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# Treating methicillin-resistant *Staphylococcus aureus* with the drug vancomycin in a home infusion therapy setting

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# TREATING METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS WITH THE DRUG VANCOMYCIN IN A HOME INFUSION THERAPY SETTING

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## ABSTRACT

The basic purpose of this paper is to examine the effects the home infusion therapy has on the cost, duration of, and effectiveness of treatment between those individuals under 60 and those 60 and over. The results show that those 60 and over had a slightly higher cost/day. The older age group had slightly smaller treatment duration, then the younger group. The number of adverse effects was small. The results suggest that home infusion therapy appears to be a viable alternative to hospitalization.

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## INTRODUCTION

The risk of being exposed to nosocomial infections and/or antibiotic resistant organisms such as Methicillin-Resistant Staphylococcus Aureus (MRSA) has experienced a dramatic increase over the past decade (CDC, 2010; Guilbeau & Fordham, 2010; Klein, Smith, & Laxminarayan, 2007; Klevens, 2007; Capitano, Leshem, Nightingale, Nicolau, 2003). It has been estimated that in the U.S. in 2005, there were 94,360 individuals infected with MRSA; the most recent comprehensive study of the infection (CDC, 2010; Klevens, 2007). MRSA has been easily classified as endemic and even an epidemic in many U.S. hospitals and long-term care facilities, with an increase of MRSA related hospitalizations of 62% between 1999 and 2005 (Crum, et al.; Klein, et al., 2007). What was once confined primarily to intensive care units and acute care hospitals, MRSA has emerged as a major public health problem that only prolongs hospitalization and increases morbidity (Guilbeau & Fordham, 2010; Klein, et al., 2007; Klevens, 2007; Capitano, et al., 2003).

### Antibiotic choice

Susceptibility testing is necessary to determine the treatment regimen (Wilcox, 2008). Treatment of the infection is biased to a variety of factors: severity of the infection, area and association of the infection, risk of bacteraemia, whether it is CA-MRSA or MA-MRSA; just to name a few (Wilcox, 2008). Resistance of *Staphylococcus aureus* to vancomycin has been particularly rare in the medical community; and therefore, vancomycin has been extensively used to treat these types of infections – specifically MRSA (Barclay, 2008; Wilcox, 2008; WMHS, 2006).

### Home infusion therapy

MRSA has by and large been treated in an in-patient setting (Wilcox, 2008). However, due to an increased recognition that it is safe for patients with MRSA to be treated at home, treatment provided through Home Infusion Therapy (HIT) has emerged (GAO, 2010; Wilcox, 2008).

HIT is the administration of medication intravenously in the patient's home as an alternative to receiving the same treatment in a hospital, inpatient setting (NHIA, 2011; Williams, 2011). This method of treatment has been proven to be an effective, efficient, and safe alternative to in-patient therapy, and is generally provided through a HIT pharmacy in collaboration with the physician, home health nurse, and dietitian (if applicable) to administer

the therapy plan (Williams, 2011). The infusion therapy is typically performed through the injection of liquid medicines directly into the vein; either through a catheter or needle (National Home Infusion Association, 2011).

### **Purpose of research**

The purpose of this research was to analyze the treatment of MRSA with the drug vancomycin in a HIT setting. The research focused on the differences between two patient groups; patients < 60 years of age and patients ≥ 60 years of age, as well as patients being treated for a secondary diagnosis and those being treated only for MRSA, both being analyzed with regard to clinical outcomes and costs associated with the therapy.

## **METHODOLOGY**

### **Research hypothesis**

The research hypothesis was that patients in the older age group (≥ 60) would experience a higher mean cost per day for the therapy, longer therapy duration, with lower positive clinical outcomes than that of the younger age group.

### **Research settings**

This retrospective quantitative case study was performed in a Mid West Home Infusion Pharmacy that provided the infusion services.

### **Sample population and description**

Data of patients being treated for MRSA with the drug vancomycin in a home infusion setting between 2007 and 2010 were obtained with 60 cases used for this study. Only cases involving the treatment of MRSA using the drug vancomycin were used due to the relevance of the research. All insurance and payer types were allowed to avoid limitations on comparisons between the differences in reimbursement by Medicare, Medicaid, Commercial, Workers Compensation, and Private Pay.

### **Data collection and instruments**

Patient age, gender, diagnosis, insurance provider, treatment duration, treatment method, costs, reimbursements, and clinical outcome(s) were provided in the data acquired from the Home Infusion Pharmacy. The cases were measured in age categories – cases of patients 60 years and older, patients younger than 60 years, and by total population. The categories were then analyzed by the total mean cost-per-day for therapy regimens, the mean cost by insurance payer type, treatment duration, adverse events, and positive clinical outcomes. Adverse events were defined as events that complicated the completion of therapy regimens or events that resulted in the unsuccessful completion of therapy regimens. Positive clinical outcomes were defined as cases that completed the therapy regimens without any adverse events and resulted in the successful treatment of the infection. Treatment Costs were measured in Cost-Per-Day; this included cost of the drug, supplies, equipment rentals, and nursing services if required.

### **Dependent and independent variables**

The study analyzed each therapy case in < 60 years of age group and a ≥ 60 years of age group to better understand the differences in both clinical outcomes and financial implications – with Medicare eligibility and reimbursement being a major factor. In addition, the study analyzed the difference between patients being treated with a secondary diagnosis and patients being treated solely for MRSA.

The dependent variables were: the patient's age group, and whether or not he/she was being treated for a secondary diagnosis. The independent variables were: Bacteremia, Carbunkle, Cellulitius, E.Coli, Epidural Abscess, Infected Pacemaker, Osteomyelit, Post Operation Infections, Pseudomonas Infection, Septic Joint, Urinary Tract Infection, and No Secondary Diagnosis.

## Ethical considerations

Secondary, non-identifiable data was provided by a Mid-West Home Infusion Pharmacy, thus an IRB was not required in conducting this research.

## RESULTS

### Basic analysis

Basic frequencies and percentages were performed on all the data. The two groups, Age  $\geq$  60 and Age < 60, were used. The frequencies and percentage were performed for both groups combined. Due to the small sample size, other statistical analysis did not provide any significant results.

### Gender and age data

A total of 60 patient cases that underwent IV infusion therapy in a HIT setting were analyzed for the treatment of MRSA with the drug vancomycin; this included therapy in an older age group (60 years and older) and in a younger age group (Less than 60 years). There were 26 cases (43.3%) of patients aged 60 years or older and 34 cases (56.7%) of patients younger than 60 years of age. The overall mean age was 56.1 (range 8-90). Of those aged 60 years and older, the mean age was 71.5 (range 60-90), and of those aged younger than 60 years, the mean age was 44.3 (range 8-57). Of the 60 patient cases, 33 (55%) were male and 27 (45%) were female. Of those aged 60 years and older (N=26), 16 were male and 10 were female. Of those aged less than 60 years of age (N=34), 17 were male and 17 were female.

### Diagnosis data

A total of 1,529 therapy days of IV infusion therapy in a HIT setting between January 1, 2007 and December 31, 2010, were reviewed. Thirty-four patients (57%) were being treated for a second diagnosis in addition to MRSA, while 26 cases (43%) were being treated solely for MRSA with no secondary diagnosis. Eleven different secondary diagnoses were found, with the following being the most prevalent: Cellulitis, 7 (12%); Osteomyelitis, 7 (12%); Bacteremia, 5 (8%). Eleven cases (18.3%) were reported to be hospital acquired MRSA infections with 49 cases (81.7%) not reported as hospital acquired MRSA (Table 1).

**Table 1: Secondary Diagnosis of 60 Patients Receiving 1,529 Therapy Days of Home IV Vancomycin**

	Aged $\geq$ 60 (N=26)	Aged < 60 (N=34)	Total (N=60)
Secondary Diagnosis		Cases, N (%)	
Bacteremia	2 (7.5)	3 (9)	5 (8)
Carbunkle	0 (0)	1 (3)	1 (2)
Cellulitis	1 (4)	6 (17)	7 (12)
E.Coli	0 (0)	1 (3)	1 (2)
Epidural Abscess	1 (4)	1 (3)	2 (3)
Infected Pacemaker	1 (4)	0 (0)	1 (2)
Osteomyelitis	5 (19)	2 (6)	7 (12)
Post Operation Infections	2 (7.5)	0 (0)	2 (3)
Pseudomonas Infection	1 (4)	2 (6)	3 (5)
Septic Joint	1 (4)	1 (3)	2 (3)
Urinary Tract Infection	1 (4)	2 (6)	3 (5)
No Secondary Diagnosis	11 (42)	15 (44)	26 (43)

### Treatment duration and clinical outcomes

The mean treatment duration of the total sample population (N=60) was 25.5 days; this included patients from both age groups. Further, this included patients being treated for MRSA alone, as well as the patients being treated for MRSA with a secondary diagnosis. Patients in the 60 years and older age group (N=26) presented a total mean treatment duration of 25.9 days. When this age group was divided into those being treated for MRSA alone and those being treated for a secondary diagnosis, the MRSA patients without a secondary diagnosis (N=11) provided a treatment duration mean of 21.5 days. Patients with a secondary diagnosis (N=15) had a mean treatment duration of 29.1 days. The age group younger than 60 years of age (N=34) produced a mean treatment duration of 25.1 days. When dividing the younger age group between MRSA patients without a secondary diagnosis (N=15) and patients with a secondary diagnosis (N=19) saw mean treatment durations of 19.1 days and 30.9 days respectively (Table 2).

**Table 2: Treatment Duration of 60 Patients Receiving 1,529 Therapy Days of Home IV Vancomycin**

	Aged ≥ 60 (N=26)	Aged < 60 (N=34)	Total (N=60)
	<b>Mean Treatment Duration, N (days)</b>		
MRSA	11 (21.5)	15 (19.1)	26 (19.4)
Secondary Diagnosis	15 (29.1)	19 (30.9)	34 (30.1)
Total	26 (25.9)	34 (25.1)	60 (25.5)

The total sample population (N=60) experienced five adverse event cases (8%) with 55 cases (92%) having no complications and successfully completing the therapy regiment. These adverse events included: Infected Peripherally Inserted Central Catheter (PICC) Line, Hospitalization, and Non-Compliance of treatment plan. Further, the case in which the PICC Line was infected was still able to complete the treatment regiment; leaving only three cases not completing the treatment. When analyzing the difference between the older age group and the younger age group, the 60 and older age group (N=26) experienced two adverse events (8%) leaving the remaining 24 patients (92%) without complications and successfully completing treatment. The younger age group, younger than 60 years of age (N=34), experienced similar results having three adverse events (9%) with 31 cases (91%) successfully completing treatment without complications (Table 3).

**Table 3: Adverse Events of 60 Patients Receiving 1,529 Therapy Days of Home IV Vancomycin**

	Aged ≥ 60 (N=26)	Aged < 60 (N=34)	Total (N=60)
	<b>Adverse Events, N (%)</b>		
Infected PICC Line	1 (4)	1 (3)	2 (3)
Hospitalized	1 (4)	1 (3)	2 (3)
Non-Comply	0 (0)	1 (3)	1 (2)
No Adverse Events	24 (92)	31 (91)	55 (92)

### Treatment costs

The total population sample (N=60) cost per day mean was \$114.14. Mean costs of patients being treated for MRSA alone and patients being treated for MRSA with a secondary diagnosis was \$123.97 per day and \$106.63 per day respectively. Patients aged 60 years or older saw a mean cost of 112.28 per day while the younger age

group saw a mean cost per day of \$115.75. Patients in the 60 years and older age group being treated for MRSA alone had a mean cost per day of \$122.98. Patients in this same age group being treated for MRSA with a second diagnosis saw a reduced mean cost per day of \$88.07. The younger age group saw increased costs per day with the patients in this age group being treated for MRSA alone and patients being treated for MRSA with a secondary diagnosis saw mean costs of \$115.01 and \$121.28 respectively (Table 4).

**Table 4: Mean Cost Per Day of 60 Patients Receiving 1,529 Therapy Days of Home IV Vancomycin**

	Aged ≥ 60 (N=26)	Aged < 60 (N=34)	Total (N=60)
	<b>Average Cost Per Day (\$)</b>		
Gender			
MRSA Only	122.98	115.01	123.97
Secondary Diagnosis	88.07	121.28	106.63
Total	112.28	115.75	114.14

Patients with Commercial Insurance (N=18) experienced the highest mean cost per day of \$148.41. Medicare Patients (N=19) and Medicaid Patients (N=19) produced cost per day means of \$128.69 and \$108.65 respectively. Workers Compensation Patients (N=2) produced a mean cost per day of \$125.27, while the Private Pay Patients (N=2) experienced the lowest with a mean cost per day of \$85.08. When breaking these measures down by age group, the older age group saw mean costs of the Commercial, Medicare, Medicaid, and Private Pay of \$110.05, \$128.69, \$28.44, and \$78.00 respectively. The younger age group experienced mean costs of Commercial, Medicaid, Workers Compensation and Private Pay of \$163.06, \$66.51, \$125.27, and \$78.41 respectively (Table 5).

**Table 5: Cost by Insurance Type of 60 Patients Receiving 1,529 Therapy Days of Home IV Vancomycin**

	Aged ≥ 60 (N=26)	Aged < 60 (N=34)	Total (N=60)
	<b>Mean Cost Per Day by Insurance Type, N (\$)</b>		
Commercial	4 (110.05)	14 (163.06)	18 (148.41)
Medicare	19 (128.69)	0 (0)	19 (128.69)
Medicaid	2 (28.44)	17 (66.51)	19 (62.51)
Workers Compensation	0 (0)	2 (125.27)	2 (125.27)
Private Pay	1 (78.0)	1 (78.41)	2 (78.20)

## DISCUSSION

### Cost-per-day analysis

Patients in the 60 years or older age group saw a slightly lower cost than patients in the younger age group; which could be credited to the fact that 19 of the group's 26 patients (73%) were Medicare patients, whereas 18 of the younger group's 34 patients (52%) were Commercial Insurance holders. The difference in reimbursements between the two payer groups was \$19.72 per day. Additionally, the four cases of Commercial Insurance holders in the older age group saw a reimbursement rate of \$53.01 per day less than the Commercial Insurance holders in the younger age group.

One interesting finding in this sample population was that of the cost-per-day difference in the older age group when comparing the patients being treatment for MRSA alone versus those in the group being treated for MRSA and a secondary diagnosis. Patients in the older age group actually saw a lower cost-per-day when being treated for a secondary diagnosis than those in the group being treated only for MRSA. Although there was no evidence contained in the data to support this theory, perhaps the cause of this reduced rate in those with a secondary diagnosis was that the pharmacy only provided the drugs to these patients; without the costs of supplies, skilled nursing, etc. The younger age group did see increased costs per day when being treated for a secondary diagnosis in addition to the treatment of MRSA.

### **Clinical outcome analysis**

As previously mentioned, this research yielded a 92% positive clinical outcome with only five adverse events. Both age groups saw identical treatment durations when compared to one another; including total age group samples, patients being treated for only MRSA, and patients being treated for MRSA and a secondary diagnosis. Both age groups saw increased duration of treatments in the patients being treated with a secondary diagnosis, which would be expected.

With regard to the percentage of the age groups having a secondary diagnosis, the older age group only saw a two percent increase than that of the younger group having a secondary diagnosis. Therefore, the patient's age did not factor into this element; at least not in this study.

### **Limitations of research**

Limitations were imposed on this research which included: dependency of accurate secondary data from Home Infusion Pharmacy; Sample size of research population; and the lack of detailed cost associations with treatment from the Home Infusion Pharmacy data.

The sample size was extremely small. More data is available and that data may provide statistically significant result

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