

# Incidence and Potential Financial Impact of Resistant *Staphylococcus aureus* in an Academic Community Hospital

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## Abstract

**Objective:** To identify the impact of Methicillin resistant *Staphylococcus aureus* (MRSA) on mortality rates, hospital lengths of stay (LOS), and total patient costs among eight DRG codes. A secondary analysis of hypothetical cost reduction strategies was also performed.

**Methods:** Retrospective chart review using ICD-9 V09.0.

**Results:** CHF patients w/ MRSA had greater mean LOS, costs and mortality than those w/o MRSA ( $p = 0.001$ ,  $0.001$ , and  $0.001$ , respectively). COPD patients w/MRSA had greater mean LOS, costs and mortality, than patients without MRSA ( $p = 0.001$ ,  $0.001$ , and  $0.141$ ). SEPT patients w/ MRSA had greater mean LOS and costs ( $p = 0.001$ ,  $0.007$ ). K&UTI and OCS patients with MRSA also had mean LOS double that of patients w/o MRSA.

**Conclusion:** The health risk and institutional financial burden of MRSA may not be fully recognized.

## INTRODUCTION

Over the past two decades hospital-acquired infection (HAI) rates have increased dramatically (Klebens, 2007). Nearly 70% of these HAIs are due to antibiotic resistant microorganisms. Of these, methicillin-resistant *Staphylococcus aureus* (MRSA) is a major cause of invasive infection and colonization, resulting in substantial morbidity and mortality (Klebens, 2007). Additionally, persons infected with antibiotic-resistant organisms such as MRSA are more likely to have longer, costlier hospital stays (Klebens, 2007).

Resistant to most commonly prescribed antibiotics, MRSA has plagued the U.S. Health Care industry over the past several years. According to a recent article published in the Journal of the American Medical Association, an estimated 94,360 invasive MRSA infections occurred in the United State in 2005 alone, almost 20% of which were fatal (Klebens, 2007). The average cost of a MRSA HAI was estimated to be \$35,367 (Klebens, 2007). When compared with the mean cost of \$13,973 of a non-MRSA HAI, MRSA

adds to an infected individuals' hospital costs by approximately \$25,000.(Research Foundation (2007, Siegel (2006), Pittet (1994), Peng (2006), Cosgrove (2005), Kopp (2004), Reed (2005))

In the past, MRSA was considered a problem primarily affecting patients who had contact with the healthcare industry or had established risk factors. However, recent changes in the epidemiology and transmission dynamics of this infection have shown that MRSA is now a problem afflicting otherwise healthy, unexposed individuals in the community as well (Shorr, 2006). The spread of MRSA infections within the community has presented many challenges for infection control practitioners throughout the country in their efforts to prevent and contain this superbug.

With the recent publication of such alarming statistics by major media outlets, MRSA has garnered much public attention and prompted large-scale surveillance efforts by organizations such as the Centers for Disease Control and Prevention and the National Institute of Health in an effort to obtain a more accurate assessment of the incidence and

prevalence rates of this infection (Klevens, 2007). On a smaller scale, several states have also proposed or enacted legislation making MRSA infection a legally reportable disease. Pennsylvania lawmakers passed a Bill in July of 2007 which requires hospitals to implement electronic infection monitoring systems as well as document and report infections within 24 hours of diagnosis to the State Department of Health and eventually the CDC via the National Health and Safety Network (Hospital Buyer.com, 2007). Several other states, including Indiana and Illinois, are also considering adopting similar legislation (PHC4 Brief ,2006). This new legislation has prompted many hospitals to conduct extensive analyses of their infection control and prevention programs in order to provide a better basis from which to design control strategies.

The primary objective of this study was to explore the implications of invasive MRSA infections in a large, academic, community hospital with particular focus on the financial burden of MRSA as well as its impact on morbidity and mortality rates.

## **MATERIALS AND METHODS**

A retrospective study was conducted at Lehigh Valley Hospital and Health Network (LVHHN), a multi-center, academic, community hospital with 886 beds, located in Allentown, Pennsylvania. Data were extracted from Horizon Performance Manager, the LVHHN's administrative data warehouse. Exemption from IRB approval under 45 CFR 46.101(b)(4) was obtained prior to the start of this study from our Institutional Review Board.

A total of eight diagnosis related group (DRG) codes were selected for comparison, based upon the results of a recent statewide report issued by the Pennsylvania Health Care Cost Containment Council (PHC4 Brief ,2006). The DRG codes examined in this study included the following:

## **Figure 1**

88: Chronic Obstructive Pulmonary Disease  
120: Other Circulatory System Diagnoses with cormorbidities or complications  
127: Congestive Heart Failure  
144: Other Circulatory System Operating Room (O.R.) Procedures  
217: Wound Debridement and Skin Graft  
320: Kidney and Urinary Tract Infections  
415: O.R. Procedures for Infectious and Parasitic Disease  
416: Septicemia

All patients who had been previously assigned to one of the eight selected DRG codes by LVHHN's medical billing and coding department and who had a hospital admission between 1/1/2002 and 12/31/2006 were included in this study. Patients with an invasive MRSA infection were defined as those having both an ICD-9 discharge diagnosis code of V09.0 (Infection with micro-organisms resistant to penicillin) and a positive MRSA culture. Positive cultures were verified through chart review of microbiology reports for all patients in the initial sample with a V09.0 code.

Cost, length of hospital stay (LOS), and mortality rates were examined for patients with and without an invasive MRSA infection in the selected DRG groups. LOS was defined as the duration of a unique hospitalization and calculated by subtracting the day of admission from the day of discharge. Cost was defined as the total dollar amount billed for a patient's hospital stay. Invasive MRSA infections were not differentiated according to hospital or community acquisition in this study.

Statistical analyses included Student's t test and Pearson's  $\chi^2$  using SPSS 15.0 software. Results are reported as mean  $\pm$  standard deviation for LOS and cost and proportions for mortality, respectively. Statistical significance was considered at  $p < 0.05$ . A secondary analysis of hypothetical cost reduction strategies was also performed (Table 2). Cost savings for reductions of 5%, 10%, 20% and 30% in MRSA infections were calculated.

## **RESULTS**

From January 1, 2002 to December 31, 2006 there were a total of 7,946 admitted patients who belonged to one of the selected DRG groups. Of those, 595 (7.5%) were diagnosed with an invasive MRSA infection during their hospital stay. OR Procedures for Infectious and Parasitic Diseases had the highest incidence of MRSA infections (27.4%) among the

eight DRG categories, while Congestive Heart Failures had the lowest (1.7%).

In the majority of the DRGs that were examined in this study both mean charges and LOS almost doubled in those patients infected with MRSA compared to that of uninfected patients. Patients infected with MRSA in DRG 127 had a mean cost of \$13,099±\$10,714 (p=.001) and a mean LOS of 9.8±7.2 days (p=.001) compared to patients who were not infected (mean cost of \$6,204±\$5,376 and mean LOS of 5.1±3.8 days). The exception was seen in DRG 217 in which the mean cost for a MRSA infection (\$22,403±\$22,331) was similar to that of a non-MRSA infection (\$19,421±\$23,612).

Noticeably higher than other DRGs was DRG 88 where the mean cost and LOS for a MRSA infected patient (\$12,330±\$7,463 and 11.2±7.2 respectively) were almost triple that of the uninfected group (\$4,872±\$3,888 and 4.3±3.2).

The mortality rates of persons infected with MRSA were also found to be greater than that of the uninfected population in DRGs 127,88,320,120 and 144, (ns). Overall, Table 1 demonstrates that MRSA infections are associated with a longer length of hospital stay, increased costs, and a higher probability of death.

**Figure 2**

Table 1: LOS/Total Cost/Mortality of MRSA in Selected DRGs (1/1/2002-12/31/2006).

	n	LOS	Charges	Mortality
DRG 127: Congestive Heart Failure				
w/ MRSA	44	9.8 ± 7.2	\$13,099 ± \$10,714	9.1%
w/o MRSA	2507	5.1 ± 3.8	\$6,204 ± \$5,376	5.5%
p-value		0.001	0.001	0.298
DRG 88: Chronic obstructive pulmonary disease				
w/ MRSA	27	11.2 ± 7.2	\$12,330 ± \$7,463	7.4%
w/o MRSA	1443	4.3 ± 3.2	\$4,872 ± \$3,888	2.2%
p-value		0.001	0.001	0.075
DRG 416: Septicemia				
w/ MRSA	149	10.5 ± 8.8	\$18,401 ± \$19,893	23.5%
w/o MRSA	1120	6.1 ± 4.9	\$10,702 ± \$11,301	32.9%
p-value		0.001	0.001	0.007
DRG 320: Kidney & urinary tract infections				
w/ MRSA	24	8.5 ± 4.4	\$9,877 ± \$6,280	4.2%
w/o MRSA	820	4.3 ± 3.3	\$4,830 ± \$3,140	1.0%
p-value		0.001	0.001	0.137
DRG 120: Other circulatory system diagnoses w cc				
w/ MRSA	116	9.8 ± 8.7	\$15,328 ± \$13,580	8.8%
w/o MRSA	694	5.6 ± 5.8	\$8,423 ± \$9,802	3.1%
p-value		0.001	0.001	0.054
DRG 144: Other circulatory system O.R. procedure				
w/ MRSA	57	18.2 ± 22.6	\$26,395 ± \$32,088	6.9%
w/o MRSA	255	7.9 ± 7.2	\$13,696 ± \$16,499	4.0%
p-value		0.001	0.001	0.166
DRG 217: Wound debridement & skin graft				
w/ MRSA	44	15.8 ± 15.3	\$22,403 ± \$22,331	2.3%
w/o MRSA	157	10.8 ± 10.8	\$19,421 ± \$23,612	2.5%
p-value		0.001	0.001	0.918
DRG 415: O.R. procedure for infectious & parasitic Disease				
w/ MRSA	134	17.9 ± 20.4	\$31,232 ± \$45,834	8.2%
w/o MRSA	355	12.2 ± 10.6	\$23,231 ± \$24,528	12.4%
p-value		0.001	0.001	0.191

## DISCUSSION

Since the 1980's, MRSA infection rates have continued to increase at alarming rates presenting many challenges to the prevention and control of the spread of this bacterium. Community hospitals have been particularly slow in adopting MRSA surveillance and control practices (West, 2006). Widespread implementation of surveillance practices have been hindered by complaints of expense, time consumption, and the emergence of community-acquired MRSA infection (Harbarth (2003), Richert (2003), Fridkin (2005), LeBlanc (2007)).

As seen in Table 1, the hospitalization of a MRSA infected patient is significantly more costly than that of an uninfected patient. This is in large part due to a prolonged hospitalization, need for more expensive therapeutic agents, implementation of isolation and barrier precautions, and increased laboratory utilization. Previous studies have estimated that hospital costs attributed to MRSA range from \$7,781 to \$34,000 per infection (Lodise and Mckinnon (2007), Rubin (1999), Kim (2001), Chaix (1999)). To further explore the financial implications of an invasive MRSA infection we sought to examine the potential cost savings our

institution could experience if they were to eliminate MRSA within the various DRGs previously examined. Several hypothetical scenarios in which MRSA incidence rates were lowered by 5, 10, 20 and 30% were explored and the findings presented in Table 2.

**Figure 3**

Table 2: Estimated cost savings by DRG code for hypothetical MRSA reduction scenarios

DRG	Mean Added Cost of MRSA Infection	Cost Savings for 5% Reduction	Cost Savings for 10% Reduction	Cost Savings for 20% Reduction	Cost Savings for 30% Reduction
127	\$6,895.00	\$20,685	\$34,475	\$62,055	\$96,530
88	\$7,458.00	\$14,916	\$22,374	\$44,748	\$67,122
416	\$7,899.00	\$61,592	\$115,485	\$230,970	\$346,455
320	\$5,047.00	\$10,094	\$15,141	\$25,235	\$40,376
120	\$6,905.00	\$41,430	\$82,860	\$165,720	\$241,675
144	\$12,699.00	\$38,097	\$76,194	\$152,388	\$228,582
217	\$2,982.00	\$8,946	\$14,910	\$26,838	\$41,748
415	\$8,001.00	\$56,007	\$112,014	\$216,027	\$328,041
<b>TOTAL</b>		<b>\$251,767</b>	<b>\$473,453</b>	<b>\$923,981</b>	<b>\$1,390,529</b>

The results of this secondary analysis indicate an astounding cost savings. A reduction of just 5% of the MRSA cases within the selected DRGs could potentially result in a cost savings of over \$250,000 for our institution. As exemplified in Table 2, this savings continues to steeply increase as the incidence rates of MRSA within these DRGs are further lowered. Cost reduction data such as these present a strong case for our institution, as well as healthcare facilities worldwide, to adopt strict infection control programs that are aimed at the elimination of MRSA.

Locally, however, hospital networks must seriously consider not "if" but "when" they will dedicate resources to regional collaboration in addressing this increasing burden of disease nosocomially and within the community. One such example is the healthcare network in Indianapolis, IN (Kho (2007), Kho (2007), Kho (2007)). In order to enhance the city's infection control practitioners' (ICPs) ability to protect and potentially improve the standard of care for their patients, four out of the six major health systems established an electronic network where known cases of both community-acquired and healthcare-associated MRSA were reported and shared with all collaborating members. This allowed ICPs to inform and better prepare physicians in the direct care of a known MRSA infected patient of the risk of infection and avoid associated complications (Kho (2007), Kho (2007), Kho (2007)).

Simple measures such as this are only a first step in containing and eliminating the potential astronomical costs and resource drain facing hospital and healthcare networks. If resources are spent preventing infections, more resources

will ultimately be available for providing better patient care. Healthcare networks could potentially save up to \$400,000 per prevented MRSA infection, a relevant consideration as reimbursement agencies continue to rethink what will and will not be reimbursed to hospitals. Healthcare facilities are already not fully reimbursed for several nosocomial infections by many Healthcare Management Organizations (HMOs) and more insurers, such as Medicare and Medicaid, are considering following suit.

Prudent evaluation and strict clinical observance to proven preventative and control measures should be adhered to in both the clinical setting and the community at large to thwart the effects of this superbug. As the Center for Disease Control and Prevention continuously update guidelines and protocols, it is the "first responders," namely the medical community, who must remain vigilant and educated on the most recent recommendations. As MRSA continues to be epidemic worldwide it is imperative for future studies to examine screening strategies, transmission dynamics, and prevention efforts with respect to both hospital and community populations.

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