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Reinstatement of Reflex Testing of Stool Samples for Vancomycin-Resistant Enterococci (VRE) Resulted in Decreased Incidence of Hospital-Associated VRE

Vancomycin-resistant enterococci (VRE) infections result in increased hospital costs and lengths of stay.¹ Previously, we described a hospital-wide “reflex” testing program for detecting VRE intestinal colonization as an intervention to limit nosocomial transmission.² Inpatients that had diarrheal stools submitted to the clinical microbiology laboratory for *Clostridium difficile* (*C. difficile*) toxin testing also had screening cultures for VRE. In July 2010, this program was discontinued, and in the following 18 months, the monthly incidence of healthcare-associated VRE increased by 71%.

Based on these findings, the VRE reflex testing program was reinstated in January 2012. We examined the effect of reinstatement of the VRE reflex testing program on healthcare-associated VRE incidence.

METHODS

Barnes-Jewish Hospital is a 1,250-bed academic tertiary care hospital in Saint Louis, Missouri. We examined the healthcare-associated VRE rate between January 2009 and December 2015. Reflex testing for VRE was discontinued in July 2010 and was reinstated in January 2012. Clinicians were notified of these changes to VRE reflex testing. Throughout the study

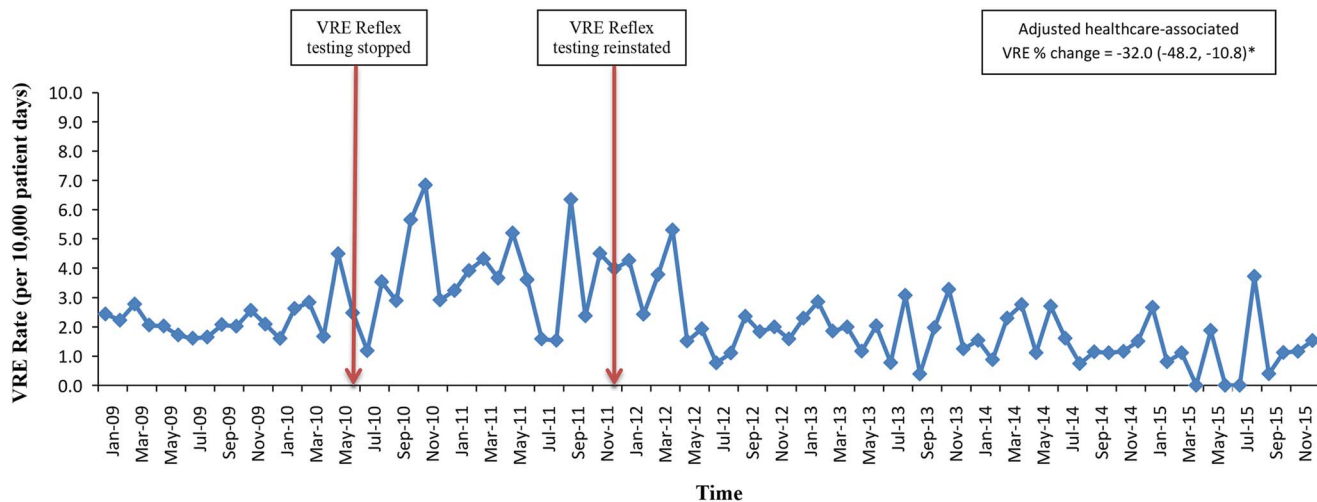
period, clinicians could order stool or perirectal cultures for VRE testing at their discretion. The hospital policy during the study was to place VRE colonized or infected patients on contact precautions in a private room. During the reflex screening period 1 (January 2009 to July 2010), stool specimens were plated on Enterococcosel Agar (Becton Dickinson, Sparks, MD). During screening period 2 (January 2012 to December 2015), chromID VRE (bioMerieux, Durham, NC) was used. No differences in the screening cultures performed that were positive for VRE were detected for either screening period: 2,457 of 9,637 (25.5%) for period 1 versus 6,289 of 24,920 (25.2%) for period 2 ($P = .62$).

All hospitalized patients with a positive urine or blood culture for VRE were identified. A healthcare-associated VRE case was defined as the first positive specimen per patient, where VRE was detected in blood or urine ≥ 3 calendar days after admission. A VRE case was considered present on admission if VRE was detected in blood or urine < 3 calendar days after admission.³ In the original study, we defined healthcare-associated VRE as an initial positive culture within 48 hours after admission. The VRE incidence was expressed as cases per 10,000 patient days.

The effect of reflex testing on the incidence of healthcare-associated VRE was evaluated using regression models with autoregressive integrated moving average (ARIMA) errors. In addition to reflex testing, VRE prevalence on admission, central line utilization, urinary catheter utilization, and overall temporal trend were considered in the model to evaluate the effects of these factors on healthcare-associated VRE rate during the study period. The Washington University Human Research Protection Office approved this study.

RESULTS

In the initial reflex testing period, there were 99 cases of healthcare-associated VRE; 36 cases (36.4%) were identified via blood cultures and 63 cases (63.6%) were identified via urine cultures, for an overall rate of 2.3 VRE cases per 10,000 patient days. During the period when reflex testing was discontinued, there were 166 cases of healthcare-associated VRE; 63 cases (38.0%) were identified via blood cultures and 103 cases (62.0%) were identified via urine cultures, for an overall rate of 3.7 cases per 10,000 patient days. During the study period after reflex testing was reinstated, there were 218 cases of VRE; 57 cases (26.1%) were identified via blood cultures and 161 cases (73.9%) were identified via urine cultures, for an overall rate of 1.8 cases per 10,000 patient days (Figure 1). Accounting for the overall temporal trend, healthcare-associated VRE decreased at a rate of 36.4% (-36.4 ; 95% CI, -50.9 to -17.7) per month over the entire study period. The average healthcare-associated VRE rate was 1.9 cases per 10,000 patient days during the reflex testing periods versus 3.7 cases per 10,000 patient days during the nontesting period. When adjusted for VRE prevalence on admission and overall temporal trend, reflex testing was associated with a 32.0% reduction (-32.0 ;



*Rate adjusting for overall temporal trend and VRE prevalence on admission by Autoregressive integrated moving average.

FIGURE 1. Monthly incidence of healthcare-associated vancomycin resistant enterococci (VRE) infections, January 2009 - December 2015

95% CI, -48.2 to -10.8) in healthcare-associated VRE incidence compared to the non-reflex testing period.

DISCUSSION

In this follow-up study, we noted that hospital-wide reinstatement of a VRE reflex screening program led to a decrease in hospital-associated VRE incidence to a baseline rate similar to pre-discontinuation period, which further suggested a causal relationship between the program and a reduction in hospital-associated VRE transmission.⁴ Most hospitals, often due to the lack of routine active surveillance, do not identify a large proportion of colonized patients who are potential sources for ongoing hospital transmission.^{5,6} Some studies have demonstrated the benefit of active surveillance cultures to control VRE transmission in hospitals; however, these were generally conducted during an outbreak in which multiple interventions were introduced simultaneously.^{7,8} In our previous study, we found that discontinuation of reflex VRE testing of each stool sample submitted for testing for *C. difficile* at our hospital resulted in a 71% increase in the endemic healthcare-associated VRE rate (Figure 1). This long-term, follow-up analysis indicated that when reflex VRE testing was reimplemented, healthcare-associated VRE rates returned to the prediscontinuation baseline.

Our study has several limitations. Our data were collected from a single care center and did not include patient-level characteristics. Another concern is the change in the screening method of stool specimens. However, the percentage of positive screening tests did not change significantly. The strengths of our study include repeated treatment design⁹ and the use of regression models with ARIMA errors to appropriately account for correlated observations over time and to adjust for the overall temporal trend and important

confounders such as VRE prevalence on admission. Furthermore, no other specific infection prevention measures were implemented over the study period, and laboratory methods for identifying VRE from urine and blood cultures did not change. Also, there were no outbreaks of *C. difficile* during this period.

In conclusion, we found that the use of VRE reflex testing of stool submitted for *C. difficile* testing was effective in reducing the incidence of hospital-associated VRE infections when combined with a contact precautions program. This strategy should be considered a valid method of reducing VRE transmission in hospital settings.

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Impact of Changes to the National Healthcare Safety Network (NHSN) Definition on Catheter-Associated Urinary Tract Infection (CAUTI) Rates in Intensive Care Units at an Academic Medical Center

Catheter-associated urinary tract infections (CAUTIs) account for >30% of hospital-acquired infections (HAIs) reported by acute-care hospitals.^{1,2} Acute-care hospitals are incentivized to reduce CAUTIs because it is one of the measures included in the Centers for Medicare and Medicaid (CMS) hospital-acquired condition reduction program.³ The National Healthcare

Safety Network (NHSN) provides standardized criteria for the surveillance definitions for CAUTI. There were major concerns with the previous 2013 NHSN CAUTI surveillance definition.⁴ Effective January 2015, significant changes were made to the NHSN CAUTI definition: (1) the removal of urinalysis criteria, (2) an increase in the urine culture bacterial threshold from 10³ to 10⁵ colony-forming units (cfu), and (3) the exclusion of yeasts or molds as potential CAUTI pathogens.⁵ The objective of our study was to determine the impact of the current 2015 NHSN CAUTI definition on publicly reported CAUTI rates in intensive care units (ICUs) at our academic medical center.

METHODS

We performed a retrospective analysis of the prospectively collected CAUTI surveillance data from January 1, 2013, to June 30, 2016. The setting included 7 ICUs at the University of Alabama at Birmingham Hospital, a 1,157-bed academic medical center. Trained infection preventionists perform CAUTI surveillance using the applicable NHSN definition and calculate the standardized infection ratio (SIR). To decrease the incidence of CAUTI, a CAUTI prevention bundle was implemented in late 2013, which included a nurse-driven urinary catheter removal protocol, an annual mandatory HAI prevention education module for all healthcare providers, and training of nursing staff in the proper techniques for urinary catheter insertion.

We examined the trend of our reported CAUTI rates from January 2013 to June 2016 in 7 ICUs and applied the current 2015 CAUTI definition to 2013 and 2014 CAUTI cases. Rates were compared using Pearson's χ^2 test; means were compared using 2-sample t test; and $P \leq .05$ was considered statistically significant. Catheter utilization ratio (CUR, catheter days divided by patient days) was calculated to determine changes in the volume of catheter use. Data analyses were performed using Stata version 12.0 (StataCorp, College Station, TX).

RESULTS

When the corresponding NHSN definition for the respective year was applied, we observed a trend for decreasing yearly CAUTI rates. Even before the NHSN definition was updated, but during the implementation of the CAUTI prevention bundle, we observed a significant decrease in the CAUTI incidence rate (IR) from 5.7 UTIs per 1,000 catheter days in 2013 to 3.9 UTIs per 1,000 catheter days in 2014 ($P < .001$). During the 2-year period between January 2013 and December 2014, 345 CAUTIs occurred, but more than half of these did not meet the current (2015) NHSN definition. Notably, 44.1% of CAUTIs in 2013 and 50.3% in 2014 were due to yeast (Table 1).

With the current 2015 NHSN definition, we observed a significant decline in the CAUTI IR in 2015: 0.98 UTIs per 1,000 catheter days in 2015 versus 3.89 in 2014 ($P < .001$). When the current 2015 NHSN definition was applied to the 2013 CAUTI data, the CAUTI IR decreased by 57.5% from 5.7