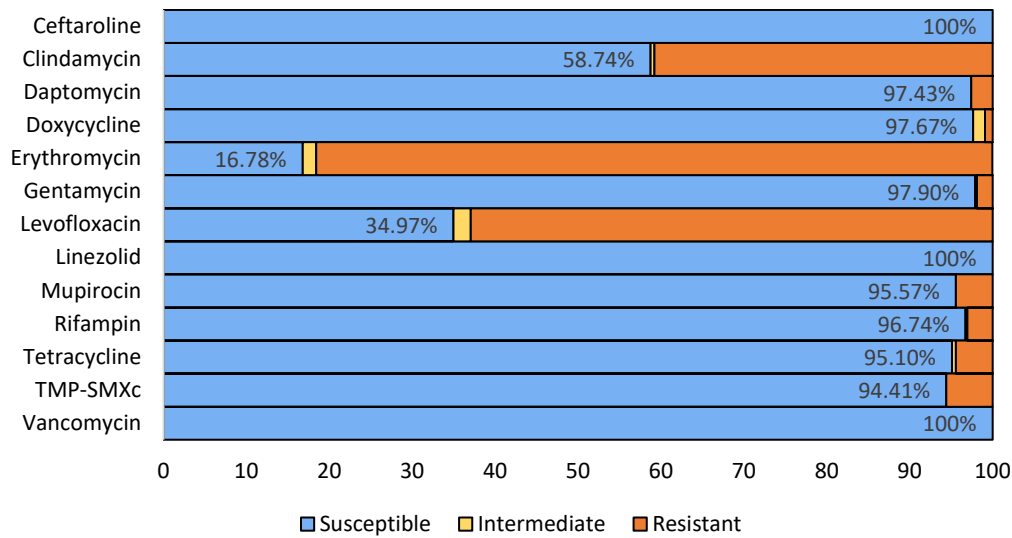
[d] HO MRSA rate imputed from a sample of cases.

MRSA Inferred PFGE Type by Epidemiological Classification, isolates tested at CDC

Class	Total	CC5 USA100 No. (%)	CC5 Other CC5 No. (%)	CC8 USA300 No. (%)	CC8 Other CC8 No. (%)	Other (not CC5 or CC8) No. (%)
CA	104	18 (17.3)	12 (11.5)	57 (54.8)	3 (2.9)	14 (13.5)
HCA[a]	322	118 (36.6)	10 (3.1)	118 (36.6)	25 (7.8)	51 (15.8)
HO	58	20 (34.5)	1 (1.7)	25 (43.1)	7 (12.1)	5 (8.6)
HACO	264	98 (37.1)	9 (3.4)	95 (36.0)	25 (9.5)	37 (14.0)
Total[b]	429	137 (31.9)	22 (5.1)	179 (41.7)	35 (8.2)	56 (13.1)

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

[b] n= 3 epidemiologic category unknown

MRSA antimicrobial susceptibility testing results by agent[a,b] (n=429 isolates tested at CDC)

Agent	Susceptible %
Ceftaroline	100%
Clindamycin	58.74%
Daptomycin	97.43%
Doxycycline	97.67%
Erythromycin	16.78%
Gentamycin	97.90%
Levofloxacin	34.97%
Linezolid	100%
Mupirocin	95.57%
Rifampin	96.74%
Tetracycline	95.10%
TMP-SMXc	94.41%
Vancomycin	100%

Legend: ■ Susceptible □ Intermediate ■ Resistant

[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; isolates with inducible resistance to clindamycin are considered resistant

[c] Trimethoprim-Sulfamethoxazole

Reported MSSA (n=314) and MRSA (n=441) Cases on Chronic Dialysis

Dialysis and Access Type	MSSA No. (%)	MRSA No. (%)
Type of dialysis		
Peritoneal	24(7.6)	12 (2.7)
Hemodialysis[a]	287 (91.4)	425 (96.3)
AV Fistula/Graft	163 (56.7)	182 (42.8)
CVC	121 (42.1)	230 (54.1)
Unknown	4 (1.4)	13 (3.1)
Unknown	3(1.0)	4 (0.9)

[a] One MSSA patient had AV Fistula/Graft and CVC

Reported MSSA and MRSA Clinical Syndrome by Epidemiological Class, 2016

Syndrome [a]	CA		HACO		HO	
	MSSA	MRSA	MSSA	MRSA	MSSA	MRSA
	(n=899)	(n=746)	(n=1201)	(n=1898)	(n=276)	(n=154)[b]
	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
Bloodstream Infection [c]						
with other syndrome	451(50.2)	476(63.8)	593(59.6)	1045(55.1)	127(46.0)	65(42.2)
with no other syndrome	222(24.7)	141(18.9)	402(40.4)	652(38.4)	76(27.5)	51(33.1)
Pneumonia	77(8.6)	93(12.5)	94(7.8)	220(11.6)	21(7.6)	21(13.6)
Osteomyelitis	132(14.7)	102(13.7)	128(10.7)	249(13.1)	31(11.2)	14(9.1)
Endocarditis	71(7.9)	67(9.0)	52(4.3)	131(6.9)	7(2.5)	8(5.2)
Cellulitis	160(17.8)	169(22.7)	127(10.6)	193(10.2)	19(6.9)	9(5.8)
Wounds						
Surgical [d]	5(0.6)	11(1.5)	75(6.2)	91(4.8)	7(4.6)	4(1.5)
Decubitus/Pressure Ulcers	2(0.2)	10(1.3)	19(1.6)	33(1.7)	4(2.6)	4(1.5)
Skin Abscesses [e]	38(4.2)	75(10.1)	30(2.5)	48(2.5)	2(1.3)	3(1.1)
Other Wounds [f]	20(2.2)	17(2.3)	32(2.7)	74(3.9)	1(0.7)	2(0.7)
Traumatic	7(0.8)	10(1.3)	3(0.3)	4(0.2)	2(1.3)	4(1.5)

[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 of Invasive *Staphylococcus aureus*, by Epidemiologic Class, Age Group, and Methicillin-Resistance Status, Children, 2016
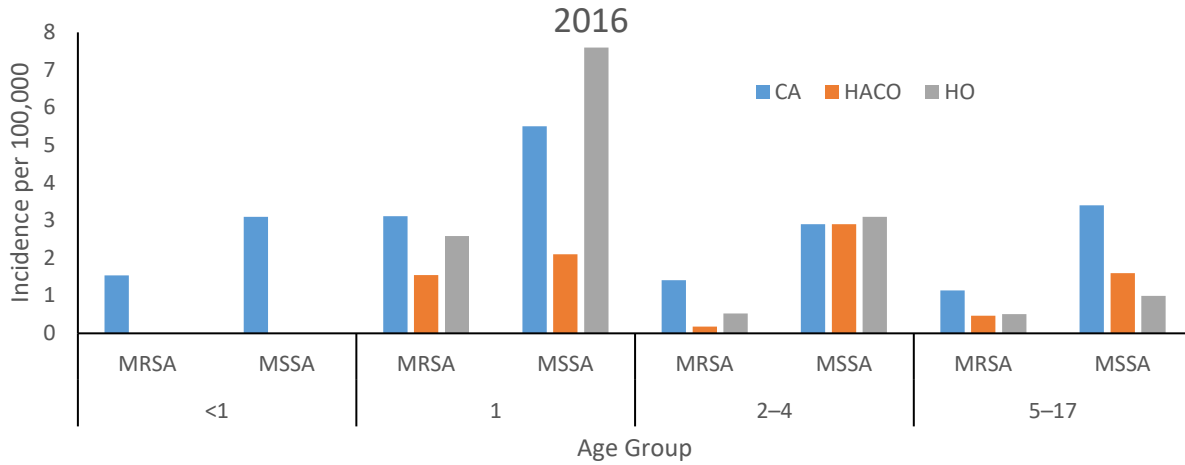
Incidence of Invasive *Staphylococcus aureus*, by Epidemiologic Class, Age Group, and Methicillin-Resistance Status, Adults, 2016
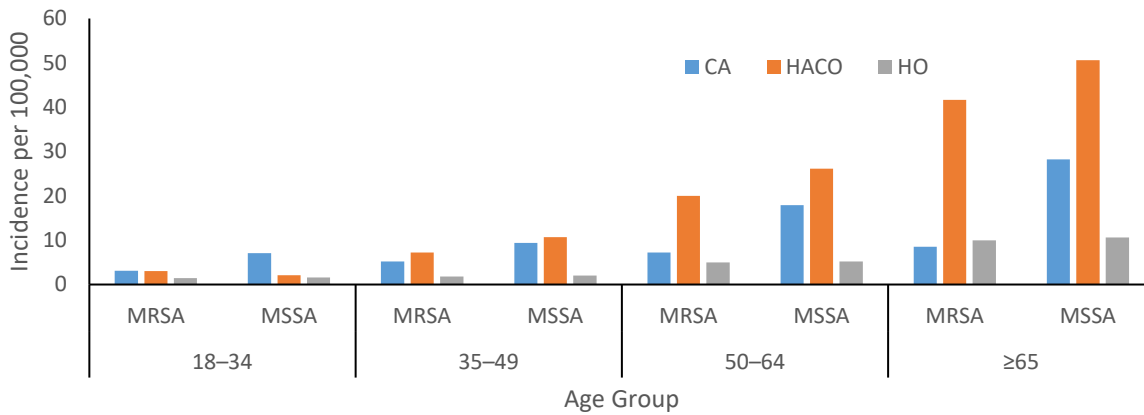
[a] Incidence (no. per 100,000 population per year) calculated using 2016 U.S. Census Data

[b] MSSA case counts multiplied by 1.2 for one site

Number and Incidence Rates of Invasive MRSA and MSSA[a] Infections by Dialysis Status and Epidemiologic Category, 2016

| Epidemiologic Category	Dialysis Status											
	Dialysis Patients[b]				Non-Dialysis Patients[c]				Total			
	MSSA		MRSA		MSSA		MRSA		MSSA		MRSA	
	No.	Incidence Rate	No.	Incidence Rate	No.	Incidence Rate	No.	Incidence Rate	No.	Incidence Rate	No.	Incidence Rate
CA	0	0	0	0	910	11.67	746	4.7	910	11.65	746	4.7
HCA[d]	318	2552.99	503	1940.4	1177	15.10	1905	12.0	1495	19.15	2408	15.1
HO[e]	22	178.23	77	297.0	257	3.3	433	2.7	279	3.58	510	3.2
HACO	296	2374.76	426	1643.4	920	11.80	1472	9.3	1216	15.57	1898	11.9
Overall	318	2552.99	503	1940.44	2128	27.29	2711	17.06	2446	31.32	3214	20.2

[a] MSSA case counts multiplied by 1.2 for one site

[b] Incidence (no. per 100,000 dialysis patients per year) for dialysis patients calculated using 2015 USRDS point prevalence data

[c] Incidence (no. per 100,000 population per year) calculated using 2016 U.S. Census Data

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

[e] Dialysis and non-dialysis estimated number and incidence based on data from a sample of HO MRSA cases.
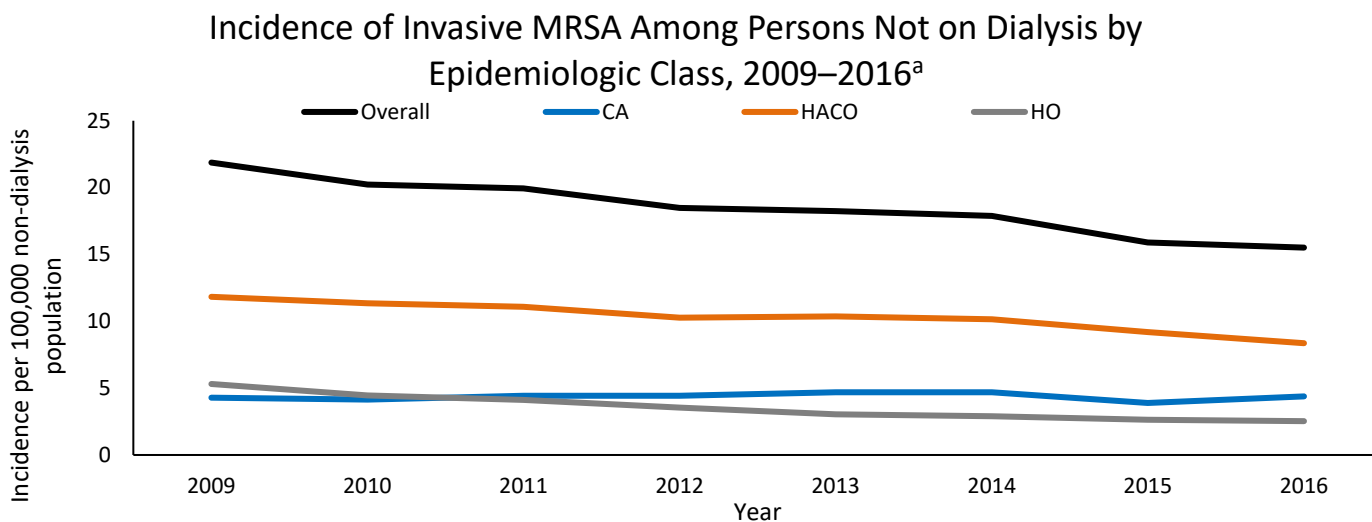
Incidence of Invasive MRSA Among Persons Not on Dialysis by Epidemiologic Class, 2009–2016[a]

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

Incidence of Invasive MRSA among Persons on Dialysis by Epidemiologic Class, 2009–2016[a]
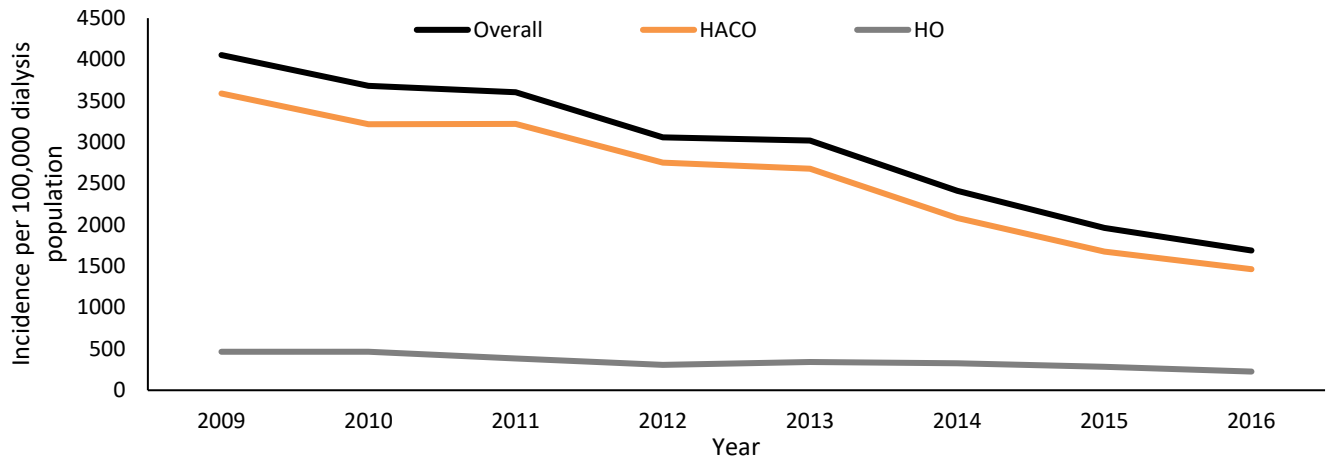
[a] Restricted to the continuous catchment area (California [3 county San Francisco Bay area]; Connecticut; Georgia [8 county Atlanta area]; Minnesota [1 metro Twin City county]; New York [1 Rochester county]; and Tennessee [1 Nashville county]) for comparison of trends over time.

Brief Summary

Surveillance data from 2016 represents the twelfth full year of performing population-based surveillance for invasive MRSA infections through the Emerging Infections Program, and the first for MSSA. Incidence of invasive HCA MRSA has decreased since 2009.

Reported invasive MSSA incidence was greater than invasive MRSA incidence for every age group, race category, and epidemiologic classification.

Citation

1. Centers for Disease Control and Prevention. 2016. Healthcare-Associated Infections – Community Interface Surveillance Report, Emerging Infections Program Network, Methicillin-Resistant *Staphylococcus aureus*, 2016. Available via the Internet: https://www.cdc.gov/hai/eip/pdf/2016-MRSA-Report-P.pdf

For more information, visit our web sites: https://www.cdc.gov/hai/eip/saureus.html, http://www.cdc.gov/mrsa