HEALTHCARE COST AND UTILIZATION PROJECT

Agency for Healthcare Research and Quality

STATISTICAL BRIEF #35

July 2007

Infections with Methicillin-Resistant Staphylococcus Aureus (MRSA) in U.S. Hospitals, 1993–2005

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Introduction

Infections with methicillin-resistant Staphylococcus aureus (MRSA) are resistant to the usual antibiotics used to treat them (beta-lactam antibiotics, including methicillin, oxacillin, amoxicillin, and penicillin). Although Staphylococcus is a common bacterium that resides on skin and in nasal passages, it can cause infections if it enters the body through a cut in the skin, and these infections can be serious. MRSA infections can occur among hospitalized patients who undergo surgery or who have suppressed immunity; however, they also increasingly occur among non-hospitalized patients who are otherwise healthy. Previous analyses have presented data on an earlier time period (before 1991)[1] and a cross-sectional view of MRSA hospitalizations from 1999–2000.[2]

This Statistical Brief presents data from the Healthcare Cost and Utilization Project (HCUP) on the trend in MRSA infections over the 13 years from 1993 to 2005 and provides details on MRSA hospitalizations for 2004. Although it is not possible to determine whether these infections originated in the hospital or were community acquired, this information can provide insight into the growth in MRSA infections and what types of patients are affected. All differences noted in the text, tables, and figures are significant at the 0.05 level or better.

Findings

Figure 1 shows the growth in MRSA infections over the 13 years from 1993 to 2005. In 2005, there were about 368,600 cases of MRSA infection in U.S. hospitals, a figure that increased by 30 percent after 2004, more than tripled after 2000,[3] and increased

Highlights

- In 2005, there were about 368,600 hospital stays for infections with MRSA (an antibiotic-resistant bacterium). Hospital stays for these infections more than tripled after 2000 and increased nearly tenfold after 1995. The increase from 2004 to 2005 was 30 percent.
- On average, hospital stays for MRSA infections cost $14,000, compared with $7,600 for all other stays, and the length of hospitalization was more than double—10.0 days for MRSA infections versus 4.6 days for all other stays.
- MRSA hospitalizations were more likely to begin in the emergency department, to be transfers from another hospital, or transfers from long-term care settings. The in-hospital death rate for MRSA stays was 4.7 percent compared with 2.1 percent for non-MRSA stays.
- The highest rate of MRSA hospitalization was among the elderly—360.8 MRSA stays per 100,000. This was more than three times higher than for any other age group: 114.7 stays for infants, 19.2 for 1- to 17-year-olds, 58.1 for 18- to 44-year-olds, and 111.5 for 45- to 64-year-olds per 100,000.
- Hospital stays for MRSA infections were highest in the South where there were 113.2 MRSA hospitalizations per 100,000 population. In the West, there were 95.9 MRSA stays, and in the Midwest and Northeast, there were about 89 MRSA stays per 100,000.
- The most common conditions associated with MRSA are skin infections (18.9 percent of all MRSA cases), pneumonia (9.0 percent), complications of medical care (about 16 percent), and septicemia (7.3 percent).

[1] Panlilio AL, Culver DH, Gaynes RP et al., Methicillin-resistant Staphylococcus aureus in U.S. hospitals, 1975–1991. *Infection Control and Hospital Epidemiology* 1992; 13:582–586.

[2] Kuehnert MJ, Hill HA, Kupronis BA, Tokars JI, Solomon SL, Jemigan DB. Methicillin-resistant-Staphyloccoccus aureus Hospitalizations, United States. *Emerging Infectious Diseases* 2005; 11(6):868–872.

[3] A prior study (Kuehnert et al., 2005) estimated 125,969 hospitalizations annually during 1999 and 2000, a figure that is in the range of the estimates presented in Figure 1: 108,600 for 1999 and 128,500 for 2000.

nearly tenfold after 1995. In 1993, there were fewer than 2,000 MRSA infections recorded in U.S. hospitals.

Characteristics of patients with MRSA infections
Table 1 presents details on the characteristics of hospital inpatients with MRSA infections in 2004 and compares patients with MRSA infections with those without MRSA infections. Overall, 44.0 percent of all hospital inpatients with MRSA were over the age of 65, 27.6 percent were 45 to 64 years old, and 22.2 percent were age 18 to 44. Compared with patients without MRSA infections, a significantly larger proportion of patients in the hospital with MRSA infections tended to be 45 years and older. With respect to gender, only 47.3 percent of MRSA patients were female compared with 59.0 percent of non-MRSA patients.

Parallel to the age distribution, 45.6 percent of all MRSA hospitalizations were covered by Medicare compared with 32.9 percent of hospital stays during which MRSA was not recorded. A significantly smaller proportion of MRSA patients were covered by private insurance (20.4 percent) compared with non-MRSA patients (34.5 percent). There was no difference in MRSA infection rates for patients covered by Medicaid and for the uninsured.

MRSA hospitalizations were more likely to begin in the emergency department (56.8 percent versus 43.0 percent for non-MRSA stays), to be transfers from another hospital (5.9 percent versus 3.5 percent for non-MRSA stays), or transfers from long-term care settings (4.4 percent versus 1.5 percent for non-MRSA stays). The in-hospital death rate for MRSA hospitalizations was more than double that for non-MRSA-stays (4.7 percent versus 2.1 percent).

Resource use for MRSA hospital stays
MRSA hospitalizations cost nearly double that for non-MRSA stays—$14,000 for MRSA stays compared with $7,600 for non-MRSA stays (table 1). The average length of stay in the hospital for a patient with MRSA infection was more than double that for non-MRSA stays—10.0 days versus 4.6 days.

Population rates of MRSA hospitalization
Figure 2 shows the rate of hospitalizations for MRSA infections per 100,000 population for U.S. regions and gender. The rate of MRSA infection was highest in the South where there were 113.2 MRSA-related hospital stays per 100,000 population. The next highest rate was in the West with 95.9 stays per 100,000 population. The Northeast and the Midwest had comparable rates of about 89 stays per 100,000 population.

The rate of MRSA infection was higher for males than for females—106.6 stays per 100,000 population for males compared with 92.2 for females.

Figure 3 shows the rate of hospitalization for MRSA infections per 100,000 population for age groups and expected payer. The highest rate of MRSA hospitalization was for those 65 years and older with 360.8 stays per 100,000. Infants less than one year of age were the next highest group with 114.7 MRSA stays per 100,000 population. This group was followed closely by 45 to 64 year olds who had 111.5 MRSA stays per 100,000 population. Patients in the 1 to 17 year age group had the lowest rate of MRSA infections.

Parallel to the findings by age, there were 331.6 stays per 100,000 for patients covered by Medicare. Patients covered by Medicaid had 184.1 stays per 100,000, and the uninsured had 43.2 stays per 100,000. All these rates were higher than the rate for the privately insured.

Most common principal diagnoses associated with MRSA infections
MRSA infection can only appear as a secondary diagnosis; the principal diagnosis provides information on the main reason for admission to the hospital. Table 2 lists the top 10 principal conditions for patients with MRSA infections. These 10 conditions account for nearly two-thirds of all MRSA cases. Five of the top 10 principal conditions were related to infections—skin and subcutaneous infections and pneumonia (the two most common conditions), septicemia, infective arthritis and osteomyelitis, and urinary tract infections. The third and fourth most common conditions represented complications of medical care (about 16 percent of MRSA cases). Complications from diabetes ranked seventh (3.3 percent of MRSA cases). Also ranked in the top 10 were respiratory failure (an indication of the seriousness of this

condition) and chronic ulcer of the skin. All of these conditions were significantly more common among MRSA patients than among patients with no MRSA infection.

Most common procedures associated with MRSA infections
The top two procedures associated with MRSA infections are related to surgical treatment of skin infection—incision/drainage and debridement of skin (table 3). These procedures were performed in about 13 percent of cases, many times more frequent than among non-MRSA patients. A third procedure that is likely related to surgical care of infection was partial excision of the bone, accounting for 1.4 percent of cases. Blood transfusions, respiratory intubation, hemodialysis, and enteral and parenteral nutrition all signal severe illness and were performed more frequently for MRSA patients. Several diagnostic studies were relatively common and more prevalent among MRSA patients.

Data Source

The estimates in this Statistical Brief are based upon data from the HCUP 2004 and 2005 Nationwide Inpatient Sample (NIS). Historical data were drawn from the 1993–2003 NIS.

Definitions

Diagnoses, ICD-9-CM, and Clinical Classifications Software (CCS)
The principal diagnosis is that condition established after study to be chiefly responsible for the patient's admission to the hospital. Secondary diagnoses are concomitant conditions that coexist at the time of admission or that develop during the stay. All-listed diagnoses include the principal diagnosis plus these additional secondary conditions.

ICD-9-CM is the International Classification of Diseases, Ninth Revision, Clinical Modification, which assigns numeric codes to diagnoses. There are about 12,000 ICD-9-CM diagnosis codes.

The ICD-9-CM code defining methicillin-resistant Staphylococcus aureus infection is V09.0 Infection with microorganisms resistant to penicillins (methicillin-resistant Staphylococcus aureus infection [MRSA]). This code can only appear as a secondary diagnosis.

CCS categorizes ICD-9-CM diagnoses into 260 clinically meaningful categories.[4] This "clinical grouper" makes it easier to quickly understand patterns of diagnoses and procedures.

Types of hospitals included in HCUP
HCUP is based on data from community hospitals, defined as short-term, non-Federal, general and other hospitals, excluding hospital units of other institutions (e.g., prisons). HCUP data include OB-GYN, ENT, orthopedic, cancer, pediatric, public, and academic medical hospitals. They exclude long-term care, rehabilitation, psychiatric, and alcoholism and chemical dependency hospitals, but these types of discharges are included if they are from community hospitals.

Unit of analysis
The unit of analysis is the hospital discharge (i.e., the hospital stay), not a person or patient. This means that a person who is admitted to the hospital multiple times in one year will be counted each time as a separate "discharge" from the hospital.

Region
Region is one of the four regions defined by the U.S. Census Bureau:
- Northeast: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, and Pennsylvania
- Midwest: Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, and Kansas
- South: Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida, Kentucky, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma, and Texas

[4] HCUP Clinical Classifications Software (CCS). Healthcare Cost and Utilization Project (HCUP). August 2006. U.S. Agency for Healthcare Research and Quality, Rockville, MD. http://www.hcup-us.ahrq.gov/toolssoftware/ccs/ccs.jsp

- West: Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Washington, Oregon, California, Alaska, and Hawaii

Payer
Up to two payers can be coded for a hospital stay in HCUP data. When this occurs, the following hierarchy is used:
- If either payer is listed as Medicaid, the payer is "Medicaid."
- For non-Medicaid stays, if either payer is listed as Medicare, the payer is "Medicare."
- For stays that are neither Medicaid nor Medicare, if either payer is listed as private insurance, the payer is "private insurance."
- For stays that are not Medicaid, Medicare or private insurance, if either payer is some other third-party payer, the payer is "other," which consists of Worker's Compensation, TRICARE/CHAMPUS, CHAMPVA, Title V, and other government programs.
- For stays that have no third-party payer and the payer is listed as "self-pay" or "no charge," the payer is "uninsured."

Costs and charges
Total hospital charges were converted to costs using HCUP Cost-to-Charge Ratios based on hospital accounting reports from the Centers for Medicare and Medicaid Services (CMS).[5] Costs will tend to reflect the actual costs of production, while charges represent what the hospital billed for the case. For each hospital, a hospital-wide cost-to-charge ratio is used because detailed charges are not available across all HCUP States. Hospital charges reflect the amount the hospital charged for the entire hospital stay and does not include professional (physician) fees. For the purposes of this Statistical Brief, costs are reported to the nearest hundreds.

About the NIS

The HCUP Nationwide Inpatient Sample (NIS) is a nationwide database of hospital inpatient stays. The NIS is nationally representative of all community hospitals (i.e., short-term, non-Federal, non-rehabilitation hospitals). The NIS is a sample of hospitals and includes all patients from each hospital, regardless of payer. It is drawn from a sampling frame that contains hospitals comprising 90 percent of all discharges in the United States. The vast size of the NIS allows the study of topics at both the national and regional levels for specific subgroups of patients. In addition, NIS data are standardized across years to facilitate ease of use.

About HCUP

HCUP is a family of powerful health care databases, software tools, and products for advancing research. Sponsored by the Agency for Healthcare Research and Quality (AHRQ), HCUP includes the largest all-payer encounter-level collection of longitudinal health care data (inpatient, ambulatory surgery, and emergency department) in the United States, beginning in 1988. HCUP is a Federal-State-Industry Partnership that brings together the data collection efforts of many organizations—such as State data organizations, hospital associations, private data organizations, and the Federal government—to create a national information resource.

For more information about HCUP, visit http://www.hcup-us.ahrq.gov/.

HCUP would not be possible without the contributions of the following data collection Partners from across the United States:

Arizona Department of Health Services
Arkansas Department of Health & Human Services
California Office of Statewide Health Planning & Development
Colorado Health & Hospital Association
Connecticut Integrated Health Information (Chime, Inc.)
Florida Agency for Health Care Administration

[5]HCUP Cost-to-Charge Ratio Files (CCR). Healthcare Cost and Utilization Project (HCUP). 2001–2003. U.S. Agency for Healthcare Research and Quality, Rockville, MD. www.hcup-us.ahrq.gov/db/state/costtocharge.jsp

Georgia GHA: An Association of Hospitals & Health Systems
Hawaii Health Information Corporation
Illinois Health Care Cost Containment Council and Department of Public Health
Indiana Hospital&Health Association
Iowa Hospital Association
Kansas Hospital Association
Kentucky Cabinet for Health and Family Services
Maryland Health Services Cost Review Commission
Massachusetts Division of Health Care Finance and Policy
Michigan Health & Hospital Association
Minnesota Hospital Association
Missouri Hospital Industry Data Institute
Nebraska Hospital Association
Nevada Division of Health Care Financing and Policy, Department of Human Resources
New Hampshire Department of Health & Human Services
New Jersey Department of Health & Senior Services
New York State Department of Health
North Carolina Department of Health and Human Services
Ohio Hospital Association
Oklahoma Health Care Information Center for Health Statistics
Oregon Office for Oregon Health Policy and Research and Oregon Association of Hospitals and Health Systems
Rhode Island Department of Health
South Carolina State Budget & Control Board
South Dakota Association of Healthcare Organizations
Tennessee Hospital Association
Texas Department of State Health Services
Utah Department of Health
Vermont Association of Hospitals and Health Systems
Virginia Health Information
Washington State Department of Health
West Virginia Health Care Authority
Wisconsin Department of Health & Family Services

For additional HCUP statistics, visit HCUPnet, our interactive query system at www.hcup.ahrq.gov.

For More Information

For a detailed description of HCUP and more information on the design of the NIS and methods to calculate estimates, please refer to the following publications:

Steiner, C., Elixhauser, A., Schnaier, J. The Healthcare Cost and Utilization Project: An Overview. *Effective Clinical Practice* 5(3):143–51, 2002.

Design of the HCUP Nationwide Inpatient Sample, 2004. Online. August 8, 2006. U.S. Agency for Healthcare Research and Quality. http://www.hcup-us.ahrq.gov/db/nation/nis/reports/NIS_2004_Design_Report.pdf

Houchens, R., Elixhauser, A. *Final Report on Calculating Nationwide Inpatient Sample (NIS) Variances, 2001.* HCUP Methods Series Report #2003-2. Online. June 2005 (revised June 6, 2005). U.S. Agency for Healthcare Research and Quality. http://www.hcup-us.ahrq.gov/reports/CalculatingNISVariances200106092005.pdf

Houchens R. L., Elixhauser, A. *Using the HCUP Nationwide Inpatient Sample to Estimate Trends.* (Updated for 1988-2004). HCUP Methods Series Report #2006-05 Online. August 18, 2006. U.S. Agency for Healthcare Research and Quality. http://www.hcup-us.ahrq.gov/reports/2006_05_NISTrendsReport_1988-2004.pdf

Suggested Citation

Elixhauser, A. (AHRQ) and Steiner, C. (AHRQ). *Infections with Methicillin-Resistant Staphylococcus Aureus (MRSA) in U.S. Hospitals, 1993–2005.* HCUP Statistical Brief #35. July 2007. Agency for Healthcare Research and Quality, Rockville, MD. http://www.hcup-us.ahrq.gov/reports/statbriefs/sb35.pdf

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AHRQ welcomes questions and comments from readers of this publication who are interested in obtaining more information about access, cost, use, financing, and quality of health care in the United States. We also invite you to tell us how you are using this Statistical Brief and other HCUP data and tools, and to share suggestions on how HCUP products might be enhanced to further meet your needs. Please e-mail us at hcup@ahrq.gov or send a letter to the address below:

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Rockville, MD 20850

Table 1. Characteristics of discharges with MRSA infections compared with discharges without MRSA infections, 2004**

	Discharges with MRSA infections	Discharges without MRSA infections	
Number of discharges (% of all stays)	289,000 (0.7%)	38,372,700 (99.3%)	
Age distribution, N (%)			
<1	4,600 (1.6%)	4,893,000 (12.8%)	*
1-17	13,400 (4.6%)	1,771,000 (4.6%)	
18-44	64,300 (22.2%)	10,259,100 (26.7%)	*
45-64	79,700 (27.6%)	8,466,700 (22.1%)	*
65+	127,100 (44.0%)	12,932,100 (33.7%)	*
Percent female, N (%)	136,800 (47.3%)	22,620,700 (59.0%)	*
Distribution by payer, N (%)			
Medicaid	69,900 (24.2%)	9,475,400 (24.7%)	
Privately insured	58,900 (20.4%)	13,223,600 (34.5%)	*
Uninsured	18,800 (6.5%)	1,937,300 (5.0%)	
Medicare	131,700 (45.6%)	12,626,800 (32.9%)	*
Distribution by admission source, N (%)			
Emergency department	164,300 (56.8%)	16,507,800 (43.0%)	*
Another hospital	17,000 (5.9%)	1,333,300 (3.5%)	*
Long-term care facility	12,700 (4.4%)	558,700 (1.5%)	*
Total hospital costs, mean dollars	$14,000	$7,600	*
Length of stay, mean days	10.0	4.6	*
In-hospital mortality, %	4.7%	2.1%	*

*p<0.05.

**MRSA can only appear as a secondary diagnosis.

H Residual cases include other payers such as VA, DoD, Worker's Compensation, and other state government programs, and missing payer.

Source: AHRQ, Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project, Nationwide Inpatient Sample, 2004.

Table 2. Most common principal diagnoses for hospital stays with MRSA infection,* 2004

Rank	Principal diagnosis	Number of stays with MRSA infection	Percent of stays with this principal diagnosis among stays with	
			MRSA	No MRSA
1	Skin and subcutaneous tissue infections	54,600	18.9	1.2
2	Pneumonia	26,000	9.0	3.1
3	Complication of device, implant or graft	23,500	8.1	1.5
4	Complication of surgical procedure or medical care	22,200	7.7	1.1
5	Septicemia	21,200	7.3	1.1
6	Infective arthritis and osteoarthritis	10,400	3.6	0.2
7	Diabetes mellitus with complications	9,600	3.3	1.3
8	Urinary tract infections	8,700	3.0	1.3
9	Respiratory failure	7,100	2.5	0.7
10	Chronic ulcer of skin	6,800	2.3	0.2

*MRSA can only appear as a secondary diagnosis.

Source: AHRQ, Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project, Nationwide Inpatient Sample, 2004.

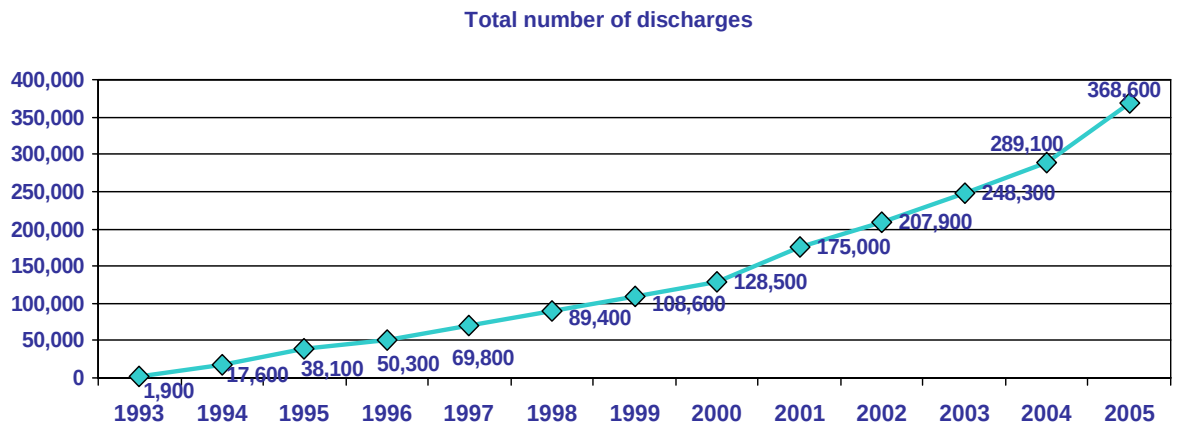
Table 3. Most common all-listed procedures for hospital stays with MRSA infection,* 2004

Rank	All-listed procedures	Number of stays with MRSA infection	Percent of stays with this procedure among stays with	
			MRSA	No MRSA
1	Incision and drainage, skin and subcutaneous tissue	33,300	6.7	0.3
2	Debridement of wound, infection, or burn	32,000	6.5	0.7
3	Blood transfusion	31,600	6.4	4.6
4	Respiratory intubation and mechanical ventilation	22,400	4.5	2.5
5	Hemodialysis	16,400	3.3	1.4
6	Echocardiogram	10,400	2.1	1.4
7	Enteral and parenteral nutrition	10,300	2.1	1.0
8	Upper gastrointestinal endoscopy and biopsy	9,400	1.9	2.6
9	Diagnostic bronchoscopy	8,800	1.8	0.7
10	Partial excision bone	7,000	1.4	0.5

*MRSA can only appear as a secondary diagnosis.

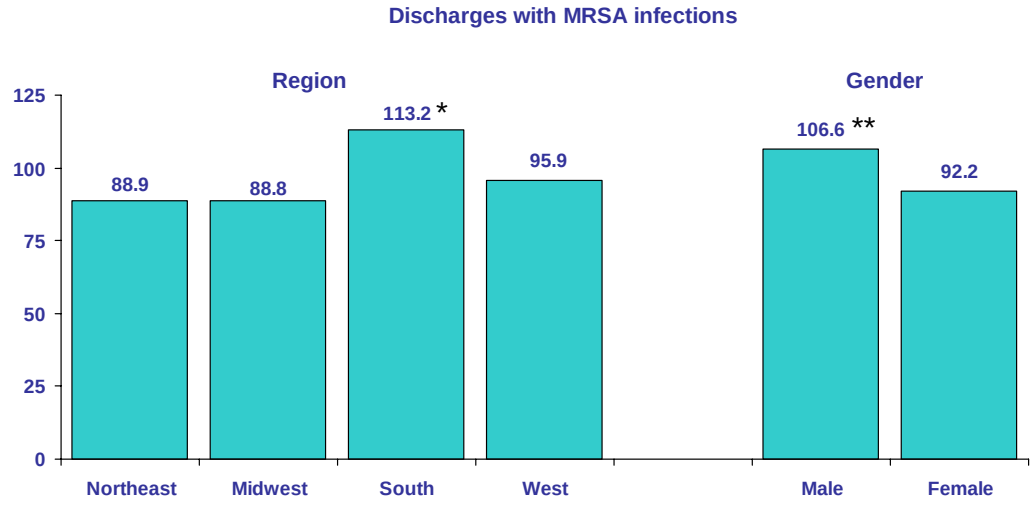
Source: AHRQ, Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project, Nationwide Inpatient Sample, 2004.

Figure 1. Hospital stays with methicillin–resistant Staphylococcus aureus (MRSA) infections, 1993–2005



Source: AHRQ, Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project, Nationwide Inpatient Sample, 1993-2005

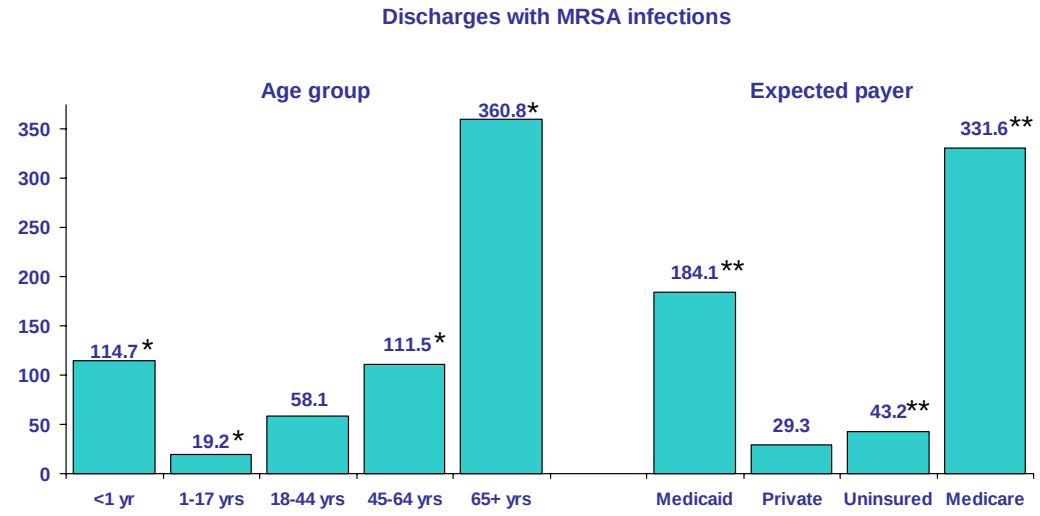
Figure 2. Rates of hospitalization with MRSA infection per 100,000 population, by region and gender, 2004



*Significantly higher than the other three regions. **Significantly higher than females.

Source: AHRQ, Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project, Nationwide Inpatient Sample, 2004

Figure 3. Rates of hospitalization with MRSA infection per 100,000 population, by age group and expected payer, 2004



*Significantly different from 18-44 year olds. **Significantly higher than privately insured.

Source: AHRQ, Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project, Nationwide Inpatient Sample, 2004