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ORIGINAL RESEARCH

Decolonization with Mupirocin and Subsequent Risk of Methicillin-Resistant *Staphylococcus aureus* Carriage in Veterans Affairs Hospitals

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ABSTRACT

Introduction: Hospital-acquired methicillin-resistant *Staphylococcus aureus* (MRSA) infections remain one of the leading causes of preventable patient mortality in the US. Eradication of MRSA through decolonization could prevent both MRSA infections and transmission; however, there is currently no consensus within the infectious disease community on the proper role of decolonization in the prevention of infections. The purpose of this study was to assess the impact of decolonization with mupirocin on subsequent MRSA carriage.

Methods: Patients included in this study were those with an inpatient admission to a Department of Veterans Affairs (VA) hospital between January 1, 2008 and December 31, 2009 who had a positive MRSA screen on admission and a subsequent re-admission during the same time period. Exposure to mupirocin on the initial hospital admission was measured using Barcode Medication Administration data and MRSA carriage was measured using microbiology text reports and lab data containing results from surveillance swabs collected from the nares. Chi-square tests were used to test for differences in re-admission MRSA carriage rates between mupirocin-receiving and non-mupirocin-receiving patients.

Results: Of the 25,282 MRSA-positive patients with a subsequent re-admission included in the present study cohort, 1,183 (4.7%) received mupirocin during their initial hospitalization. Among the patients in the present study cohort who were re-admitted within 30 days, those who received mupirocin were less likely to test positive for MRSA carriage than those who did not receive mupirocin (27.2% vs. 55.1%,

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$P < 0.001$). The proportion of those who tested positive for MRSA during re-admissions that occurred 30–60 days, 60–120 days, and >120 days were 33.9, 37.3, and 41.0%, respectively, among mupirocin patients and 52.7%, 53.0%, and 51.9%, respectively, for patients who did not receive mupirocin ($P < 0.001$ at each time point).

Conclusion: Patients decolonized with mupirocin in VA hospitals were less likely to be colonized with MRSA on re-admission as long as 4 months after decolonization.

Keywords: Decolonization; Hospital-acquired infection; Methicillin-resistant *Staphylococcus aureus*; Mupirocin; Re-admission; Veterans

INTRODUCTION

Nearly 5% of all patients admitted to a hospital in the US develop a hospital-acquired infection (HAI) [1], and close to 20% of these infections are fatal [2]. HAI prevention has received a great deal of attention in recent national legislation aimed at reducing healthcare costs [1, 3], and more than 15 states already have legislative mandates requiring either reporting or screening of methicillin-resistant *Staphylococcus aureus* (MRSA), one of the most virulent and common HAIs [4]. Despite this considerable attention, hospital-acquired MRSA infections remain a major cause of preventable hospital mortality in the US [2].

Roughly 20% of healthy individuals are consistently colonized with *Staphylococcus aureus*, while another 30% are intermittently colonized [5]. Although many MRSA carriers remain asymptomatic, carriage does increase the risk of MRSA infection and can be transmitted to other individuals [5]. There is controversy over the proper role of MRSA decolonization in the prevention of MRSA infections, though some advocate for a policy of decolonization [6]. Support for institutionalizing the practice of decolonization is based on the presumption that MRSA eradication can lower the risk of subsequent MRSA infection and may decrease transmission to other individuals. MRSA decolonization with the topical agent, mupirocin, has not been widely practiced for several reasons, including concern that widespread use could lead to resistance [7, 8], uncertainty surrounding mupirocin's decolonizing efficacy [9], and the absence of an endorsement of this strategy in national guidelines.

Since October 2007, universal nasal surveillance with contact isolation for patients who screen positive for MRSA has been standard procedure across Department of Veterans Affairs (VA) hospitals [10]. Some facilities also choose to decolonize patients, although it is not required or encouraged as part of VA policy. The purpose of the present study was to assess the impact of decolonization on subsequent MRSA carriage in a cohort of patients admitted to any of 111 VA hospitals across the US. The authors hypothesized that use of mupirocin would be associated with a reduced probability of subsequent MRSA carriage.

MATERIALS AND METHODS

This study was approved by the University of Utah Institutional Review Board and the VA Salt Lake City Office of Research.

Subjects

Patients included in this study were those with an inpatient admission to a VA hospital between January 1, 2008 and December 31, 2009

who had a positive MRSA screen on admission and a subsequent re-admission during the same time period.

Exposure and Outcome Variables

The exposure of interest in this study was treatment with mupirocin, a topical agent applied nasally, for MRSA decolonization. Patients were classified as having been exposed to decolonization if mupirocin was ordered or dispensed for the patient during their initial inpatient stay. The outcome in this study was subsequent MRSA carriage, as measured by surveillance swabs collected from the nares. The authors measured this at four time periods (<30, 30–60, 60–120, and >120 days), using each patient's MRSA screening test result at the time of first re-admission.

Data

The authors identified exposure to mupirocin using VA Bar Code Medication Administration (BCMA) data. BCMA captures inpatient medication administration throughout all VA hospitals using scanned barcode labels [11]. Natural language processing was used to identify positive MRSA tests from semi-structured microbiology text reports and structured lab data containing results from MRSA surveillance tests [12].

Statistical Analysis

The authors used a Chi-square test to test for differences in re-admission MRSA carriage rates between mupirocin-receiving and non-mupirocin-receiving patients at each re-admission time period.

RESULTS

A total of 25,282 MRSA positive patients with a subsequent re-admission were included in the present study cohort (Fig. 1). Of these, 1,183 (4.7%) received mupirocin during their initial hospitalization. Among the patients in the present study cohort who were re-admitted within 30 days, those who received mupirocin were less likely to test positive for MRSA carriage than those who did not receive mupirocin (27.2% vs. 55.1%, $P < 0.001$; Fig. 2). The percentage of those who tested positive for MRSA during re-admissions that occurred between 30–60, 60–120, and >120 days were 33.9%, 37.3%, and 41.0%, respectively, among mupirocin patients and 52.7%, 53.0%, and 51.9%, respectively, for patients who did not receive mupirocin ($P < 0.001$ at each time point).

DISCUSSION

The results of present study showed that patients who receive mupirocin for decolonization of MRSA carriage may be less likely to have MRSA carriage on re-admission to the hospital. Comprising more than 25,000 patients from over 100 VA hospitals across the US, this study is by far the largest study to assess the effect of mupirocin on subsequent MRSA carriage.

The finding that decolonization may lead to reduced risk of MRSA carriage over a prolonged period of time has important implications for patient safety efforts. Frequent re-admissions of MRSA-colonized patients are associated with increased colonization pressure and contribute to the endemicity of MRSA [13, 14]. Successful eradication of MRSA through decolonization could lead to decreased importation, reduced MRSA acquisitions, and fewer infections.

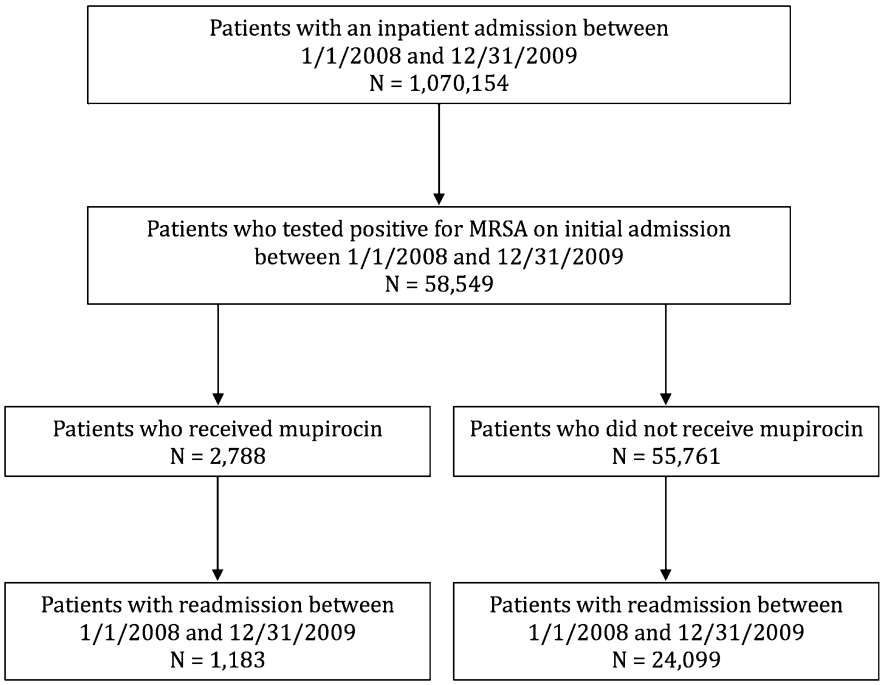

Fig. 1 Patient selection. *MRSA* methicillin-resistant *Staphylococcus aureus*

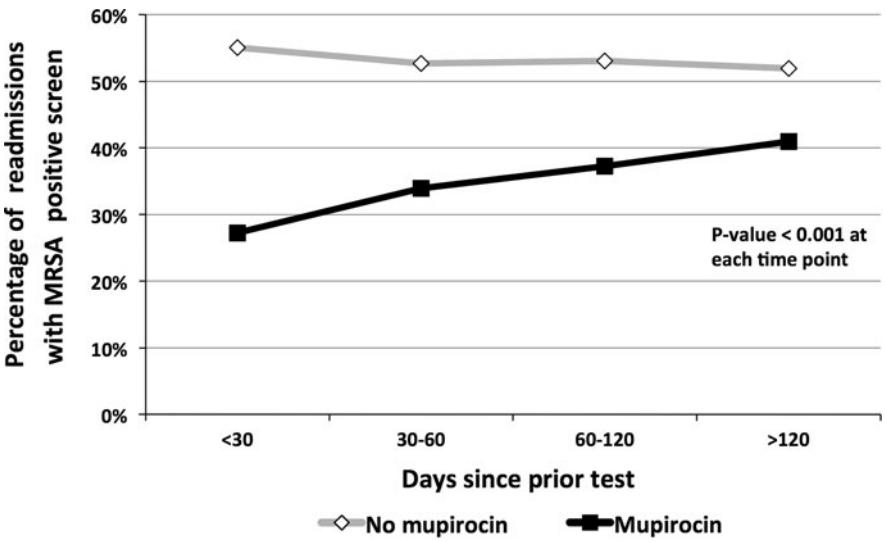

Fig. 2 Percentage of re-admissions with MRSA-positive screen <30, 30–60, 60–120, and >120 days after initial admission with MRSA-positive screen for mupirocin-receiving and non-mupirocin-receiving patients ($P < 0.001$ at each time point). *MRSA* methicillin-resistant *Staphylococcus aureus*

The results from the present study are similar to those seen in other studies. A study of three Chicago-area hospitals found that, regardless of the number of doses received, patients treated with mupirocin were less likely to have persistent colonization than those not treated with mupirocin [15]. The effects of decolonization are believed to last up to 90 days;

however, few studies have followed patients for longer periods of time [16]. Exceptions to this include two studies of decolonization in patients in long-term care facilities. Mody et al. [17] found that 61% of patients remained decolonized for up to 90 days, with some remaining decolonized for up to 6 months. Simor et al. [18] reported statistically significant differences in recolonization rates between decolonized and non-decolonized patients at 8 months.

Reflecting the debate over widespread administration of mupirocin, less than 5% of VA study subjects from the present study received mupirocin, whereas another study surveying 674 infectious disease physicians reported much higher rates of decolonization among surgical patients [19]. There are many possible explanations for these differences, including differences in patients (surgical vs. all admitted patients) and method of data collection (self-reported survey vs. secondary data from medical records).

The present study had several limitations. First, the outcome of the study was MRSA carriage, and not MRSA infection, which is the more important outcome from a clinical standpoint. Future research is needed to evaluate the effect of mupirocin on MRSA infection. Second, because the authors conducted this study using secondary data, the authors were not able to prospectively test patients for recolonization at various time points after the initial decolonization. The authors, therefore, had to select patients who were re-admitted to a VA facility in order to capture subsequent colonization. While this method of selecting study subjects has been employed in other studies [15], it is possible that conditioning on the common effect of having a re-admission could introduce selection bias if re-admission rates differ between mupirocin-receiving and non-mupirocin-receiving patients [20]. Notably, of the 55,761 non-mupirocin-receiving patients and 2,788 mupirocin-receiving patients who tested positive for MRSA, 43.2% and 42.4% ($P = 0.413$) had a re-admission, respectively; these similar re-admission rates between the two groups of patients suggest that selection bias is not a substantial problem in the present study. Finally, chlorhexidine bathing is another commonly used decolonization technique that may be used separately or in conjunction with mupirocin [21]. Unfortunately, it is not possible to identify chlorhexidine through VA BCMA data, so the authors were not able to explore the effect of different decolonization techniques.

In conclusion, mupirocin was negatively associated with MRSA carriage more than 4 months after use in MRSA carriers admitted to a VA hospital. These long-term effects may provide important protection from MRSA infections. In light of these findings, the authors reiterate the call for large-scale trials, in conjunction with screening and isolation, to evaluate decolonization as a tool for reducing nosocomial MRSA infections [22, 23].

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Conflict of interest. The authors have no financial interests to disclose.

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