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ORIGINAL ARTICLE

Effect of Educational Intervention on Healthcare Providers' Knowledge and Adherence to Infection Control Standards at Zagazig University Neonatal Intensive Care Units

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ABSTRACT

Background: Healthcare-associated infections (HAIs) in the neonatal intensive care unit (NICU) are major causes of mortality and morbidity in NICUs. Infection control measures play a major role in reducing the incidence of HAIs. Thus, the purpose of the current study is to assess the effect of the implementation of an infection control program on the knowledge and adherence of NICU healthcare providers to infection control measures, to improve it.

Methods: An interventional study was conducted from November 2016 to February 2018 at Zagazig University Hospital in pediatric hospitals and emergency NICUs. The study included an assessment of healthcare providers' knowledge and adherence to infection control measures before and 3 months after the implementation of the infection control program.

Results: A high statistically significant improvement in health care providers' knowledge and adherence to infection control measures in the studied NICUs after intervention (P value ≤ 0.05). Total knowledge of resident physicians had been improved after intervention by 28.57% and 33.06% in pediatric and emergency NICUs respectively. Also, nurses' total knowledge scores had improved by 40% and 44.44% in pediatric and emergency NICU respectively after the intervention.

Conclusion: Implementation of the infection control program improved the knowledge and adherence of resident physicians and nurses about infection control measures at Zagazig University hospitals' NICUs.

Keywords: Infection Control, Healthcare-associated infections, Neonatal Intensive Care Units, Knowledge, Adherence.

INTRODUCTION

Health care-associated infections (HAIs) in the neonatal intensive care unit (NICU), are defined as infections acquired while receiving treatment for other conditions and neither present nor incubating at the time of admission. It is a major cause of mortality and morbidity in NICUs and has considerable health and economic consequences [1].

The incidence of neonatal HAIs varies between 6% and 50% with three to twenty-fold higher rates in developing countries in comparison to developed countries. [2]

A previous study in Egypt found that the incidence of HAIs in the NICU is 28% (85%bloodstream infections accounted and 10% pneumonia) in the NICU of Ain Shams University Hospital of Obstetrics and Gynecology. [3]

A previous study in Zagazig University hospitals found the rate of HAIs in NICU is (38.5%). The main neonatal nosocomial infection (NI) was bloodstream infection (58.0%), followed by pneumonia (46.0%). [4]

Bloodstream infection, pneumonia, urinary tract infections, meningitis, gastro-enteritis, skin infections, and eye infections are the most frequent forms of HAIs in the NICU. [5]

Numerous risk factors of HAIs in the NICU are involved. The principal risk factors are the degree of both prematurity and low birth weight, where there is a negative correlation between gestational age, birth weight, and occurrence of infection.

Also, immaturity of the immune system, and incomplete barrier functions of the skin and the gastrointestinal tract. [6]

Also, the neonates in NICU are exposed to multiple invasive diagnostic and therapeutic interventions which provide a route to entry for the pathogens rendering them more susceptible to infections. Moreover, the duration of hospital stay has an important role; as the longer the duration of stay, the higher the rate of HAIs. [7]

Infection control plays a crucial role in lowering medical costs, periods of hospital stays, and mortality in hospitalized patients. [8]

Preventing HAIs is based on enhancing neonatal management, preventing the unnecessary use of central venous catheters, and controlling the use of antibiotics. [9]

METHODS

The current study was an interventional study, it was conducted during the period from November 2016 to February 2018 in Zagazig University Hospital at two NICUs; Pediatric hospital NICU (12 incubators) and emergency NICU (10 incubators).

Administrative consideration

An authorized agreement from Zagazig University, Faculty of Medicine was taken to the studied NICUs and head of pediatric department. The title and objectives of this study were explained to them to ensure their cooperation.

Ethical considerations

Approval of the protocol of the current study by the institutional review board (IRB) was obtained (ZU-IRB #3148-26-10-2016). The local authority and manager of the pediatric hospital, Zagazig University Hospital were informed about the kind and the steps of the study, and written consent was taken. The study participants (physicians and nurses) were informed about the kind and the purpose of the study.

The target population for the present study included all healthcare providers who were working in the studied units during the study period (the resident physicians and the nurses). The healthcare providers were distributed in the studied units as follows: The pediatric hospital NICU included 30 nurses and 10 physicians, and the Emergency NICU included 25 nurses and 8 physicians. The study included 3 phases as follows:

A. ***The first phase (pre-intervention***) of the study included an assessment of health care providers' (nurses and physicians) knowledge and adherence to infection control measures through a constructed questionnaire and performance observation checklist.

1. The questionnaire consists of 2 parts: the first part included questions about demographic characteristics of health care providers in the studied NICUs (age, education, duration of experience in NICU) and history of training courses on infection control. The second part involved questions for the assessment of knowledge about guidelines recommended by the National Guideline for Infection Control in the NICU (MOHP) [10]. The questionnaires covered knowledge about hospital-acquired infection; guidelines recommended by the National Guideline for Infection Control for hand hygiene, antisepsis and glove wearing, infection control measures during umbilical catheterization, installation of peripheral venous catheter, and Intravenous fluids preparation and care for the incubator. The internal consistency of the questionnaire was measured after the pilot study and Cronbach alpha was (0.68). The questionnaire was revised and modified by public health professors from the Community medicine department for its validity.

2. The performance observation checklists were about guidelines recommended by the National Guideline for Infection Control in the NICU (MOHP) [10] through two observation checklists, one for physicians and the other for nurses. Both checklists covered the indications for hand hygiene, and antisepsis, glove-wearing, and gown-wearing for physicians and nurses. As for nurses, the checklist also included the procedure of installation of the peripheral venous catheter, intravenous fluids preparation, and giving intravenous medication.

B. ***The second phase (intervention phase)*** included the implementation of a health education intervention program developed on the guidelines recommended by the National Guide for Infection Control (MOHP) [10] targeting all health care providers in the studied NICUs; including 18 physicians and 55 nurses, who were included in the study.

The program included:

- Guidelines which were disseminated in both NICUs as booklets in Arabic, prepared by the researcher, as handouts to all health care providers in the studied NICUs to improve their knowledge and adherence.
- Lectures (PowerPoint): 4 sessions, once weekly for one month, each session 30 minutes.
- Simple Posters were stuck on the walls of NICUs.

C- The third phase (post-intervention) was done 3 months after the intervention and included a re-assessment of the knowledge of healthcare providers about guidelines recommended by the National Guideline for Infection Control in the NICU using the same pre-intervention

questionnaire and re-observation of health care providers using the same pre-intervention checklists to assess their adherence to guidelines after intervention.

A pilot study was conducted before the beginning of the field study in April 2016 to test the tools of data collection, the procedure of data collection, the duration of filling the questionnaire and to detect any barriers in the field of the work.

Data management:

1. Scoring of knowledge:
   Total correct knowledge score:
   Physicians:
   - Total correct knowledge about hospital-acquired infection (7)
   - Total correct knowledge about standard precautions of infection control (4)

   Nurses:
   - Total correct knowledge about hospital-acquired infection was (7)
   - Total correct knowledge about standard precautions of infection control is (9)
2. Scoring of checklists:
   - Checklist for assessing physicians' adherence to infection control guidelines with a total score of 8 degrees.
   - Checklist for assessing nurses' adherence to infection control guidelines with a total score of 23 degrees.

- Adequacy of knowledge was as follows: Unsatisfactory knowledge is considered < 60 % of the total correct knowledge score and scores ≥ 60 % are considered as satisfactory knowledge, for adherence, if a total score < 60% it will be considered unsatisfactory adherence to infection control guidelines, if total score ≥ 60% it will be considered satisfactory adherence [11].

STATISTICAL ANALYSIS

Statistical analysis for the collected data was done by using the statistical package for the Social Sciences (SPSS) version 26. The proper statistical tests were used.

RESULTS

The present study showed that pediatric NICU had 12 incubators that received care through 30 nurses and 10 physicians while emergency NICU had 10 incubators that received care through 25 nurses and 8 physicians. Both studied NICUs had an equal nurse/incubator ratio. The infection control infrastructure during the study period is satisfactory for both units except for the availability of soap and towels.

Table (1) shows that no statistically significant differences in the demographic characteristics of resident physicians and nurses in both studied NICUs.

According to **Table (2),** the resident physicians' mean knowledge score about HAIs, standard precaution of infection control measures, and total knowledge score increased significantly post-intervention in both NICUs. Total knowledge of resident physicians had been improved by 28.57%. in pediatric NICU and 33.06% in emergency NICU.

Table (3) demonstrates that there was a statistically significant improvement in the nurses' mean knowledge score about HAIs, standard precaution of the infection control measures, and total knowledge score in both NICUs after intervention (P value ≤0.05). Total knowledge of nurses had been improved by 40% and 44.44% in pediatric and emergency NICUs respectively.

Regarding the resident physicians' adherence to infection control measures.

Figure (1) demonstrates that in pediatric NICU, the percentage of resident physicians with satisfactory knowledge has increased from 80% to 100%, and that for nurses has increased from 50% to 93.3% after intervention. **Figure (2)** shows that in the emergency NICU, the percentage of resident physicians with satisfactory knowledge has improved from 62% to 87% and that of nurses improved from 28% to 92% after the intervention.

Table (4) shows that the resident physicians' mean total adherence score in pediatric NICU shows statistically significant improvement post-intervention (P value ≤0.05). The median percentage of change in total adherence of resident physicians in pediatric NICU was 40%. Total adherence of resident physicians in emergency NICU had been improved by 50%.

Table (5) reveals that there were statistically significant improvements in the nurses' adherence scores to general measures, peripheral venous catheterization, intravenous drug administration, intravenous fluid preparation, and total adherence to infection control measures in pediatric NICU where the higher scores were after intervention (P value ≤0.05). Total adherence of nurses in pediatric NICU had been improved by 32.05%.

Table (6) illustrates that there was statistically significant advancement in the nurses' adherence scores to general measures, peripheral venous catheterization, and total adherence to infection control measures in emergency NICU after intervention. However, it revealed no statistically significant differences in the nurses' adherence scores to intravenous drug administration and intravenous fluid preparation. Total adherence of nurses in emergency NICU had been improved by 21.43% post-intervention.

In pediatric NICU, the percentage of resident physicians with satisfactory adherence to infection

control measures has improved from 50% to 100%, and that of nurses has improved from 64.7% to 90% after intervention **(Figure 3).** While in the emergency NICU, the percentage of resident physicians with satisfactory adherence to infection control measures has improved from 75% to 100% and that of nurses has improved from 52% to 100% after intervention **(Figure 4).**

Table 1: Demographic characteristics of resident physicians and nurses in the studied NICUs:

Items (Physicians)	**Pediatric NICU (No.=10)**	**Emergency NICU (No.=8)**	**Test of sig.**	**P value**
Age (years): ▪ ***Mean ± SD*** ▪ ***Range***	 26.9 ± 1.37 25–29	 26.5 ± 1.19 25–28	 (t) 0.650	 0.525
Duration of experience in NICU (years): ▪ ***Mean ± SD*** ▪ ***Range***	 1.8 ± 0.789 1–3	 2 ± 0.92 1–3	 (t) 0.495	 0.627
Training courses on infection control: No. (%) ▪ **Yes** ▪ **No**	 2 (20) 8 (80)	 5 (62.5) 3 (37.5)	Fisher exact test	0.066
Items (Nurses)	**Pediatric NICU (No.=30)**	**Emergency NICU (No.=25)**	**Test of sig.**	**P value**
Age (years): ▪ **Mean ± SD** ▪ **Range**	 26.6 ± 5.8 21–39	 27.2 ± 6.1 19–40	 (t) 0.371	 0.712
Duration of experience in NICU (years): ▪ **Mean ± SD** ▪ **Range**	 5.7 ± 5.9 1–21	 6.6 ± 6.0 1–22	 (t) 0.515	 0.609
Training courses on infection control: No (%) ▪ **Yes** ▪ **No**	 24 (80%) 6 (20%)	 23 (92%) 2 (8%)	 (χ2) 1.579	 0.209
Qualification: ▪ **Nursing school diploma** ▪ **Technical institute** ▪ **Bachelor of Nursing**	 8 (26.7%) 18 (60%) 4 (13.3%)	 11(44%) 10 (40%) 4 (16%)	 (χ^2) 2.324	 0.313

(t) Student t-test, (χ^2) Chi-square test

Table 2: Knowledge of resident physicians about HAIs and standard precaution of infection control measures in pediatric NICU (No. = 10) and emergency NICU (No.=8) before and after intervention

Item (Pediatric NICU)	**Pre-intervention (No.=10)**	**Post-intervention (No.=10)**	**Test of sig.**	**P value**
Total Knowledge about HAI (total score=7) ▪ **Mean ± SD** ▪ **Range**	 5.5 ± 1.3 4-7	 6.6 ± 0.5 6-7	3.161 [(a)]	0.012*
Total Knowledge about standard precaution (total score=4) ▪ **Mean ± SD** ▪ **Range**	 2.7 ± 0.9 1-4	 3.6 ± 0.7 2-4	3.657 [(a)]	0.004*

Item (Pediatric NICU)	Pre-intervention (No.=10)	Post-intervention (No.=10)	Test of sig.	P value
Total Knowledge (total score=11) ▪ **Mean ± SD** ▪ **Range**	8.2 ± 1.9 6-11	10.2 ± 1.1 8-11	4.743 (a)	0.001*
Percentage of change in total knowledge **Median (IQR)**	28.57 (10-42.41)			
Total Knowledge about HAI (total score=7) • **Mean ± SD** • **Range**	5.1 ± 1 4-7	6.1 ± 0.6 5-7	3.1 (a)	0.018*
Total Knowledge about standard precaution (total score=4) **Median (IQR)**	2 (2-3)	4 (3-4)	1.82 (b)	0.068
Total Knowledge (total score=11) • **Mean ± SD** • **Range**	7.6 ± 1.9 6-11	9.5 ± 1.6 6-11	2.707 (a)	0.03*
Percentage of change in total knowledge **Median (IQR)**	33.06 (0-60.71)			

(*) Significant difference; (IQR) Inter-quartile range; (a) Paired t-test

Table 3: Knowledge of nurses about HAIs and standard precaution of infection control measures in pediatric NICU (No. = 30) and emergency NICU (No.=25) before and after intervention

Item (Pediatric NICU)	Pre-intervention (No.=30)	Post-intervention (No.=30)	Test of sig.	P value
Total Knowledge about HAI (total score=7) ▪ **Mean ± SD** ▪ **Range**	5.1 ± 1.6 2-7	5.9 ± 1.1 4-7	4.557 (b)	<0.001*
Total Knowledge about standard precaution (total score=9) ▪ **Median (IQR)**	5 (3-5)	7 (6-8)	4.83 (b)	<0.001*
Total Knowledge (total score=16) ▪ **Mean ± SD** ▪ **Range**	9.1 ± 2.7 5-15	12.9 ± 1.8 8-16	13.136 (a)	<0.001*
Percentage of change in total knowledge ▪ **Median (IQR)**	40 (29.32-118)			
Total Knowledge about HAI (total score=7) **Median (IQR)**	4 (3-5.5)	6 (5-6)	4.381 (b)	<0.001*

Item (Emergency NICU)	Pre-intervention (No.=25)	Post-intervention (No.=25)	Test of sig.	P value
Total Knowledge about standard precaution (total score=9) ▪ **Median (IQR)**	4 (3-5)	6 (5.5-7)	3.817 (b)	<0.001*
Total Knowledge (total score=16) ▪ **Mean ± SD** ▪ **Range**	8.2±2.6 4-16	11.9±1.8 7-16	11.166 (a)	<0.001*
Percentage of change in total knowledge ▪ **Median (IQR)**	44.44 (31.67-66.96)			

(*) Significant difference; (IQR) Inter-quartile range; (a) Paired t-test; (b) (Wilcoxon signed ranks test).

Table 4: Adherence of physicians to infection control measures before and after intervention in both NICUs:

Item	Pre-interventionPre intervention (No.=10)	Post-intervention (No.=10)	Test of sig.	P value
Pediatric NICU **Total adherence (score=8)** ▪ **Mean ± SD** ▪ **Range**	4.3±1.63 2-7	6.3±0.95 5-8	6.0 (a)	<0.001*
Percentage of change ▪ **Median (IQR)**	40 (19.17-112.5)			
Emergency NICU **Total adherence (score=8)** ▪ **Mean ± SD** ▪ **Range**	5.25±1.38 3-7	7.38±0.74 6-8	5.833 (a)	0.001*
Percentage of change ▪ **Median (IQR)**	50 (19.05-71.25)			

(*) Significant difference; (a) Paired t-test; (IQR) Inter-quartile range.

Table 5: Adherence of nurses to infection control measures before and after intervention in pediatric NICU (No.=30)

Item	Pre intervention (No.= 30)	Post-intervention (No.= 30)	Test of sig.	P value
General measures (score=8) ▪ **Median (IQR)**	4 (3-5)	5 (5-7)	3.68 (b)	<0.001*
Peripheral venous catheterization (score=3) ▪ **Median (IQR)**	2 (1-2)	3 (2-3)	3.42 (b)	0.001*
IV drugs administration (score=3) ▪ **Median (IQR)**	1(1-2)	2 (1-3)	2.47 (b)	0.014*
IV fluids preparation (score=9) ▪ **Mean ± SD** ▪ **Range**	5.57±1.67 3-8	6.6±1.27 5-9	3.76 (a)	0.001*

Item	Pre intervention (No.= 30)	Post-intervention (No.= 30)	Test of sig.	P value
Total adherence (score=23) ▪ **Mean ± SD** ▪ **Range**	12.67±3.39 6-20	16.57±2.08 12-21	6.84 (a)	<0.001*
Percentage of change in total adherence score ▪ **Median (IQR)**	32.05 (11.67-64.39)			

(*) Significant difference; (IQR) Inter-quartile range; (a) Paired t-test; (b) (Wilcoxon signed ranks test).

Table 6: Adherence of nurses to infection control measures before and after intervention in emergency NICU (No.=25)

Item	Pre intervention (No.= 25)	Post-intervention (No.=25)	Test of sig.	P value
General measures (score=8) ▪ **Median (IQR)**	4 (3-5)	5 (5-6)	3.98 (b)	<0.001*
Peripheral venous catheterization (score=3) ▪ **Median (IQR)**	2 (1-2)	2 (2-3)	2.47 (b)	0.013*
Intravenous drug administration (score=3) ▪ **Median (IQR)**	1 (0.5-2.5)	2 (1-2.5)	1.61(b)	0.108
Intravenous fluids preparation (score=9) ▪ **Mean ± SD** ▪ **Range**	5.92±1.58 3-8	6.68±1.21 5-9	2.001(a)	0.057
Total adherence (score =23) ▪ **Mean ± SD** ▪ **Range**	13.2±3.15 6-18	16.48±1.73 14-21	5.154 (a)	<0.001*
Percentage of change in total adherence score ▪ **Median (IQR)**	21.43 (6.27-47.73)			

(*) Significant difference; (IQR) Inter-quartile range; (a) Paired t-test; (b) (Wilcoxon signed ranks test

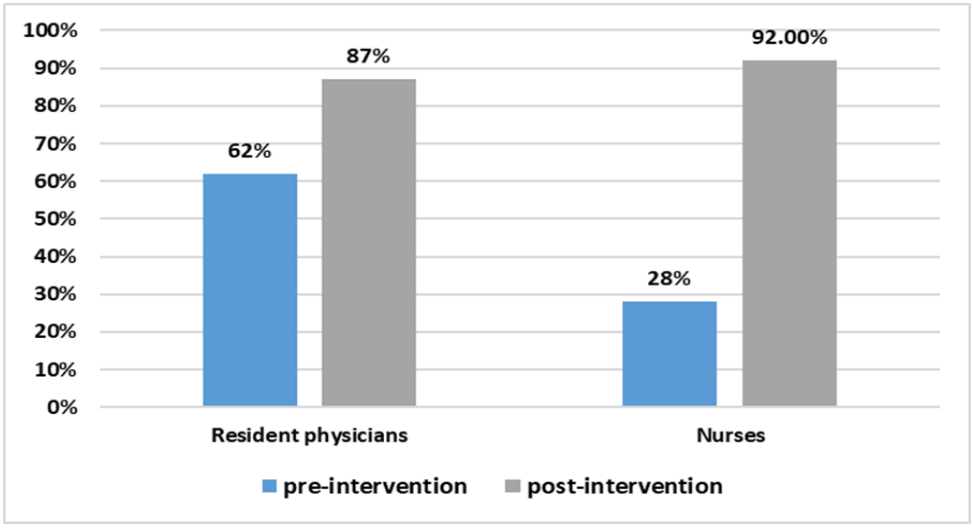

Figure 1: Percentage of satisfactory knowledge score of resident physicians and nurses about HAIs in pediatric NICU before and after intervention

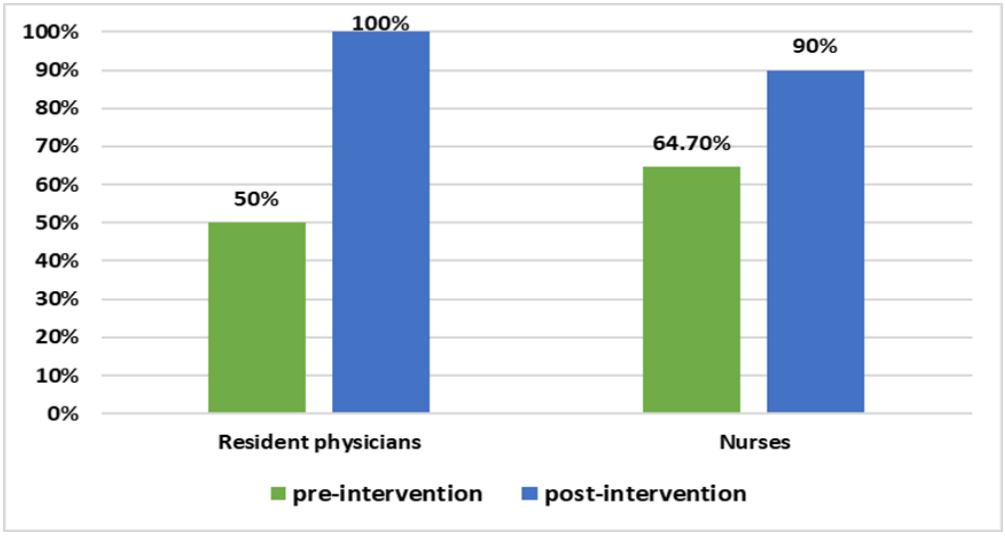

Figure 2: Percentage of satisfactory knowledge score of resident physicians and nurses about HAIs in emergency NICU before and after intervention.

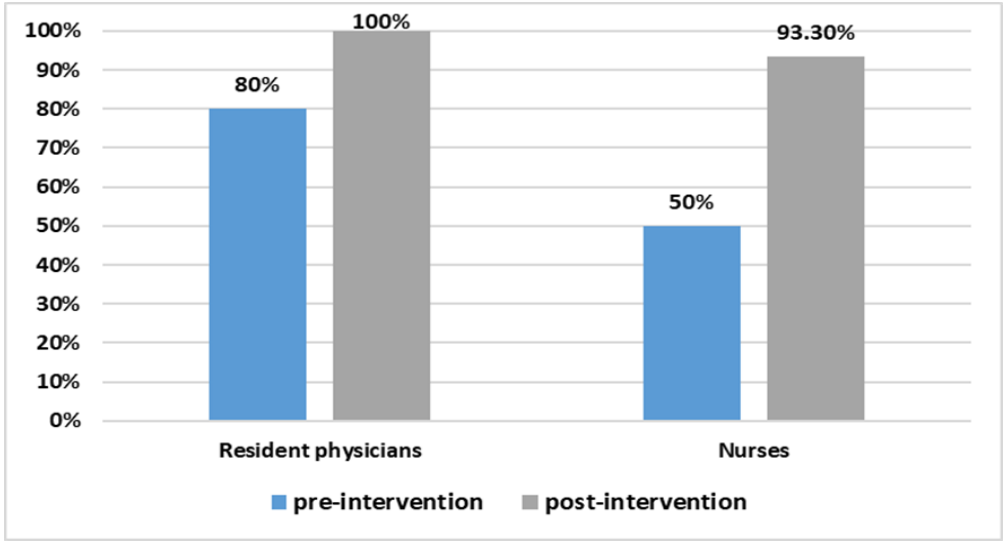

Figure 3: Percentage of satisfactory adherence score of resident physicians and nurses to infection control measures in pediatric NICU before and after intervention.

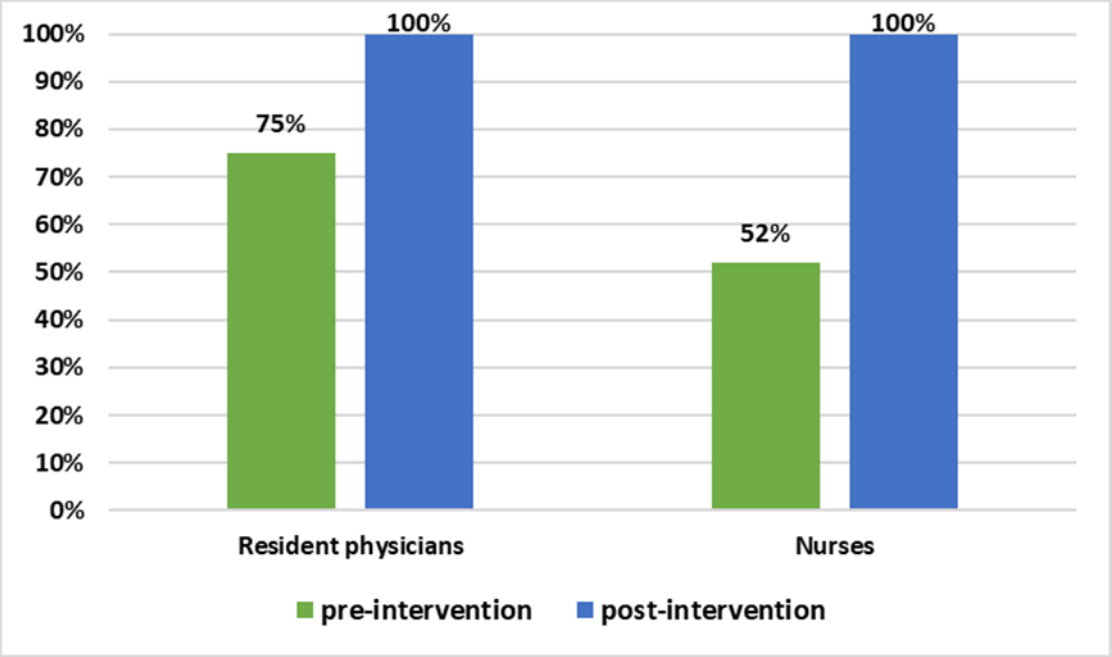

Figure 4: Percentage of satisfactory adherence score resident physicians and nurses to infection control measures in emergency NICU before and after intervention.

DISCUSSION

HAIs constitute a global health problem that is a key reason for neonatal morbidity and mortality with prevalence rates in low and middle-income countries three to twentyfold higher than high-income countries. [12] The impact of HAIs can be seen at both individual patient level as well as the community level, because of the link between HAIs and multidrug-resistant infections.

Successful implementation of Infection control program helps minimize HAIs and its impact on the healthcare system. Moreover, the knowledge and behavior of healthcare workers are important in the healthcare field where evidence proposes that healthcare workers' knowledge and attitude can increase adherence to standard hygiene measures which in turn can lower the incidence of HAIs. [13]

Therefore, this study was carried out to evaluate the effect of infection control program implementation in NICUs at Zagazig University Hospitals on healthcare providers' knowledge about HAIs their prevention guidelines, and their adherence. The current study was conducted in 2 NICUs, pediatric NICU and emergency NICU to allow us to compare our findings in 2 working areas with different locations, working circumstances, and neonates characteristics. Pediatric NICU is located in a pediatric hospital, and neonates admitted to it are referred from different health centers, while the emergency NICU is located in Obstetrics and Gynecology emergency hospital, it receives neonates from deliveries in the hospital where many of it is of complicated pregnancies.

The present study showed that both studied NICUs had 1:2 nurse/incubator ratios per shift which was insufficient according to the World Health Organization. [14] Exposing nurses to work overload could negatively affect the quality of care and subsequently threaten the safety of neonates.

The nurse per incubator ratio was not equivocal through the studies where the NICU of a tertiary center in AL-Kasr Al-Ainy Hospital, Cairo University, Egypt reported a higher nurse: incubator ratio of 1:3 that revealed that one nurse would care for three incubators. [15] On the other hand, a tertiary referral teaching hospital in India demonstrated a ratio of 1:1 nurse to infant. [16]

Nurses are responsible for providing direct care to newborns in the hospitals. [17] Adequate nurse staffing is a fundamental prerequisite for satisfactory and safe neonatal care. [18]

As for the knowledge of the health care providers, the unsatisfactory level of knowledge of resident physicians before intervention can be rendered to the lack of updated infection control training in a residency training program at Zagazig University hospitals at the time of data collection of this study. In addition to considering some of them infection control measures are the responsibility of nurses.

The knowledge score of nurses about HAI and infection control measures in the studied NICUs before intervention was mostly unsatisfactory. This can be explained that our conducted intervention represented the first

training course for nurses about recent updates in HAIs and coping infection control measures to prevent such infections. In agreement with Elfiky et al. who found that only 40% of the included nurses from the working staff inside Egyptian NICUs had a satisfactory practice level indicating a lack of adequate practice, and it was found that knowledge and training courses were positive predictors of practice that mirror how training courses can improve the practice of nurses regarding infection control measures. [22]

In agreement with different cross-sectional studies in Italy, India, and US and Canadian hospitals that revealed poor knowledge about infection control precautions among physicians and nurses and recommended improving the training programs targeting infection control procedures among physicians and nurses to enable them to provide highly specialized care. [13, 19, 20, 21]

Poor knowledge of health care providers about infection control measures in this study outlines the need for training programs to improve their knowledge. The mean total knowledge scores were 8.2±2.6, 7.6±1.9 for resident physicians and 9.1±2.7, 8.2±2.6 for nurses in pediatric and emergency NICUs respectively. It is important to recognize the degree of healthcare providers' knowledge and to determine considerations that could influence their practice so that healthcare delivery can be enhanced, and the HAIs burden limited.

On the other hand, a recent cross-sectional study that included nurses working inside the NICUs in three Egyptian hospitals found that most of the participants (67%) had a satisfactory level of knowledge. [22]

Similarly, a study performed at the faculty of nursing in a Saudi University showed good knowledge about infection control measures in 60% of the studied nurses. [23]

The current study revealed that the pediatric NICU resident physicians' mean knowledge score about standard precaution of infection control measures significantly improved after intervention which indicates the effectiveness of the conducted intervention on this aspect.

The application of this intervention was consistent with several studies that revealed that a higher level of knowledge was among those who had participated in meetings sharing results of the surveillance activity. This finding confirms that providing periodic feedback and increasing healthcare providers' awareness has a role in improving their knowledge about HAIs and infection control. [24, 25]

Similarly, a study conducted in Brazilian neonatal units found that providing a nurse-training package including infection and prevention control measures leads to significant improvement in nurses' knowledge. [26]

Also, Angelozzi et al. suggested that healthcare professional training is an important factor in preventing the spread of HAIs. Furthermore, by supporting more Healthcare workers' involvement, they determine that a bottom-up approach can possibly improve HAIs prevention and management. [13]

Following the current study, a Brazilian study at neonatal units found a significant improvement in nurses' practice after the introduction of a training program on infection and prevention control measures. [26] In addition, Abd-Elhamid et al. concluded that the implementation of health educational programs leads to improvement of the nurse's infection control practice. [29]

Consistent with several studies had a quasi-experimental design following an intervention found that the overall compliance to hand hygiene among healthcare workers at NICUs was significantly increased after intervention for all hand hygiene opportunities from 28.5 to 95.9% in Bangladesh, from 3 to 70.1% in India, from 9.2% to 68.8% in Nepal, 30.9 to 69.5% in Egypt. [30, 31, 32, 33] So, implementation of infection control program had positive outcomes on their knowledge and adherence to infection control measures.

This study had limitations in that it was conducted on a small number of healthcare workers in Zagazig University Hospital only, so the results cannot be generalized.

CONCLUSION

The present study concluded that the implementation of an evidence-based infection control program showed significant improvement in total knowledge and adherence of both resident physicians and nurses' infection control measures after intervention.

RECOMMENDATIONS

The current study recommended to; organize pre-employment infection control training courses for resident physicians and nurses, increasing the budget for infection control in NICUs, update infection control protocols in dealing with neonates in NICUs according to recent evidence-based guidelines.

Conflict of interest: None.

Funding sources: None.

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Supplementary data:

https://docs.google.com/document/d/1ZGPPz0CvUw_DSndMCJXBqJzuh53iViOz/edit?usp=sharing&ouid=104844605072674380383&rtpof=true&sd=true

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