

Infection Control: Hand Hygiene Practices among Nurses in the Neonatal Intensive Care Unit at Benha University Hospital

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ABSTRACT

Background: Hand hygiene is a basic strategy in all infection control programs. Poor hand-hygiene practices are the cause of 40% of hospital-acquired infections; however, the implementation of proper practical nursing skills can help prevent these infections. **Objectives:** The aim of the work was to investigate the availability of hand-hygiene equipment and supplies at the neonatal intensive care unit (NICU) at Benha University Hospital, to assess the hand-washing practices among nurses working on this unit, and to determine the factors underlying improper hand-hygiene practices. **Subjects and methods:** This observational cross-sectional study included 28 nurses working at the NICU, Department of Pediatrics, Benha University Hospital. Data were collected using a questionnaire sheet consisting of two parts; the first included socio-demographic data and the second included the observational checklist of hand-hygiene equipment, supplies, and practices according to the infection control assessment tool (ICAT).

Results: The results showed that 7.1% of the studied nurses fell under class A, in which the recommended hand-hygiene practices are followed accurately, whereas 75% fell under class B, where standard practices are usually followed, and 17.9% fell under class C, in which training, close observation, and follow-up on standard practices are recommended. A significant associations ($P < 0.05$) were found between proper hand-hygiene practices of nurses and both the institute from which they graduated and the completion of previous training courses on infection control.

Conclusion: It could be concluded that hand hygiene compliance among health care providers in our local environment was poor. Further educational and training courses are needed.

Keywords: Infection Control; Hand hygiene; Nurses; NICU.

INTRODUCTION

Hospital-acquired infections are a common problem worldwide. Up-to-date knowledge and refined practical nursing skills can play important roles in preventing infection [1,2]. Hand hygiene is the most effective strategy in the prevention of nosocomial infections [3] and transmission of infection has been shown to decrease as hand-hygiene adherence increases [4]. A review of the relevant literature reveals that if adequate hand hygiene protocols are strictly followed by healthcare personnel, it could lead to a significant, 15–30% reduction in hospital-acquired infections; however, observational studies show that current compliance rates of hand-hygiene in hospitals are approximately 50% [5].

The World Health Organization (WHO) describes key situations when proper hand hygiene should be applied: before and after contact with a patient, after contact with a contaminated material or the patient's environment, and before performing an aseptic procedure [6]. Though hand-washing with plain soap has been a time-honored practice, hand rubbing with alcohol-based solutions ensures greater safety [7].

and is recommended by the Centers for Disease Control and Prevention (CDC) [8].

Hospital-acquired infections are a problem in intensive care units (ICUs) due to heavy workload, low compliance with prevention and control measures of infection, impaired patient immunity, prolonged admission and invasive procedures such as mechanical ventilation and central venous catheterization [9,10].

This study aimed to investigate the availability of hand-hygiene equipment and supplies in the neonatal intensive care unit (NICU) of Benha University Hospital to assess hand-washing practices among its nurses, and to detect the factors underlying improper practices.

SUBJECTS AND METHODS

This observational cross-sectional study was conducted on 28 nurses, working at the NICU, Department of Pediatrics, Benha University Hospital. The field work was conducted between January 1, to April 30, 2019.



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Ethical approval:

Approval of the Research Ethics Committee at the Benha University Hospital Faculty of Medicine was obtained. Each nurse provided informed written consent for participation. The consent form included information about the aims, benefits, and risks of participating and on the confidentiality of any data collected.

The neonatal unit consists of two rooms with 12 incubators (six incubators per room) with two washing sinks. Twenty-eight out of 30 nurses (93.3%) consented to participate in the study. A minimum sample size of 26 was determined with MedCalc Software (Mariakerke, Belgium) using the percentage of appropriate hand-washing technique (76.3%) according to AbdElaziz and Bakr, 2009^[11], a null hypothesis value of 50%, type I error of 0.05, and type II error of 0.2.

Data collection

Data were collected using a questionnaire sheet divided into two sections. The first section collected data on socio-demographic variables and on the completion of previous courses on infection control; the second section included the observational checklist of hand-hygiene equipment, supplies, and practices from the infection control assessment tool (ICAT, 2009)^[12], which is the tool adopted by the department.

The items of the hand-hygiene equipment and supplies section focuses on the availability of equipment and supplies recommended for good hand-hygiene practices. It comprises 11 items, and each item has a number of response categories from which one must be selected. Each response has a specific score according to the ICAT, with a highest possible score of 19 for this section. An assessment score was calculated by the investigators after observing the environment carefully and choosing the response category that best describes the current situation, by putting a check mark inside the brackets [□].

The section on hand-hygiene practices included six items, (they were listed in table 3 in order). The first item asked NICU nurses to mark all applicable responses among a choice of six options, each scored 1. The remaining five items asked for only one response, with a score of 0 for “no” and 1 for “yes” except for item #4, for which a score of 1 was given for “no” and 0 for “yes”, and for item #6, for which a score of 0 was given to the first two options and 1 for the last two options. The highest possible score for this section is 11. For each nurse, a percentage score

was calculated as follows: percentage score = (assessment score / section total score) × 100. The assessment score is the sum of points for all marked responses. The scores were classified as follows: class A if >75% (indicating that the recommended practices are followed accurately), class B if 50–75% (indicating that the standard practices are usually followed), or class C if <50% (indicating that training and follow-up are recommended).

The hand-hygiene practices section was completed by the researcher for each nurse on an individual basis during surreptitious observation throughout the nurse’s shift. The practice was assessed 3 times for each nurse. Each nurse was observed during 3 visits by the researcher throughout a 6-hour shift a day, which was a morning shift (hereafter named shift A). The investigator chose this shift as all nurses employed on the unit are included in it periodically. Two nurses were assessed each week in average. The practice of each nurse did not change through the 3 visits. To avoid the Hawthorne effect, the observer was employed at the NICU and the nurses were unaware when they were being observed. Regarding the potential for observer bias, data were collected by only one observer using clear and fixed rules for all participants, and the nurses’ behaviors were clearly defined in the tool.

Statistical analysis

SPSS v.16 was used to analyze the data. Qualitative data were presented as numerals and percentages, using Fisher’s exact test for their analysis. Monte Carlo method was used to calculate Fisher’s test in tables exceeding 2 × 2. Quantitative data were tested for normality using Shapiro–Wilks test, assuming normality at $p > 0.05$, and expressed as mean ± SD or median and range, accordingly. Differences among three independent groups were analyzed using the Kruskal–Wallis test. The statistical significance of this work was set at $p \leq 0.05$.

RESULTS

Demographic data found the average age of the nurses to be 28.7 ± 5.7 years, ranging from 21–42 years. All nurses were female, and 67.9% of them were rural residents. Fifty percent of nurses graduated from a nursing school, 42.9% from the Technical Institute of Nursing and only 7.1% from the Faculty of Nursing. Regarding marital status, 67.9% of them were married, 25% were single, and 7.1% were engaged. Only 39.3% of them completed previous training courses on infection control (Table 1).

Table (1) : Socio-demographic characters of the studied nurses

Variable		No (n=28)	% (100.0)
Age (years)	Mean±SD	28.7±5.7	
	Range	21-42	
Sex	Male	0	0.0
	Female	28	100.0
Residence	Urban	9	32.1
	Rural	19	67.9
Graduation	Faculty of nursing	2	7.1
	Technical institute of nursing	12	42.9
	Nursing school	14	50.0
Marital status	Married	19	67.9
	Single	7	25.0
	Engaged	2	7.1
Previous training courses on infection control	Yes	11	39.3
	No	17	60.7

Table 2 describes the hand-hygiene equipment and supplies in the NICU, showing that the number of hand-washing stations was less than one per every two beds. Running water from the sink is the usual source of water for hand-washing and plain liquid soap is used, both of which are always available. Hand-operated pump dispensers are used, which are emptied, washed, and dried before refilling. Paper towels are used for drying the hands after hand-washing. An alcohol-based antiseptic without emollient is usually available, but its dispensers number is less than one for every four beds. The total score was found to be 14/19 (73.6%).

Table (2) : Description of hand hygiene equipments and supplies in the studied unit

Variable	Response	Score
No. of hand washing stations	2	----
No. of beds	12	----
No. of hand washing stations / beds on the unit	Fewer than one hand washing station per two beds	1
The usual source of water for hand washing	Running water from sink	2
How frequently is running water available?	Always	2
Type of soap most frequently available for hand washing	Plain liquid soap	1
How frequent the soap is available?	Always	2
What types of dispensers are used on this unit for liquid soaps?	Hand operated pump dispenser	1
How are liquid soap dispensers usually cleaned?	Dispensers are emptied, washed, and dried before refilling	1
What method is usually available for drying hands after hand washing?	Single use cloth towel	1
Is a waterless alcohol-based hand antiseptic used for hand hygiene?	Yes, alcohol-based antiseptic without emollient	1
How frequently is there a sufficient supply of waterless alcohol-based hand antiseptic?	Usually	1
How many dispensers of waterless alcohol-based antiseptic are available on the ward?	Fewer than one for every four beds	1
Total score /19	14	73.6%

Concerning hand-hygiene practices, the results showed that all nurses routinely wash their hands before contact with patients, before manipulating medical devices, and after using the bathroom. The results also found that 39.3% of nurses wash their hands after touching potentially contaminated materials or surfaces, 21.4% after removing gloves, and only 17.9% after contact with individual patients or the patient's immediate environment. Furthermore,

67.9% of nurses were found to follow a policy on covering skin lesions with waterproof dressings. All of them were found to follow a policy on keeping fingernails trimmed and avoiding the use of artificial nails or nail extenders, and 57.1% of them were found to prefer wearing gloves rather than washing their hands for contact with patients or potentially contaminated environmental surfaces. Hand lotion was usually available for 64.3% of the nurses to use after hand-washing. When a hand lotion container was empty, 57.1% of the nurses refilled the container without cleaning, while 42.9% emptied, washed, and dried the container prior to refilling (Table3).

Table (3): Hand hygiene practices among the studied nurses.

Variable	No. (N=28)	% (100.0)	
Item-1	Before contact with patients	28	100.0
In which situation the nurse routinely washes her hands with soap and water or a waterless alcohol-based Hand antiseptic?	After contact with individual patients or their immediate environment	5	17.9
	Before manipulating medical devices* or handling wound dressing	28	100.0
	After touching potentially contaminated objects or surfaces	11	39.3
	After removing gloves	6	21.4
	After using bathroom, toilet, latrine	28	100.0
	Item-2	No	9
Does the nurse follow a policy on covering skin lesions and cuts with waterproof dressings?	Yes	19	67.9
	Item-3	No	0
Does the nurse follow a policy on keeping finger nails short and/or not using artificial nails or nail extenders?	Yes	28	100.0
	Item-4	Yes	12
Does the nurse wear gloves instead of washing hands for contact with patients or potentially contaminated environmental surfaces?	No	16	57.1
	Item-5	No	10
Is hand lotion usually available for nurse to use after hand washing?	Yes, hand lotion in disposable containers	18	64.3
	Yes, hand lotion in reusable containers	0	0.0
	Item-6	Hand lotion is not usually available	0
When a hand lotion container is empty, what usually happens?	Container is refilled or topped off without cleaning	16	57.1
	Container is emptied, washed, and dried before refilling	12	42.9
	Container is disposed of when empty and new container is used	0	0.0

* *Such as intravenous catheters, urinary catheters, or endotracheal tubes*

The results also revealed that the mean assessment score of the sample was 7.1 ± 1.2 , with a range from 4–9. The mean percentage score was $64.2\% \pm 11.3$, with a range of 36.4–81.8%. Figure 1 shows that 7.1% of nurses were classified as class A (wherein the recommended practices are followed accurately), while 75% fell under class B (wherein standard practices are usually followed), and 17.9% fell under class C (wherein training, close observation, and follow-up are needed).

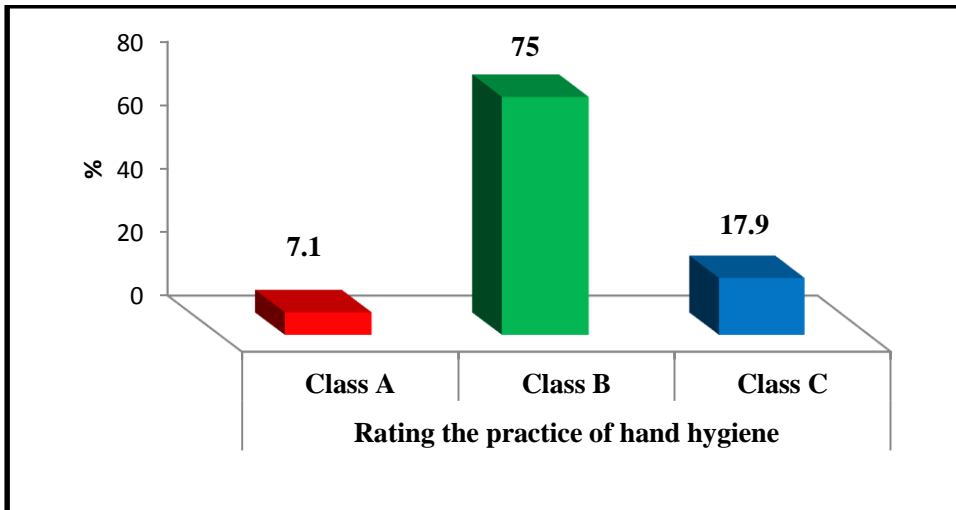


Figure (1): Bar chart showing the rating of hand hygiene practices among the studied nurses

Table 4 demonstrates that all nurses in class A had graduated from the Faculty of Nursing, 52.4% of nurses in class B had graduated from the Technical Institute of Nursing, and 80% of those in class C had graduated from the Nursing School. These differences were statistically significant ($p < 0.05$). All nurses in class A completed previous training courses on infection control, compared to 42.9% in class B and none in class C. This association was statistically significant ($p < 0.05$). However, no statistically significant associations were found between nurses' practice grade and age, residence, or marital status (all $p > 0.05$).

Table (4) : Rating hand hygiene practices of the studied nurses according to their socio-demographic characters.

Variable		Class A (n=2)		Class B (n=21)		Class C (n=5)		Fisher's test	P
Age (years)	Median	29.5		28.0		23.0		KW=	0.46
	Range	29-30		22-42		21-40			
		No.	%	No.	%	No.	%	1.52	(NS)
Residence	Urban	0	0.0	7	33.3	2	40.0	0.92	1.0
	Rural	2	100.0	14	66.7	3	60.0		
Marital status	Married	2	100.0	16	76.2	1	20.0	7.05	0.12
	Single	0	0.0	4	19.0	3	60.0		
	Engaged	0	0.0	1	4.8	1	20.0		
Graduation	Faculty of nursing	2	100.0	0	0.0	0	0.0	12.2	0.002
	Technical institute of nursing	0	0.0	11	52.4	1	20.0		
	Nursing school	0	0.0	10	47.6	4	80.0		
Training courses on infection control	Yes	2	100.0	9	42.9	0	0.0	5.76	0.023
	No	0	0.0	12	57.1	5	100.0		

Kw-Kruskal Wallis test, NS-Not significant, S-Significant

DISCUSSION

Nurses should be extremely diligent with hand-washing as they are often exposed to many biohazards^[2]. Our study included 28 nurses working at the NICU, with an average age of 28.7 years. Though this work revealed that age is an insignificant factor for compliance with proper hand-washing. Other studies have concluded otherwise. A study in Philippines, for instance, evaluated 58 student nurses on their knowledge and degree of compliance regarding standard precautions in a government university, and found that younger nurses were able to acquire knowledge and improve behaviors for keeping up-to-date on these precautions^[13]. Another study found that the level of knowledge of 152 physicians and 227 nurses on blood-borne infections in two randomly selected health regions in Kuwait was poorer in older participants^[14].

The percentage score of the availability of hand-hygiene equipment and supplies in the NICU under study was 73.6%. This is consistent with other studies that concluded that hand-washing facilities in developing countries were suboptimal; a lack of sufficient sinks and running water is not uncommon^[15]. The current study illustrates that all participants washed their hands with the standard materials before initiating contact with patients, before manipulating medical devices or handling wound dressing, and after using the bathroom, toilet, or latrine. On the other hand, only 39.3% washed their hands after touching potentially contaminated objects or surfaces, 21.4% after removing their gloves, and 17.9% after contact with patients or their surrounding environments. These figures are lower than those declared by Lawal et al. (2018), who studied 113 nurses in a federal medical center in Nigeria and found that 68.8% of subjects washed their hands before contact with patients, and nearly all of them (99%) washed their hands after interacting with patients and after removing their gloves^[16].

Moreover, a study in Kano investigated the situations of hand-washing among 137 medical and nursing students. Their findings revealed that 72 students (52.6%) washed their hands before interacting with patients, but the majority (94.9%) washed their hands afterwards^[17]. The study by *Labrague et al.* found that 65.5% of their studied sample usually complied with washing their hands before interacting with patients, and most (93.1%) washed their hands immediately after dealing with any blood, bodily fluid, secretion, excretion, or waste substances^[13]. The majority of nurses always washed their hands after each

patient contact rather than before. This selective implementation could be explained by nurses wanting to protect themselves more than protecting their patients. This suggests that nurses prioritize their own safety over their patients' safety^[18].

Our results were similar to those of *Sharma et al.* who evaluated hand-washing behaviors among healthcare workers in Chandigarh Teaching Hospital and found a low baseline rate of hand-washing adherence in the NICUs^[19]. Regarding hand-hygiene practices, the present work showed that the mean assessment score among the studied sample was 7.1 ± 1.2 and the mean percentage score was 64.2 ± 11.3 . This agrees with the results of a study conducted in 10 wards in Ain Shams University Hospital that found the practice of appropriate hand-washing technique in 76.3% of their sample^[11].

With respect to the rating of nurses' hand-washing behaviors, 7.1% followed the recommended practices consistently, while 75% usually complied with the recommended practices, and 17.9% required training and follow-up on these practices. This corroborates the findings of Erasmus et al. (2010), who stated that, despite clear guidelines and monitoring, hand-hygiene adherence of nurses in healthcare organizations remains unsatisfactory^[20]. Additionally, 163 physicians were investigated by *Pittet et al.* who studied hand-hygiene practices during routine patient care and found a 57% adherence rate^[3]. Moreover, the research conducted by O'Boyle et al. stated that nurses were unaware of their poor hand-washing practices given that the self-reported rates and the observed rates were vastly different^[21]. This low adherence to proper hand-washing practices may be due to the lack of adequate equipment and supplies, absence of appropriate infrastructure, lack of support for a hand-washing program (e.g., low priority for an organization, lack of active participation, lack of role models), and conflict between the need to provide care and the instinct for self-safety.

This study revealed a statistically significant difference between nurses in class A, class B, and class C regarding hand-washing practices and nursing program attended. The practices were better among nurses who graduated from the Faculty of Nursing compared to those from either the Technical Institute of Nursing or the Nursing School. This conflicts with the results of *Binbach et al.* who found that even when medical students receive intensive hand hygiene education, compliance remains low; therefore, the completion of annual safety courses is encouraged^[22]. This bolsters our finding that a lack of training courses

on infection control is significantly associated with poor hand-hygiene practices.

Research work in eastern Ethiopia failed to find any significant differences in the rate of adequate hand-hygiene practices among 110 nurses in a university hospital; however, Its conclusion showed that there was a statistically significant difference between class A, class B, and class C regarding training courses on infection control; the practices were higher among trained nurses than among non-trained nurses ^[23]. This finding is also coincides with another study conducted in Saudi Arabia where the level of knowledge regarding hand-hygiene by health care workers was found to be low, which the authors attributed to insufficient training ^[24]. The same conclusion was reached by *Awoke et al.* ^[23]. Moreover, a multimodal intervention program was conducted on hand-washing in a friendly competition setting and showed that overall hand-hygiene adherence increased significantly at the end of the program ^[25]. On the other hand, a study that evaluated infection control measures in public vs. private ICU sectors in South Africa using the ICAT tool found that hand-hygiene adherence was 100%, which they attributed to the Hawthorne effect ^[26].

CONCLUSION

Improper hand-hygiene practices are a significant problem among the studied NICU nurses, for which a lack of adequate supplies plays a contributory role. The recommended practices are followed consistently and thoroughly by only 7.1% of nurses. A significant associations were found between proper hand-hygiene practices of nurses and both the institute from which they graduated and the completion of previous training courses on infection control.

Study limitations

The present study was conducted in one shift (the morning shift); afternoon and night shifts were not studied given that not all nurses were included in them. Consequently, the analysis of matched values could be called into question. Furthermore, some deficiencies regarding ICAT have been highlighted and published, but these deficiencies were related to other modules not included in our study ^[26].

RECOMMENDATIONS

Training courses on infection control items, especially hand-hygiene, should be attended periodically by NICU nurses. Further studies on hand-

hygiene practices with a larger sample size of nurses in different ICUs are recommended.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest:

The authors declare that they have no conflicts of interest.

Acknowledgement:

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