adherence to communicable disease control measures. Despite these challenged, the implemented control measures (ie, vaccination, enhanced environmental cleaning, closure of the unit to new admissions, and closure of common day areas) during the surveillance period prevented additional cases from occurring, and the hospital unit was re-opened for admissions.

Maintaining a clean and safe environment for this patient population is challenging. The spread of HAV in this hospital was likely due to both close contact with the index patient and contaminated living quarters and hospital unit restroom of the index case. Although similar outbreaks have been identified among adults with developmental disabilities[5] and disabled patients in congregate living situations,[6] outbreaks in mental health facilities are rare.[7] Screening patients in mental hospitals who lack the ability to adhere to hygienic practices and vaccinating susceptible persons on admission may reduce the risk for outbreaks of acute HAV infection in these facilities.

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Association of an Active Surveillance and Decolonization Program on Incidence of Clinical Cultures Growing *Staphylococcus aureus* in the Neonatal Intensive Care Unit

Staphylococcus aureus remains a leading cause of hospital-acquired infections (HAIs) in neonates.[1] Some neonatal intensive care units (NICUs) use active surveillance cultures (ASCs) and decolonization to prevent methicillin-resistant *S. aureus* (MRSA) transmission and infections.[2] However, methicillin-susceptible *S. aureus* (MSSA) infections occur more frequently and have similar mortality in neonates.[3]

In The Johns Hopkins NICU, prior to April 2013, neonates were screened for MRSA colonization and carriers were decolonized.[4] In April 2013, the program expanded to include MSSA screening and decolonization. Previously, we showed that after implementation of MSSA ASCs and targeted decolonization, *S. aureus* clinical cultures and infections decreased.[4] Our objective was to assess whether the reduction was sustained over 3 years.

METHODS

Using The Johns Hopkins Pathology information system, we retrospectively identified neonates admitted to the NICU between April 1, 2011, and June 30, 2016. Clinical cultures positive for *Staphylococcus aureus* were defined as non-surveillance cultures growing *S. aureus*. Cultures from the same patient were considered unique events if they were collected from the same body site at least 30 days apart or from different body sites at least 14 days apart. NICU-attributable was defined as clinical cultures obtained >2 days after unit

admission. A neonate was considered to have a bloodstream infection (BSI) if a blood culture grew *S. aureus*. Incidence rates for NICU-attributable *S. aureus* clinical cultures and BSIs and 95% confidence intervals (CI) were calculated for the pre- and post-intervention periods and were compared using 2-sample Poisson tests. Interrupted time series models were fit to the log-transformed quarterly incidence rates to quantify the immediate impact of the program, and the relative change in incidence rates per quarter during the pre- and postintervention period.[4] Our institutional review board approved this study.

RESULTS

During the 24 months before implementation of the intervention (29,200 patient days) and 39 months post-implementation (47,135 patient days), 74 and 68 NICU-attributable *S. aureus* clinical cultures occurred, respectively. There were 116 unique patients with 142 *S. aureus* cultures, of which 131 (92%) were MSSA and 11 (8%) were MRSA. Sources for the 142 isolates included 84 (59.2 %) respiratory, 20 (14%) blood, 10 (7.0%) conjunctiva, 11 (7.7%) wound, 7 (4.9%) other, 5 urine (3.5%), 3 abscess (2.1%), and 2 cerebral spinal fluid (1.4%). In the post-intervention period, 1,847 neonates were screened for *S. aureus* colonization as part of the ASC and decolonization program. Of the 333 colonized patients, 243 were treated with mupirocin.

Overall, a 43% reduction in the incidence rate of *S. aureus* clinical isolates occurred when comparing the post- to the pre-intervention period (IRR, 0.57; 95% CI, 0.40–0.80) (Figure 1a). Prior to the intervention, the incidence rate of *S. aureus* clinical cultures was estimated to increase at a nonsignificant rate of 14% per quarter (IRR, 1.14; 95% CI, 0.95–1.38). In the quarter following introduction of MSSA to the ASC program, we observed an immediate 65% decrease (IRR, 0.35; 95% CI, 0.15–0.82); thereafter, we observed an estimated 2.0% quarterly decrease in the incidence of NICU-attributable *S. aureus* clinical cultures (IRR, 0.98; 95% CI, 0.92–1.05). The rate at which the incidence rates changed over time during the pre- and post-intervention periods did not differ statistically (estimated relative quarterly rate of change, 0.86; $P = .12$).

Prior to the intervention, there was no change in the incidence rate of BSIs (IRR, 1.00; 95% CI, 0.78–1.29). After implementation, there were statistically nonsignificant reductions (1) in the overall incidence rate of *S. aureus* BSIs (IRR, 0.50; 95% CI, 0.18–1.34) (Figure 1b), (2) in the immediate change in rate of *S. aureus* BSIs (IRR, 0.73; 95% CI, 0.20–2.58), and (3) in the quarterly incidence rate of *S. aureus* BSIs (IRR, 0.97; 95% CI, 0.92–1.03).

With an average of 5.5 BSIs per year in the pre-intervention period, 18 BSIs were expected to occur in the post-intervention period, yet we observed 9. In the setting of ≥70% compliance with the decolonization protocol, 50% fewer infections occurred than expected, suggesting that 27 neonates were treated to prevent 1 BSI.

DISCUSSION

Our data suggest that an active MSSA screening and decolonization program in the NICU can lead to a sustained reduction (43% overall) in the incidence of clinical *S. aureus* isolates.

Prior studies have found that ASC and decolonization, in conjunction with other infection control measures, can reduce MRSA colonization and infection.[2,5] The burden of MSSA infections exceeds that of MRSA infections in the NICU,[3] yet few studies have examined the impact of MSSA ASC and decolonization. Recently, Wisgrill et al[6] reported promising results of an MSSA surveillance and decolonization program that led to a 50% reduction of MSSA-attributable infections in very low-birth-weight infants. Our study reports similar findings, and we included all neonates admitted to the NICU to reflect the impact on overall burden of *S. aureus* HAIs.

Efficacy, cost-effectiveness, and safety influence the decision to perform ASCs and decolonization. While neonatal data are limited, reports from adult populations suggest that active surveillance, targeted decolonization, and at times, universal decolonization are cost-effective compared to other prevention methods.[7] Possible unintended consequences of decolonization include replacing *S. aureus* with more virulent pathogens. However, in a multicenter NICU study examining MRSA decolonization, patients treated with mupirocin did not show increased risk of novel gram-negative and fungal infections.[8] Emerging resistance to mupirocin must also be considered with widespread use, but recent *S. aureus* ASC and decolonization programs have not found an increase in resistance to mupirocin.[4–6,9]

Incorporating MSSA screening into a NICU's infection control protocol may be an important step to reduce *S. aureus* infections in this vulnerable neonatal population.

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Comparison of Two Glove-Sampling Methods to Discriminate Between Study Arms of a Hand Hygiene and Glove-Use Study

In the absence of a gold standard for sampling gloved hands, we aimed to compare direct-imprint versus sponge-stick sampling methods to identify an effective glove-sampling method with the ability to detect a difference between the 2 study arms (Figure 1).

METHODS

This study, approved by the University of Maryland, Baltimore Institutional Review Board, was performed in 2 units at the University of Maryland Medical Center in Baltimore, Maryland. This study is imbedded in a randomized trial in which healthcare personnel (HCP) entering contact precaution rooms are randomized to either intervention or usual care. Intervention participants are directed by research staff to cleanse gloves with alcohol-based hand rub (ABHR) at each World Health Organization (WHO) hand hygiene opportunity.[1] For usual care, HCP behavior at each WHO hand hygiene opportunity is silently recorded. We excluded HCP if they were providing care for patients with *Clostridium difficile* or if they previously participated. The primary outcomes were (1) total colony-forming units (CFUs) and (2) presence of pathogenic bacteria.

In both study arms, at the last hand hygiene opportunity before exiting the room or after the HCP had completed 7 opportunities, gloved hands were sampled to assess bacterial contamination. One hand of each HCP was sampled using the sponge-stick method (3M, St Paul, MN), and the other hand was sampled by direct imprint of the glove onto a 150-mm tryptic soy agar (TSA) plate (Teknova, Hollister, CA), with the right hand being randomized to receive one or the other method.

In the sponge-stick method, the large flat side of the sponge was used to make vertical overlapping "S" strokes and then flipped to make horizontal overlapping "S" strokes along the palmar side of the hands, fingers, and thumb. Next, each finger and thumb were sampled using 3 upward strokes per digit and then 3 downward strokes using the opposite thin edge of the sponge. Last, using the tip of the sponge, the fingertips were sampled 3 times each. In the direct imprint method, the research team instructed the HCP to imprint for 5 seconds their gloved fingertips, thumb, and palm.

Direct agar imprint samples were incubated overnight, and colony counts were performed. Sponge-stick samples were processed as previously described.[2] From the eluent, 1/10 dilutions were made. Each dilution was plated on TSA in triplicate for quantitative culturing. Plates were incubated overnight, colonies were counted, and the number of CFUs per milliliter was then calculated.

For each sampling method, CFUs and presence of bacteria were compared across study arms to detect differences between the intervention and the usual care arm (Figure 1). The results from each sampling method were then compared to detect a difference among the differences. For example, we assessed for a difference in total colony counts between intervention and usual care using the sponge-stick sampling method and then assessed for a difference using the direct imprint sampling method. The Wilcoxon rank-sum test was