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Concise Communication

Evaluation of computerized clinical decision support system to reduce unnecessary nasal methicillin-resistant *Staphylococcus aureus* (MRSA) polymerase chain reaction (PCR) testing

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Abstract

Our health system implemented a novel clinical decision-support system to reduce unnecessary duplicate nasal methicillin-resistant *Staphylococcus aureus* (MRSA) polymerase chain reaction (PCR) orders. In an 8-month period, the rate of duplicate MRSA PCR orders within 7 days declined from 4.7% (370 of 7,861) to 1.2% (120 of 9,833).

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The Division of Healthcare Quality Promotion within the Centers for Disease Control and Prevention (CDC) has underscored the importance of advancing diagnostic stewardship to enhance treatment, outcomes, and patient safety.[1,2] A recent study conducted by Turner et al[3] assessed the extent to which the nasal methicillin-resistant *Staphylococcus aureus* (MRSA) polymerase chain reaction (PCR) maintained its negative predictive value (NPV) in ruling out MRSA-positive respiratory cultures relative to the duration of hospitalization. The study highlighted a high NPV of 95.7% from 49 hours to 7 days and 92.9% from 8 to 14 days.[3] Given the high retention of NPV up to 14 days, there is opportunity in optimizing ordering of nasal MRSA PCRs and to reduce the costs of unnecessary testing. Although universal nasal MRSA screening is not required at our institution, it is highly recommended to de-escalate anti-MRSA therapy prescribed for pneumonia. In March 2022, our antimicrobial stewardship committee implemented a clinical decision support (CDS) system within Epic software (Epic Systems, Verona, WI) to mitigate duplicate nasal MRSA PCR testing. We evaluated the impact of this CDS system on nasal MRSA PCR diagnostic stewardship across the health system.

Methods

In this retrospective study, we evaluated patients admitted to a health system comprising 7 acute-care hospitals in the greater Houston area. Patients were included if they were aged ≥18 years with at least 1 nasal MRSA PCR result during the preimplementation period (May 1–December 31, 2021) or the postimplementation period (May 1–December 31, 2022). This timeframe was selected to compare similar periods while allowing for appropriate washout to account for CDS implementation in March 2022. Patients with the same medical record number but a different encounter number (ie, same patient that could have been readmitted) were included if they were admitted during the study period. Nasal MRSA screening cultures and indeterminate MRSA PCR results were excluded from the analysis. Data were obtained from the electronic health record (EHR). The primary end point was the incidence rate of duplicate MRSA PCR orders within 7 days, defined as number of duplicate MRSA PCR orders divided by total numbers of MRSA PCR orders multiplied by 100%. Secondary end points included incidence rate of duplicate MRSA PCR orders within 24 hours, discordance between duplicate MRSA PCRs within 7 days (defined as the number of discordant MRSA PCR results from the initial result divided by total numbers of MRSA PCR orders multiplied by 100%), and estimated cost savings achieved (based on average wholesale price of $48 per MRSA PCR order). A comparative analysis between the pre- and postimplementation arms was performed using the χ^2 test. Data were analyzed using Minitab 2.0 software (Minitab, State College, PA).

The CDS system implemented is composed of dynamically displaying sections within an order panel that includes a hard stop for nasal MRSA PCRs ordered within 24 hours of a prior order and two separate soft stops for nasal MRSA PCRs ordered within 1–7 days and 7–14 days of a prior result. If an additional nasal MRSA PCR order is entered within 24 hours of a prior order, providers are notified via a display that a recent order has been placed, and the nested option within the order set will automatically convert the nasal MRSA PCR order into a nursing order, requiring nurses to confirm that additional nasal MRSA PCR tests are not necessary. This process establishes a firm restriction that does not generate an alert for best practice advisories (BPA) while maintaining the

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Table 1. Primary and Secondary End Points

Variable	Before Implementation, n/N (%)	After Implementation, n/N (%)	Incidence Rate Difference (95% CI)	*P* Value
Incidence of duplicate MRSA PCR orders within 7 d	370/7,861 (4.7)	120/9,833 (1.2)	0.035 (0.03–0.04),	<.001
Incidence of duplicate MRSA PCR orders within 24 h	159/7,861 (2)	30/9,833 (0.3)	0.02 (0.01–0.02)	< .001
Discordance results between duplicate MRSA PCR orders within 7 d	7/370 (2)	2/120 (2)	. . .	. . .

Note. CI, confidence interval; MRSA, methicillin-resistant *Staphylococcus aureus*; PCR, polymerase chain reaction.

limitation on nasal MRSA PCR ordering within the same 24-hour period. Upon order placement within the given periods for soft stops, a notification within the order populates displaying the most recent nasal MRSA PCR result (Supplementary Material online). Additionally, the current build allows for display of results from previous admissions if obtained within 14 days.

Results

In total, 7,048 and 8,650 unique patients met inclusion criteria for the pre- and postimplementation arms, respectively. The total nasal MRSA PCR orders were 7,861 in the preimplementation arm and 9,833 in the postimplementation arm after applying exclusion criteria. With the addition of the CDS system, the incidence of duplicate nasal MRSA PCR testing order rates within 7 days decreased by 74% (incidence rate difference, 0.03–0.04; $P < .001$). Outcomes are summarized in Table 1. This reduction in duplicate nasal MRSA PCR orders was sustained over time when compared monthly between the 2 arms (Fig. 1). When analyzing hard stops within 24 hours, a duplicate testing reduction of 85% (0.01–0.02; $P < .001$) was achieved. Notably, duplicate testing within 24 hours in the postimplementation arm was due to a prior test result being available within 24 hours that made it a soft stop. The discordance rate of nasal MRSA PCR results within a 7-day period was 2% in both the pre- and postimplementation arms. Also, 2 patients in the postimplementation arm had a discordant result with a positive nasal MRSA PCR result after an initial negative result. Cost savings amounted to an estimated $16,416.

Discussion

To our knowledge, no published studies have evaluated the effectiveness of a CDS system in reducing duplicate nasal MRSA PCR tests ordered within 7 days. With an evaluation of 15,698 patients, we have demonstrated a statistically significant reduction in duplicate nasal MRSA PCR ordering up to 74% within a 7-day period and an estimated cost savings of $16,416. Notably, cost estimations do not include the cost of nursing time, specimen transportation, or microbiology laboratory medical technologist time. The discordance rates in both arms were 2%, and our CDS system allows clinicians to order additional nasal MRSA PCR orders if clinically necessary. With evidence of the high retention of NPV of MRSA PCR and low discordance rates among duplicated test results, an opportunity to develop a CDS system to optimize healthcare personal time and expenditures, without imposing harm to patients, was successfully employed in both the academic and community hospital settings. Importantly, these reductions were achieved using CDS integrated into the ordering process and avoided the use of interruptive alerts such as BPAs.

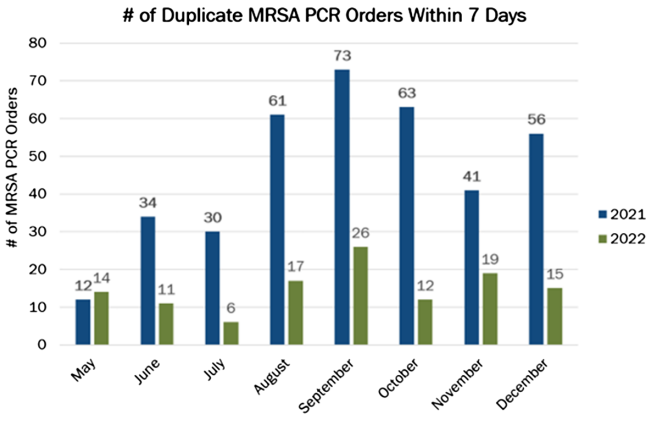

Figure 1. Monthly duplicate MRSA PCR orders within 7 days.

This study had several limitations. Nasal MRSA screening cultures orders were removed from the preimplementation arm. Prior to the introduction of our intervention, 2 testing methods existed for clinicians to screen for colonization in the form of nasal MRSA PCR and the nasal MRSA screening culture. The hospital system made the decision to remove nasal MRSA screening culture orderable moving forward given the improvement of turnaround time of PCR testing.[4] As a result of the removal, we have eliminated >2,000 MRSA screening cultures in the preimplementation arm, which likely underestimates the number of duplicate orders. These study findings would likely be even stronger with the inclusion of screening cultures. Additionally, this study did not assess whether this implementation influenced clinician satisfaction, alert fatigue, the patient's empiric regimen, duration of MRSA therapy, or length of stay.

Despite these limitations, this study provides insight into a novel CDS protocol that has proven to reduce duplicate nasal MRSA PCR orders and cost while potentially minimizing alert fatigue. Nasal MRSA PCR testing requirements may vary across states. Hence, it is important to be cognizant of local regulations prior to implementing this CDS system. Based on the findings of this study, antimicrobial stewardship programs can leverage diagnostic testing results to facilitate the implementation of a CDS systems across health systems.

Supplementary material. To view supplementary material for this article, please visit https://doi.org/10.1017/ice.2023.256

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