Individual QI projects from single institutions

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Focusing on Families and Visitors Reduces Healthcare Associated Respiratory Viral Infections in a Neonatal Intensive Care Unit

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Abstract

Introduction: Healthcare-associated respiratory viral infections (HARVIs) result in significant harm to infants in the neonatal intensive care unit (NICU). Healthcare workers and visitors can serve as transmission vectors to patients. We hypothesized that improved family and visitor hand hygiene (FVHH) and visitor screening would reduce HARVIs by at least 25%. **Methods:** This quality improvement project took place in a large tertiary NICU to reduce HARVIs. Interventions primarily focused on improving FVHH and reducing visitation by symptomatic family members and visitors. We defined correct FVHH as hand hygiene performed immediately before touching their child. Hand hygiene observations were performed by direct observation by NICU staff using a standardized tool. Interventions to improve FVHH included education of staff and visitors, reminder signs, and immediate reminders to families to prevent lapses in hand hygiene. Staff screened family and visitors before NICU entry. Symptomatic individuals were asked to defer visitation until symptoms resolved. HARVIs were identified during prospective surveillance by infection preventionists using standard definitions. **Results:** Baseline FVHH was 27% in 2015. After May 2017, the average FVHH remained at 85%. When reminded, family members and visitors performed hand hygiene 99% of the time. Staff screened ~129,000 people for FVHH. Between January 2013 and March 2019, there were 74 HARVIs; 80% were rhinovirus/enterovirus. After the implementation of improved FVHH, the HARVI rate decreased from 0.67 to 0.23/1,000 patient days. **Conclusions:** Adding interventions to improve FVHH and visitor management to existing healthcare worker prevention efforts can help reduce HARVIs in the NICU. *(Pediatr Qual Saf 2019;4:e242; doi: 10.1097/pq9.0000000000000242; Published online December 16, 2019.)*

INTRODUCTION

Healthcare-associated respiratory viral infections (HARVIs) are increasingly recognized as important causes of harm in high-risk children, especially neonates and children with underlying immunosuppression, or chronic cardiac or respiratory conditions.[1–6] With the implementation of multiplex polymerase chain reaction (PCR) tests capable of detecting multiple respiratory viruses, viruses such as rhinovirus are frequently identified as the cause of clinical deterioration of infants in the neonatal intensive care unit (NICU).[2,7–10] Studies have shown HARVIs in the NICU result in escalations of care, prolonged respiratory support, and prolonged hospitalizations.[2,3,11]

Interventions to prevent the transmission of HARVIs such as influenza vaccination, hand hygiene, standard precautions, transmission-based precautions, and environmental cleaning, have focused primarily on the behavior of healthcare workers (HCWs).[1,12,13] Family members and visitors play important roles in the care and well-being of hospitalized children, but unfortunately, they occasionally expose the hospitalized child to viruses. In 1 study, about 30% of children with healthcare-associated viral infections were exposed to an ill caregiver or visitor.[1] In efforts to limit transmission of viral infections, most pediatric hospitals enact some form of visitor restrictions or visitor screening in an attempt to limit the presence of symptomatic persons in the hospital.[14] The

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scope and implementation of these types of interventions are variable.

The hands of family members and visitors may become contaminated with viruses after contact with their secretions or mucous membranes or contact with fomites.[15–17] There are few studies focused on the hand hygiene behavior of families and visitors. In general, the hand hygiene practices of families and visitors are often poor, with most studies reporting family and visitor hand hygiene (FVHH) as low as 10%.[18–20] There are few studies discussing efforts to improve FVHH, and to our knowledge, no studies show the impact of improved FVHH on HARVIs.[20,21]

Despite successful efforts to improve HCW adherence to basic infection prevention practices, HARVIs continued to account for ~20% of healthcare-associated infections (HAIs) in our NICU. Given the potential role families and visitors play in the transmission of viruses, we developed a quality improvement (QI) project that aimed to sustainably reduce HARVIs in the NICU by at least 25% by focusing on interrupting transmission by families and visitors.

METHODS

This project was reviewed by the University of Arkansas for Medical Sciences Institutional Review Board and determined to be QI.

Setting

We implemented this QI project at the Arkansas Children's Hospital NICU, which is a 104-bed, level IV NICU within a tertiary freestanding children's hospital. The NICU is primarily arranged into "pods," each containing 8 cribs/isolettes. There were 3 sinks in each pod, including sinks at each entrance. Also, there were alcohol-based hand rub dispensers in multiple locations throughout each pod. All admissions to the NICU were transfers from other nurseries or NICUs. There were no infants previously discharged to home that were admitted to the NICU.

Baseline Infection Prevention

The average monthly HCW hand hygiene compliance in the NICU was consistently around 90%. Patients with respiratory symptoms or diagnosis of a specific viral respiratory infection were placed on both droplet and contact precautions. HCW compliance with posted isolation signs remained over 95%. Since the 2011–2012 influenza season, all HCWs were required to receive the annual influenza vaccination, resulting in HCW influenza vaccination coverage consistently around 99%.

All families and visitors were required to sign in and enter the NICU through a single locked door. Upon entry, families and visitors were encouraged to wash their hands at a sink located at the entrance to the NICU. We did not formally measure FVHH before the start of this project. During periods of increased circulation of influenza-like illness in the community, children under the age of 14 were restricted from visiting the NICU. Formal symptom-based screening of families and visitors was not performed. Although family members or visitors displaying symptoms of a contagious illness were frequently asked to defer visiting until the symptoms improved, this occurred inconsistently. We have offered influenza immunization to the parents/primary caregivers of neonates in the NICU free of charge since 2007.

Team Formation

In July of 2016, a formal team was created to reduce HARVIs in the NICU. The team included the Medical Director of Infection Prevention and Hospital Epidemiology, Infection Preventionists, nurses from the NICU, and a Process Improvement Consultant. The team consulted the NICU Family Advisory Board. Based on a review of the literature, NICU HARVI cases, and initial NICU infection prevention efforts, the team identified key processes/drivers associated with reduced HARVIs. In addition to sustaining existing HCW infection prevention behaviors, the team chose to focus on FVHH and visitor screening.

Interventions

Family and Visi*tor* Hand Hygiene. Before the formal start of the project to reduce HARVIs, a pilot project to improve FVHH was initiated in 3 pods in the NICU in October 2015. NICU nurses measured FVHH behavior by using a standardized paper observation tool. Interventions included education of nursing staff on the importance of FVHH. Signs were placed over the sinks at the entrance to the NICU as well as at the entrance to each NICU pod and highlighted the importance of performing hand hygiene immediately before touching their child. Nurses were encouraged to intervene and remind families and visitors to perform hand hygiene. This intervention was facilitated by providing a standardized tool and scripting for nursing staff (Supplemental Digital Content at http://links.lww.com/PQ9/A146 for FVHH Audit Tool).

In July 2016, the QI team expanded FVNN measurement to include the entire NICU, and the FVHH observation tool was converted to a web-based tool. Reminder signs, education of staff, families, and visitors; and staff reminding families and visitors continued but spread throughout the NICU. We shared FVHH data with staff during monthly staff meetings. In May 2017, a reminder was added to the visitor screening tool for Unit Secretaries to remind family members and visitors to perform hand hygiene before touching their child (Supplemental Digital Content at http://links.lww.com/PQ9/A147 for Visitor Screening Form).

Visitor screening

In January of 2016, as part of a hospital-wide process change, the NICU began wellness screening of all family

and visitors at the point of entry into the NICU. After January 2016, there were no age-based visitor restrictions, but wellness screening occurred throughout the year. All family and visitors had to sign in at the NICU entrance. Before entry, the Unit Secretary performed a quick wellness screen by asking how everyone was feeling and if anyone had any ill symptoms such as fever, vomiting, and/or diarrhea or any respiratory symptoms. Visitors, including children who passed the wellness screening, were given a sticker to wear that included the current date and was valid for 24 hours. Although staff screened parents, they were not given a visitor sticker because they had a parent badge. Family members and visitors were required to repeat the screening daily. If symptoms were present, families and visitors were asked to defer visitation until after their symptoms had resolved.

Although this process worked fairly well during the 2015–2016 influenza season, screening became inconsistent by the spring of 2016. In November of 2016, formal visitor screening training was provided to Unit Secretaries and other screeners. The training emphasized their critical role in patient safety, reviewed the screening process and scripting options, and addressed common questions and problems encountered.

Between January 22–April 1, 2018, and February 8–April 17, 2019, due to significant influenza circulating in the community, only 2 parents/primary caregivers were allowed to visit.

Implementation

We used the Model for Improvement as the primary QI framework.[22] Interventions were tested using multiple plan, do, study, act cycles. We incorporated successful interventions into standard practice. Outcome and process measure data were displayed over time using run charts and statistical process control charts. Annotations helped show the relationship between interventions and changes in the data. Standard rules were used to detect shifts and trends in the data that were unlikely to have occurred by chance.[22–24]

Measurement

Outcome Measure. HARVIs were identified by trained Infection Preventionists during prospective surveillance using standard National Health and Safety Network definitions.[25] We defined a HARVI as a patient with a positive nasopharyngeal PCR for a respiratory virus and new symptoms (ex. fever, hypothermia, apnea, bradycardia, respiratory symptoms or increased respiratory support) representing a significant clinical change that developed during hospitalization but after the typical incubation period for the virus (2–5 days depending on the virus). Respiratory viruses were detected using a respiratory pathogen PCR panel (RPP; Biofire, Biomerieux Diagnostics, Salt Lake City, Utah) and included: adenovirus, coronavirus, human metapneumovirus, human rhinovirus/enterovirus, influenza A, influenza B, parainfluenza, and respiratory syncytial virus (RSV). The panel did not distinguish rhinovirus and enterovirus. We report HARVIs as the rate of HARVIs/1,000 patient days.

The number of RPP tests ordered in the NICU from January 2013 to March 2019 was displayed by month to show testing frequency over time. To estimate the burden of various respiratory viruses circulating in the community, we summarized the results of all respiratory pathogens detected by the hospital's RPP each month from February 2012 through March 2019. RPP tests included specimens collected from Arkansas Children's Hospital inpatient units, outpatient clinics, and the emergency department. Monthly results were stratified by pathogen type.

Process Measures

We defined correct FVHH as hand hygiene performed immediately before touching their hospitalized child. It could be performed using either an alcohol-based hand rub or soap and water. FVHH was recorded by HCW volunteers (primarily nurses) trained by Infection Prevention. The staff recorded their observations during routine care on all days and all shifts using a standardized tool. Between August 2015 and June 2016, observations were recorded on paper. In July of 2016, observations were recorded using a web-based tool accessible from any computer or mobile device. The electronic tool required the HCW document whether or not that person was reminded to perform hand hygiene and a result of that reminder, but FVHH was determined based on the intended (pre-intervention) behavior. From August 2015 to January 2016, FVHH observations were made in only 3 NICU pods. Starting in February 2016, FVHH observations were made throughout the NICU. Data were transmitted in real-time to an electronic data visualization tool.

Families and visitors completed the visitor log daily before entering the NICU. Data provided by the family and visitors included the date, time, their name and signature, and the number of children <18 years of age with them. The Unit Secretary would note whether or not they passed the wellness screen (yes or no) and then initial the log entry. After May 2017, Unit Secretaries also noted whether or not persons were reminded to perform hand hygiene. De-identified summary-level data from the log sheets were transferred to an Excel database by Infection Prevention staff.

RESULTS

Between August 2015 and March 2019, there were a total of 1,995 FVHH observations with an average of 49 observations/month. There were ~3,300 family members and visitors/month. Assuming that each person touches the child once (some touch the child more than once and some not at all), we estimate that we captured about 1.5% of the FVHH opportunities.

Figure 1 shows the annotated run chart of FVHH compliance in the NICU by month. Baseline compliance was around 27%. During the FVHH pilot project (October–December, 2015), FVHH increased to 79% in the 3 test pods. There was a lag between the expansion of FVHH observations across the NICU in February of 2016, and the spread of improvement interventions (July 2016), resulting in a brief drop in FVHH. With the addition of just-in-time education during visitor screening in May 2017, FVHH increased to a median of 85%.

Data for staff reminding families and visitors to perform hand hygiene were available starting July 2016. Observers were able to intervene 54% of the time. When staff intervened, the reminders were well received, and families and visitors performed hand hygiene 99% of the time.

Visitor screening data for the NICU were available from January 2016 to March 2019. During this time, there were 128,837 family members and visitors screened before entry into the NICU, including 11,132 children. Unfortunately, Unit Secretaries did not document symptomatic visitors, who were asked to defer visitation, limiting our ability to quantify the impact of screening.

Between January 2013 and March 2019, there were 74 HARVIs identified in the NICU, including 2 clusters (May 2013 and December 2014). Rhinovirus/enterovirus caused 80% of the HARVIs, and RSV caused 6%. No HARVIs were caused by influenza. The baseline rate of HARVIs in the NICU was 0.67 infections/1,000 patient days. Coinciding with an increase in FVHH to 85% in May 2017, the HARVI rate decreased to 0.23/1,000 patient-days (Fig. 2).

Figure 3 shows the monthly number of RPP tests ordered in the NICU. Test utilization remained fairly consistent over time. Figure 4 shows the monthly distribution of respiratory viruses detected by the RPP panel. We observed the typical seasonal fluctuation with peak utilization and virus detection in the winter months. Rhinovirus/enterovirus and RSV were detected most frequently (Fig. 4). For the most part, NICU HARVIs occurred sporadically throughout the year. Etiologies paralleled the most frequently detected viruses in the hospital-wide data.

DISCUSSION

Despite sustained high levels of HCW compliance with hand hygiene, isolation precautions, and influenza immunization, HARVIs continued to occur frequently in our NICU. Through the addition of interventions focused on interrupting viral transmission from families and visitors, such as visitor screening and FVHH immediately before touching their child, we decreased HARVIs by 66% in our NICU.

A recent survey of visitor restriction policies and practices in pediatric facilities found that 88% of facilities had some form of visitor restriction policies in place.[14] There are limited data regarding the overall effectiveness of visitor restrictions or which strategy is most effective. Age-based restrictions limit exposure to children who may have inadequate respiratory hygiene but do not address the role contagious adult visitors play in HARVIs. Limiting the number of visitors to a small cohort of key individuals determined by the family (including children) may be more effective than age restrictions. Washam et al[26] recently described a 37% reduction in HARVIs after standardization of visitor restriction policies that included restricting the number of visitors during a hospitalization. It is also important to identify potentially

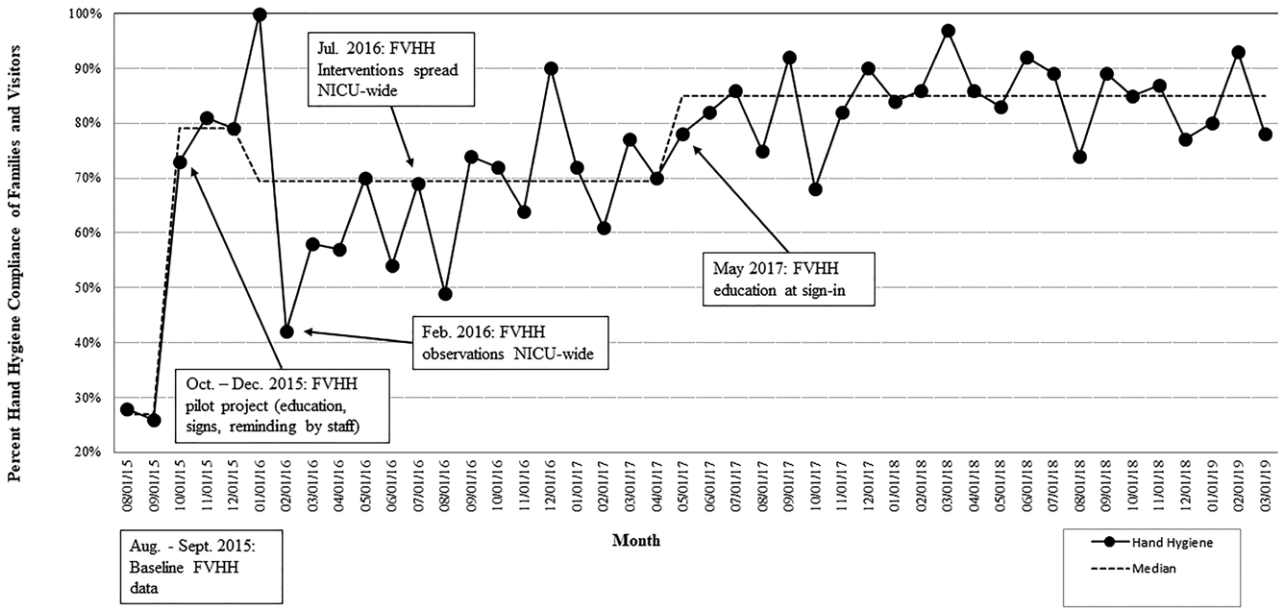

Fig. 1. Run chart showing the percentage of families and visitors performing hand hygiene immediately before touching their child in the neonatal intensive care unit by month from August 2015 to March 2019.

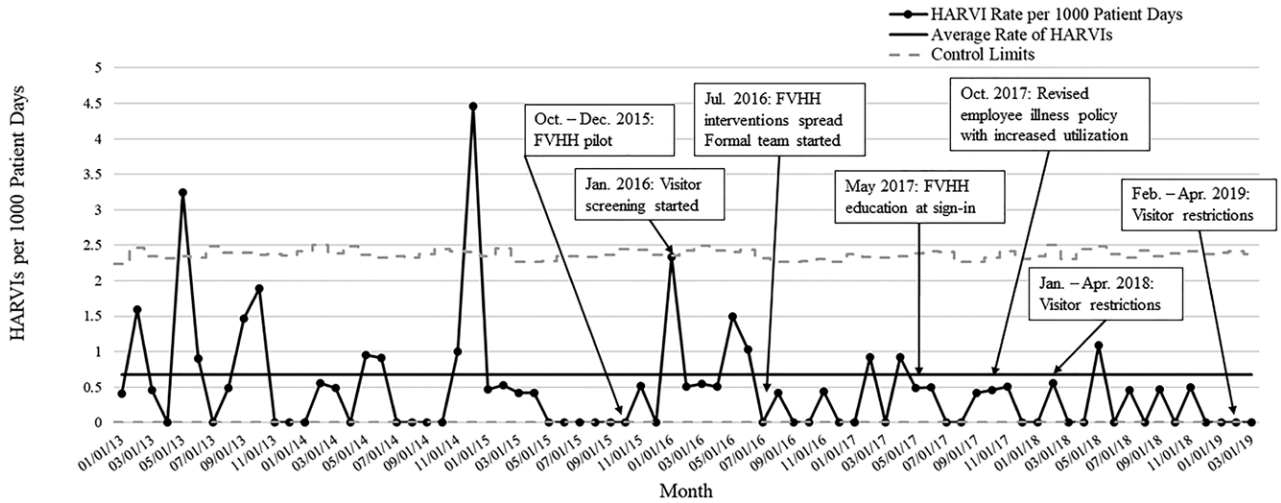

Fig. 2. Statistical process control chart showing the rate of HARVIs per 1,000 patient days in the NICU by month from January 2013 to March 2019. Upper and lower control limits set 3 standard deviations from the mean.

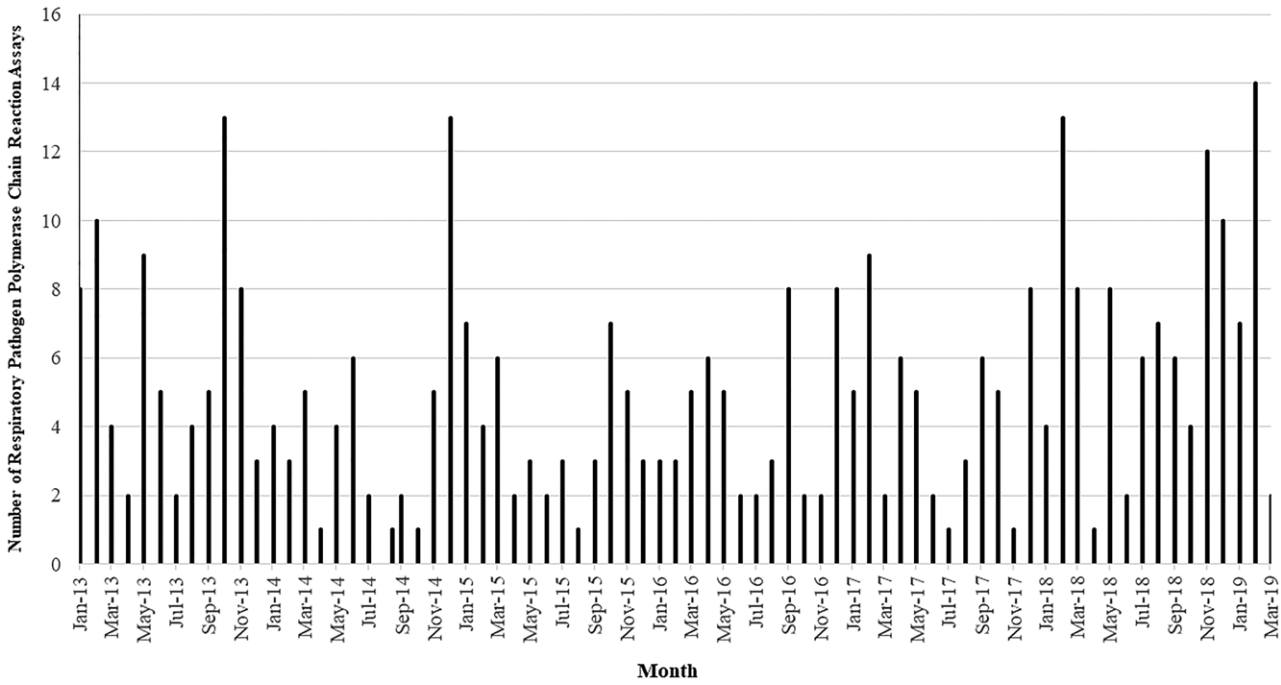

Fig. 3. The number of RPP assays ordered in the NICU by month between January 2013 and March 2019.

contagious individuals and prevent them from visiting until symptoms improve. A recent study by Mermel et al[27] reported relatively fewer HARVIs in units that performed visitor screening compared with units that did not screen. Unfortunately, these investigators did not measure compliance with visitor screening. We implemented a similar process to screen family members and visitors before entry into the NICU. Although Unit Secretaries asked symptomatic family members and visitors to defer visitation, these episodes were not documented, which limited our ability to assess the full effectiveness of the screening process. In addition to screening, during the 2017–2018 and 2018–2019 influenza seasons, visitation was restricted to 2 parents/caregivers. This intervention likely provided additional protection for patients. Hospitals must balance the decreased family-centeredness of more restrictive policies with the challenges of implementing visitor screening when developing a visitor management plan. Finally, since respiratory viruses circulate throughout the year, processes must also provide year-round protection.

Families and visitors are often unaware of the role their contaminated hands can play in the transmission of infection in healthcare settings. It is well-documented that respiratory viruses such as rhinovirus and influenza

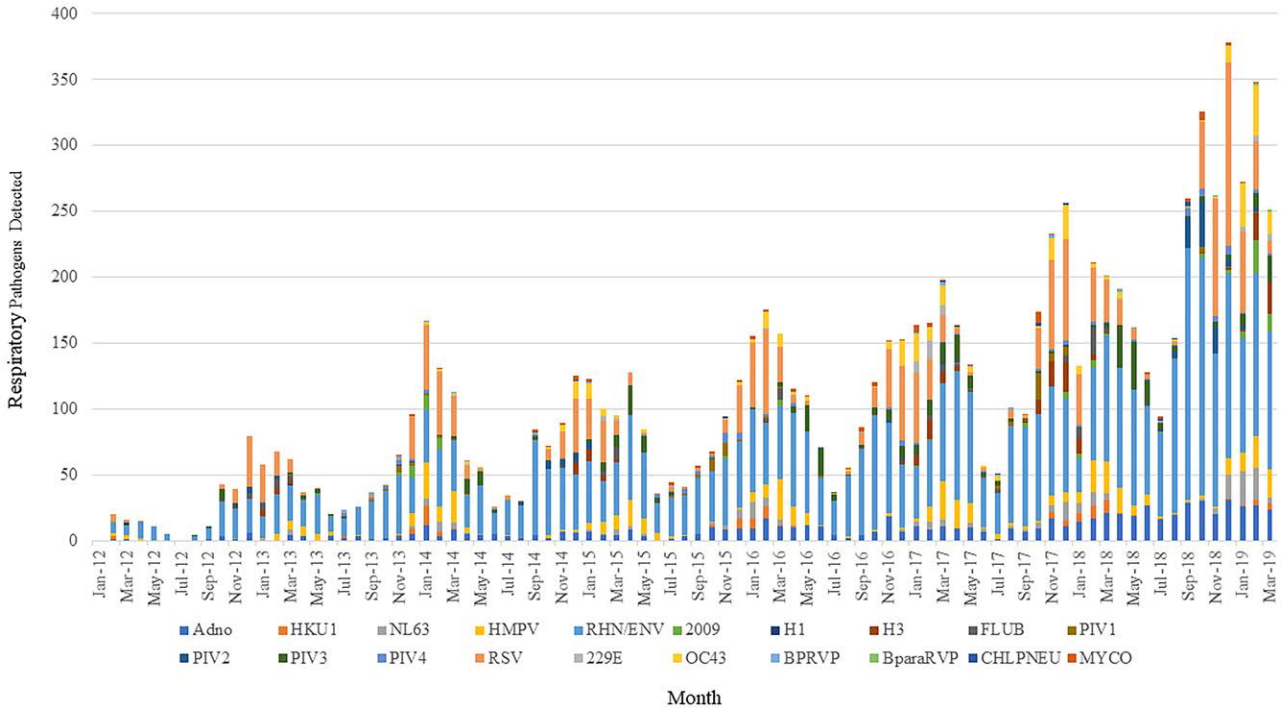

Fig. 4. The distribution of all respiratory pathogens detected by the hospital's RPP assay by month between February 2012 and March 2019. Adno, adenovirus; HKU1, coronavirus HKU1; HMPV, human metapneumovirus; NL63, coronavirus NL63; RHN/ENV, human rhinovirus/enterovirus; 2009, influenza A 2009 H1N1; H1, influenza A H1N1; H3, influenza A H3N2; FLUB, influenza B; PIV1, parainfluenza 1; PIV2, parainfluenza 2; PIV3, parainfluenza 3; PIV4, parainfluenza 4; RSV, respiratory syncytial virus A; 229E, coronavirus 229E; OC43, coronavirus OC43; BPRVP, *Bordetella pertussis*; BparaRVP, *Bordetella parapertussis*; CHLPNEU, *Chlamydophila pneumonia*; MYCO, *Mycoplasma pneumoniae.*

can survive for hours to days on surfaces.[15,28] Hand contact with contaminated hands and surfaces has resulted in fingertip acquisition of rhinovirus 22%–70% of the time.[16,17,29] People frequently touch their faces, with almost half of the touches contacting mucous membranes.[30] As a result, there are numerous opportunities for hands to become contaminated with respiratory viruses and serve as a vector to patients. It is common to instruct families and visitors to wash their hands upon entry to the NICU, but given the frequent opportunities for re-contamination after touching their face and contaminated surfaces, moving the timing of hand hygiene to immediately before contact with their child will likely improve the effectiveness of hand hygiene.

Few studies have measured FVHH behavior in the hospital, but it is frequently below 10%.[18–20] Improvement efforts have included education, reminders, and supply availability. The transient nature of families and visitors create barriers to effective hand hygiene education. We were able to include a brief reminder to perform hand hygiene at the bedside as part of the visitor screening process. After the addition of this just-in-time education, the median FVHH increased to 85%. Compared with more passive forms of education, concise, direct verbal education/reminders may be more effective. Since families and visitors may be unfamiliar with the unit, it is also important to ensure their awareness of the location of hand hygiene supplies. Real-time reminders have played a role in sustained increases in HCW hand hygiene above 95%.[31–33] Although 99% of families and visitors performed hand hygiene when reminded by staff, reminders were only documented with 54% of failures. Our results highlight both the effectiveness and challenges of implementing real-time reminders.

Starting in May 2017, we revised the employee illness policy such that absences due to potentially contagious illness were no longer considered unscheduled absences if approved by Employee Health. Before May 2017, there was no consistent documentation of employee absence due to contagious illness. The utilization of the new policy by NICU staff was minimal until October of 2017. Afterward, reduced presenteeism likely began to impact HARVIs positively.

There are a few limitations to note. We performed this QI project in a single NICU. Interventions and the improvement that occurred may not readily translate to other healthcare settings. Observers only captured ~1.5% of the FVHH opportunities, but observations were made on all days and all shifts throughout the NICU, providing a representative sample of FVHH behavior. Despite attempts to maintain accurate data collection, observers may have recorded FVHH inaccurately. Incompletely documented compliance with process measures such as visitor screening and employee illness policies affected the

ability to assess their implementation and impact on reducing HARVIs.

CONCLUSIONS

Our project demonstrated that adding interventions to improve FVHH and visitor screening to existing HCW infection prevention efforts significantly reduced HARVIs in our NICU. This study adds to the developing literature on best prevention practices for HARVIs and highlights the importance of preventing transmission by families and visitors. Future studies are needed to define the epidemiology of HARVIs in children better and to refine the key prevention strategies.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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