Outcome of Decolonization Therapy in a Hospital in Southern Puerto Rico

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Objective: Methicillin resistant Staphylococcus aureus (MRSA) is a resistant bacteria responsible for hard-to-treat infections. To understand the primary impact of this infection in healthcare settings, a retrospective study was performed at a hospital in southern Puerto Rico. Our objectives were to classify the types of MRSA infection, identify factors associated with the infection, and evaluate the outcome of decolonization therapy after its having been implemented at the hospital.

Methods: Medical records of cases encompassing October 2009 through October 2011 were reviewed. A total of 761 MRSA-positive patients were identified and their infections classified as community-acquired MRSA (CA-MRSA), hospital-acquired MRSA (HA-MRSA), or healthcare-associated community-onset MRSA (HACO-MRSA). Basic demographics, reason for hospitalization, medical history, and culture sites, along with other information, were obtained for each case. SPSS v17 was used for statistical analysis. Fisher's exact test was used to measure the statistical significance of the crude OR, using the patients with CA-MRSA as the comparison group. HA-MRSA cases were compared before and after the intervention, using Epidat v4.0 to calculate the cumulative incidence of HA-MRSA before and after the implementation of decolonization therapy at the hospital.

Results: In our study, 5.0% of the patients were found to be infected with HA-MRSA, 72.8%, with CA-MRSA, and 22.2%, with HACO-MRSA. After the intervention, we found a decrease of 10.35% (p = 0.704) in HA-MRSA, of 2.6% (p = 0.791) in CA-MRSA, and of 7.0% in HACO-MRSA (p = 0.650).

Conclusion: Our findings suggest that CA-MRSA could be responsible for the majority of the infections caused by MRSA within the hospital at which the study took place. Decolonization of MRSA is a useful tool in helping to control the spread of infection, although future studies are needed to confirm our study's findings. [*P R Health Sci J 2015;34:182-188*]

Key words: Methicillin-resistant Staphylococcus aureus, HA-MRSA, CA-MRSA, HACO-MRSA, Puerto Rico, Incidence

Methicillin was first introduced in 1959 and was used to resist the action of penicillinase, the enzyme responsible for the resistance to penicillin. However, in 1961 the first case of methicillin resistant S. aureus (MRSA) was reported. Even though this particular case was reported in 1961, it wasn't until the 1980s that MRSA became a frequent cause of infection (1). Currently, MRSA is known to be a multi-drug-resistant organism that has been notably increasing in hospital settings, accounting for more than 60% of the isolates in US hospital intensive care units (ICUs) (2, 3). MRSA infections alone kill approximately 19,000 hospitalized American patients, annually (2).

MRSA has become a major cause of infections in both community and healthcare settings, being associated with high rates of morbidity and mortality (4). However, MRSA also affects such high-risk populations outside of hospital settings as IV drug users, elderly patients living in nursing homes, and chronically ill patients. Moreover, MRSA is now being reported even in healthy children (5, 6). The incidence of community-acquired MRSA (CA-MRSA) has been increasing in the US for the past decades (7–9). At present, fewer than 5% of MRSA clinical isolates are sensitive to penicillin (10–12). Screening has been introduced as part of the MRSA surveillance at hospitals for patients who are considered to be at high risk of being MRSA carriers and for patients undergoing high-risk

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procedures, such as surgeries (13, 14). It has been reported that MRSA colonization increases the risk of an individual's developing an infection during hospitalization, which is dangerous for that patient and expensive for the hospital (15, 16). The purpose of the decolonization of MRSA is to prevent both infection and the transmission of disease (17, 18). The study described herein, decolonization of MRSA was implemented specifically to prevent post-surgical infections. Although the effectiveness of the MRSA decolonization is still under study, it has proven to be efficient in reducing the risk of post-surgery infections (15, 19).

Because this infection has a major impact within healthcare settings, a retrospective study was performed at a hospital in Ponce, Puerto Rico. The aims of this study were to determine the incidence of MRSA at the hospital, identify factors associated with MRSA infection in the study population at the hospital, and evaluate the effectiveness of the MRSA decolonization protocol implemented at the hospital from the period of October 2009 through October 2011.

Methods

Study design

This study was approved by the Institutional Review Board of the "Ponce Health Sciences University (formerly Ponce School of Medicine and Health Sciences). A total of 761 MRSA cases were identified through microbiology reports provided by the reference laboratory from the aforementioned hospital. The participating hospital's medical records of all MRSA-positive patients who had been diagnosed as such at any time from October 2009 through October 2011 were reviewed in order to collect data on the date of the initial MRSA isolation, the body site of isolation, and the number and type of positive culture results. We selected a time range that began a year prior to the implementation of the MRSA decolonization (which was October 2010) and ran until fully a year after that implementation; the procedure under study took place at a 328-bed tertiary-care hospital. The intervention was the decolonization of MRSA that was implemented at the hospital (20). The protocol consisted of performing surveillance cultures (to identify MRSA colonization) on patients in the ICU who had undergone cardiovascular or peripheral vascular surgery. If a given patient's surveillance culture yielded a positive result, decolonization therapy was implemented in that patient. This therapy consisted of the application of 2% mupirocin ointment to the nostrils for 5 days and chlorhexidine gluconate baths, given daily for 7 days. The baths offered to the patient consisted of chlorhexidine (4%) added to the water; additionally, such a patient might receive towels impregnated in chlorhexidine (2%).

Patients with MRSA infections were classified as having hospital-acquired MRSA (HA-MRSA), community-associated MRSA (CA-MRSA), or healthcare-associated community-onset MRSA (HACO- MRSA). HA-MRSA was defined as a positive MRSA culture from a clinical specimen collected 48 hours or more after admission to the participating hospital (21), while CA-MRSA was defined as a positive MRSA culture from a clinical specimen collected fewer than 48 hours after such admission from a patient without a prior history of hospitalization, surgery, hemodialysis, or residence in a long-term healthcare facility and without, as well, any indwelling intravenous lines, catheters, or percutaneous medical devices present at the time the culture was performed (22, 23). The classification HACO-MRSA was applied to patients with an MRSA-positive culture that had been collected fewer than 48 hours after admission, which patients also had a history of previous hospitalization, surgery, hemodialysis, or residence in a long-term healthcare facility and who, in addition, had one or more indwelling intravenous lines, catheters, or other percutaneous medical devices present at the time of the culture (24).

Data collection

Information was collected from electronic medical records and recorded on a spreadsheet (SPSS version 17). Data included basic demographics (i.e., age, sex), reason for hospitalization, medical history, site or sites of MRSA infection and culture, length of stay in the hospital, and location in the hospital before, during, and after MRSA isolation. In addition information regarding healthcare exposures (to MRSA) and the presence about any comorbidities that were present in a specific patient was collected. The following data concerning MRSA exposure were gathered: previous hospitalizations, blood transfusions, or hemodialysis; surgical or invasive procedures; the presence of wounds; and the use of indwelling devices. Comorbidities included malignancies, transplants, hepatic dysfunction, renal insufficiency, coronary artery disease, chronic heart failure, peripheral vascular disease, chronic lung disease, diabetes mellitus, morbid obesity, and the use of illegal drugs.

Statistical analysis

The SPSS® 17 statistical package (SPSS; Chicago, IL) was used for analysis. For the purposes of this analysis, the population studied was divided into 2 groups, one consisting of youths (≤21 years) and the other of adults (>21). Descriptive analysis was used to assess the distribution of HA-MRSA, CA-MRSA, and HACO-MRSA cases, the distribution of cases by hospital area (data not shown), and comorbidities. Comparisons were made, using CA-MRSA as the comparison group, to identify risk factors associated with MRSA infection related to healthcare settings. For categorical variables, the odds ratio (OR) was used as a measure of association, and the 95% confidence interval of the OR was utilized to assess the precision of this estimate. Fisher's exact test was used to measure the statistical significance of the crude OR, using CA-MRSA as the comparison group. To determine the effectiveness of the intervention, HA-MRSA cases were compared before and after intervention. Epidat v4.0 was used to assess the cumulative incidence from HA-MRSA to determine whether or not there had been any kind of (unrelated) decrease in incidence before the intervention and to determine, as well, whether or not there was a decrease after

(and presumably resulting from) the intervention. To calculate the incidence, information regarding admissions in the period of time studied was used. The total of admissions was used as the denominator (subtracting all the positive MRSA cases).

Results

During the 2-year study period, a total of 761 patients with MRSA-positive cultures were identified. From this population 113 (14.8%) were pediatric patients and 649 (85.2%) were adults. In the data analyzed, 38 (5.0%) of the infections found were HA-MRSA, 554 (72.8%) were CA-MRSA, and 169 (22.2%) were HACO-MRSA (Figure 1).

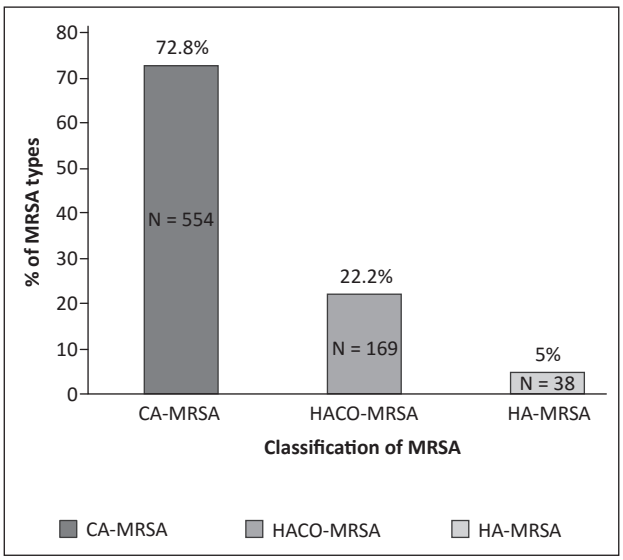

Figure 1. Comparison of the different MRSA cases seen at the hospital from October 2009 through October 2011. CA-MRSA: community-acquired MRSA; HACO-MRSA: healthcare-associated community-onset MRSA; HA-MRSA: hospital-acquired MRSA.

Table 1 presents the demographics of the study population. All the pediatric patients had CA-MRSA infections. These patients were previously healthy individuals who presented skin and soft-tissue infections at the time of their admissions to the hospital. The mean age for this group was 8.4 ± 6.5 years, with a mean length of stay in the hospital of 6.6 days. A difference in gender was observed, with 57.1% of the patients being female and 42.9% being male ($p<0.001$). The adult population was divided into categories, according to the definitions previously mentioned. In each category (CA-MRSA, HA-MRSA, and HACO-MRSA), males were predominantly affected, with the smallest difference being found in the HACO-MRSA group. In terms of age, CA-MRSA patients were younger than both HA-MRSA ($p = 0.038$) and HACO-MRSA ($p<0.001$) patients. However, in each category, patients older than 61 years of age comprised the largest group to be affected. CA-MRSA patients had shorter lengths of stay at the hospital than did the members of the HA-MRSA ($p<0.001$) and the HACO-MRSA ($p = 0.002$) groups, with the members of the HA-MRSA group having with longest hospitalization times. Patient employment (both whether or not employed and the nature of that employment if so) was determined for the members of all 3 groups. Seventy-three percent (73%) of the patients with CA-MRSA were unemployed (which category includes retirees, housewives, and disabled individuals), while the remaining 27% had jobs that entailed working with the public. Of the HA-MRSA patients, 95% were unemployed (retirees, disabled individuals, housewives), while only 5% were working (e.g., cashiers and individuals in some form of domestic service). In the HACO-MRSA group, 93% were unemployed, while the other 7% were working (data not shown). The distribution of risk factors associated with MRSA infection among adult patients was also studied. Diabetes was found to be the most common risk factor among the study population: 64.4% of the CA-MRSA patients, 46.4% of the HA-MRSA patients, and 36.4% of the HACO-MRSA patients reported that they were diabetic. Among CA-MRSA patients, peripheral vascular disease was the second most common (with 8.3% reporting having this disease) risk factor associated with MRSA infection, followed by morbid obesity or obesity (5.6%). Of the HA-MRSA patients, 14.3% had undergone some kind of surgical procedure, while 12.5% suffered from end-stage renal disease. In the HACO-MRSA group, 34.4% of the patients had end-stage renal disease; patients who were bedridden comprised 11.7% of this group.

Table 2 presents the distribution of MRSA cases by site of infection among the CA-MRSA, HA-MRSA, and HACO-MRSA groups. The most predominant sites of MRSA infection in all 3 groups were the skin and soft tissue. Our findings demonstrate that the odds of an HA-MRSA patient's having a skin infection are 70% lower than are the odds of a CA-MRSA patient's having the same ($p<0.001$). The odds of having such an infection are 50% lower for the members of the HACO-MRSA group than they are for the members of the CA-MRSA group ($p<0.001$). Finally, in comparing the members of the HA-MRSA group with those of the CA-MRSA group, we found that former were 10.2 times more likely to have bloodstream infections than were the latter ($p<0.001$); HACO-MRSA patients, on the other hand, were 9.4 times more likely to suffer from these kinds of infections than were CA-MRSA patients ($p<0.001$).

After analyzing the data collected pre- and post-intervention, we found that the number of HA-MRSA cases decreased by 10.35% from October 2009 through October 2011 ($p = 0.704$), the number of CA-MRSA cases decreased by 2.6% ($p = 0.791$), and the number of HACO-MRSA cases decreased by 7.0% ($p = 0.650$). The incidence of infection among HA-MRSA patients was 9.05 per 10,000 hospitalizations in 2010 and 8.1 per 10,000 hospitalizations in 2011. This represents a reduction of 1% in the incidence of HA-MRSA from 2010 to 2011. Figure 2 shows the number of cases (by month) before and after having implemented the decolonization therapy. A slight decrease in cases was observed after the implementation of the decolonization therapy.

Table 1. Basic demographics of CA-MRSA, HA-MRSA, and HACO-MRSA patients (data obtained from October 2009 through October 2011)

Characteristics	CA-MRSA n (%)	HA-MRSA n (%)	p-value[3]	HACO-MRSA[1] n (%)	p-value[3]
Gender					
Female	200 (45.2)	18 (47.4)	0.805	84 (49.7)	0.798
Male	242 (54.8)	20 (52.6)		85 (50.3)	
Total adults	442 (100.0)	38 (100.0)		169 (100.0)	
Mean age ± SD (yrs)	56.6 ± 18.9	63.3 ± 17.0	0.038	65.0 ± 16.5	<0.001
Gender[2]					
Female	64 (57.1)	---		---	
Male	48 (42.9)	---		---	
Total pediatric cases	112 (100.0)				
Mean age + SD (yrs)[2]	8.4 ± 6.5				
Age group					
0 – 212	112 (20.2)	---		---	
21 – 30	45 (8.2)	3 (7.9)		8 (4.7)	
31 – 40	65 (11.7)	---		7 (4.5)	
41 – 50	65 (11.7)	3 (7.9)		18 (10.7)	
51 – 60	65 (11.7)	7 (18.4)		30 (17.8)	
61+	202 (36.5)	25 (65.8)		106 (62.7)	
Total	554 (100.0)	38 (100.0)		169 (100.0)	
Length of hospital stay (in days)					
Mean	11.4	28.4	<0.001	18.0	0.002
Median	8.0	21		12.0	
Range	1 – 90	3 – 103		1 – 126	
Length of hospital stay (in days)[2]					
Mean	6.6	---		---	
Median	4.0	---		---	
Range	1 – 68	---		---	
Risk factors associated with MRSA[4]					
Alzheimer's	12 (3.6)	1 (1.8)		12 (3.4)	
Alcoholism	4 (1.2)	2 (3.6)		-----	
Being bedridden	-----	2 (3.6)		41 (11.7)	
Cancer	15 (4.5)	4 (7.1)		6 (1.7)	
Surgery	---	8 (14.3)		6 (1.7)	
Diabetes	217 (64.4)	26 (46.4)		127 (36.4)	
Morbid obesity or obesity	19 (5.6)	3 (5.4)		12 (3.4)	
End-stage renal disease	---	7 (12.5)		120 (34.4)	
Epilepsy	---	1 (1.8)		4 (1.1)	
Mechanical ventilator	---	1 (1.8)		3 (0.9)	
HIV	5 (1.5)	---		---	
Hepatitis	4 (1.2)	1 (1.8)		---	
Peripheral vascular disease	28 (8.3)	---		17 (4.9)	
Chronic liver disease	8 (2.4)	-----		1 (0.3)	
Drug use	16 (4.7)	-----		-----	
Other	9 (2.7)	-----		-----	

[1]Includes patients with catheters, indwelling devices, and lines; those undergoing hemodialysis; and those who are bedridden as well as nursing-home patients who had the infection at the time of admission to the study hospital. [2]Pediatric cases (0 – 21 years). [3]Statistical result using CA-MRSA as the comparison group. [4]Only adults were tabulated. CA-MRSA: community-acquired MRSA; HA-MRSA: hospital-acquired MRSA; HACO-MRSA: healthcare-associated community-onset MRSA.

Discussion

This manuscript provides an overview of the number and types of MRSA infections that were reported at the hospital at which the study described herein took place. Our findings are consistent with those of previous studies, which report low rates of HA-MRSA infection but an increasing incidence of CA-MRSA cases (23, 25, 26). We also identified CA-MRSA and HACO-MRSA as the principal sources of the MRSA infections found at the study hospital. CA-MRSA was the principal cause of skin infections among children, as has been noted in other, similar studies (25, 27). We also discovered that diabetic men of 61 years of age or older who had endured prolonged stays at the hospital were highly susceptible to MRSA infection; it is strongly suggested, therefore, that this population be monitored. This finding (regarding the previously noted susceptibility of older diabetic men) was consistent over all 3 categories of MRSA studied; however, further studies are needed to confirm these results.

In order to stress the importance of prevention in public work-related areas, especially among CA-MRSA patients, the patients' occupations were analyzed. Twenty percent of the CA-MRSA patients had jobs that required regular interaction with the public (e.g. cashiers and teachers, among others; data not shown). In addition, a significant part of the study population were disabled, which might be indicative of the health-related conditions present in this population, which conditions include end-stage renal disease, itself closely correlated to diabetes. Chronic conditions and the presence of invasive devices (e.g., catheters, G-tubes) also appear to make patients more prone to acquiring this kind of infection (24).

The skin, soft tissue, and bloodstream were the most common sites of infection in all the categories studied. The MRSA infection sites in the members of the CA-MRSA and HA-MRSA groups were similar to those reported in several studies on MRSA-infected adults (28–31). The identification of hospital areas with the greatest number of the MRSA cases is useful in the identification of the areas with the greatest risk of spread (data not shown) (32). Since Puerto Rico has one of the highest rates of diabetes in the US (33), the identification of diabetes as the principal risk factor associated (in this study population)

Table 2. Distribution of CA-MRSA, HA-MRSA, HACO-MRSA by site of infection in adults during the period of October 2009 through October 2011

Infection spectrum	CA-MRSA n (%)	HA-MRSA n (%)	OR (95%CI) n (%)	p-value[2]	HACO-MRSA	OR (95% CI)	p-value[2]
Skin and soft tissue	296 (67.0)	14 (36.8)	0.3 (0.1, 0.6)	<0.001	85 (50.3)	0.5 (0.3,0.7)	<0.001
Respiratory tract	47 (10.6)	5 (13.2)	1.3 (0.5, 3.4)	0.588	15 (8.9)	0.8 (0.4, 1.5)	0.553
Urinary tract	25 (5.5)	4 (10.5)	2.0 (0.6, 5.9)	0.273	4 (2.4)	0.4 (0.1, 1.2)	0.093
		10 (26.3)	10.2	<0.001		9.4 (5.1, 17.0)	<0.001
Bloodstream	15 (3.4)		(4.1,24.7)		42 (24.9)		
Otitis Media	3 (0.7)	----	0.9 (0.8,0.94)	1.0	1 (0.6)	1.1 (0.1,11.2)	1.0
Other	56 (12.7)	5 (13.2)	1.0 (0.4, 2.8)	1.0	22 (13.0)	0.9 (0.6,1.7)	1.0
Total	442 (100.0)	38 (100.0)			169 (100.0)		

[1]Includes patients with catheters, indwelling devices, and lines; those undergoing hemodialysis; and those who were bedridden, as well as nursing nursing-home patients who had the infection at the time of admission to the study hospital. [2]Statistical result using CA-MRSA as the comparison group. CA-MRSA: community-acquired MRSA; HA-MRSA: hospital-acquired MRSA; HACO-MRSA: healthcare-associated community-onset MRSA.

with MRSA infection will allow healthcare professionals to develop prevention tools for special care in this patient population. The results of the intervention, although not statistically significant, show that there was a decrease in the number of cases reported after the intervention. Preventive practices, especially among patients who will undergo surgery, are important to prevent infection and spread (34). Decreasing the probability of spreading the infection can help to lower the rates of MRSA cases at the hospital and at the community level. We are reporting a significant number of MRSA infections, which number provides a glimpse of the magnitude of this problem in southern Puerto Rico.

The current practices at the hospital, which practices include the education of healthcare workers and the families of patients in combination with the implementation of decolonization protocols, isolation procedures, cleaning protocols (in terms of patients' rooms), and preventive measures (e.g., hand hygiene) seem to be effective in the control of HA-MRSA infections. The increase in the incidence and prevalence of CA-MRSA and its relationship with increased morbidity and mortality has become a challenging public health problem (13, 35). Further studies are needed to elucidate the epidemiology of the disease in Puerto Rico.

There are several limitations to our study. Given that information was collected from medical records and that no personal interviews were performed, there is some risk that MRSA cases were misclassified. In addition, incomplete medical records could lead to bias, therefore leading to an underestimation of the factors associated with MRSA infection. Another limitation of our study is the lack of genetic testing to confirm MRSA classification. Future studies, which need to include genetic testing, should be performed.

Resumen

Objetivo: El Staphylococcus aureus resistente a meticilina (SARM) es una bacteria responsable de infecciones difíciles de tratar. Los objetivos de este estudio fueron clasificar los tipos

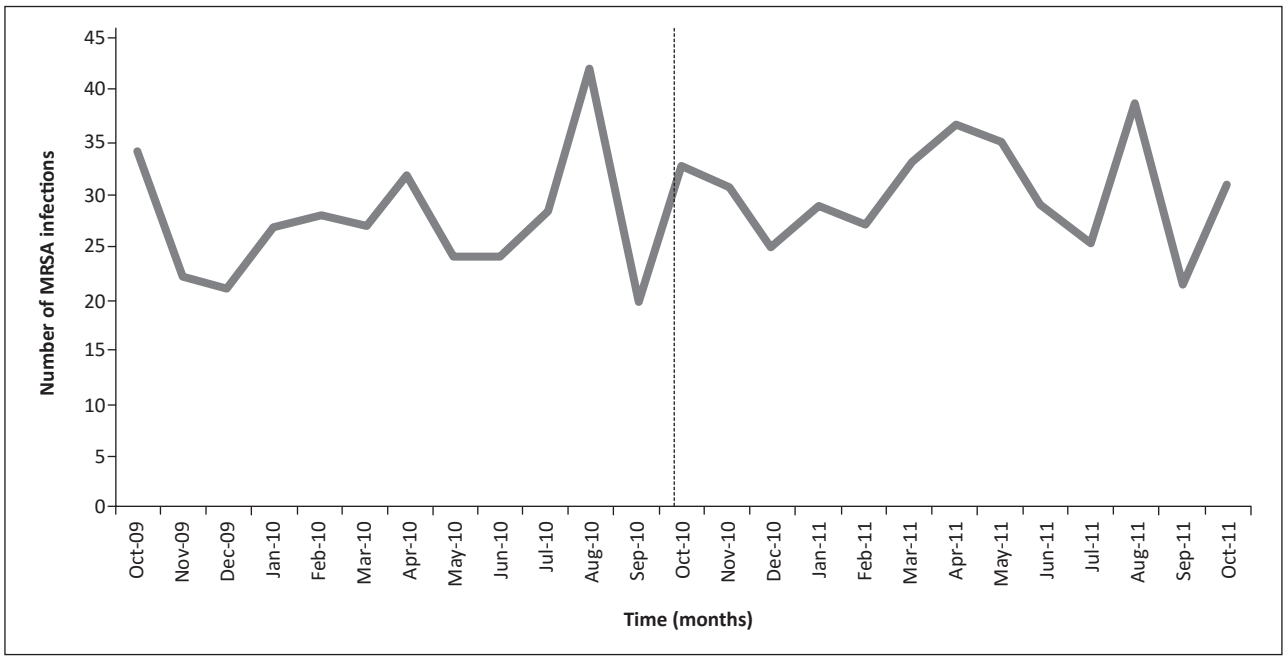

Figure 2. Cases of MRSA infection from October 2009 through October 2011. The dotted line represents the date of the implementation of decolonization therapy (N = 761).

de SARM presentes en el hospital, identificar factores asociados con la infección con SARM en la población bajo estudio y evaluar el resultado de la terapia de descolonización de SARM implementada en el hospital. Métodos: Luego de revisar los expedientes médicos de 761 pacientes con resultados positivos para SARM, estos se clasificaron como: SARM adquirido en el hospital (SARM-AH), SARM adquirido en la comunidad (SARM-AC) o SARM asociado a cuidados de salud con inicio en la comunidad (SARM-ACAH). Se obtuvo información de demografía básica, razón para hospitalización, historial médico y áreas de cultivo, así como otros parámetros. SPSS v17 fue utilizado para llevar a cabo el análisis estadístico. La prueba Fisher se utilizó para medir significancia estadística del OR crudo utilizando SARM-AC como grupo de comparación. Epidat v4.0 se utilizó para calcular la incidencia acumulada de SARM-AH antes y después de implementada la terapia de descolonización. Resultados: En nuestro estudio, 5.0% de los pacientes fueron clasificados como SARM-AH, 72.8% como SARM-AC y 22.2% como SARM-ACAH. Luego de la intervención, se encontró una disminución de 10.35% (p=0.704) en SARM-AH, de 2.6% (p=0.791) en SARM-AC y de 7.0% en SARM-ACAH (p=0.650). Conclusión: Nuestros hallazgos sugieren que el SARM-AC es responsable de la mayoría de las infecciones causadas por SARM en el hospital donde se llevó a cabo el estudio. La terapia de descolonización es una herramienta útil en el control de SARM. Sin embargo, estudios adicionales serán necesarios para confirmar estos hallazgos.

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