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Major Article

Assessment of current methicillin-resistant *Staphylococcus aureus* screening protocols and outcomes at an academic medical centerVeronica Richards MPH, CPH^{a,b,*}, Elizabeth Tremblay MPH, CPH, CIC^b^a Department of Epidemiology, College of Public Health and Health Professions & College of Medicine, University of Florida, Gainesville, FL^b Department of Infection Prevention and Control, University of Florida Health Shands Hospital, Gainesville, FL

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Background: Methicillin-resistant *Staphylococcus aureus* (MRSA) is responsible for many hospital-associated infections. Both MRSA-colonized and MRSA-infected patients must be isolated on contact precautions per the Centers for Disease Control and Prevention guidelines. This study evaluates the current practice for removing MRSA-colonized patients from contact precautions and proposes a new protocol to decrease inconsistencies with screening methodologies.

Methods: This was a retrospective chart review of MRSA screening swabs collected at an academic medical center between January 1, 2010 and December 31, 2017. Of those patients with MRSA screening swabs, extra-nasal cultures were also evaluated for MRSA infection. Screening swabs were analyzed for appropriateness of order and timing between swabs and active infections. Analysis of variance and the χ^2 tests were used to determine significance between groups.

Results: This study included 8,310 patients with a combined total of 11,601 nasal swabs. Significantly more ($P = .0159$) patients with 2 negative nasal swabs returned with a recurrent MRSA infection or colonization than those who had 3 consecutive negative nasal swabs (27.8% vs 17.0%, respectively). Additionally, 47.8% of patients only had 1 appropriately ordered negative nasal swab, indicating that a nurse-driven protocol may be more effective in obtaining the full series of samples required to remove contact precautions.

Conclusions: The current practice for removing a patient from contact precautions for MRSA is insufficient. The number of negative nasal swabs required should be increased from 2 to 3 and a decolonization protocol should be implemented.

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Long-term colonization with methicillin-resistant *Staphylococcus aureus* (MRSA) has been associated with an increased risk of serious infection and death.^{1,2} MRSA infections have become increasingly more prevalent and are a significant cause of global morbidity. The estimated cost to treat a single MRSA infection is anywhere between \$7,070 and \$20,489, depending on the severity of the infection.³

Because of the ability of MRSA to spread via contact, patients who have a history of MRSA colonization or infection are placed on contact precautions per the Centers for Disease Control (CDC) and Prevention Healthcare Infection Control Practices Advisory Committee Multi-drug-Resistant Organism guidelines,⁴ which may result in emotional distress and decreased patient satisfaction.^{5,6} Hospitals may also suffer financially from unnecessary isolation precautions through the

loss of semiprivate bed spaces that become blocked for isolation patients. Despite the negative outcomes associated with MRSA colonization, there is currently no standard protocol for removing a patient from MRSA-associated contact precautions. It was not until midway through this study that the Society for Healthcare Epidemiology of America (SHEA) published an expert guidance document regarding duration of contact precautions for acute care settings.⁷

When a patient tests positive for MRSA, the medical record is flagged and contact precautions are instituted until the MRSA infection and or colonization is no longer present. Although no universal protocol exists, Banach et al⁷ found that the most common number of negative nasal swabs required to remove a patient from contact precautions for MRSA was 3.

According to the same study, 74.7% of facilities (surveyed in their study) have policies in place that allow for the discontinuation of contact precautions for MRSA.⁶ However, from that same sample, only 20.7% of facilities have a decolonization protocol in place to assist in clearing the patient's MRSA colonization. Therefore, 54% of facilities

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are just waiting for the patient’s MRSA colonization to resolve on its own over time.⁶ Additionally, 1 study indicated that physician-initiated screening was inadequate for removing a patient from contact precautions, resulting in just 31% of eligible patients being screened, with only 9.6% of patients finishing the series.⁸

The objective of this study was to evaluate the practice for removing previously colonized patients from contact precautions at a large academic medical center from January 1, 2010 through December 31, 2017 by (1) examining the proportion of recurrent MRSA infection or colonization, and (2) examining the number of patients with only 1 swab collected.

METHODS

Background

The study took place in a 972-bed academic medical center located in Gainesville, Florida. To be removed from contact precautions at this facility, a patient must be free from active MRSA infection and then the provider must obtain 2 negative MRSA screening swabs, each collected on separate days. To screen for MRSA colonization, the facility has varied between using Remel Spectra MRSA chromogenic agar (Thermo Fisher Scientific, Lenexa, KS) and GeneXpert SA Nasal Complete PCR (Cepheid, Sunnyvale, CA) to detect the presence of MRSA, each using a swab taken from the anterior nares. Also note, the use of PCR for MRSA nasal screening ended altogether in July 2014.

Data collection

All data were collected via electronic medical records (Epic Systems, Madison, WI). Records from January 1, 2010 through December

31, 2017 were included. Patients were included in the sample if they had lab results for nasal swabs to screen for MRSA.

Using this same list of patients, we also obtained a list of positive MRSA cultures (this time excluding nasal swabs) to measure the prevalence of extra-nasal MRSA infections. These specimens also had to have been collected within the study period.

Study design

Patients were sorted into 1 of 3 independent groups, depending on their MRSA nasal screening results (Fig 1). These groups included: (1) consistent positive, (2) consistent negative, or (3) inconsistent. A patient was considered a “consistent positive” if all nasal swabs within the study period were positive, including those with only 1 positive swab; a patient was considered a “consistent negative” if all nasal swabs within the study period were negative, including those with only 1 negative swab; and a patient was considered “inconsistent” if they had at least 1 positive and 1 negative nasal swab. These patients were then further divided within these groups based on a history of active MRSA infection (described by the presence of a positive extra-nasal culture). Per facility policy, we do not offer a lab test to screen a patient for extra-nasal colonization. Therefore, any positive extra-nasal MRSA cultures were assumed to be owing to active infection, not collected for surveillance purposes.

Additionally, nasal swab timing (rather than individual patients) was analyzed (Fig 2). Swabs were placed into 1 of 2 groups: pass or fail. In order for a nasal swab to be considered a “fail,” 1 of 3 events could have occurred: (1) >1 nasal swab was collected on the same day; (2) a nasal swab was collected on the same day as an extra-nasal clinical culture (for the purposes of diagnosing or treating active MRSA infection); or (3) a nasal swab was taken within the active infection period (<30 days). We used 30 days as our active infection

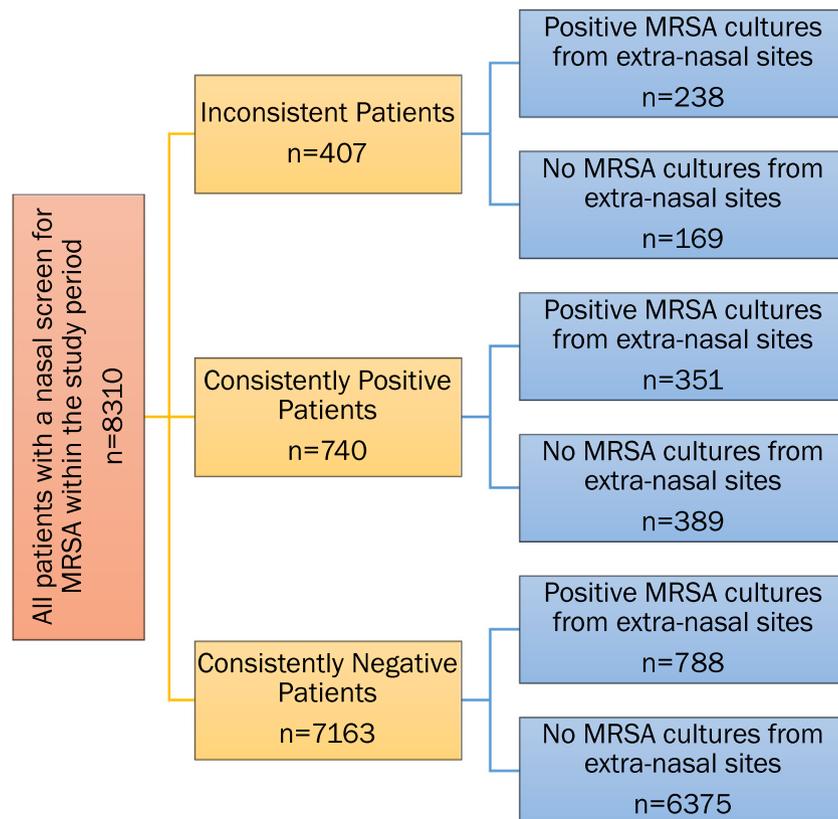


Fig 1. Method to sort patients into 3 groups based on MRSA history. MRSA, methicillin-resistant *Staphylococcus aureus*.

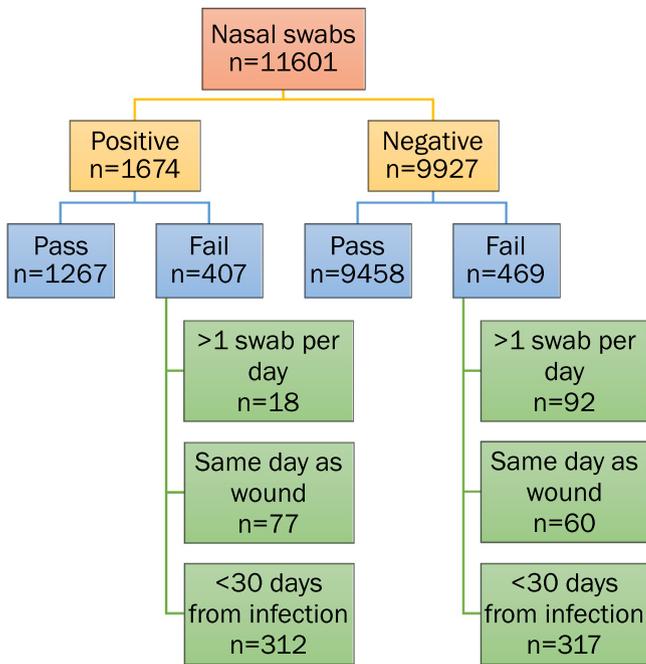


Fig 2. Method for sorting nasal swabs into passing or failing groups.

period because of the average length of treatment for MRSA infection (all sites) in combination with current literature.^{7,8} These swabs were considered a fail because swabbing a patient when they are ineligible to be removed from contact precautions is a waste of laboratory resources, health care dollars, and may result in inappropriate clearance that poses a patient safety risk.

Failing swabs were included in the analysis to evaluate our current MRSA clearance protocol and to highlight areas for improvement. The term “failing” does not imply that the results of the swab were not used to make a clinical decision when removing a patient from contact precautions, but rather a failing swab was collected inconsistent with hospital policy.

Statistical analysis

Excel (Microsoft Corp, Redmond, WA) pivot tables were used to sort patients and calculate summary statistics. The χ^2 tests were used to detect differences between MRSA recurrence for patients after 2 versus 3 negative nasal swabs.

Table 1
Patient demographics (n = 8310)

	Consistently negative n = 7,163	Inconsistent n = 407	Consistently positive n = 740	Total n = 8,310
Age				
mean (SD*)	52.9 (19.4)	50.2 (22.0)	56.0 (19.9)	53.1 (19.6)
median	56.0	54.3	59.0	56.0
Male (%)	3,677 (51.3%)	192 (47.2%)	384 (51.9%)	4,253
Number of patients with MRSA infections				
Yes (%)	788 (11.0%)	238 (58.5%)	351 (47.4%)	
No (%)	6,365 (89.0%)	169 (41.5%)	389 (52.6%)	
Average number nasal swabs (SD*)	1.27 (0.66)	3.86 (2.22)	1.29 (0.72)	1.39 (0.99)
Number of admissions, mean (SD*)	1.28 (1.00)	3.2 (2.22)	1.73 (1.95)	1.41 (1.27)

MRSA, methicillin-resistant *Staphylococcus aureus*.

*Standard deviation.

Ethics

This study was approved by the University of Florida’s institutional review board (IRB01) under protocol IRB201800133.

RESULTS

Between January 1, 2010 and December 31, 2017, a total of 8,310 patients were screened for MRSA at this facility, accounting for a total of 11,601 nasal swabs. Table 1 summarizes patient demographics, stratified by patient group.

Patients in the group with nasal swabs collected correctly (“passing” group) had a mean age of 52.9 (SD = 19.3) years, compared with those with nasal swabs incorrectly collected (“failing” group) who had a mean age of 43.4 (SD = 25.5) years. Of the 876 nasal swabs in the “failing” group, 92.5% were done using cultures, rather than PCR.

Examination of “passing” negative nasal swabs among consistent negative patients with history of infection and inconsistent patients with or without history of infection indicate that almost half (47.8%) of this population only obtained 1 (properly collected) negative nasal swab. Similarly, the majority (80.0%) of consistently positive patients had only 1 nasal swab taken during the study period.

Based on the hospital clearance protocol of requiring 2 negative nasal swabs, the population of patients who would have been removed from contact precautions regardless of swabbing correctness (n = 559) versus those who would have been properly removed (n = 478) was compared. A total of 81 patients appeared to have been improperly removed from isolation.

The number of patients with MRSA recurrence within a period of <1 year was also examined. Patients with just 2 negative [passing or failing] nasal swabs returned with a recurrent MRSA infection or colonization 27.8% of the time, whereas patients with 3 or more negative nasal swabs returned with a recurrent MRSA infection or colonization 17.0% of the time. A χ^2 analysis resulted in a P value = .0159.

DISCUSSION

This study suggests that the current protocol for removing a patient from contact precautions for MRSA at our university hospital is inadequate. With a significantly larger proportion of patients experiencing MRSA recurrence after having 2 consecutive negative nasal swabs versus 3 negative nasal swabs, the requirement to remove a patient from contact precautions should be increased to 3 negative nasal swabs, consistent with the majority of acute care facilities.⁶ Increasing the number of negative nasal swabs required could reduce hospital-associated infections, benefiting both the patient and the hospital.³

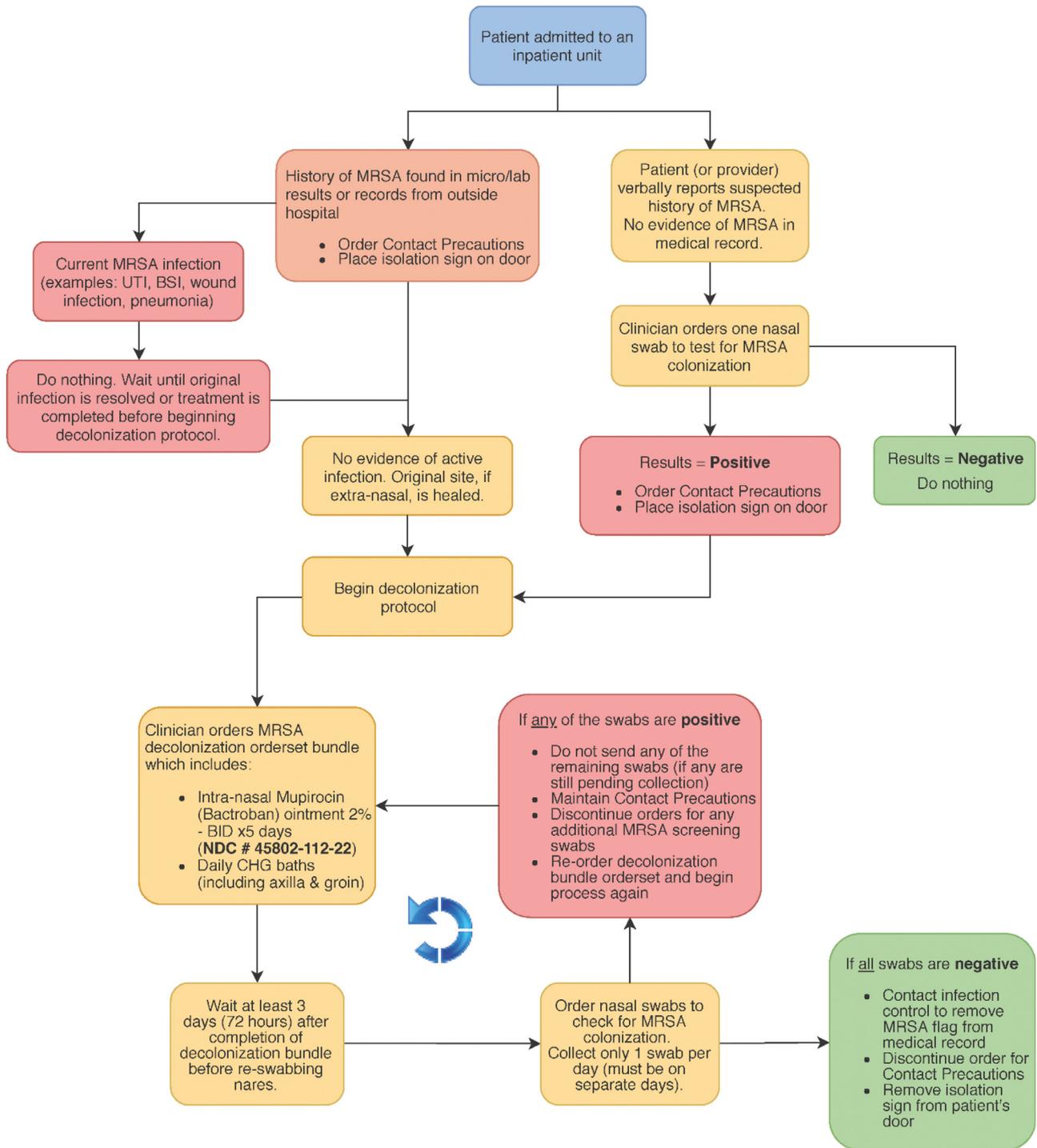


Fig 3. Proposed MRSA clearance protocol. *BID*, 2 times a day; *BSI*, bloodstream infection; *CHG*, chlorhexidine gluconate; *MRSA*, methicillin-resistant *Staphylococcus aureus*; *UTI*, urinary tract infection.

Additionally, the findings support the need for a nurse-driven protocol for MRSA clearance. With almost half of patients eligible to be removed from contact precautions only having 1 negative nasal swab obtained, it is apparent that physician-initiated screening is not sufficient.^{7,8} Similarly, patients could benefit from a nurse-driven decolonization protocol, allowing the consistently-positive group to be removed from contact precautions, rather than passively waiting. Based on the findings of this study, a new protocol has been

proposed, accompanied by an easy-to-follow diagram detailing the proposed nurse-driven protocol (Fig 3).

The results of this study should be viewed with caution. As with all retrospective chart reviews, this study is limited owing to the nature of the data. It is possible that data were missing or incomplete, however, data were validated whenever possible. Because of the defined study period, it is also possible that some data may be lacking in respect to MRSA history outside of the period. As mentioned previously, our

hospital ended the use of GeneXpert SA Nasal Complete PCR (Cepheid) midway through this study, however, we do not suspect that the results would have been significantly affected by this change, as the sensitivity is similar to that of Remel Spectra MRSA chromogenic agar (Thermo Fisher Scientific). Screening data were collected only from the nares, and thus, it is possible that a participant could have been considered a “false negative” when they were colonized with MRSA in the axilla or groin. However, because of our current hospital policy, examining screening results from the nares was the only feasible option. It is important to remember that MRSA colonization prevalence varies by facility and by patient population. This study took place at a large academic medical center, and thus, may be generalized to other large academic medical centers with all patient populations; it may not be generalizable to small community hospitals or population-specific hospitals, however. There is currently no standard protocol regarding MRSA screening and decolonization, therefore the results for this study may not be applicable to other centers.

CONCLUSIONS

Despite these limitations, this study provides useful guidance regarding MRSA clearance. With a large sample size of over 8,000 patients, errors owing to a non-normal study population were avoided. The data indicate that requiring 3 negative nasal swabs, at least 24 hours apart, could reduce the amount of MRSA recurrence in the hospital setting. To further strengthen this finding, it is

recommended that a future study be conducted on DNA fingerprinting to determine if the MRSA causing extra-nasal infection is the same strain that previously colonized the patient's nose.

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