Impact of hand hygiene training module among healthcare providers working in neonatal intensive care unit: A before and after trial

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ABSTRACT

Background: Healthcare-associated infections (HAI) include central line-associated bloodstream infections, catheter-associated urinary tract infections, and ventilator-associated pneumonia. Maintaining strict hand hygiene (HH) compliance and asepsis is pivotal in reducing the HAI. **Objective:** The objective of this study is to evaluate the impact of a training module on HH practices of healthcare providers (HCPs) working in neonatal intensive care unit (NICU). **Methods:** An uncontrolled before and after study was conducted in a tertiary level NICU of a government hospital. All HCPs working in the NICU were eligible and included in the analyses. In the pre-intervention Phase I (November–December 2016) and in the post-intervention Phase II (February–March 2017), trained HH auditors noted the HH compliance of all HCPs. All HCPs were trained in HH practices using the National Accreditation Board for Hospitals SAFE-I Hospital infection control training module, and then, HH compliance was compared in both the phases. HH compliance rates were measured among HCP at the end of each phase. **Results:** Overall HH compliance rates improved significantly in phase II when compared with phase I (97% and 77%, respectively, p=0.0001). **Conclusion:** Maintaining high HH compliance in an intensive care setting is challenging; therefore, adopting training modules to educate HCPs significantly improves HH compliance rates.

Key words: *Compliance rates, Hand hygiene, Healthcare-associated infection, Neonatal intensive care unit*

Healthcare-associated infections (HAI) iinclude central line-associated bloodstream infections, catheter-associated urinary tract infections, and ventilator-associated pneumonia, are a major cause of morbidity and mortality in most intensive care units. The recent examples of HAI are the emergence of New Delhi metallo-beta-lactamase 1 strains of *Escherichia coli* and *Klebsiella*. Healthcare providers (HCPs) are running out of options to treat these infections. The World Health Organization (WHO) has predicted that complete resistance to all antibiotics and post-antimicrobial era would commence by the year 2030; Therefore, the focus of treatment should be shifted from treating infections to prevent them. Maintaining strict hand hygiene (HH) compliance and asepsis plays a pivotal role in reducing the HAI.

Neonates are most susceptible to infection because their host defense mechanisms are not mature enough to compete with the infections. Frequent use of antibiotics and invasive interventions in neonatal intensive care unit (NICU) often puts the neonates at risk of invasion from common nosocomial pathogens. Organisms that cause nosocomial infection in NICUs are most commonly transmitted by the hands of physicians, nurses, physiotherapists, and other HCPs [1-5].

HH has often been singled out as the most important procedure in preventing nosocomial infection [5]. It has been incorporated as a core competency in the Global Patient Safety Challenge initiative "Clean Care is Safer Care," set up by the WHO in 2005 with the goal of reducing the burden of HAIs worldwide [6].

Despite recognizing that HH is crucial in reducing infection rates, compliance rates of HH among HCP remain low. In a recent systematic review of 96 studies (with 65 studies in intensive care settings) on HH compliance of HCPs from industrialized nations, it was noted that compliance rates were as low as 30–40% in intensive care settings compared with 50–60% in other settings [7]. Physicians, in particular, wash their hands significantly less frequently than nurses [8,9].

Hence, the present study was conducted with an aim to evaluate the impact of the National Accreditation Board for Hospitals and HCP (NABH) SAFE-I training module on HH compliance in NICU setting.

METHODS

An observational study (uncontrolled before and after study) was conducted in the NICU of government medical college and hospital. The study was approved by the institutional ethical committee. Informed written consent was obtained from all subjects before enrolment in the study. This is a 25-bed

NICU, which admits neonates born intramurally with medical conditions. There are two rooms and one washbasin. Each room was accommodating a maximum of 10 neonatal warmers. The mean distance between any sick neonate cared and the washbasin was 3.9±2.0 m, and all the wash basins had elbow operated taps. Antiseptic alcohol-based hand rub was also made available at each neonatal warmer.

The HH compliance and techniques were observed unobtrusively by the observer under the guidance of two medical interns assigned to document NICU activity in the units. The observer underwent 1 week of training to become familiarized with NICU procedures and settings. The consistency of the observation criteria was validated by checking on selected episodes immediately after each observation period by one of the authors (AM). The observation period lasted for 4 weeks and covered day and night shifts. A target NICU patient was selected randomly by drawing lots before each observation period, which lasts for 8 h.

All personnel, who contact the target patient, including doctors, nurses, and allied health workers (e.g., physiotherapists and occupational therapists) were observed. Types of personnel were documented, but names were not recorded. The general NICU settings and patient characteristics were recorded. For each observed contact with the target patient, there were five HH opportunities and five moments which were recorded separately. For complex or interrupted care procedures, if the healthcare worker contaminated her or his hands by contacting contaminated objects outside the patient environment, then a separate HH opportunity was needed. Failure to do so will be counted as noncompliance. HH compliance was defined as per the WHO HH guidelines [10]. HH was required regardless of whether gloves were used or changed. The data were recorded by a standard computer-based data sheet. The different phases of the study with the various interventions and HH audits are described in Fig. 1.

In August 2016, medical interns were recruited as HH auditors after a detailed training process. The training consisted of reviewing an interactive HH module created by the WHO, reviewing various local HH policies at GMC, Nagpur, and going through detailed presentations on observation and auditing. This provided the trainees with adequate knowledge of when HH is required in a clinical setting, defined as an opportunity or indication, what appropriate HH consists of and how to complete an assessment form. The training was followed by viewing a training video made by the WHO, consisting of mock scenarios with the trainees assessing for opportunities and indications for HH and rating the compliance of HCPs with HH. Then, the trainees were described the actual scenarios from the NICU with real-time discussions on the indications and opportunities.

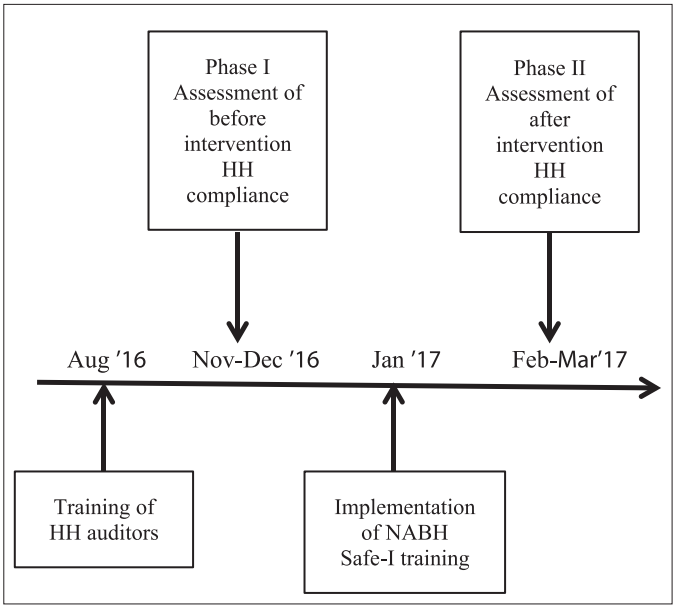

Figure 1: Flowchart of the study

All of these were followed by trainees going into the clinical environment accompanied by at least another observer (one of the authors) and assessing for HH compliance with discussions on disagreements. Once a >95% rate of agreement was consistently reached with other observers, the trainees were deemed qualified to be an independent HH auditor.

In Phase I (before intervention: November 2016–December 2017), HH compliance rates in the Phases I and II NICU were determined for the five "moments" of HH as delineated by the "SAFE-I" campaign by trained assessors. These moments were before initial patient/patient environment contact, before the aseptic procedure, after body fluid exposure risk, after touching patient, and after touching patient environment.

In Phase II , NICU in Government Medical College (GMC), Nagpur, was observed. There was 14 nursing staff, one nursing in charge, with four nursing staff in each shift. We have one senior consultant, one assistant professor, one senior resident, and four junior residents, of whom two faculty members and two junior residents are on duty in all shifts all year round.

In Phase II (after intervention: February 2017–March 2017), NABH SAFE-I, learning module was implemented to train HCPs on the five moments of HH as described above. This module consisted of education material that included a detailed description of the moments of HH and interactive tools to further clarify what constitutes the patient environment ("baby space"), along with case scenarios. A quiz had to be completed, in which there were 10 questions with a pass mark of 80%. All HCPs working in the NICUs at the time of introduction of this module completed the training by February 2017. In November–December 2016 and February–March 2017, trained HH auditors evaluated the HH compliance rates.

Data were analyzed in statistical software STATA, version 10.1, 2011. Within the groups, comparisons were done using McNemar's Chi-square test and paired t-test. Between the groups, comparisons (doctor vs. nurses) were done using unpaired t-test and Pearson's Chi-square test. $p<0.05$ was considered statistically significant.

RESULTS

All neonates (n=430), admitted in NICU over the study period, were eligible for participation. Of these, 163 were low birth

weight (LBW) (<2500 g; 37% of total admissions), 194 were very LBW (45%), and preterm (<37 weeks gestational age [GA]; 83% of total admissions). The mean birth weight and GA at admission were 1770±668 g and 34±3.2 weeks, respectively.

The results of the HH compliance rates for all HCP in the NICU are shown in Table 1. The overall HH compliance improved with statistical significance in Phase II ($p<0.0001$). In Phase I, among the HCPs, doctors' compliance was poor as compared to nurses which improved significantly in Phase II.

Table 2 depicts the consolidated compliance rates of HCPs with respect to the five moments of HH. There was a statistically significant improvement during Phase II for the encounters of "before patient contact," "before aseptic procedure," and "after body fluid exposure," after implementing the NABH SAFE-I training module ($p<0.05$).

DISCUSSION

Our study revealed higher basic HH compliance rates among the HCPs compared to international compliance rates. The overall international HH compliance rates for HCPs ranged between 30% and 91% [7,10-12]. The HH compliance rates in our study were poor among the doctors compared to nurses. Similar results were also reported by various studies [8,9,13]. The WHO case study in Saudi Arabia also reported HH compliance rates of 78% and 91% in doctors and nurses, respectively [14]. To understand this discrepancy, we came up with this explanation that the HCPs had to have a good understanding of what constituted "patient space" and apply the principles in practice, which was a major challenge in the open-concept space, particularly in a busy unit. bags and the cover on top of the baby's isolette could have easily been not thought of as being part of "patient space." Another explanation may be owing to the need for sudden and quick clinical interventions if an infant had a significant desaturation or apneic episode, which may have occurred in smaller and more preterm babies.

Although doctors are trained to maintain strict asepsis, the involvement of fresh undertraining doctors in a busy unit might be a factor for poor HH compliance. It is well known that the widespread acceptance to a new practice takes time. It has been described by sociologist Everett Rogers as part of the Diffusion of Innovations theory [15], which notes that acceptance and adoption of an innovation happen in stages whereby some people are "early adopters" and others constitute the "early majority," while many others are in the "late majority." It is only after reaching a critical mass that a change in practice is able to self-sustain, hence the need for ongoing reinforcement. Moreover, change can only happen if the practice is consistent with habits, values, and experiences of the potential adopters and that it provides tangible results. In the context of HH, this underscores the notion that to achieve long-term sustainability in compliance rates, reinforcement is needed. Mukerji *et al.* in their study also reported the importance of reinforcement to achieve long-term sustainability [16]. Picheansathian *et al*. studied the effect of single intervention promotion program of HH and came out with improved HH compliance rates [17].

The study also revealed poor HH compliance when it comes to moments 1, 2, and 3 as compared to moments 4 and 5 in Phase I. This could be explained by the Hawthorne effect where HH compliance would increase if HCPs are aware that

Table 1: Basic compliance rates

HCP Category	Phase I			Phase II			% Change	P value
	OP	Act	CR	OP	Act	CR		
Doctors	144	110	76.38	136	133	95	18.62	0.0001
Nurses	296	230	77.70	237	230	97.05	19.35	0.0001
Overall	440	340	77.27	373	363	97.32	20.01	0.0001

Act - actions; OP - opportunities; CR - compliance rate

Table 2: Indication wise compliance by health professional category

Events* →			1		2		3		4		5		P value
Phase →			I	II	I	II	I	I	I	II	I	II	
Health care providers	Doctors	Act	56	40	11	22	18	31	19	25	14	15	0.001
		OP	61	41	20	24	29	31	19	25	15	15	
		CR	91.8	97.5	55.0	91.6	62.0	100	100	100	93.3	100	
	Nurses	Act	105	67	28	53	22	30	40	54	35	26	0.001
		OP	128	67	49	56	32	30	46	57	41	27	
		CR	82.0	100	57.1	94.6	68.75	100	87.0	94.7	85.4	96.3	
	Overall	Act	161	107	39	75	40	61	59	79	49	41	0.001
		OP	189	108	69	80	61	61	65	82	56	42	
		CR	85.2	99.1	56.5	92.6	11.8	100	90.8	96.3	87.5	97.6	

***1- Before patient contact; 2- Before aseptic procedure; 3- After body fluid exposure; 4- After patient contact; 5- After touching patient surroundings. Act: Actions; OP: Opportunities; CR: Compliance rate**

they are being observed [18]. HH auditors in our study directly observed HH compliance instead of using CCTV surveillance. This could have prompted HCPs to observe HH more strictly, during moments 4 and 5, where the situation is more relaxed and HCPs will be more conscious of their surroundings as compared to moments 1, 2, and 3. Helder *et al.* [19] also reported an increase in HH compliance in indication 1 (before patient contact, 88% vs. 65%, $p<0.001$) after an education program on HH in NICU setting.

Strengths of our study were as follows: (1) Direct observation (which is the gold standard method) to measure HH compliance instead of using proxy measures such as the amount of alcohol hand rub used and (2) the use of moment specific compliance rates helped us to identify deficiencies in specific situations and can be used to target and provide training in those areas.

Our study had few limitations as well. Due to small sample size and limited observation period, results cannot be generalized and larger study with longer observation time is needed. Potential of Hawthorne effect - as discussed earlier- could have confounded HH compliance. Moreover, whether this improvement in HH compliance is long lasting is unknown.

The findings of this study revealed that the use of innovative methods in educating and engaging all the stakeholders responsible for patient safety with an aim to reduce the burden of HAI is of prime importance. For this, full organizational support for promoting patient-safety culture is required and approaches such as provision of incentives for HH compliance and giving real-time feedback from HH auditors by conducting random safety audits can be considered.

CONCLUSION

This study proves that implementation of an extensive educational intervention detailing the "5 moments of HH" and introducing the concept of "patient space" is an effective tool in improving the compliance rates among the HCPs. It also highlights the importance of training modules such as NABH SAFE-I that can help HCPs in significantly improving the HH compliance and the overall quality of medical care. Further studies directed to evaluate patient outcome after improved HH compliance is needed.

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