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# Methicillin-Resistant *Staphylococcus aureus* (MRSA) in Michigan, 2002-2008

A Descriptive Analysis of Acute Care Facilities' Discharge Data

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## Executive Summary

Background: Methicillin-resistant *Staphylococcus aureus* (MRSA) are drug-resistant, cluster-forming bacteria that may colonize skin and mucosal membranes. Once colonized, persons may remain in a state of colonization, revert to a receptive state through decolonization, or progress to infection. MRSA infections range in severity from those of the skin and soft tissue, to more severe infections like pneumonia or septicemia. MRSA infections are increasingly plaguing Michigan's healthcare facilities, yet the specific burden and healthcare costs are unknown. The objectives of this study are to evaluate the frequency, severity, and cost of MRSA infections among Michigan's hospitalized patients.

Methods: Discharge data representing all Michigan acute care hospitals were purchased by the Michigan Department of Community Health (MDCH) from the Michigan Health and Hospital Association (MHA). All hospital discharge data from 2002 through 2008 containing the International Classification of Diseases, 9<sup>th</sup> edition (ICD-9) codes for infection with *Staphylococcus aureus*, along with the ICD-9 code for resistance to the penicillin class of antibiotics, were extracted. Cases were stratified by comorbidities, and hospitalization charges were standardized to the 2008 dollar.

Results: During 2002 through 2008, 70,557 patients were discharged with MRSA infections. The rate of MRSA increased annually from 412 to 1,158 cases per 100,000 discharges. Incidence and mortality rates were substantially higher among the elderly than youth, and among Blacks than Whites. Death occurred in 4,337 (6.1%) patients discharged with MRSA. The average total healthcare charge among patients was \$48,897 and rose 10% during the time period. Hospital costs varied by race and by type of MRSA infection; Asians experienced the largest healthcare charges and MRSA pneumonias were the most costly at an average of \$83,092 dollars.

Conclusion: Across Michigan, the burden of MRSA infections is growing substantially, and disproportionately affecting vulnerable populations. Utilizing hospital discharge data can help illuminate trends and inform intervention targets as more sensitive and specific surveillance systems evolve. Infection control and prevention efforts should be directed toward highest risk populations in order to reduce disease and healthcare-associated costs.

## MRSA in Michigan

**Background:** Methicillin-resistant *Staphylococcus aureus* (MRSA) are gram positive, cluster-forming bacteria with acquired resistance to the penicillin class of antibiotics. *Staphylococcus aureus* (*S. aureus*) is found to colonize the skin and mucous membranes of roughly 30% of people<sup>1</sup>. MRSA carriage rates in the general population are estimated at 1.5%<sup>1</sup> and higher, with a reported 6.2% among healthcare workers<sup>2</sup>. A person who carries MRSA may retain a state of asymptomatic colonization or cease to carry the bacteria naturally or through decolonization treatment. In some cases, however, bacterial colonization may progress into infection. The most common types of *S. aureus* (including MRSA) infections are those of the skin and soft tissue, which may spontaneously occur and resolve. Depending on the location and severity of the infection, persons with a MRSA infection may need a variety of medical care ranging from none for a minor infection, to intensive care for a severe or life-threatening infection such as a MRSA abscess, pneumonia, or bacteremia.

**Risk factors for MRSA infections:** Certain people may be at greater risk for getting a MRSA infection than others. In particular, people with frequent hospitalizations and medical procedures, those using invasive medical devices, or those residing in a long term care facility may be at increased risk for acquiring MRSA. Healthy members of the community may be at risk for developing community-associated MRSA (CA-MRSA) infection. Although not all CA-MRSA cases have risk factors, persons who participate in close contact sports, live in crowded living conditions (such as jails), or have openings in their skin (such as cuts or abrasions) may also be at higher risk for acquiring MRSA.

**Transmission:** Transmission can occur in several ways. MRSA can be spread from a colonized or infected individual to another through direct contact, such as skin touching skin, improperly cleaning a wound, or physical contact during athletic events. MRSA can also be spread through contaminated surfaces, such as touching a surface/object that has MRSA on it. For example, sharing a towel, sports or medical equipment, or other contaminated objects can spread MRSA. Additional studies are underway to determine the potential and extent of other common methods of transmission.

**Prevention:** Keeping your hands clean (also called hand hygiene), covering your mouth and nose with a tissue or sleeve when you cough or sneeze (also called respiratory hygiene), and keeping skin clean and dry, and infected wounds covered (also called personal hygiene) are the best ways to prevent MRSA infections. In hospitals, nursing homes, doctors' offices, and other healthcare settings, following guidelines for preventing infections and properly cleaning patient rooms, laundry, and equipment (for instance, ventilators) are also important ways to prevent MRSA. For people with a MRSA infection, it is important to use the appropriate treatment to prevent spreading infection to others: follow doctors' orders, take antibiotics if necessary, take good care of open wounds, and never share personal items, such as towels.

**Reporting of MRSA:** In Michigan, individual cases of MRSA are not required to be reported to the state health department. Clusters of culture-confirmed MRSA affecting three or more epidemiologically-linked persons are reportable to the local health department who will then report to the state health department.

## MRSA Study Methods

To gain insight into the number of MRSA cases and their trends, de-identified discharge data from all 193 Michigan hospitals, from January 1, 2002 through December 31, 2008, was used to track single cases of MRSA in order to estimate the frequency, severity, and costs of MRSA infection among Michigan residents.

**Case Classification:** To classify cases of MRSA infection, all records were selected that contained the International Classification of Disease, 9<sup>th</sup> edition, (ICD-9) codes for infection with *Staphylococcus aureus*, along with the code of resistance to penicillin.

The ICD-9 codes for infection with *Staphylococcus aureus* included:

- 038.11 *S. aureus* septicemia
- 482.41 *S. aureus* pneumonia
- 041.11 Other *S. aureus* infection

and the ICD9 code for resistance:

- V09 "Resistance to penicillin" (which includes methicillin)

Additionally in 2008, three ICD-9 codes were also added that included:

- 038.12 MRSA septicemia
- 482.42 MRSA pneumonia
- 041.12 Other MRSA infection

From 2002 through 2007, cases that had both a *S. aureus* infection and the penicillin resistance ICD-9 code were classified as MRSA cases. For 2008, MRSA cases were either classified by the same method as 2002 through 2007, or with the single code of a MRSA infection that was introduced for use that year.

**Data management and analysis:** All MRSA cases were maintained in Microsoft's Excel and Access databases. Cases of MRSA were classified for severity based on the Charleston Score which was modified through assessment of their ICD-9 discharge diagnoses<sup>7,8</sup>. As each case included up to 30 discharge diagnoses, an assessment of underlying conditions or comorbidities could be established. Characterization and statistical analysis was done using SAS 9.1.3, and results were compared to a report using national discharge data.

**Discharge Data:** The Michigan Health and Hospital Association (MHA) was established in 1919. As part of its responsibility, the MHA collects, organizes, and holds discharge data from all of Michigan hospitals. The Michigan Department of Community Health (MDCH) has an agreement with MHA to annually purchase sets of discharge data. During the time of this report, MDCH had obtained discharge data from 2002 through 2008 from MHA. The discharge database is organized into three tables. The first table includes: demographic information, outcome, admission and discharge location as well as principle diagnoses. The second and third tables contain up to 30 diagnoses and 30 procedures per patient per admission. These tables can be linked by a unique identifier to relate the demographic data and the ICD-9 diagnosis and procedure codes. The unit of analysis for this project was 'hospital discharge', which does not necessarily correlate to a unique individual. The same person could have visited a hospital multiple times during the study period. This individual would be counted as a MRSA discharge event each time they were discharged.

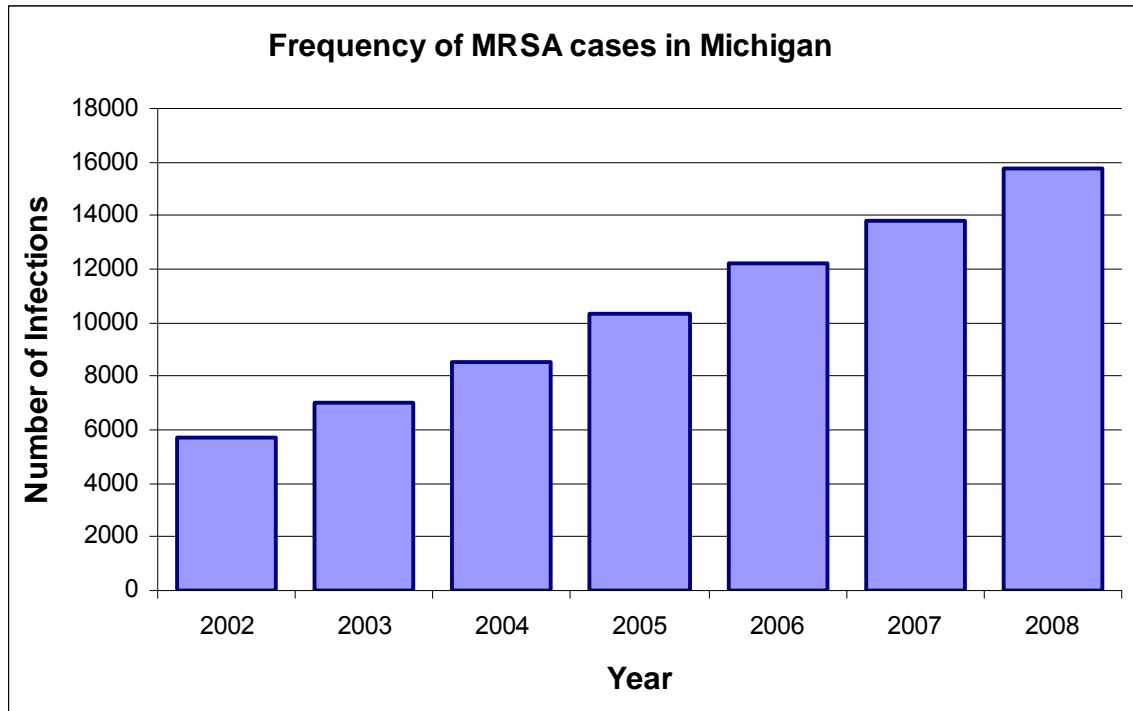
**Variables Contained in Discharge Data:** Data on race were determined through a combination of self-assignment, documentation, and imputation. Racial categories included White, Black, Native American, Asian, Hispanic or Other. Racial data were classified at patient intake into the hospital based upon self-identification or assessment by hospital staff. Where race was unknown, (~25% of cases), the discharge database was linked with the Michigan Birth Registry, Michigan Death Registry, or searched for multiple admissions for the same patient matching on hospital, medical record number, zip code, date of birth, and gender. If race was still unknown after linking the database with other records available (~13% of cases), race was imputed by age, sex, and zip code.

Data on total charge was voluntarily reported by the hospitals to reflect the total costs incurred during the hospitalization and did not include additional expenses accrued by the patient, such as doctors' fees. In addition, total charge does not take into account reimbursements from the Centers for Medicaid and Medicare Services (CMS) or costs experienced by the patient such as deductibles or co-pays. For patients discharged with a MRSA infection, 69% of cases included information on the total charge variable. This can be compared to the overall discharge dataset, in which total charge was reported for 65%. Total charges were standardized to the 2008 dollar using the Consumer's Price Index for comparison.



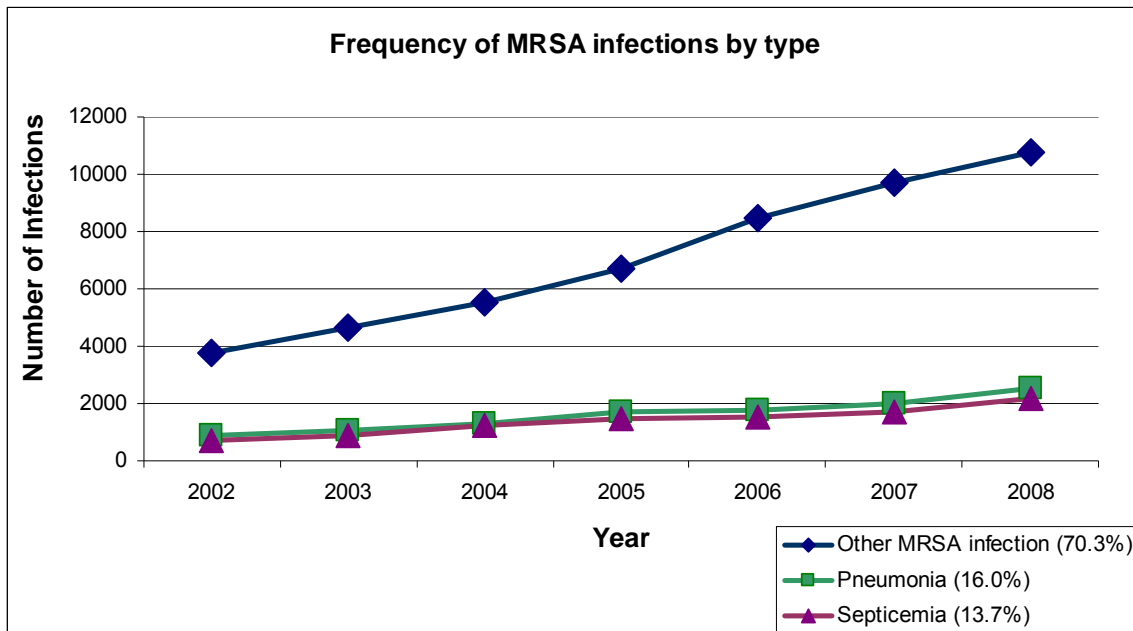
## Results

**Figure 1:** Overall number of discharges from MI hospitals with MRSA infection diagnosed from 2002 through 2008



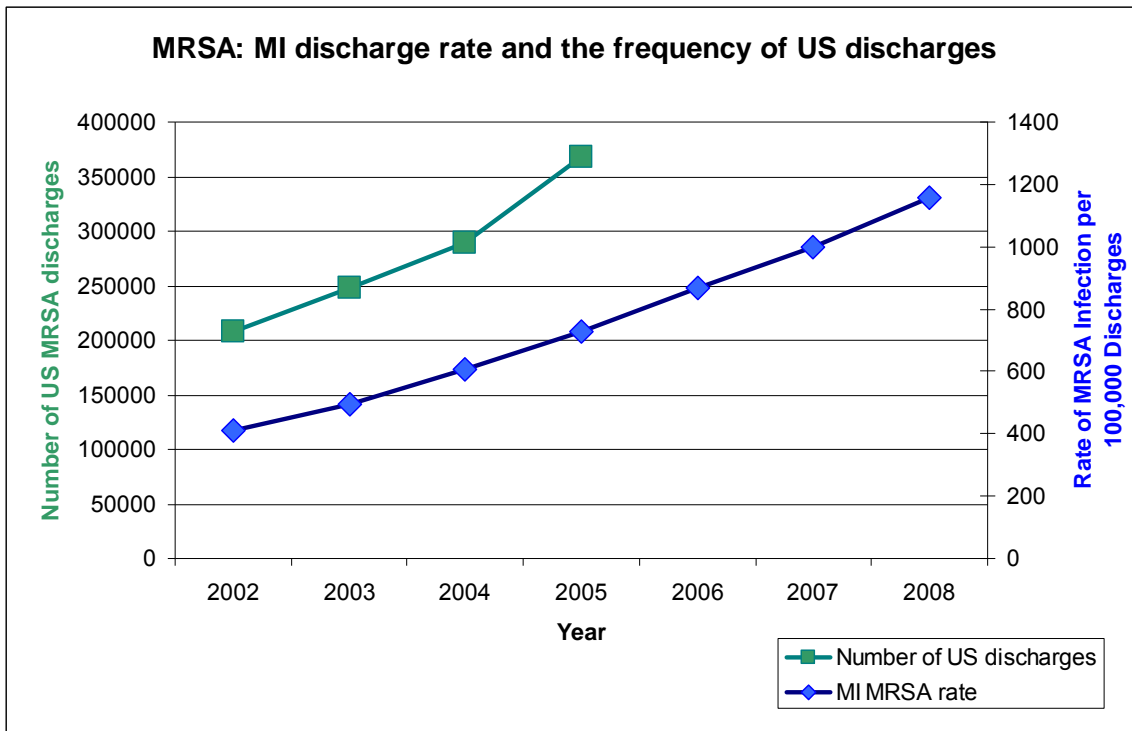
**Figure 1** shows the total number of MRSA infections from 2002 through 2008 documented from discharge records. These include MRSA skin and soft tissue infections, as well as MRSA pneumonia and bloodstream infections. The number of infections has risen by **275%** over this time period. The increase in cases in MI is similar to the growing number of cases of MRSA in the U.S.

**Figure 2:** Frequency of MRSA infections, by infection type, for all Michigan residents from 2002 through 2008



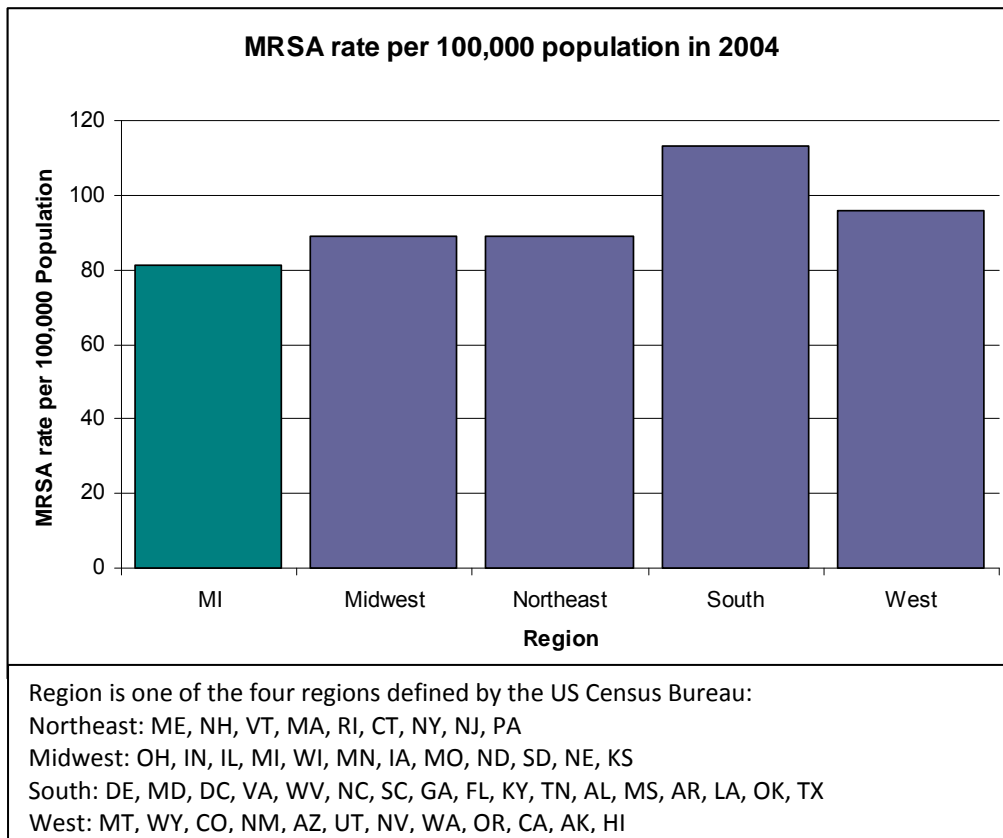
The numbers of MRSA pneumonia and septicemia infections are approximately equal during this time period. Overall, MRSA pneumonias contributed to 16% of all MRSA infections, while septicemias comprised 13.7%. The vast majority of infections (70.3%) include those reported as “other MRSA infections”. This grouping includes skin and soft tissue infections, various abscesses or other MRSA infections. This is also reflective of national data, where the most common MRSA conditions are skin and soft tissue infections.

**Figure 3a:** Rate of MRSA infection per 100,000 hospital discharges among MI residents compared to the frequency of national discharges from 2002 through 2008



**Figure 3** shows the rate of MRSA infections per 100,000 hospital discharges among MI residents compared to the number of national US discharges. The Michigan MRSA rate has increased rapidly over this time period and follows the trend in the US. In 2007, the Michigan rate was roughly 1,000 MRSA infections per 100,000 discharges, i.e. for every 100 discharges from the hospital in 2007, one person discharged had a MRSA infection. National trends prior to and during this time period show a substantial increase in MRSA, such as a tenfold increase from 1995 to 2000 and a 30% increase between 2004 and 2005<sup>3</sup>.

**Figure 3b:** Rate of MRSA infection per 100,000 population in Michigan compared to other regions of the United States in 2004.



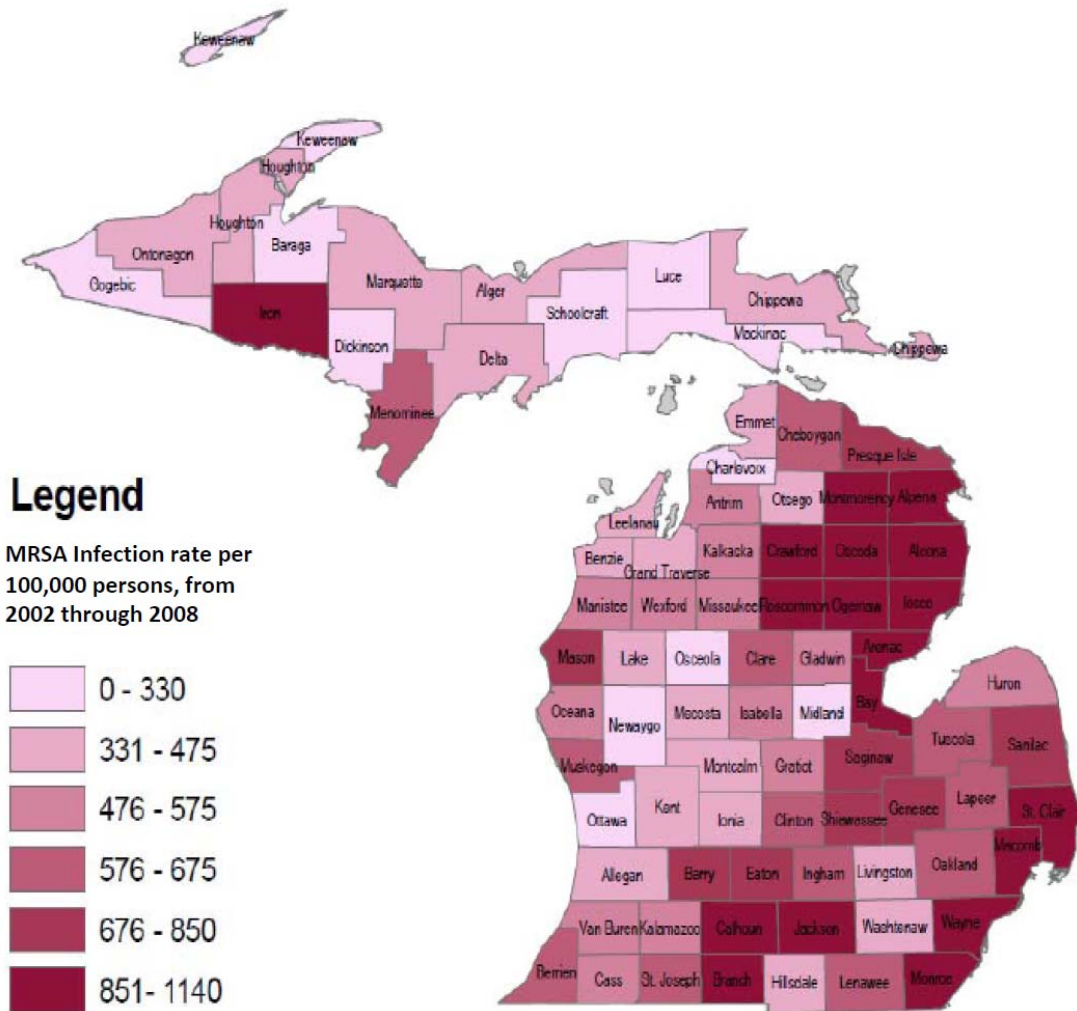
Comparing MI to the national rate using 2000 US census data, the rate was lower in MI, 81.3 cases during 2004 compared to the Midwest rate of 88.9 cases per 100,000 population<sup>3</sup> calculated by the Healthcare Cost and Utilization Project (HCUP) data. From a historical perspective, Michigan has decades of experience with MRSA infections. Some of the first reports of MRSA in the U.S. came from Michigan in the 1980's<sup>4</sup> and likely spurred increased antimicrobial use, including vancomycin, in the area. Further, the majority of the cases of vancomycin-resistant *Staphylococcus aureus* (VRSA), another recently emerging threat, were identified here in Michigan.

**Table 1:** Number of patients by age and sex distribution of MRSA infections among hospitalized MI patients

Number of MRSA Infection by Year								
Characteristic	2002	2003	2004	2005	2006	2007	2008	Average N (%)
Under 5 years	60	131	151	222	337	431	467	273 (2.7)
5 to 9 years	15	16	19	35	70	85	74	48 (0.5)
10 to 14 years	18	18	37	60	97	118	115	71 (0.7)
15 to 19 years	42	49	71	130	202	276	223	152 (1.5)
20 to 24 years	47	67	116	202	284	369	290	206 (2.1)
25 to 34 years	162	242	338	478	695	799	660	512 (5.1)
35 to 44 years	383	525	725	966	1206	1433	1146	964 (9.6)
45 to 54 years	718	881	1207	1498	1805	2174	1770	1,517 (15.1)
55 to 59 years	421	552	626	741	982	1124	975	815 (8.1)
60 to 64 years	385	483	618	798	909	1069	926	785 (7.8)
65 to 74 years	1095	1186	1549	1622	1827	1984	1907	1,618 (16.8)
75 to 84 years	1393	1603	1767	2027	2154	2352	1979	1,992 (19.5)
85 years and over	640	812	826	1016	1109	1168	1084	1,010 (10.0)
Male	2842	3498	4258	5203	6251	7090	8183	5332 (52.9%)
Female	2540	3071	3824	4625	5524	6346	7302	4747 (47.1%)

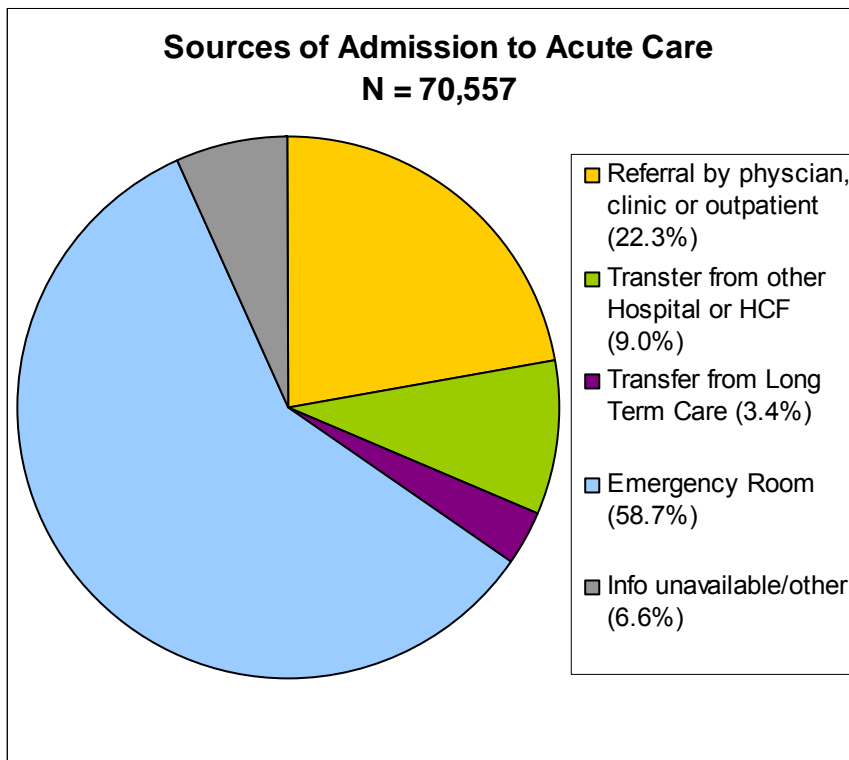
The overall number and percent of persons most often discharged with MRSA infections are those 65 years of age and older. Overall, MI males have a significantly higher percent of MRSA infections. Nationally men are also more likely to be infected with MRSA. According to national discharge data, from 1993 to 2005, males had a higher rate of discharge (106.6 stays per 100,000 population), compared to females (92.2 stays per 100,000 population)<sup>3</sup>.

**Figure 4:** Rate of MRSA infection per 100,000 persons by county for all hospital discharges, aggregated from 2002 through 2008



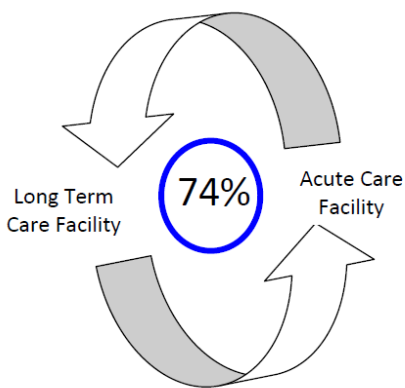
The rate of persons with MRSA infections varies by county. The counties with the highest rates of MRSA infection appear to be concentrated in the northeast corner of the Lower Peninsula, as well as a small cluster in the southern part of the state and the greater Detroit area. The lowest infection rates are reported from the Upper Peninsula with the exception of Iron County. Such geographic differences could arise due to local variances in reporting, population composition, or other factors that influence risk, such as differences in utilization of healthcare and antibiotics.

**Figure 5:** Admitting location of patients discharged with MRSA in Michigan hospitals, 2002 through 2008



Of the patients discharged from acute care hospitals with a MRSA infection, there was a wide array of admitting location. The purple portion of the chart indicates that 3% of cases were admitted from a skilled nursing facility. Referral from a physician, clinic or outpatient center accounted for 22% while the majority of

cases came through the Emergency Room (58%, light blue) and may include individuals coming from various locations.



There is overlap of infection between acute and long term care facilities, so much that it has even been referred to as a revolving door. During 2002 though 2008, 74% of MRSA patients admitted to an acute care facility from a LTC facility were discharged back to a LTC facility. These cases were classified based on a discharge diagnosis of a MRSA infection from acute care. Without laboratory,

LTC, or more thorough acute care data (including dates and symptomatology) complementing the discharge data, it is not possible to determine where MRSA acquisition took place.

**Figure 6:** MI MRSA infection rate by patient age from 2002 through 2008 (Figure 6a) and compared to national data (Figure 6b)

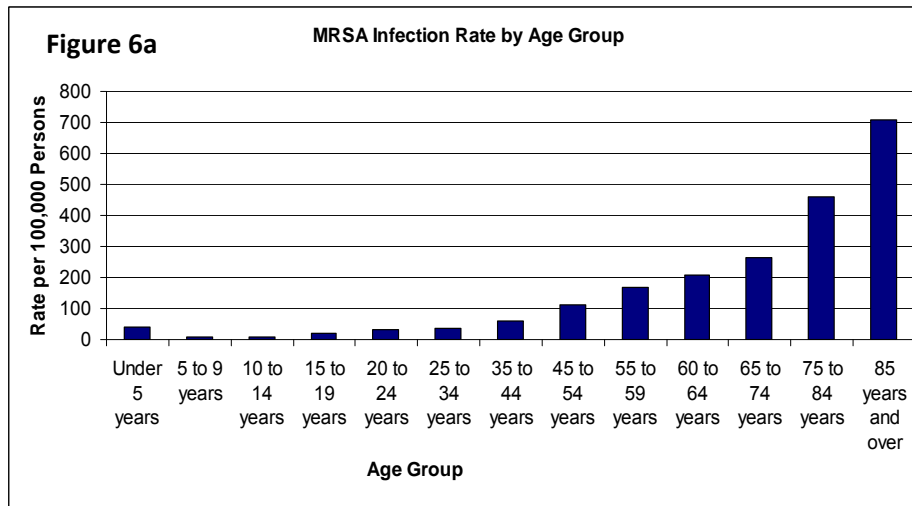
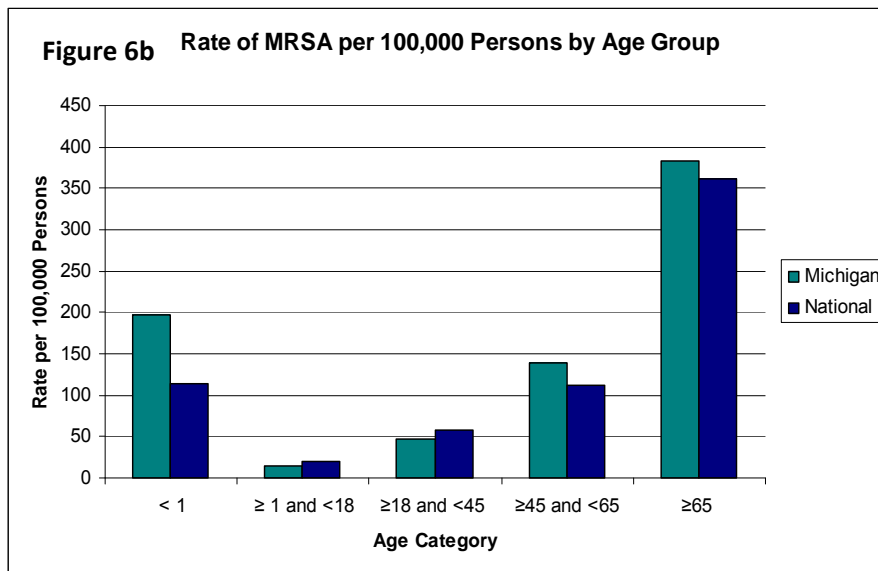


Figure 6a shows the MI MRSA infection rate by age group. The highest rates of MRSA infections are experienced by

the elderly in MI. Among children, there is an elevated rate of infection among those less than five years compared to teens.

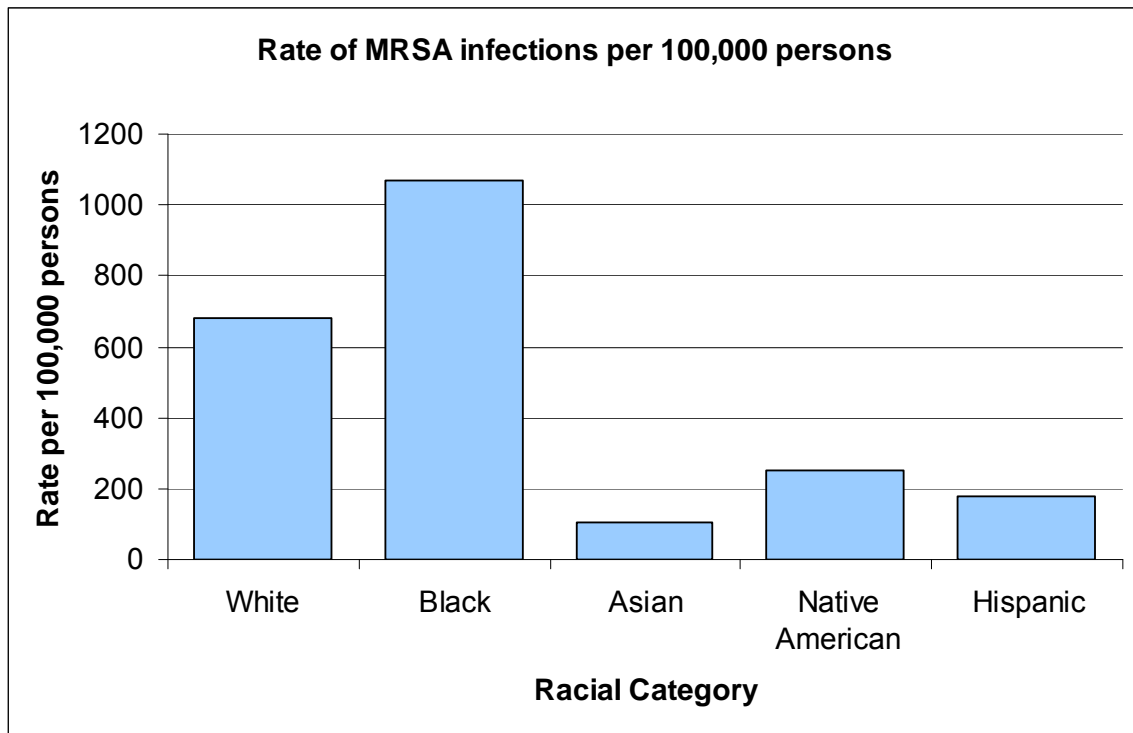


Comparing broader age groups to national data in Figure 6b, the same trends hold. Michigan data trends fairly closely with national data, although the MRSA

rate among infants appears to be higher in Michigan than in the U.S.

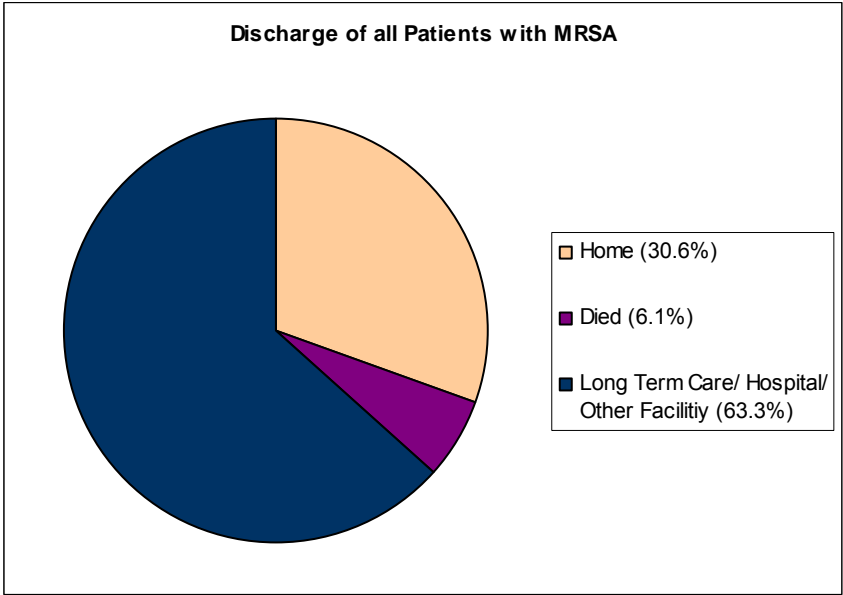


**Figure 7:** MRSA infection rate by race among MI residents from 2002 through 2008



Comparing the MRSA infection rate to 2000 Michigan census data, we are able to calculate the rate of infection by race. In 2000, 80% of Michigan's population was White, while 14% were Black, 0.6% Native American, 1.8% Asian, 3.3% Hispanic and 1.3% other race. The rate of MRSA infection during 2002 through 2008 was 683 cases per 100,000 persons among Whites. A higher rate of infection occurred among by Blacks, 1,071 infections per 100,000 persons during the same time period. Asians, Native Americans, Hispanics, and other races had substantially lower rates of infections than both Blacks and Whites. Nationally, elevated MRSA infection rates have been documented among Blacks<sup>5</sup>. Explanations for differences in MRSA infection rates by race continue to be explored.

**Figure 8:** Severity and outcomes of Michigan patients discharged with MRSA infections from 2002 through 2008

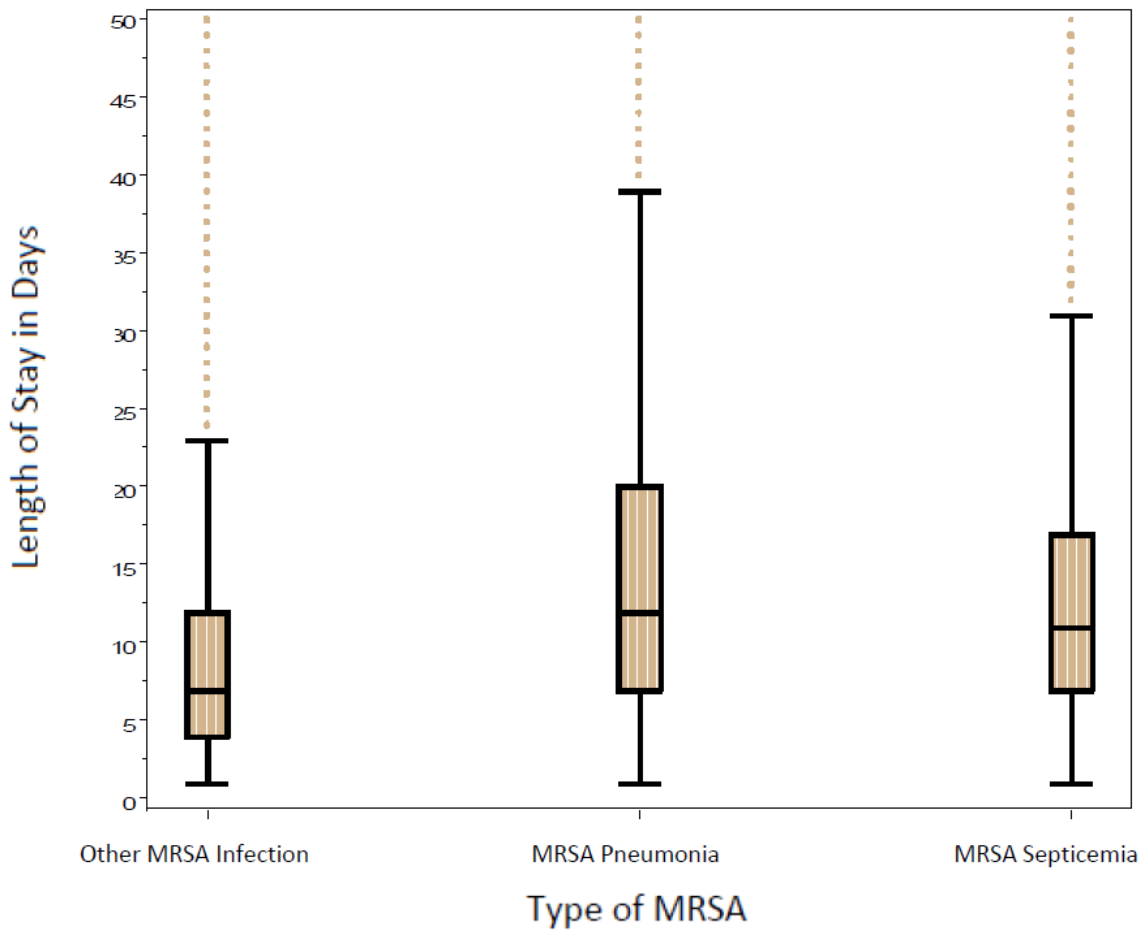


**Table 2:** Severity and outcomes of Michigan patients discharged with MRSA infections, by type, from 2002 through 2008

Type of MRSA Infection	Home	Expired	Long term care/ other hospital/ other facility
Septicemia	19.4	12.9	67.7
Pneumonia	16.4	14.0	69.6
Other Infections	36.0	3.1	60.9

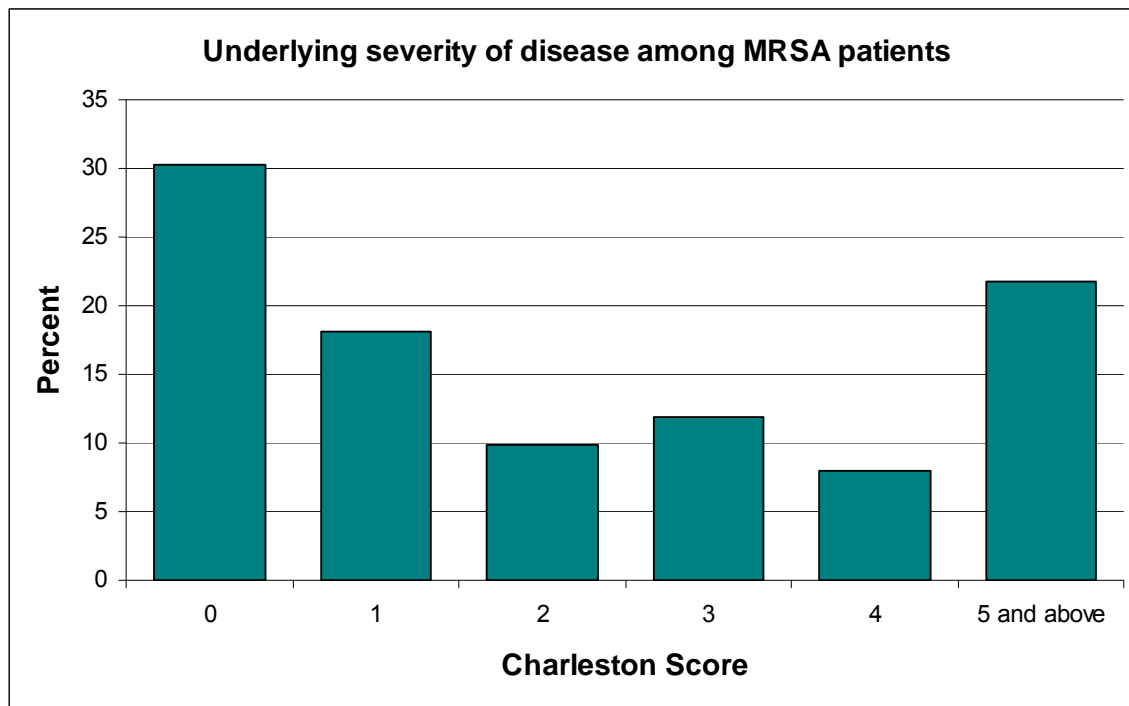
Discharge status varies by type of MRSA infection. Among patients with the most common MRSA infection, “Other Infections”, there were few deaths (3%) and a large proportion of discharges to home (36%). These infections include abscesses, skin and soft tissue, and other various infections. Among patients with MRSA pneumonia or septicemia, there were more deaths, (13 – 14%), and a smaller percentage who were discharged home (16 –19%). Nationally, the overall mortality rate for MRSA is 4.7%<sup>3</sup>, which is lower than Michigan’s mortality rate of 6.1%.

**Figure 9:** Average length of stay by infection type for patients discharged with MRSA infections from 2002 through 2008



**Figure 9** is a box plot displaying length of stay (LOS) in days by type of MRSA infection. The tan boxes show the range in LOS of 50% of MRSA discharges. The line within the box indicates the average LOS for that condition. The “whiskers” above and below the box show the LOS for the top and bottom 25% of people with MRSA infections. Outliers are represented by dots. MRSA pneumonia has the greatest variation and longest LOS, 17 days. Those with “Other MRSA” infections have the shortest average LOS, 11.9 days. The national average LOS for a patient hospitalized with MRSA is 10 days<sup>3</sup>.

**Figure 10:** Underlying Conditions of MRSA Patients from 2002 through 2008



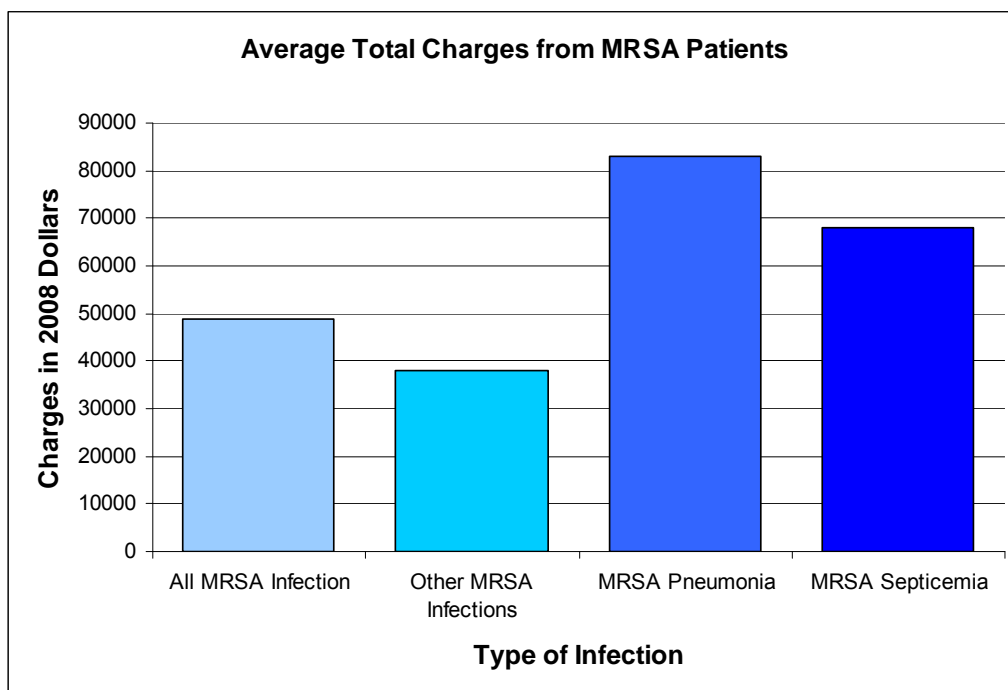
**Figure 10** is a representation of underlying conditions or comorbidities of the patients who were discharged with a MRSA infection. The Charleston score<sup>6,7</sup> is a way to score underlying conditions by severity. The score of “0” reflects no known serious illness in the same hospitalization stay as the MRSA infection, whereas a score of 5 or more represents patients who have severe documented comorbidities, such as liver disease or lymphoma, in addition to their MRSA infection. Thirty percent (30%) of the MRSA infections occurred in patients with no serious underlying conditions (Charleston score of 0), while over 20% occurred among patients with severe or multiple underlying health conditions (Charleston Score of 5 or above).

**Table 3:** Top ten underlying conditions among patients discharged with MRSA as a primary diagnosis from 2002 through 2008

Rank	Condition	Percent
1	Other cellulitis and abscess	15.64%
2	Septicemia	11.51%
3	Complications peculiar to certain specified procedures	9.08%
4	Bacterial pneumonia	6.99%
5	Other complications of procedures	5.89%
6	Other diseases of the lungs	4.27%
7	Diabetes Mellitus	3.18%
8	Acute osteomyelitis	2.66%
9	Chronic ulcer of the skin	1.90%
10	Heart failure	1.83%

**Table 3** shows the most common underlying conditions coded for patients discharged with a MRSA infection as their primary diagnosis. Many of the conditions correspond directly to a MRSA infection such as cellulitis and abscess, likely a primary MRSA infection, while other patients might have had a MRSA infection secondary to another condition such as heart failure.

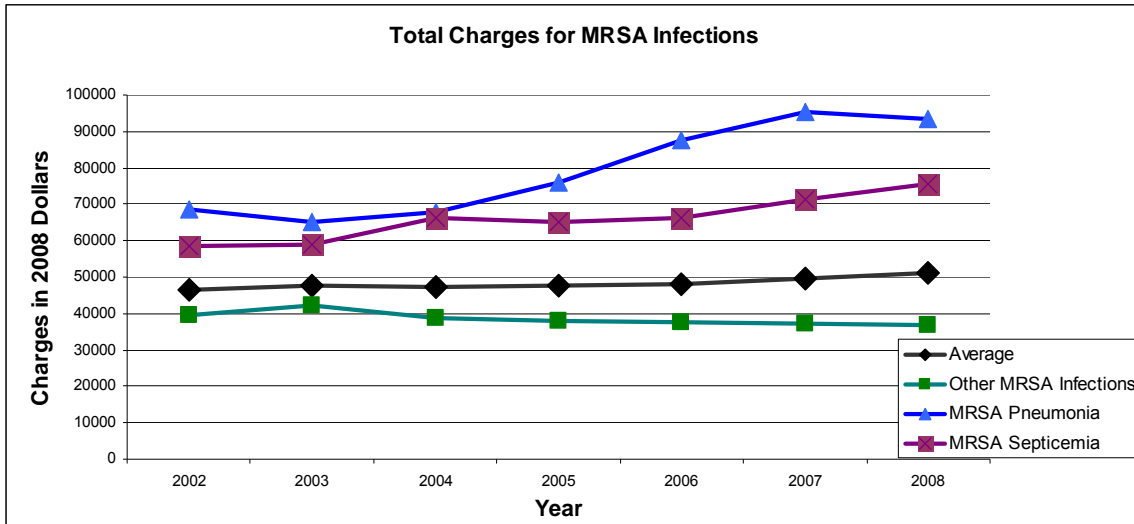
**Figure 11:** Total average charges reported by the facility by type of MRSA infection from 2002 through 2008, standardized to the 2008 dollar



**Figure 11** displays the average total costs reported by the facility for a patient discharged with MRSA. This total cost includes all aspects of the patient's stay and expenses related to other underlying conditions and procedures. There is substantial cost difference for patients with MRSA, dependent upon the type of MRSA infection. MRSA infections that are "other" do not have the same level of total charges that are seen with the more serious MRSA infections. The most costly MRSA hospitalizations are among patients discharged with MRSA pneumonia.

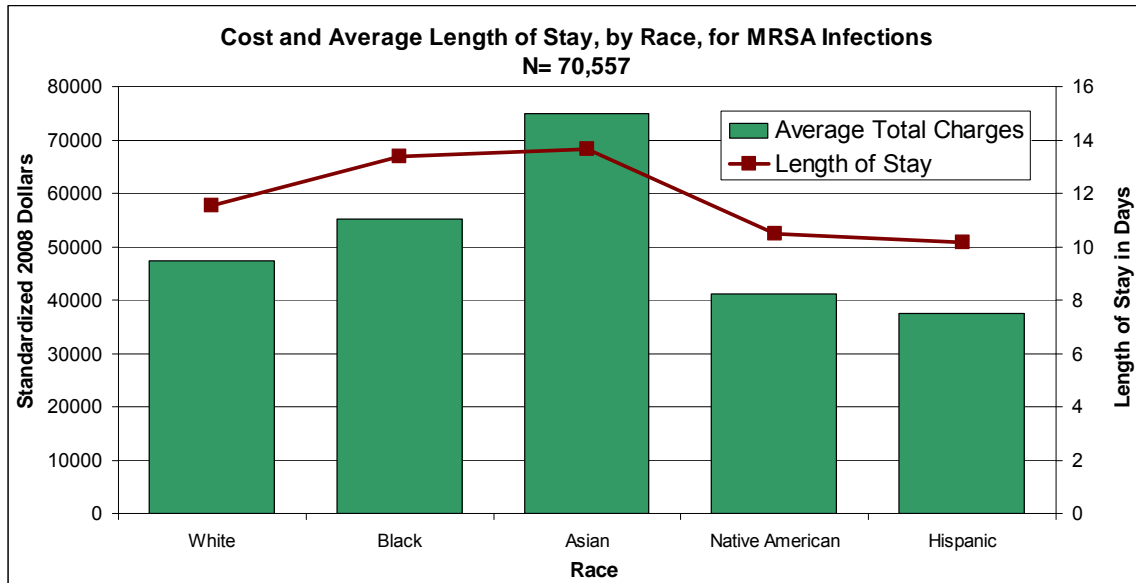
The total charges that a hospital undergoes per discharge may be different than the amount of money that will be reimbursed to them. Reimbursement to hospitals is dependent on insurance coverage and the individual procedures and conditions of the discharged patient. Cost in this report is not exclusive to the MRSA infection, but rather includes total charges for the entire duration of the patient's stay. Other sources that have looked more directly at cost have found that, between the years of 1993 and 2004, the average hospital stay for a MRSA patient was 10 days and cost \$14,000, compared to 4.6 days and \$7,600 for all other hospital stays<sup>3</sup>.

**Figure 12:** Average total charges from MRSA patients in MI from 2002 through 2008 by type of MRSA infection, standardized to the 2008 dollar



From 2002 to 2008, the standardized charge incurred by a patient with MRSA has risen from \$46,000 to \$51,000. The cost of MRSA hospitalizations vary by type of infection. The MRSA infection with the highest associated charges, MRSA pneumonia, remains the most costly infection and its cost increased by over \$20,000 from 2002 to 2008 using standardized dollars. Charges associated with MRSA septicemia also increased over time, but at a slower rate than MRSA pneumonia. Lastly, charges associated with “Other” type of MRSA infections have remained steady or slightly decreased during this time period.

**Figure 13:** Average charges and length of stay by race for MRSA infections among MI residents from 2002 through 2008



Average, standardized total hospitalization charges for patients with MRSA infections varied by race; Hispanics, Native Americans, and Whites had lower charges compared to Blacks and Asians. Asians had the highest average length of stay (LOS) at 13.7 days, compared to Blacks (13.4 days) and Whites (11.6 days). The LOS among Blacks was significantly longer than Whites, ( $p < 0.0001$ ). Likely due to a smaller sample size, the average LOS among Asians was not significantly different ( $p = 0.101$ ) than Whites. The remarkable difference in total charge reflects some of the variance seen in LOS but is an area where continued surveillance and ongoing evaluation are needed to better determine any key differences underneath the large difference.



**Figure 14:** Average daily MRSA hospitalization costs by race among MI residents, 2002 through 2008

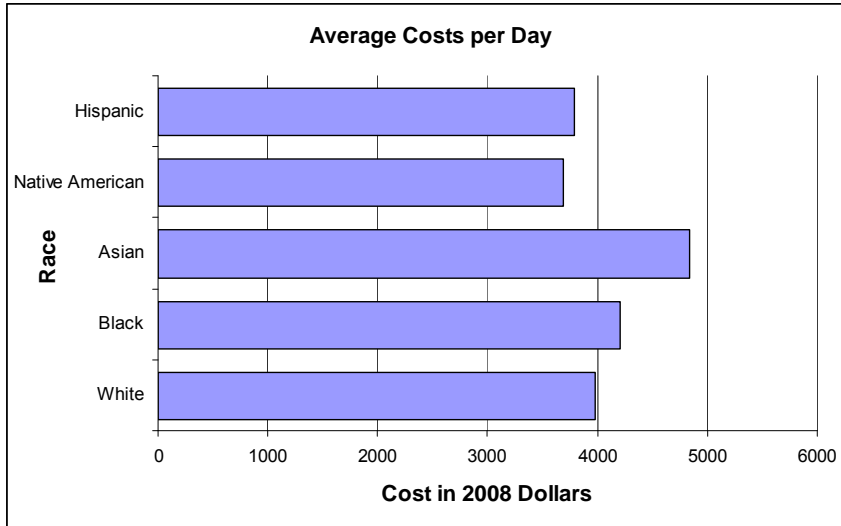
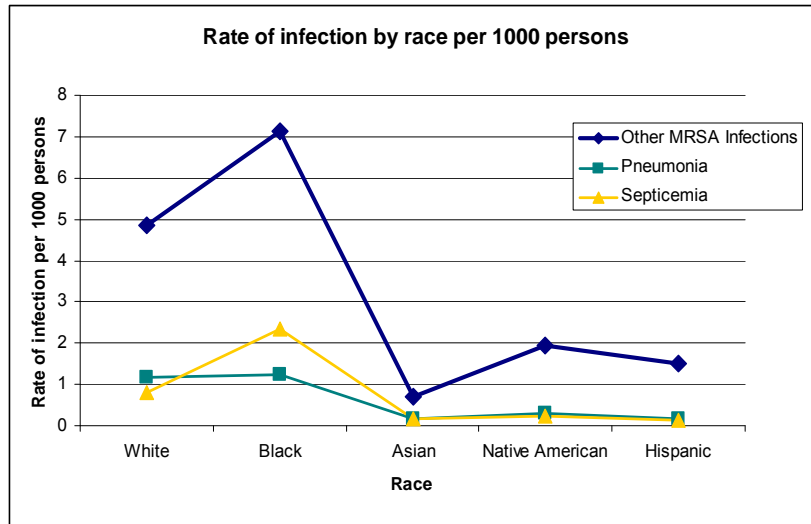


Figure 14 shows the daily average cost of MRSA hospitalization by race. The highest daily cost occurs in the Asian population. Compared to Whites, Black populations also have elevated daily costs.

**Figure 15:** Rate of infections by race and infection type among MI residents, 2002

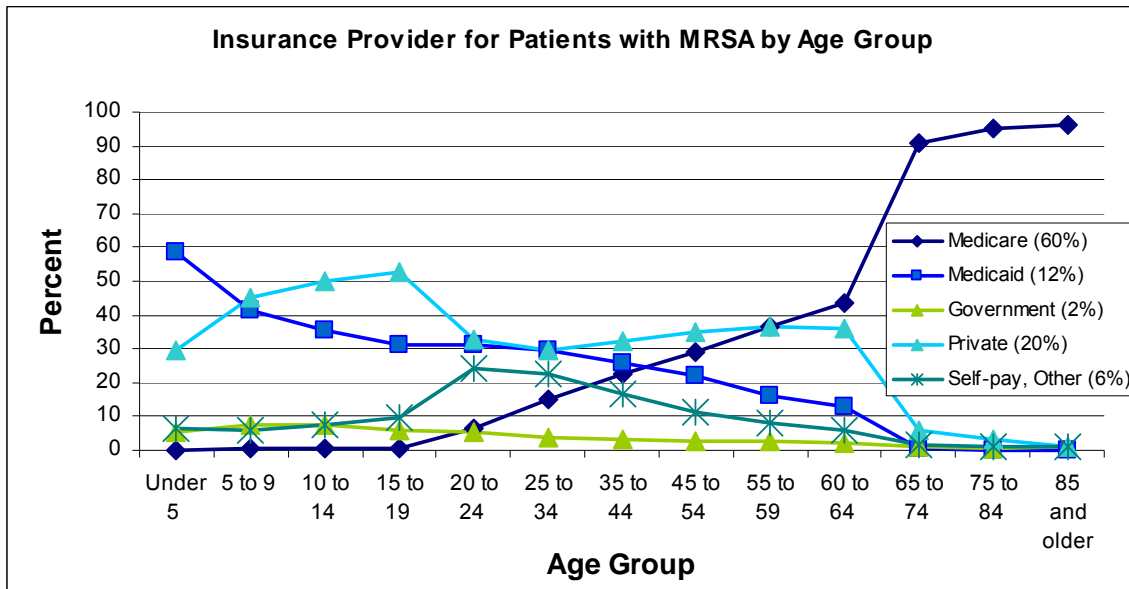
through 2008



Among racial groups, there are differences in infection rates by type. Blacks had

the highest rates of all types of infections and Whites also had a large rate of “other” MRSA infections compared to other groups.

**Figure 16:** Insurance provider for MRSA patients discharged from MI acute care facilities from 2002 through 2008 by age



Insurance providers varied slightly over the time period from 2002 through 2008, but across all age groups the majority of patients with MRSA (approximately 60%) had Medicare insurance. Private insurance covered 20% of MRSA patients, and Medicaid insurance covered 12%. Differences in insurance provider by age group were detected. Private insurance is the dominant type of insurance until age 65, when individuals are eligible for Medicare insurance. Government insurance remained a low percentage across all age groups and self-pay had its highest percent between the ages of 20 to 24. Medicaid had an inverse trend with age; as the age groups increased, the percent that were insured by Medicaid declined.

## Limitations

There are many limitations in using discharge data. The first is that discharge data restricts the study of MRSA patients to inpatient settings and does not include MRSA cases diagnosed, treated, or managed in an outpatient setting. It also does not capture the number of MRSA infections for which medical care is not sought.

Further, analysis of discharge data is not able to accurately distinguish cases of community-acquired versus healthcare-acquired MRSA. In order to distinguish between community- and healthcare-acquired strains, additional information is needed including MRSA isolate laboratory data, dates with symptomatology, as well as admission status. In the discharge data, only one condition may be coded as present on admission. It is challenging to code MRSA as present on admission as it required two ICD-9 codes (*S. aureus* infection and resistance to penicillin) prior to 2008. Few *S. aureus* infections were documented as the admitting diagnosis. In addition, MRSA cases that were present on admission may have been missed or passed over in order to report a different condition that was also present. The lack of outpatient and lab data, as well as the lack of symptom onset dates, limits our ability to determine the source of acquisition as community- or healthcare facility-acquired.

Discharge data is used to establish statewide trends rather than to detect outbreaks because of the delay that occurs between the event and the distribution of discharge data. There is a lengthy process for finalizing and cleaning the discharge data which might take a year or more before the data is ready to be analyzed. Discharge data is thus not useful to rapidly detect outbreaks.

A final limitation to the study is that the accuracy of ICD-9 coding for MRSA has not yet been validated. However, during the period of this study, the ICD-9 definitions were expanded to include three MRSA specific ICD-9 codes which should improve the accuracy of the data. Various aspects of the ICD-9 reporting process and differences in laboratory techniques and levels of detection should also be taken into consideration as limitations to the study.

## **Discussion**

MRSA is gaining increasing attention among the general public, healthcare workers and consumers, government agencies, and the media. Due to high profile outbreaks, along with the emergence of CA-MRSA, this pathogen is becoming a household name. In Michigan, only epidemiologically-linked clusters of MRSA are reportable to public health and thus the true prevalence of MRSA in the community and among inpatients is unknown. This report is the first known to use Michigan hospital discharge data to evaluate Michigan MRSA trends.

The results of this analysis show that MRSA rates are increasing at an alarming rate. In fact, the number of persons discharged with a MRSA infection has doubled in the four years, from 2002 through 2006, and the numbers continue to climb. Each type of MRSA infection is rising: pneumonia, septicemia, and “other” types of MRSA infections. The rate of these infections also seems to vary geographically across the state. Higher rates of MRSA are traditionally thought to cluster in the more densely populated areas; however, in Michigan our highest rates are reported among fairly rural

counties. More research is needed to better determine risk factors in these counties and to better understand the nuances of MRSA surveillance and reporting at the county level.

Assessing the demographic trends of patients with MRSA allows us to evaluate populations at elevated risk. Analysis of demographic characteristics has revealed differing MRSA infection rates. For example, men were more likely to be discharged from an acute care facility with a MRSA infection. Age was a substantial risk factor; the highest rates of MRSA infection occurred in the eldest patients. In fact, those who were 85 and older had rates that were five times greater than those who were aged 55-59 and were ten times greater than those aged 35-44 years. There were also differences in MRSA infection rate based on race; Blacks had elevated infection rates, and Asians, Native Americans and Hispanics had decreased rates compared to Whites. Assessing the most vulnerable populations in Michigan allows prevention efforts to focus on groups at the highest risk of infection with MRSA.

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