Methicillin-Resistant *Staphylococcus aureus* (MRSA) Surveillance Report 2010

Oregon Active Bacterial Core Surveillance (ABCs)

Office of Disease Prevention & Epidemiology
Oregon Health Authority

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Background

The Active Bacterial Core surveillance (ABCs) program is a core component of the Emerging Infections Program (EIP) Network sponsored by the Centers for Disease Control and Prevention (CDC). The purpose of the ABCs program is to determine the incidence and epidemiologic characteristics of invasive disease due to *Haemophilus influenzae*, *Neisseria meningitidis*, group A streptococcus (GAS), group B streptococcus (GBS), *Streptococcus pneumoniae*, and methicillin-resistant *Staphylococcus aureus* (MRSA). The entire EIP Network for invasive MRSA represents over 19 million persons in 10 surveillance areas around the United States. More information on the EIP/ABCs Network is found at: http://www.cdc.gov/abcs/index.html.

In Oregon, the surveillance area for invasive MRSA comprises the tri-county (Clackamas, Multnomah, and Washington) Portland metropolitan area, with a 2010 estimated population of 1,644,536.[*] More information on the Oregon ABCs program is found at: http://public.health.oregon.gov/DiseasesConditions/CommunicableDisease/Pages/abc.aspx.

Methods

An invasive MRSA infection[†] is defined as the isolation of MRSA from a normally sterile body site in a tri-county resident. Tri-county hospital laboratories voluntarily submit all sterile site MRSA isolates to the Oregon State Public Health Laboratory (OSPHL). A subset is sent to CDC for further characterization and antimicrobial susceptibility testing. Additional cases are identified through regular laboratory record reviews. Health record reviews of each case allow standardized reports of demographic characteristics, clinical syndrome, underlying illnesses or conditions, healthcare-associated risk factors, and illness outcome.

Cases of invasive disease are classified into one of three epidemiologic classifications based on the presence or absence of established healthcare risk factors and time of culture collection in relation to hospital admission, as indicated in the medical record.

- Healthcare-onset (HO-) MRSA infections are those in which the initial culture was collected >2 days after hospital admission.

[*] Source: Portland State University Population Research Center (http://www.pdx.edu/prc/)

[†] MRSA *infection* is the invasion of bacteria in the tissues of the host leading to clinical signs and symptoms of illness or infection whereas *colonization* refers to the presence of bacteria but without tissue damage and signs of illness or infection. Colonized patients are also known as asymptomatic carriers.

- Healthcare-associated, community-onset (HACO-) MRSA infections are those in which the initial culture was collected ≤2 days after hospital admission or evaluation, and the medical chart indicates one or more of the following risk factors:
    - A history of hospitalization, surgery, dialysis, or residence in a long term care facility in the previous year, or
    - Presence of a central vascular catheter ≤2 calendar days prior to collection of initial culture.
- Community-associated (CA-) MRSA infections are those in which none of the previously mentioned criteria are met.

Additional technical information on surveillance methodology, including data elements collected, healthcare risk factors, clinical manifestations, and underlying diseases and conditions can be found at the CDC EIP/ABCs Network website listed above.

Surveillance Results

Descriptive Epidemiology

In 2010, we identified 239 cases of invasive MRSA disease for an overall incidence of 14.5/100,000 persons (Figure 1). Of these, 36 (15%) cases had recurrent disease, defined as isolation of MRSA from a normally sterile site 30 or more days after any previous initial MRSA culture. Since the beginning of surveillance in 2004, when 405 cases were reported (26.6/100,000), the incidence of invasive MRSA disease has decreased 45 percent.

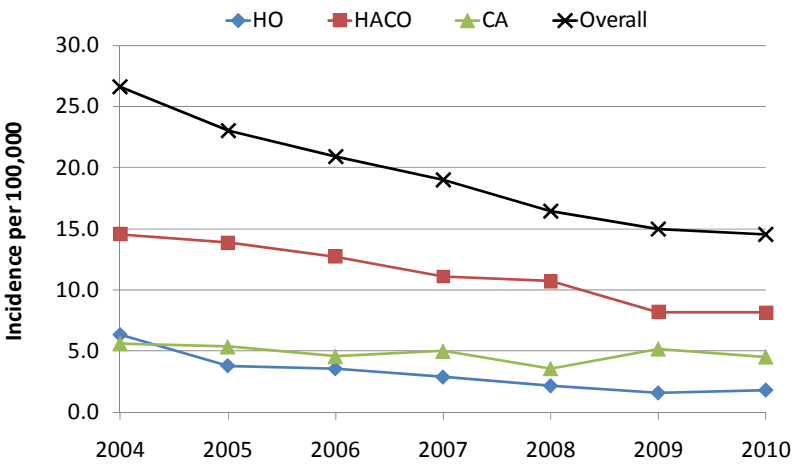
The mean and median ages of cases reported in 2010 were 60 and 59 years, respectively (range: 8-95 years). Sixty-one percent of all reported cases were male. Race was reported for 144 cases; of these, 82% were white, 13% were black, and 5% were of another race. The highest incidence of invasive MRSA disease occurred among residents of Multnomah county (20.3/100,000); followed by residents in Washington (10.3/100,000) and Clackamas (9.4/100,000) counties.

Thirty-two cases were fatal, for mortality and case fatality rates of 1.9/100,000 and 13%, respectively. The case fatality rate has decreased 12% since 2004. The mean and median ages of death due to invasive MRSA infection were 60 and 59 years, respectively, with a range of 8 to 95 years. Risk of death was associated with increasing age (p=0.0247). Among those who died, 59% were 65 and older, and 81% were 50 and older. There were two deaths among those younger than 35 years of age. One was a 31 year-old with a history of injection drug use, presenting with endocarditis, septic shock, and septic emboli. The other was a 10 year-old without any notable underlying conditions, presenting with septic shock.

Epidemiologic Classifications

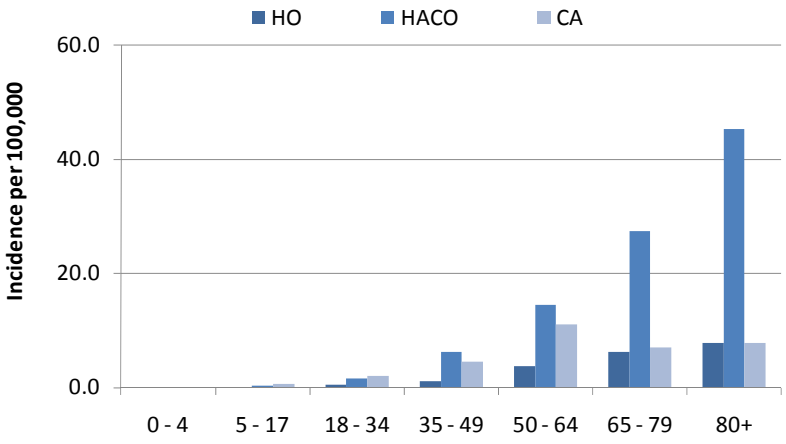
Of the 239 total cases reported, 30 (13%) were HO (1.8/100,000); 134 (56%) were HACO (8.1/100,000); and 75 (31%) were CA (4.6/100,000). Since 2004, the incidence of HO has decreased 71 percent, that of HACO has decreased 44 percent and that of CA has decreased 19 percent (Figure 1). HO cases have comprised a *decreasing* proportion of all MRSA cases, from 24 percent in 2004 to 13 percent in 2010 (test for trend, p<0.0001), while CA cases have comprised an *increasing* proportion of all MRSA cases, from 21 percent in 2004 to 31 percent in 2010 (p=0.0001). The proportion of HACO cases has not changed significantly over time.

Figure 1: Incidence of Invasive MRSA Cases in Tri-county Area



Epidemiologic classification of cases as HO, HACO, or CA-MRSA was associated with age (Figure 2). The mean and median ages for CA infections (53 and 54, respectively) were significantly lower than those seen for HACO (63 and 62, respectively) and for HO infections (62 and 64, respectively). Classification was not associated with sex or race.

Figure 2: Incidence of Invasive MRSA by Infection Type and Age 2010



Mortality was highest among HACO cases (0.97/100,000), followed by CA (0.55/100,000) and HO (0.43/100,000); case fatality was highest among HO (23%), followed by HACO and CA (13% each).

Clinical Manifestations

The most common (reported in at least 10% of 2010 cases) clinical manifestations of invasive MRSA infections are displayed in Table 1. Since 2004, the proportion of each of these clinical syndromes has not changed significantly over time, with the exception of non-skin abscesses. The proportion of abscess cases has increased significantly over time (p=0.0080). CA cases were more likely to manifest as an abscess from a normally sterile site (OR 3.2; CI 1.7, 6.2) than cases with healthcare associated risk factors (HO and HACO cases). Other syndromes were reported similarly across infection types.

Table 1: Common Clinical Manifestations of Invasive MRSA Cases† by Epidemiologic Classification, 2010

Clinical Manifestations	HO n=30 n (%)	HACO n=134 n (%)	CA n=75 n (%)	Total n=239 n (%)
Bacteremia	22 (73)	117 (87)	55 (3)	194 (81)
Abscess (not skin)	5 (17)	17 (13)	25 (33)	47 (20)
Pneumonia*	9 (30)	17 (13)	12 (16)	38 (16)
Osteomyelitis	1 (3)	21 (16)	10 (13)	32 (13)
Cellulitis	2 (7)	12 (9)	12 (16)	26 (11)
Septic shock	6 (20)	14 (10)	4 (5)	24 (10)
None	1 (3)	3 (2)	2 (3)	6 (3)

† Some cases report more than 1 syndrome.

* Only those cases of pneumonia with a sterile site isolate are included. Sputum or endotracheal aspirates are not considered sterile sites.

Underlying Conditions

Almost all (95%) invasive MRSA cases were in individuals reporting one or more underlying diseases or conditions (Table 2). Based on univariate analyses, cases with healthcare-associated risk factors (including HO and HACO) were *more* likely to report renal failure (OR 4.4; CI 1.9, 10.2) and decubitus ulcer (OR 3.2; CI 1.1, 9.5), and *less* likely to report abscess/boils (OR 0.3; CI 0.2, 0.7), intravenous drug use (IVDU) (OR 0.3; CI 0.1, 0.8), and smoking (OR 0.4; CI 0.2, 0.7) than CA cases. After controlling for age, none of the underlying conditions were individually associated with fatal outcome.

Table 2: Common Underlying Conditions Reported Among Invasive MRSA Cases† by Epidemiologic Classification, 2010

Underlying Conditions	HO n=30 n (%)	HACO n=134 n (%)	CA n=75 n (%)	Total n=239 n (%)
Diabetes	10 (33)	58 (43)	22 (29)	90 (38)
Cardiovascular disease	12 (40)	45 (34)	9 (12)	66 (28)
Smoking	4 (13)	28 (21)	29 (39)	61 (26)
Chronic skin breakdown	7 (23)	40 (30)	13 (17)	60 (25)
Chronic renal insufficiency	9 (30)	42 (31)	7 (9)	58 (24)
Obesity	5 (17)	24 (18)	11 (15)	40 (17)

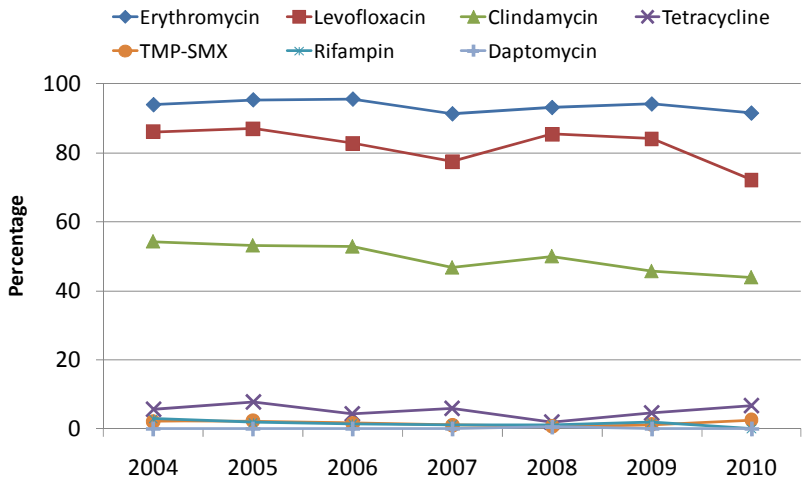
Underlying Conditions	HO n=30 n (%)	HACO n=134 n (%)	CA n=75 n (%)	Total n=239 n (%)
Abscess/boil	2 (7)	16 (12)	20 (27)	38 (16)
Immunosuppressive therapy	6 (20)	21 (16)	7 (9)	34 (14)
Chronic obstructive pulmonary disease	4 (13)	19 (14)	7 (9)	30 (13)
Solid organ malignancy	6 (20)	21 (16)	5 (7)	32 (13)
Stroke/CVA	3 (10)	21 (16)	6 (8)	30 (13)
Asthma	3 (10)	17 (13)	8 (11)	28 (12)
Decubitus/pressure ulcer	1 (3)	24 (18)	4 (5)	29 (12)
Intravenous drug use	0 (0)	13 (10)	15 (20)	28 (12)
Peripheral vascular disease	4 (13)	17 (13)	3 (4)	24 (10)
Dementia	0 (0)	16 (12)	3 (4)	19 (8)
Alcohol abuse	2 (7)	4 (3)	8 (11)	14 (6)
Cirrhosis	2 (7)	9 (7)	2 (3)	13 (5)
None	3 (10)	3 (2)	5 (7)	11 (5)

† Some cases report more than 1 syndrome.

Antibiotic Susceptibilities

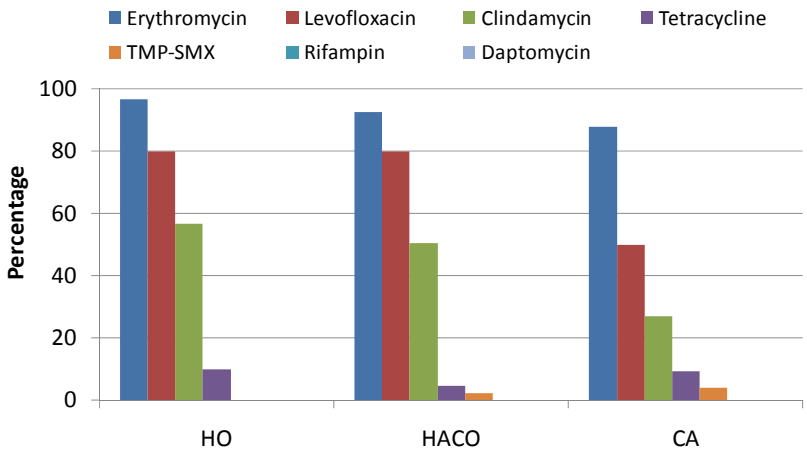
By definition, all MRSA isolates are resistant to β-lactam antibiotics, including penicillin and methicillin. Additionally, among isolates tested, a proportion displayed intermediate/full resistance or decreased susceptibility to several commonly assayed antibiotics in 2010, including: erythromycin (92%, n=238), levofloxacin (72%, n=61), clindamycin (44%, n=237), tetracycline (7%, n=181), and trimethoprim-sulfa (3%, n=237). None of the tested isolates in 2010 were resistant to daptomycin, linezolid, rifampin, or vancomycin. Since 2004, the percentages of invasive MRSA isolates with decreased susceptibility to these select antibiotics have remained relatively stable (Figure 3). No isolates during this time period have displayed decreased susceptibility to linezolid or vancomycin.

Figure 3: Percentage of Invasive MRSA Isolates with Decreased Susceptibility (Intermediate or Full Resistance) to Select Antibiotics



In 2010, HO and HACO cases, combined, were almost three times more likely to display decreased susceptibility to clindamycin (95% CI 1.6, 5.2) than community-associated cases (Figure 4). Other differences were not statistically significant or were unable to be tested due to insufficient sample size.

Figure 4: Percentage of Invasive MRSA Isolates with Decreased Susceptibility (Intermediate or Full Resistance) to Select Antibiotics by Infection Type, 2010



Expanded HACO Analysis

The distribution of healthcare risk factors among HACO cases is shown in Table 3. HACO infections are those in which the initial MRSA culture was collected ≤2 days after hospital admission or evaluation, and the medical chart indicates a history of hospitalization, surgery*, residence in a long term care facility, dialysis in the previous year, or the presence of a central vascular catheter† ≤2 calendar days prior to collection of initial culture. Among HACO cases in 2010, 33 (25%) had one healthcare risk factor; 54 (40%) had two; 39 (29%) had three; 7 (5%) had four; 1 (1%) had five.

Table 3: Distribution of Healthcare Risk Factors Among HACO

Risk Factors	2010 n=134 n (%)	2009 n=134 n (%)
Hospitalization[2]	125 (93)	121 (90)
Surgery[2]	86 (64)	76 (58)
LTCF Residence[2]	41 (31)	52 (39)
Dialysis[2]	20 (15)	24 (18)
Central Venous Catheter[1]	19 (14)	28 (21)

[1] In place ≤2 calendar days prior to initial culture
[2] Within year before date of initial culture

Since 2004, we have identified 294 (14%) patients with invasive MRSA who underwent dialysis within the year before their initial culture date. Of these individuals, 64 percent were male, 85 percent were hospitalized, 14 percent had a fatal outcome, 87 percent were classified as having a HACO infection, and 63 percent of 123 cases with known PFGE pattern were considered to be of healthcare origin (i.e. USA100, USA200, USA500). The mean and median ages were both 61 years, respectively (range: 14-90 years). Beginning in 2009, our surveillance program began collecting information on current chronic dialysis. Of the 44 (9%) patients who underwent chronic dialysis at time of culture collection, all had hemodialysis treatment, with the exception of one patient who underwent peritoneal dialysis. Of the 43 hemodialysis patients, 48 percent had an AV fistula, 45 percent had a central vascular catheter, and the remaining had unknown access type.

* The definition of this variable changed in 2009. *Old definition*: Surgery within year before index culture date. *New definition*: Surgery within year before initial culture date.
† The definition of this variable changed in 2009. *Old definition*: Central vascular catheter in place at time of admission/evaluation. *New definition*: Central vascular catheter in place at any time in the 2 calendar days prior to initial culture.

Discussion

Seven full years of surveillance have allowed for a better characterization of the epidemiology of invasive MRSA disease in the Portland tri-county metropolitan area. Over this time, the incidence of invasive MRSA disease has decreased substantially, with the greatest decrease seen among HO cases.

Results from 2010 are consistent with previous years, in that invasive MRSA disease—including community associated cases—manifests largely in those with an underlying condition or behavior that is related to their infection. Almost all cases in those with healthcare-defining risk factors were in those with underlying chronic diseases, such as diabetes, cardiovascular disease, renal failure, etc., that require frequent encounters with the healthcare system or invasive medical procedures. Invasive MRSA cases generally increase with age and occur primarily among those 65 and older.

The more frequent susceptibility of CA-MRSA isolates to clindamycin is consistent with the fact that a greater proportion of these are USA300 PFGE type, which usually carries fewer resistance genes than healthcare associated PFGE types. Clindamycin is not generally used as primary therapy for invasive MRSA disease. Intermediate or full resistance to vancomycin has not been detected among invasive MRSA isolates in Oregon, based on accepted breakpoint minimum inhibitory concentration (MIC) values. There are numerous reports in the medical literature of possible decreasing effectiveness of vancomycin due to small but significant increases in resistance of MRSA to this drug, reflected in slowly rising MIC values. However, since methods for determining MICs may vary between laboratories, and isolates are generally reported as either "susceptible" or not, the extent vancomycin MICs have been increasing over time among MRSA isolates in Oregon is unclear. Additional characterization of the MRSA isolates is required to answer this question.

The use of molecular strain type information has demonstrated an increase in the traditional community-associated USA300 strain among cases classified epidemiologically as healthcare-associated. This finding raises two possibilities: The frequency of transmission of USA300 strains within the healthcare setting could be increasing (an observation supported in recently-published literature); or cases may be misclassified as healthcare-associated, due to the presence of the established "risk factors", when colonization or infection was actually acquired in the community.[2,3] Although both factors likely play some role, further investigation will be needed to better understand the dynamics of MRSA transmission between healthcare and community settings.

References

1. Centers for Disease Control and Prevention. Invasive Methicillin-Resistant *Staphylococcus aureus* Infections Among Dialysis Patients – United States, 2005. MMWR 2007;56:09. Available via the Internet: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5609a3.htm. Accessed 4 Nov 2011.
2. Popovich KJ, Weinstein RA, Bota B. Are community-associated Methicillin-Resistant *Staphylococcus aureus* (MRSA) strains replacing traditional nosocomial MRSA strains? *Clin Infect Dis*. 2008;46:787-94.
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