

**State of Illinois**

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# MRSA in Illinois

## Descriptive Analysis of Hospital Discharge Data 2002-2006

2008

# MRSA in Illinois: Descriptive Analysis of Hospital Discharge Data 2002-2006

## Preface

Staphylococcal bacteria, often referred to as “staph,” are commonly occurring bacteria found on the skin and in the noses of most people. Most staphylococcal species never cause infection. However, when infection does occur due to staph, the species *Staphylococcus aureus* is usually the cause; only one of every three or four people carries *S. aureus*.

Staph may cause minor skin or soft tissue infections, which occur spontaneously without an obvious source of infection. Persons with staph skin infections may complain of “an infected pimple,” “an insect bite,” “a spider bite,” or “a sore.” Many staph infections cause minor redness and swelling without pain, and infected persons may not seek medical attention. However, some staph infections can cause more serious — sometimes life-threatening — infections such as abscesses, pneumonia, and bloodstream infections.

“MRSA” stands for methicillin resistant *S. aureus*, and is used to describe MRSA strains that are resistant to methicillin, a form of penicillin. Although MRSA is resistant to antibiotics commonly used in the past to treat staph infections, it remains susceptible to many other antibiotics and usually responds well to proper therapy, initiated before infections become serious. IDPH has published MRSA guidelines for primary care providers aimed at helping to ensure that proper diagnostic work-up and use of antibiotic therapy to treat MRSA. ([www.idph.state.il.us/health/infect/index.htm#mrsa](http://www.idph.state.il.us/health/infect/index.htm#mrsa))

Initially, infection with MRSA was associated with exposure to health care environments, such as hospitals. However, other MRSA strains have evolved that affect previously healthy persons who have not had contact with health care facilities. MRSA infections are becoming more common in otherwise healthy persons who have not had contact with health care personnel or patients. These infections are known as “community-associated MRSA” or CA-MRSA infections. CA-MRSA can occasionally cause serious infections requiring hospital admission.

About a quarter of the most serious (invasive) MRSA infections are CA-MRSA, occurring among individuals without health care risk factors. The majority of invasive MRSA infections first become evident outside the hospital, but among persons with health care risk factors (e.g. hospitalization within the past year). The remainder of invasive MRSA infections, (about 25%), occur in the hospital.

Invasive MRSA occurs most frequently among patients who undergo medical procedures or have weakened immune systems. MRSA in health care settings can cause serious and potentially life threatening infections, such as blood stream infections, surgical site infections, or pneumonia.

### **How MRSA is spread in health care settings.**

Patients who already have a MRSA infection or who carry the bacteria on their bodies but do not have symptoms are the most common sources of transmission. The main mode of MRSA transmission is from patient to patient through human hands, especially health care worker hands. Frequent hand washing with soap and water or an alcohol-based hand sanitizer is the best way to prevent the spread of MRSA, both in the hospital and in the community. (U.S. Centers for Disease Control, 2007)

## **MRSA can be prevented.**

In spite of MRSA becoming more prevalent in the health care setting, the good news is that it is preventable. The first step for preventing MRSA is to prevent healthcare infections in general. Infection control guidelines produced by the Center for Disease Control (CDC) are central to the prevention and control of health care infections and ultimately, MRSA, in health care settings. To learn more about infection control guidelines to prevent infections and MRSA, go to <http://www.cdc.gov/ncidod/dhqp>. If you or a family member is anticipating a hospital stay, you should ask to see your hospital's infection control policies and how those policies are operationalized and monitored.

Increasing reports and growing public concern about MRSA have prompted IDPH to publish the following study depicting the burden of MRSA infections in Illinois hospitals. Each figure and table needs to be looked at carefully and the explanation read completely to better understand the occurrence of this infection and its impact.

## **Report**

This report provides information about hospitalized patients with MRSA infections identified through an analysis of discharge billing codes provided to IDPH by each acute care hospital in Illinois for the years 2002-2006, with particular emphasis on the last three years of data (2004-2006).

The Hospital Discharge Dataset identifies hospitalized patients with MRSA infections that are acquired in the community, as well as infections acquired during hospitalization. About 75 percent of all serious (invasive) MRSA infections are diagnosed during the first 48 hours of hospitalization; these infections are unlikely to be due to acquisition of MRSA during the same hospitalization. At this point, the hospital discharge dataset does not allow determination of whether MRSA infection was acquired as a result of hospitalization; therefore, the primary utility of this dataset is to follow overall trends in the burden of MRSA at Illinois hospitals, to understand what types of patients are most likely to be affected by MRSA infections, and to raise consciousness regarding the importance of infection control measures.

**Figure 1: Overall number of hospital discharges with MRSA Diagnosis, 2002 - 2006.**

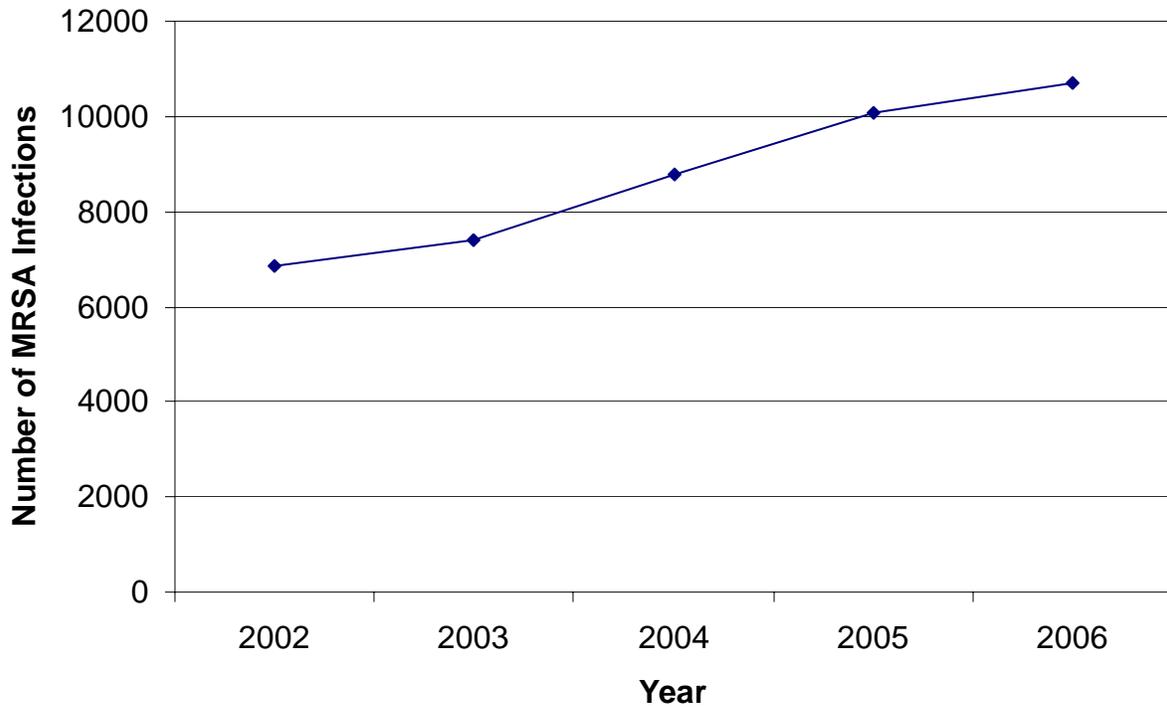


Figure 1 shows the total number of MRSA infections from 2002-2006. In 2002, there were 6,841 cases of MRSA diagnosed by Illinois hospitals. This number has increased steadily each year, with 10,714 cases diagnosed in 2006, a 56.7 percent increase in total cases over the five-year period.

**Figure 2: Number of MRSA Infections per 1,000 hospital discharges, 2002-2006.**

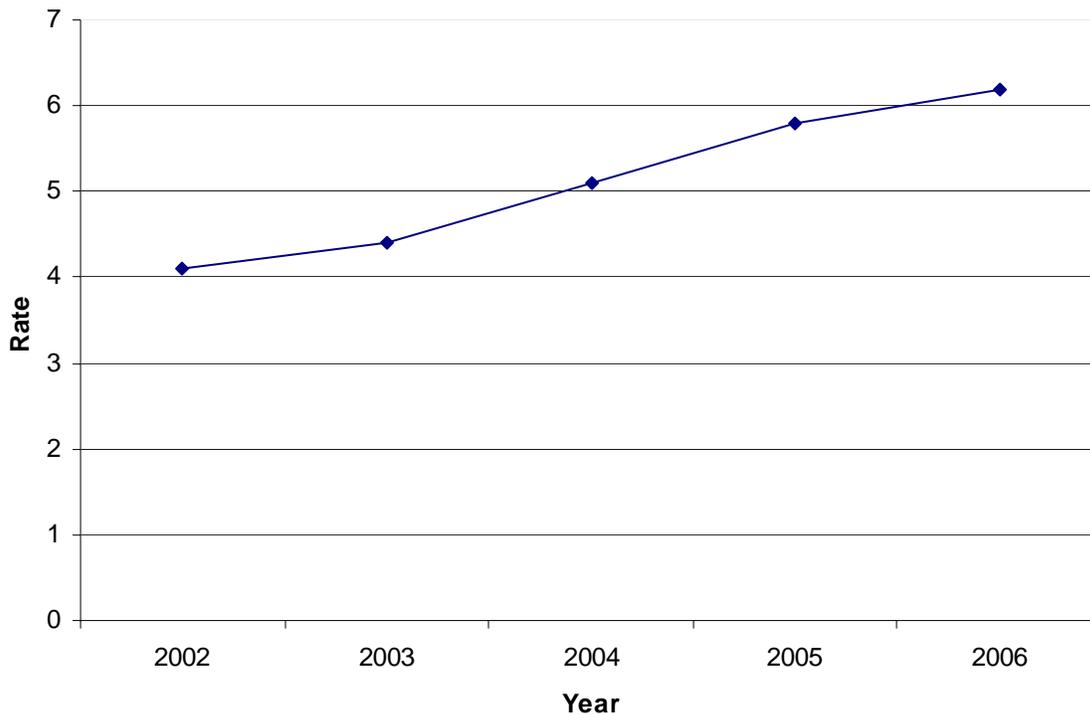


Figure 2 shows MRSA infections per 1,000/discharges in Illinois for the years 2002-2006. Overall, MRSA rates among patients at Illinois hospitals during this time period increased from 4.1/1,000 discharges to 6.2/1,000 discharges, a trend paralleling numerous national reports. In 2004, the last year for which national data have been published, the MRSA infection rate in Illinois hospitals (5.1 cases/1,000 discharges) is lower than the nation as a whole (7.5 infections/1,000 discharges).<sup>1</sup> During 2006, the last year for which data are available for Illinois, there were 10,714 MRSA infections among 1,724,612 discharges: 0.6 percent of all hospital discharges were diagnosed with MRSA infection.

<sup>1</sup> 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>.

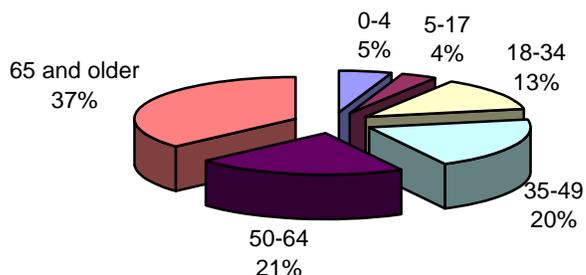
**Table 1. Age and sex distribution of MRSA infections among hospitalized patients, 2002-2006.**

Age range	Year				
	2002	2003	2004	2005	2006
	N (%)	N(%)	N (%)	N(%)	N(%)
0-4	120 (1.8)	196 (2.7)	331 (3.8)	412 (4.1)	555 (5.2)
5-17	90 (1.3)	146 (2.0)	206 (2.3)	346 (3.4)	400 (3.7)
18-34	459 (6.7)	602 (8.2)	866 (9.9)	1238 (12.3)	1408 (13.1)
35-49	975 (14.2)	1192 (16.1)	1526 (17.4)	1967 (19.5)	2170 (20.3)
50-64	1290 (18.9)	1394 (18.9)	1735 (19.7)	1967 (19.5)	2252 (21.0)
65 and older	3907 (57.1)	3854 (52.2)	4121(46.9)	4148 (41.2)	3929 (36.7)
<b>Sex</b>					
Female	3414 (49.9)	3737 (50.6)	4277 (48.7)	4861 (48.2)	5086 (47.5)
Male	3427 (50.1)	3647 (49.4)	4508 (51.3)	5215 (51.8)	5628 (52.5)

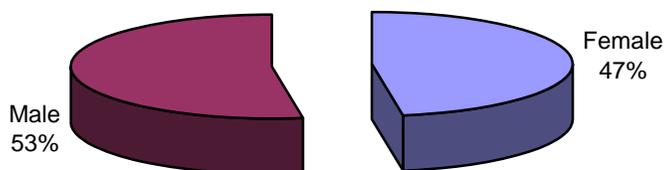
Table 1 shows the number (N) of MRSA infections stratified by age group for the years 2002-2006. The number of MRSA infection increased each year among all age groups during this time period, with the exception of the 65 and older group, for whom numbers fluctuated. School aged children (5-17) have the lowest burden of MRSA infections among hospitalized patients, but experienced the greatest percentage increase in the total number of MRSA infections. The greatest burden of MRSA infections occurred among older individuals, especially those older than 65. During 2006, the latest year for which discharge data are available, more than 58 percent of all MRSA infections occurred among individuals older than age 50, with the majority of these infections (63.6%) occurring in patients age 65 years or older.

The sex distribution of MRSA cases remained equally distributed during this period (2002-2006), with females accounting for 47 percent to 49 percent diagnoses during this time period. A graphic summary of information regarding the age and sex distribution of patients hospitalized with MRSA during 2006 is presented in Figures 3 and 4.

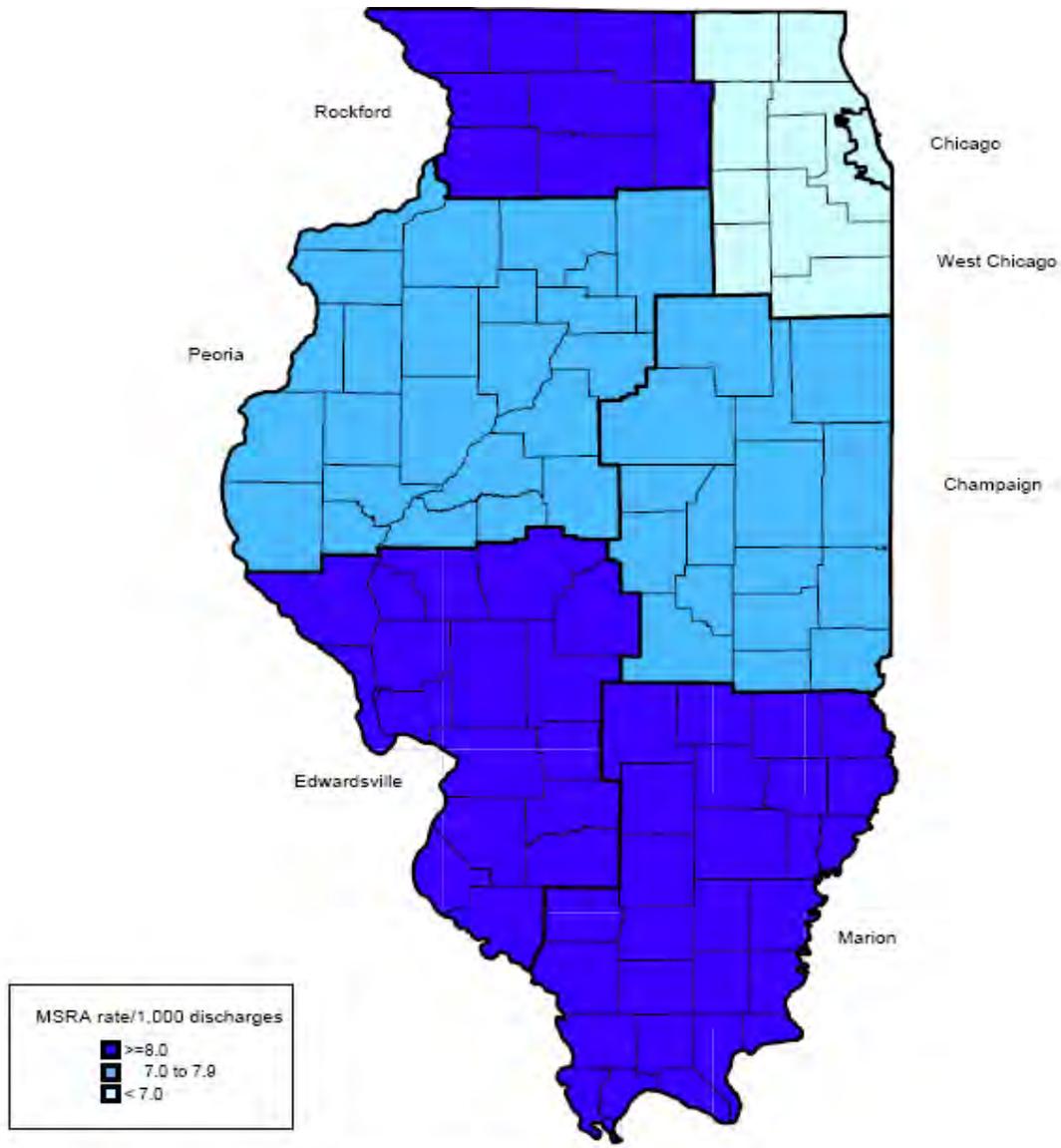
**Figure 3. Age distribution for all hospitalized patients with MRSA infections, 2006.**



**Figure 4. Sex distribution for all hospitalized patients with MRSA infections, 2006.**



**Figure 5: Rate of hospitalization with MRSA diagnosis per 1,000 discharges by region, 2006**



Source: Illinois Department of Public Health, Hospital Discharge Data

<b>Region</b>	<b>MRSA Infections</b>	<b>MRSA Rate per 1,000 Discharges</b>
Chicago	2,443	5.3
West Chicago	4,198	5.6
Champaign	699	7.3
Marion	578	8.3
Edwardsville	1,225	8.8
Peoria	984	7.2
Rockford	587	8.0
State wide	10,714	6.2

As pictured in Figure 5, rates of MRSA infection range from 5.3 to 8.8 infections /1,000 discharges among hospitalized patients in different regions of the state during 2006, with the lowest rates in the West Chicago and Chicago regions. In contrast, the total yearly burden of MRSA infection is higher in West Chicago and Chicago, based on a higher volume of patient discharges in these regions compared to other areas of the state.

**Table 2. Total number and rate (#/1,000 discharges) of MRSA infections by type of hospital, 2004-2006.**

Hospital type	Year					
	2004		2005		2006	
	# Cases	Rate	# Cases	Rate	# Cases	Rate
<b>Teaching status</b>						
Teaching	1,964	4.7	2,368	5.6	2,377	5.6
Non-teaching	6,821	5.3	7,710	5.9	8,377	6.4
<b>Location</b>						
Largest urban areas	5,941	4.7	6,841	5.4	7,305	5.7
Other urban areas	1,634	5.8	1,925	6.8	1,971	7.0
Rural	1,210	7.1	1,312	7.7	1,438	8.6
<b>Bed size</b>						
<100 beds	792	7.4	912	8.4	1,040	9.8
100-300 beds	3,592	5.5	3,991	6.1	4,249	6.5
>300 beds	4,401	4.6	5,175	5.4	5,425	5.6

As described in Table 2, based on discharge coding, MRSA rates were lowest in teaching hospitals, large urban hospitals, and hospitals with > 300 beds. Throughout this time period, the largest disparity in MRSA rates was between large (>300 bed) and small (<100 bed) hospitals, with lower rates occurring in large hospitals. However, large hospitals had the biggest increase (1,024 cases) in the overall burden of MRSA infections.

**Table 3. Total number and rate (# /1,000 discharges) of MRSA bloodstream infections at selected sites, 2004-2006.**

Year	Bloodstream (Sepsis)		Pneumonia		Other sites		Total	
	Total #	# per 1000 discharges	Total #	# per 1000 discharges	Total #	# per 1000 discharges	Total #	# per 1000 discharges
<b>2004</b>	835	0.5	904	0.5	7046	5.2	8785	5.1
<b>2005</b>	892	0.5	1039	0.6	8137	4.7	10,078	5.8
<b>2006</b>	762	0.4	941	0.5	9011	5.2	10,714	6.2

Table 3 shows the number of MRSA infections involving the bloodstream, lung (pneumonia), and all other sites combined during the period 2004-2006. Rates of MRSA bloodstream and pneumonia infections were relatively stable during this time period, but there was a significant increase in MRSA infections involving other sites. For individuals with MRSA infections not designated as causing

pneumonia or bloodstream infection, additional analysis (as described in Methods, Appendix 2) indicates that the most common associated diagnoses were skin and soft tissue infections. The number of skin and soft tissue infections associated with MRSA diagnosis more than doubled from 2004 to 2006, increasing from 1,585 to 3,191.

**Table 4. MRSA infection among discharged patients with surgical procedures, 2004-2006.**

	Year		
	2004	2005	2006
<b>All discharges</b>			
Total number of inpatient discharges	1,710,389	1,725,033	1,724,612
No. of MRSA infections	8,785	10,078	10,714
Rate per 1,000 discharges	5.1	5.8	6.2
<b>Discharges not involving a surgical procedure</b>			
Total	713,100	727,128	720,241
No. of MRSA infections	2906	3522	3800
Rate per 1,000 discharges	4.1	4.8	5.3
<b>Discharges involving a surgical procedure</b>			
Total	997,289	997,905	1,004,371
No. of MRSA infections	5,879	6,556	6,914
Rate per 1,000 discharges	5.9	6.6	6.9
<b>Discharges involving invasive cardiovascular surgery</b>			
Total	200,248	201,801	203,324
No. of MRSA infections	2,578	2,625	2,475
Rate per 1,000 discharges	12.9	13.0	12.2
<b>Discharges involving invasive neurosurgery</b>			
Total	50,998	52,047	52,338
No. of MRSA infections	152	163	184
Rate per 1,000 discharges	3.0	3.1	3.5
<b>Discharges involving invasive orthopedic surgery</b>			
Total	85,977	87,705	89,229
No. of MRSA infections	464	428	462
Rate per 1,000 discharges	5.4	4.9	5.2

Table 4 shows MRSA infection rates among all patients having any surgical procedure, as well as those having major orthopedic, cardiovascular, and neurosurgical procedures during 2004-2006. For 2006, the last year for which data are available, 0.7 percent (6,914) of 1,004,371 of having a surgical procedure had MRSA infection. Among all patients having a major cardiovascular, orthopedic or neurosurgical procedure, MRSA infections are most prevalent among cardiovascular surgery patients. Unlike the other

categories of surgery, the overall number and rate of MRSA infection declined among cardiovascular patients in 2006, compared to previous years.

**Table 5. MRSA infection among patients with chronic medical conditions, including patients requiring hemodialysis, 2004-2006**

Type of diagnosis	Year		
	2004	2005	2006
<b>All discharges</b>			
Total number discharges	1,710,389	1,725,033	1,724,612
No. of MRSA infections	8,785	10,078	10,714
Rate per 1,000 discharges	5.1	5.8	6.2
<b>Hemodialysis performed</b>			
Total	31,653	33,138	34,264
No. of MRSA infections	431	404	335
Rate per 1,000 discharges	13.6	12.2	9.8
<b>Stays with asthma diagnosis</b>			
Total	104,634	111,092	114,601
No. of MRSA infections	481	602	699
Rate per 1,000 discharges	4.6	5.4	6.1
<b>Stays with smoking related diagnoses</b>			
Total	163,409	174,320	174,523
No. of MRSA infections	1,419	1,514	1,401
Rate per 1,000 discharges	8.7	8.7	8.0
<b>Stays with diabetes diagnosis</b>			
Total	269,581	277,147	278,137
No. of MRSA infections	2,146	2,287	2,321
Rate per 1,000 discharges	8.0	8.3	8.3

As shown in Table 5, MRSA rates for individuals with diabetes, chronic lung disease due to smoking, and renal disease requiring hemodialysis were higher throughout 2004-2006 than the overall rate of infection for all hospitalized patients. MRSA rates for hemodialysis patients were more than twice the average rate for all patients during 2004 and 2005. During 2006, MRSA rates for hemodialysis patients remained high, but declined nearly 30 percent from the 2004 rate, to 9.8/1,000 discharges.

**Table 6. Comparison of individuals with MRSA vs no MRSA diagnosis, 2004**

<b>Year: 2004</b>				
	<b>MRSA infection</b>		<b>No MRSA infection</b>	
	N (%)		N (%)	
<b>Number of patient discharges</b>	8,785	(0.5)*	1,701,604	(95.5)*
<b>Hospital mortality</b>	303	(3.4)	32,244	(1.9)
<b>Distribution by payer</b>				
Medicaid	1,352	(15.4)	333,744	(19.6)
Privately insured	2,079	(23.7)	626,537	(36.8)
Uninsured	638	(7.3)	118,779	(7.0)
Medicare	4,716	(53.6)	622,544	(36.6)
<b>Payer totals</b>	8,785	(100)	1,701,604	(100)
<b>Average total hospital charges in \$</b>	27,156.85		19,552.79	
<b>Length of stay, mean days</b>	8		4.6	

**Table 7. Comparison of individuals with MRSA vs no MRSA diagnosis, 2005**

<b>YEAR : 2005</b>				
	<b>MRSA</b>		<b>No MRSA</b>	
	Total (%)		Total (%)	
<b>Number of patient discharges</b>	10,078	(0.6)*	1,714,955	(99.4)*
<b>Hospital mortality</b>	270	(2.7)	32,577	(1.9)
<b>Distribution by payer</b>				
Medicaid	1,742	(17.3)	345,344	(20.1)
Privately insured	2,620	(26.0)	620,746	(36.2)
Uninsured	902	(9.0)	115,774	(6.8)
Medicare	4,814	(47.7)	633,091	(36.9)
<b>Payer totals</b>	10,078	(100)	1,714,955	(100)
<b>Average total hospital charges in \$</b>	26,407.52		21,093.43	
<b>Length of stay, mean days</b>	7.4		4.6	

\* In Tables 6-8, the percentages of patient discharges is the ratio of MRSA cases to all discharges for the year and non-MRSA cases to all discharges for the same year. The percentages shown for hospital mortality are the ration of deaths to MRSA cases and deaths to non-MRSA cases. Distribution by payer is calculated as the percentage of each category to the total MRSA and non-MRSA cases for the year.

**Table 8. Comparison of individuals with MRSA vs no MRSA diagnosis, 2006**

<b>YEAR : 2006</b>		
	<b>MRSA</b>	<b>No MRSA</b>
	Number (%)	Number (%)
<b>Number of patient discharges</b>	10,714 (0.6)*	1,713,898 (0.6)*
<b>Hospital mortality</b>	218 (2.0)	31,978 (1.9)
<b>Distribution by payer</b>		
Medicaid	2,039 (19.0)	357,791 (20.9)
Privately insured	2,985 (27.9)	613,738 (35.8)
Uninsured	1,129 (10.5)	117,360 (6.8)
Medicare	4,561 (42.6)	625,009 (36.5)
<b>Payer totals</b>	10,714 (100)	1,713,898 (100)
<b>Average total hospital charges in \$</b>	26,237.00	22,801.04
<b>Length of stay, mean days</b>	6.8	4.5

Tables 6-8 compare patients with MRSA infections to those without MRSA infections during the period 2004-2006. Consistent with the latest available (2004) national data, mortality of patients with MRSA was nearly double that for patients without MRSA during 2004. By 2006, the death rate among patients with MRSA diagnoses declined to approximately the same rate as for as non-MRSA patients.

These tables also show the number of individuals hospitalized with MRSA increased for all payer groups. Parallel to the age distribution described above, patients covered by Medicare accounted for the greatest proportion of MRSA diagnoses throughout this time period.

Hospitalizations involving a MRSA infection cost more than non-MRSA stays. The average length of stay for a patient discharged with MRSA infection was 2.3 -3.4 days longer for non-MRSA stays, but this gap narrowed over time. The length of stay for MRSA infections declined from 8.0 to 6.8 days, while the length of stay for non-MRSA infections remained essentially unchanged.

## Discussion

The magnitude and trend of MRSA infections among hospitalized patients in Illinois have not been previously reported. Consistent with national data, analyses of Hospital Discharge data indicate that the burden of MRSA infections in Illinois hospitals has increased significantly during the past five years.

This increase in MRSA is observed in all areas of Illinois, regardless of hospital category, based on population density, bed size, and teaching status. These findings parallel numerous published reports from individual hospitals, as well as a recent national survey<sup>2</sup> that identified high prevalence of MRSA in hospitals of all types throughout the United States.

Although the discharge dataset does not distinguish between community and hospital acquired infections, health care associated MRSA infections are likely to account for the majority of MRSA infections among hospitalized patients in Illinois. Recent estimates<sup>3</sup> indicate that 30 percent of all hospitalized patients with MRSA have community-associated infections. Applying this estimate to Illinois data, approximately 2.1 infections/1000 discharges were attributable to CA-MRSA in 2006.

Skin and soft tissue infections associated with MRSA increased dramatically during 2004-2006; this is most likely due to a number of factors, including increases in CA-MRSA, as well as shifts in the bacterial causes of surgical site infections. Of note, the majority of MRSA infections are not due to bloodstream infections or pneumonia. Widespread use of evidence-based interventions aimed at limiting bloodstream and lung infections associated with catheters and ventilators may have limited the number of such infections at these sites.

MRSA infections were associated with age. This is consistent with previously published data showing an association between age and the incidence of serious *Staphylococcus aureus* infection as well as the rate of methicillin resistance. Individuals with diagnoses related to smoking, diabetes, and hemodialysis also had higher MRSA rates than average. Hemodialysis patients are especially vulnerable to infections, including MRSA, as they require vascular access for prolonged periods.

Several aspects of these data warrant cautious optimism. During the last year for which national comparative data are available, MRSA rates among hospitalized patients in Illinois (5.1/1,000 discharges) are lower than the national average (7.5/1,000 discharges). This is consistent with the latest national data (2004) that indicates that the Midwest has lower MRSA rates than most other parts of the country. In 2004 (the last year for which comparative national data are available), MRSA mortality rate was lower in Illinois (3.4%) than for the United States as a whole (4.7%). Mortality associated with MRSA infections in Illinois further declined to 2.0 percent in 2006, and was nearly identical to the mortality rate for patients without MRSA infections (1.9%). Despite the overall increase in MRSA, MRSA rates were lower in 2006 than in 2004 for cardiovascular surgery and hemodialysis patients. In addition, the rate of increase in MRSA slowed during 2005-2006, which may presage a change in MRSA trends.

This report is subject to several limitations. As it is restricted to MRSA associated with hospitalizations, it does not provide insights into MRSA managed in outpatient settings. In addition, the Hospital Discharge Dataset does not currently include information about race/ethnicity of hospitalized patients (this information will be included in discharge data information beginning in 2008.)

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<sup>2</sup> Jarvis, W.R., Schlosser, J, Chinn, R., et al. American Journal of Infection Control 2007; 35(10): 631-637.

<sup>3</sup> Klevens, R.M., Morrison, M.A., Nadle, J., et. al. Journal of American Medical Association 2007; 298 (15) : 1803-1804

The accuracy of ICD-9 coding for MRSA has not been established, either nationally, or in Illinois. The validity of various aspects of ICD-9 coding for MRSA infections should therefore be assessed, as previous analyses have suggested considerable variation in the accuracy of ICD-9 codes for tracking infections, compared to the gold standard of infection control practitioner review of medical record and laboratory data.

Based on the limited information available from the dataset, reasons for differences in observed rates (e.g. between urban and rural hospitals) cannot be determined. Factors that may impact variations in rates include different coding practices, differences in CA-MRSA rates, differences in how MRSA infections are managed (inpatient vs. outpatient), as well as differences in infection control practices that limit MRSA transmission. In addition, differences in “capture” of MRSA codes at hospitals may vary (only nine of 25 ICD-9 codes are currently captured in the Hospital Discharge Dataset); therefore MRSA diagnoses may not be captured as frequently for severely ill patients with multiple diagnoses. Based on the inability to determine whether differences between hospitals represent actual differences in hospital-acquired MRSA rates, individual hospital data are not presented in this report. Despite these limitations in interpretation of the data, consistency with national findings indicates that trend data are robust.

In summary, this report indicates that the burden of MRSA in Illinois hospitals is substantial and has increased significantly during 2002-2006. These findings highlight the importance of devoting resources to infection control and prevention activities aimed at decreasing transmission of MRSA in hospitals. Additional insights into the epidemiology of CA-MRSA as well as individual hospital performance in limiting MRSA transmission will become available from other data sources, including Communicable Disease surveillance reports, and Hospital Report Card Act reporting.

## Appendix 1.

### **Illinois Discharge Dataset**

The submission of discharge data by Illinois hospitals to the state was enacted in 1984. This law, the Health Finance Reform Act, created a state agency called Illinois Health Care Cost Containment Council that began receiving data in late 1986. This activity continues to this time, now managed by the Illinois Department of Public Health. This data includes diagnosis and procedure codes, payer (or self-pay), priority of the admission, point of entry, disposition of the patient, dates of service, charges, and birth date, sex and ZIP code of the patient. This data is treated as confidential information and handled according to HIPAA guidelines. This data was initially used to create hospital-specific charge comparison reports for release to the public. Over time, other studies and reports were created on health care issues such as delivery, asthma, heart disease, pneumonia, coronary bypass and other studies.

The collected data is based on the uniform bill (in its several iterations) and is health care billing data, not clinical data. For this reason the data is limited to the services billed by the submitting hospital, which may not include all diagnostic activities such as lab and radiology. However, as diagnosis and procedure codes are used intensively in determining payment, this information is generally well coded. It should be noted that evidence for validity of administrative coding with regards to infections is not as good as for some other conditions. It also should be noted that charges submitted are defined as the normal and usual charge master amount. This does not reflect any reduced payments negotiated with patients or payers and does not reflect the actual cost of health care provided. Information shown for the last year of this study, 2006 discharges, represents 99.2 percent of all inpatient stays reported by submitting hospitals during this period.

New codes have recently been added to the hospital discharge data set, including a present on admission code, which will apply to many conditions, including MRSA. This will impact future data organization and reporting.

## Appendix 2.

### **MRSA Study Methods**

ICD-9 diagnosis code V09.0 was used to select cases for this study. As MRSA can be used only as a secondary diagnosis, all cases for the time-period having V09.0 as a secondary were included. Within this population of cases, varieties of aggregations are presented for discharges occurring in calendar years 2002 through 2006. It should be noted that these cases include an unknown number of suspected cases of MRSA that may have proven negative by further laboratory tests completed after these data were reported.

Rate per 1,000 discharges was calculated by multiplying the number of MRSA cases by 1,000 and then dividing by the total number of discharges for each year or group. This method of rate calculation is used throughout this study. Patient age at discharge is the value used to compute the age groups shown.

The regional values are based on the location of the hospitals reporting the data, resulting in some cases of non-Illinois residents in the study. Teaching hospitals are members of the Council of Teaching Hospitals while “large urban” refers to hospitals in a Metropolitan Statistical Area with a population of 1 million or more. “Other urban” refers to hospitals in a Metropolitan Statistical Area with a population of less than 1 million and “rural” refers to hospitals not in a Metropolitan Statistical Area.

*Staphylococcus aureus* in the MRSA reported cases is identified by diagnosis code 038.11 while *S.Aureus* pneumonia is reported using diagnosis code 482.41. All other cases are presented as unspecified location or site.

Stays with a surgical procedure are those cases with at least one listed ICD-9 procedure code. Cases involving cardiovascular surgery are those cases with any listed procedure code in the range 35xx-39xx while neurosurgery cases were selected by procedure codes 01xx-05xx. Orthopedic case selection was more complex, using the following Healthcare Cost Utilization Project (HCUP) Clinical Classification Software<sup>4</sup> (CCS) categories encompassing 443 procedure codes, shown here.

<b>CCS Label</b>	<b>CCS Label Description</b>
3	Laminectomy
145	Treatment of fracture of dislocation of radius and ulna
146	Treatment of fracture of dislocation of hip and femur
147	Treatment of fracture of dislocation of lower extremity (other than hip and femur)
148	Other fracture and dislocation procedure
152	Arthroplasty knee
153	Hip replacement; total and partial
154	Arthroplasty other than hip or knee
158	Spinal fusion
161	Other OR therapeutic procedures on bone
162	Other OR therapeutic procedures on joints
164	Other OR therapeutic procedures on musculoskeletal sys

Hemodialysis includes cases coded with any listed procedure code 39.95, included here as a common treatment for a chronic condition. Also shown are two frequently occurring conditions based on any listed

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<sup>4</sup> The full listing of the CCS categories may be obtained at: <http://www.hcup-us.ahrq.gov/toolsssoftware/ccs/ccs.jsp>

diagnosis code: 1) asthma indicated by diagnosis codes 493.xx and: 2) diabetes by 250.xx. To round out the table, the impact of MRSA on patients diagnosed with smoking related conditions are included, using any listed diagnosis codes 490.xx-492.xx, 494.xx and 496.xx.

Hospital mortality figures shown are based on discharge status of “20.” Average charges and length of stay are shown to indicate the relative burden of MRSA as it relates to charges and time in the hospital. Primary payer was used to aggregate cases by category: 1) Medicare, 2) Medicaid, 3) private insurance and 4) uninsured. Average charges are based on hospital charge master amounts, not amounts actually billed or payments received.