ORIGINAL ARTICLE

Effectiveness of simple strategies in reducing multidrug resistant blood stream infections in Neonatal Intensive Care Unit of tertiary care hospital in Karachi, Pakistan

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Abstract

Objectives: To report reduction in transmission of multidrug resistant organisms from the neonatal intensive care unit after the implementation of simple risk-reduction strategies.

Methods: Using a pre-and-post design, the study was carried out from June 2010 to December 2011 at the neonatal intensive care unit of Aga Khan University Hospital, Karachi, which is 12-bed, level III facility. The intervention comprised hand washing certification for all staff, use of chlorhexidine instead of povodine iodine for skin preparation, use of non-sterile gloves for diaper change, implementation of barrier nursing for clinically-suspected and culture-proven infections, provision of separate intubation and central line trolley for each room and limiting the use of umbilical catheters to 7 days. Data is reported for 3-month pre-intervention period, one-month implementation phase, and for 3-month post-intervention phase. Data for 12 months post-implementation is reported to show sustainability.

Results: The average pre intervention rates of bloodstream infections due to extended spectrum β lactamase, Acinetobacter, Pseudomonas and methicillin resistant staphylococcus aureus were 4.7, 3.3, 1.2 and zero respectively. The average number of admissions during the 3 phases was almost similar (49, 46 and 53 respectively). There was sustained reduction in rates for all organisms 12 months after the intervention period.

Conclusion: Nosocomial transmission of multi drug resistant organisms within the neonatal intensive care unit can be effectively reduced by adopting simple strategies.

Keywords: NICU, Multidrug resistant organisms, BSI, Pakistan. (JPMA 65: 72; 2015)

Introduction

Nosocomial infection is defined by the US Department of Health and Human Services for Disease Control and Prevention as an infection during hospitalisation that was not present or incubating at the time of admission.[1] Nosocomial infections in neonatal intensive care unit (NICU) are a major cause of morbidity and mortality. The number of neonates who develop nosocomial infection varies from 6.2% to 33%.[2,3] Patients who develop nosocomial infections have longer stays in hospitals and have higher mortality.[4] According to the World Health Organisation (WHO), 1 million deaths per year are due to neonatal bloodstream infections (BSI) and 42% of these occur in the first week of life.[5] The incidence of neonatal BSI is approximately 1-10/1000 live-births in developed countries, but in Pakistan it is three times more common.[6] It has been indicated that reported rates of neonatal infections were 3-20 times higher than those reported for hospital-born babies in industrialised countries. Klebsiella pneumoniae, other gram-negative rods (Escherichia coli, Pseudomonas spp, Acinetobacter spp), and Staphylococcus aureus were the major pathogens among 11471 bloodstream isolates reported. Several interventions have been tried and tested in different countries in an effort to reduce nosocomial infections in neonates.[7] One study identified and implemented the best practices for reducing infections in NICU and demonstrated a reduction in the rate of acquired infection from 7.4 to 4.0 per 1000 patient days.[8] Another study reported a decrease of up to 29% after comprehensive infection control measures.[9] The application of 4% chlorhexidine to the umbilical cord was effective in reducing the risk of omphalitis and neonatal mortality in rural Pakistan.[10] As is obvious, simple strategies can lead to decrease in healthcare-associated infections in hospitalised neonates. We adopted six strategies to reduce the rate of nosocomial BSIs due to multi drug resistant organisms (MDRO) in the NICU and report the effect of these interventions in the reduction of such infections.

Material and Methods

Using a pre-and-post design, the study was carried out from June 2010 to December 2011 at the neonatal intensive care unit of Aga Khan University Hospital (AKUH), Karachi, which is 12-bed, level III facility, which admits in-born and out-born infants up to 28 days. There are 4 rooms out of which two have 5 incubators at a

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distance of approximately one-and-a-half meter from each other. The other two rooms are isolation units. The distance between patient and washing basin is one meter. The patient-to-nurse ratio is 1:2 in the rooms and 1:1 in the isolation units.

Surveillance for infections in intensive care areas was performed routinely. Data on BSI due to MDROS, patient days and device days were recorded routinely by designated infection control staff. The definitions used were standardised according to the National Nosocomial Infections Surveillance (NNIS) System.[8] Monitoring for hand hygiene compliance was done as part of monthly audit and data recorded by infection control staff.

Data was reported for 3 months pre-intervention period, one-month implementation phase, and for 3 months post-intervention. Pre-intervention data was collected and all strategies were planned after reviewing literature and were shared with the infection control team and NICU staff.

Data was collected from monthly reports of surveillance of the infection control department of the hospital to control for bias. Within unit, transmission of MDR acinetobacter, pseudomonas, vancomycin resistant enterococcus (VRE), extended spectrum β lactamase producer (ESBL) and methicillin resistant staphylococcus aureus (MRSA) were used as markers for nosocomial BSI. The number of admissions within the entire unit was used as the denominator. We calculated the 3 months' average and divided it by the number of admissions in that period. Data for 12 months post implementation were maintained to show sustainability.

We adopted six strategies identified from previously reported studies, and implemented it within our NICU (Figure-1). Hand washing certification was implemented in Sept 2010 for all NICU staff including physicians, nurses and paramedics. It comprised a 3-minute video on hand washing technique, followed by demonstration by the participating healthcare worker. Upon successful demonstration of the 7 steps of hand washing, the participants were certified with re-certification after 6 months.

Povodine Iodine solutions were previously used for all procedures (cannulations and catheterisations etc.) within the NICU. Based on recent evidence,[11] we implemented the use of 2% chlorhexidine instead of povidine for antisepsis.

Strict barrier nursing and gown and glove precautions were reinforced for suspected or culture-proven septic patient. All physicians and staff entering the isolation area had to wear a sterile gown. This was not being practised strictly earlier.

We introduced a separate resuscitation and central line trolley for each of the 4 rooms of the NICU, containing sterilised endotracheal tubes, stylets, laryngoscopes, sterile gloves and central lines. Earlier, a single trolley was in place for use in all rooms of the NICU.

Daily goal sheets were introduced in order to keep a record of the daily changes made in the management, ordering investigations, and particularly to review the need of umbilical and other central lines. Efforts were made to limit the utilisation days of central and umbilical lines. Umbilical lines were removed on 7th day unless deemed necessary by the consultant neo-natologist.

Finally, practice of non-sterile gloving was implemented for changing diapers. Although no recommendation for this was found in international literature, we assumed that this might be useful in decreasing the colonisation rates of enteric gram-negative infections.

Data was entered into Excel 2010. The rates of BSI are reported as per 1000 patient days, which is calculated by dividing the number BSIs by the number of patient days and multiplying the result by 1000.

The rates of infection by each pathogen in the pre- and post-intervention periods were compared using paired t-test, and $p<0.05$ was taken as significant.

Results

The average pre-intervention rates of BSI due to ESBL, Acinetobacter, Pseudomonas and MRSA were 4.7, 3.3, 1.2 and 0 per 1000 patient days respectively. In the implementation phase, the BSI rates for all organisms

Table-1: Rates of Infection per 1000 patient days with multidrug resistant organisms during the study period.

Phase	ESBL	Acinetobacter	Pseudomonas	MRSA and VRE
Pre-Implementation (June-Aug'10)	4.66	3.26	1.2	0.0
Implementation (Sep-'10)	7.5	2.5	0.0	0
Post 3 Months (Oct-Dec '10)	2.73	1.3	0.0	0
1 Year Period of Sustainability (Jan-Dec '11)	3.12	0.78	0.35	0

ESBL: Extended Spectrum β Lactamase Producer. MRS: Methicillin Resistant Staphylococcus Aureus. VRE: Vancomycin Resistant Enterococcus.

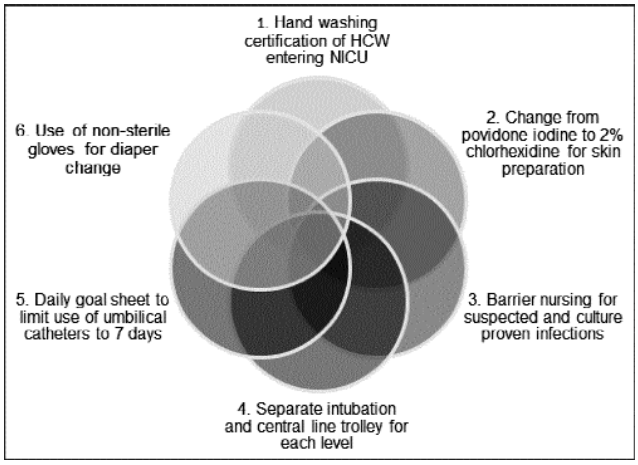

Figure-1: Strategies adopted to reduce the rate of nosocomial blood stream infection within the NICU.

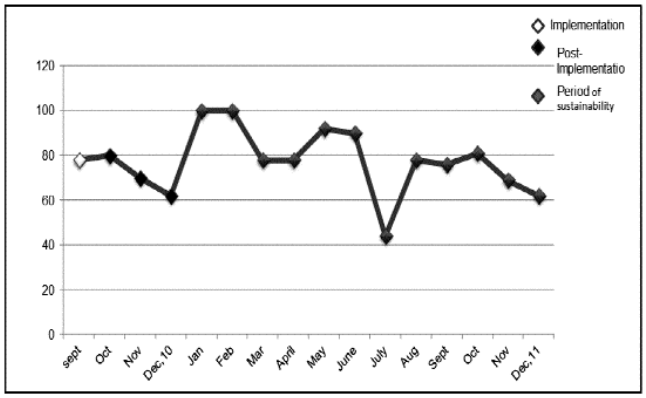

Figure-2: Hand hygiene compliance during the study period.

dropped except for ESBL. A reduction in rates was observed in the post-implementation period (ESBL 2.73 per 1000 patient days, Acinetobacter 1.3, and 0 for Pseudomonas and MRSA). The reduction in rates were not statistically significant (ESBL: p=0.6; Acinetobacter: p=0.2; and Pseudomonas: p=0.4). No case of BSI due to VRE was reported during the entire study period. The average number of admissions per month during the 3 phases was almost similar (49, 46 and 53 respectively). There was sustained reduction in rates for all organisms 12 months after the post-intervention period (Table-1).

Hand-washing compliance during the study was also closely observed (Figure-2).

Discussion

Neonates are a special population who are at risk of acquiring infections because of their immature immune system compounded by admission in NICU. Limited evidence of infection prevention measures from developing countries indicate that infection control measures are possible and are effective in reducing healthcare-associated infections (HAIs).[12] Implementation of infection control measures is complex and requires finances, communication and documentation at multiple levels. However, there is evidence of decrease in rate of infections with the use of control measures that did not require use of technology.[13] Our study also demonstrates that with the implementation of simple, practical measures the rates of BSIs in the NICU could be reduced. MDROs are a marker of infections acquired nosocomially. Reduction in rates of BSI due to MDRO is a surrogate marker of reduction in HAIs.[14] Limiting the rates of MDROs within hospitals is important due to limited therapeutic options for these organisms. Improvement in hand hygiene has been reported to be the single most effective measure for infection control in hospitals.[15] We demonstrated an increase in hand hygiene compliance by using a simple, educational strategy. Contact isolation and limiting the use of central lines has been shown to reduce the risk of acquiring and transmitting infections in healthcare settings.[16] Limiting the use of central lines did not require additional finances and was implemented easily.[17] Regarding contact isolation, the non-sterile gloves and gowns were available in limited numbers within the unit and with a little increase in resources we were able to implement it in all rooms of the NICU. Although health economics was not the objective of this study, but reduction in nosocomial infections is well known to reduce morbidity, mortality and cost of treatment and any measure that can reduce HAIs can be assumed to be beneficial financially.[18] Routine use of contact isolation outside an outbreak setting has recently been shown to be extremely effective in reducing the rates of ESBL gram-negative organisms.[19] There is little evidence of the protective effect of wearing gloves during diaper change. However, it is documented that use of gloves during diaper-change significantly decreased bacterial hand contamination.[20] As enteric gram-negative infections are a major cause of sepsis in the developing countries,[21] we hypothesised that gloves for diaper change may reduce the rate of MDR gram-negative infections within the NICU. We did not perform any surveillance cultures to document the benefit of this measure neither can we comment on the benefit of the individual measure, but together with the other measures there was an overall reduction in BSIs. Transmission and persistence of resistant strains depends upon the availability of vulnerable patients and the impact of implementation and adherence to prevention efforts.

The data for a 17-month period is reported (3-month pre-

intervention period, one-month implementation phase and 3-month post-intervention period followed by 12 months of sustainability) to avoid bias associated with seasonal trends of nosocomial infections.

Conclusion

Nosocomial transmission of MDRO within the NICU can be effectively reduced by adopting simple strategies.

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