

Developing educational program for Nurses' Related to Infection Control of Invasive Procedures in Neonatal Units at EL-Minia University and General Hospitals

Nagat Farouk Abolwafa¹, Wafaa Elsayed Ouda², Fathia Zaky Mohammed³ and Eman Sayed Masoed¹

¹ Pediatric Nursing Department, Faculty of Nursing, Minia University, Egypt

² Pediatric Nursing Department, Faculty of Nursing, Ain Shams University Egypt

³ Pediatric Nursing Department, Faculty of Nursing, Assiut University, Egypt
magy5871@yahoo.com

Abstract: All neonates at the neonatal units need invasive procedure where nearly, all of them are attached to various types of invasive procedure so infection control within a health care facility reduces the risk of nosocomial infectious thus decreases morbidity and mortality. It is associated, as well, with a decreased need to stay in the hospital for an extra-day to many weeks so the cost decreased. **Aiming** to develop and apply educational and training program for nurses' about infection control of invasive procedure in neonatal units. This study is a quasi-experimental study. It was conducted in the neonatal units at El-Minia University and General Hospitals. The study group was a convenient sample of 40 nurses, 22 nurses from El-Minia University and 18 nurses from El-Minia General Hospitals. **Educational program for nurses' were done through using the following data collection tool:** 1) Pre-designed questionnaire sheet, 2) Observation checklists sheet and 3) Educational and training program. **Results** of this study showed significant progress in nurses' knowledge and practices in post/test. **Concluded** that, by the implementation of the program there was remarkable improvement of nurses' knowledge and practices, it was clear in post-test results. **Recommended** a developed program should be applied and repeat again every 6 months in the same study setting and adopted in other similar settings with required modifications, provision of continuing education programs.

[Nagat Farouk Abolwafa, Wafaa Elsayed Ouda, Fathia Zaky Mohammed and Eman Sayed Masoed. **Developing educational program for Nurses' Related to Infection Control of Invasive Procedures in Neonatal Units at EL-Minia University and General Hospitals.** *J Am Sci* 2013;9(10):286-293]. (ISSN: 1545-1003). <http://www.jofamericanscience.org>. 37

Keywords: Educational Program, Infection Control, Invasive Procedures

Introduction

The Neonatal Intensive Care Unit (NICU) is the unit that provides specialized care that is critical to sustaining and nurturing new life. Infants who have complications due to premature birth, infections or other health challenges are admitted to this unit (**Wikimedia Foundation, 2006**). Neonates who are colonized with pathogens may have no overt signs of illness. Overcrowding and understaffing of the unit, inadequate number of sinks, or their poor accessibility may contribute to decreased hand washing. Invasive procedures increase the risk of infection due to the interruption of the normal barriers. Examples of such procedures are the use of fetal scalp electrodes, heel sticks, nasogastric tubes, endotracheal tubes and intravascular lines. Prevention of infections requires meticulous neonatal care techniques and careful attention to all aspects of infection control (**Milligan, et al., 2011**).

In Cairo, Egypt rates of sepsis are exceeding 50% in the neonatal intensive care units (NICU). Observation of clinical practices led us to culture in-use intravenous fluids and medications. In addition to monitoring rates of intravenous fluids contamination, clinical sepsis and mortality after interventions to

establish new procedures for handling and disposal of intravenous fluids, infection control training and improved clinical laboratory capacity. Extrinsicly contaminated intravenous fluids resulted in sepsis and deaths. Standard infection control precautions significantly improve mortality and sepsis rates and are prerequisites for safe NICU care (**Heath and Zerr, 2005**).

Good health depends on safe environment, which is free from any hazards. Neonate's, in all health care settings are at risk for acquiring infection (**Potter and Perry, 2004**). Infection is defined as invasion of the body by pathogens or microorganism capable of producing diseases (**White Lois, 2007**). Nosocomial infection is one that is acquired while hospitalized that is not present at admission (**Terri Kyle, 2008**).

Invasive procedure can be defined as medical procedure that invades (enters) the body, usually by cutting or puncturing the skin or by inserting instruments into the body. Invasive Procedures are punctures of the skin or insertion of an instrument into the body of the neonates (**National Institutes of Health, 2009**). For example: inserting endotracheal tube, suctioning, umbilical vessel catheterization, intravenous line placement, capillary blood sampling

and venipuncture and nasogastric tube (**Chemaly, 2007**).

Teaching and training are essential for the nursing staff members to improve the quality of health care and to acquire new knowledge and skills. Educational programs are considered as means for providing nurses with theoretical and technical information needed to acquire new skills and to continually improve nursing practice. Also help them to accept responsibilities for their professional development. The knowledge and practices of nurses in relation to infection control were deficient. The implementation of a specially developed program has led to statistically significant improvements in nurses' knowledge and practices (**Emam, et al., 2005**).

2. Subject and Method

The aim of this study was to: Develop and apply educational and training program for nurses' about infection control of invasive procedure in neonatal units

Research Hypothesis:

1. Is there a relationship between the studied nurses' personal characteristics and their knowledge and practices about infection control of invasive procedure?
2. Is there a relationship between the studied nurses' knowledge and practices?

Research design:

Quasi- experimental research design was utilized to meet the aim of this study.

Setting:

This study was conducted in neonatal units at El-Minia University and General Hospitals.

Sampling:

A convenient sample of 40 nurses (22 nurses from El-Minia University and 18 nurses from El-Minia General Hospitals).

Tools for Data Collection:

Tool I:

Pre-designed questionnaire sheet for nurses as pre/post tests that was designed by the researcher in an Arabic language after reviewing of the related literature (**Elizabeth, et al., 2006; Vicky and Cindy, 2008; Marilyn, et al., 2010**) to assess the nurses' knowledge towards infection control of invasive procedures in neonatal units. It was comprised from the following parts:-

Part₁

Personal data: as nurses' age, qualifications, years of experience and previous training courses.

Part₂

Nurses' knowledge towards infection control of invasive procedures in neonatal units. Close ended questions were used that involve 66 items divided to 37 items (knowledge about infection control) and 29 items (invasive procedure).

Tool II:

Observation checklists sheet that were adopted from **Patricia and Anne, (2005)** and **Terese and Marlene, (2010)**; to assess the nurses' practices about infection control of invasive procedure namely **Universal precautions** including: hand washing, gloving, masking, gowning and **Invasive procedures** including: nursing care before, during and after intubation of endotracheal tube, suctioning, nursing care before, during and after insertion of; an umbilical vessel catheterization, peripheral intravenous line placement, capillary blood sampling, venipuncture (phlebotomy) and nasogastric tube. The nurses' actual practices were assessed by the researcher using the checklists by direct and indirect observation (Appendix, II).

Tool III:

Educational and training program was designed in an Arabic Language in form of educational program by the researcher based upon the actual need assessment of nurses. It was also supplemented with information based on review of relevant literature (nursing textbook, journals and internet resources) about infection control of invasive procedure in neonatal units. Then the program was reviewed by a panel of experts before its implementation.

Administrative approval was obtained from the Dean of Faculty of Nursing, El-Minia University to the head manger of El-Minia University and General Hospital and the head of the neonatal units before implementation of the study.

Pilot study:

After developing the tools, a pilot study was conducted on 5 nurses in El-Minia University Hospital and 5 nurses in El-Minia General Hospital. A pilot study was conducted to test clarity & completeness of the study tools and to determine the time required to fill each tool. According to the results of pilot, the needed modification, omissions and/or additions were done. A jury acceptance of the final forms was secured before actual study work and the reliability was assessed in a pilot study by measuring their internal consistency using Cronbach's alpha coefficient method.

Ethical consideration:

The oral consent was taken from all nurses participating in the study. The researcher explained purpose of the study through direct personal communication they were secured that data will be confidential and will be used for the research purpose only.

Field of the work

The field work was started from November 2011 to April 2012; the program implementation was in six months, were 180 hours divided in 60 hours theoretical and 120 hours practical, nurses was divided into 10 small groups each group has 3-4 nurses. Every

group had 10 sessions in this program; each session was variable and ranged between 60 and 120 minutes. Each group was given the freedom to choose their optimal time for receiving the program whenever they have minimal workload. Each participant obtained a copy of the program booklet that included all the training materials. Each session usually started by a summary of what has been taught during the preceding sessions and the objectives of the new one. Giving praise and/or recognition to the interested nurses were used for motivation during program implementation.

The actual work started by meeting the nurses throughout the morning shift, the researcher first introduced herself to them and gave them a complete back ground about the study, its aim, then the pre test format, was distributed in order to collect the required data. The researcher was available for more clarification whenever needed. Then, the content of the program was designed based on actual educational need assessment of the studied nurses. Consequently, the subject content has been sequenced through theoretical and practical sessions that contained a practical performance to the targeted intervention, from the researcher and are demonstration from the studied sample.

Methods of teaching were through a modified lecture, demonstration and re-demonstration and group discussion. Suitable teaching aids were prepared and used especially for the program such as a mannequin of an infant.

Scoring system:

Scoring system: Nurses' knowledge: a score of one was given for correct answer and a zero for an incorrect answer. For each part, the scores of the items were summed up and the total divided by number of the items, giving a mean score for the part. These scores were converted into a percent score and mean and standard deviations were computed. The nurses' knowledge was considered satisfactory if the percent score is 60% or more and unsatisfactory if scored less than 60%.

Nurses' practice: a score of 2 was given for done correctly; score of 1 was given for done incorrectly. For each part, the scores of the items were summed up and the total divided by number of the items, giving a mean score for the area. These scores were converted into a percent score and mean and standard deviations were computed. These scores were converted into a percent score. The nurses' practice was considered satisfactory if the percent score is 60% or more and unsatisfactory if scored less than 60%.

Statistical analysis:

Data entry was done using compatible personal computer. The statistically analysis was done using SPSS-13 statistical software package and Excel for figures. The content of each tool was coded,

categorized and then analyzed. Data were presented using descriptive statistics in the form of frequencies and percentages for qualitative variables and means and standard deviations for quantitative variables. Quantitative continuous data were compared by using student T-test in case of comparisons between the mean scores of the two studied groups. The qualitative studied variables were compared using Chi-square test. Pearson correlation analysis used for assessment of the inter-relationships between the nurses' knowledge and practices about infection control of invasive procedure. Statistical significance used at P value < 0.05 .

3. Results:

Characteristics of the studied sample showed that, more than two thirds (70%) of them were aged 20 < 30 years, with a mean age of 1.70 ± 0.59 years. As regards qualification of the studied sample it was found that, more than half of them were (57.5%) having Diploma of Secondary Nursing school. As for the nurses' years of experience, it was noticed that about two thirds of them (65%) were having work experience that ranged from 5 < 10 years. While (Mean \pm SD 1.70 ± 0.59 years). Regarding to the previous attendance of training courses about infection control of invasive procedure, the majority of studied sample (90%) didn't had training courses about infection control of invasive procedure. Regarding to the place of work, it was found that 55% of the nurses were working at El-Minia University Hospital (MUH) and 45% from El-Minia General Hospital (MGH).

Table (1) illustrates the relation between the studied sample knowledge about infection control and their characteristics. It is evident that there is statistically significant relation between nurses' age (P . 0.02), years of experience (P . 0.01), qualification and their knowledge (P . 0.04). It is evident that higher percentages of satisfactory knowledge were observed among nurses younger than 20 years old (12.5%), about half of the nurses with years of experience from 5 years to 10 years or more (47.5%) had satisfactory knowledge, compared to only 7.5% of those with less than 5 years experience. Meanwhile, the table shows no statistically significant difference between nurses' knowledge and their previous attendance of training courses (P . > 0.05).

Table (2) shows the relation between the studied sample knowledge about invasive procedure and their characteristics. It is evident that there is statistically significant relation with the nurses' age (P . 0.001), years of experience (P . 0.01), qualification and their knowledge (P . 0.001). It is evident that higher percentages of satisfactory knowledge were observed among nurses age from 20 years old to 30 years or more (57.5%), the nurses with years of experience from 5 years to 10 years or more (15%) had satisfactory knowledge, compared to only 7.5% of those with less

than 5 years experience and nurses who having Diploma of Secondary Nursing School had higher percentages of satisfactory knowledge(40%).

Table (3) presents the nurses' knowledge mean scores related to infection control pre/post educational program. It indicates an increase in knowledge scores in all knowledge areas at the post-

program phase. However, this increase reached statistical significance for nurses' knowledge about cleaning and disinfection (P. 0.04), sterilization (P. 0.05) and universal precaution (P. 0.01), while only in infection (P. 0.04). The total mean scores of knowledge about infection control were 9.2 ± 4.26 (P. 0.001).

Table (1): The relation between the studied sample knowledge about infection control and their characteristics n= 40

Items	Knowledge				X ²	P. value
	Satisfactory		Unsatisfactory			
	No	%	No	%		
Age in years:					0.98	0.02*
< 20	5	12.5	1	2.5		
20 < 30	9	22.5	19	47.5		
30 < 40	0	0	6	15		
Years of experience:					0.71	0.01*
< 5	3	7.5	5	12.5		
5 < 10	19	47.5	7	17.5		
10 < 15	0	0	6	15		
Qualification of nurses:					0.45	0.04*
Bachelor in Nursing Sciences	8	20	2	5		
Diploma of Technical Nursing Institute	3	7.5	4	10		
Diploma of Secondary Nursing School	5	12.5	18	45		
Previous attendance of training courses:					0.48	0.34
Yes	2	5	2	5		
No	8	20	28	70		

*= Significant

Table (2): The relation between the studied sample knowledge about invasive procedure and their characteristics n= 40

Items	Knowledge				X ²	P. value
	Satisfactory		Unsatisfactory			
	No	%	No	%		
Age in years:					0.65	0.001*
< 20	0	0	6	15		
20 < 30	23	57.5	5	12.5		
30 < 40	5	12.5	1	2.5		
Years of experience:					0.27	0.01*
< 5	0	0	8	20		
5 < 10	6	15	20	50		
10 < 15	4	10	2	5		
Qualification of nurses:					0.06	0.001*
Bachelor in Nursing Sciences	1	2.5	9	22.5		
Diploma of Technical Nursing Institute	2	5	5	12.5		
Diploma of Secondary Nursing School	16	40	7	17.5		
Previous attendance of training courses:					0.40	0.55
Yes	3	7.5	1	2.5		
No	9	22.5	27	67.5		

*= Significant

Table (3): The mean scores of the nurses' knowledge related to infection control pre/post educational program n= 40

Items	Knowledge		T. test	P. value
	Pre Mean \pm SD	Post Mean \pm SD		
Infection.	2.9 \pm 1.8	4.7 \pm 1.7	4.45	.60
Cleaning and disinfection.	2.1 \pm 1.4	5.8 \pm 2.5	7.86	.04*
Sterilization.	1.7 \pm 1.6	5.1 \pm 2.1	7.35	.05*
Universal precaution.	2.5 \pm 1.96	7.2 \pm 2.1	11.75	.01*
Total of nurses' knowledge about infection control.	9.2 \pm 4.26	22.8 \pm 4.5	21.97	.001*

*= Significant

Table (4) describes the mean score of nurses' knowledge about invasive procedures pre/post educational program. The scores of satisfactory knowledge among nurses were generally low, except for suctioning and nasogastric tubes (3.0±1.1, 3.6±.7) respectively. The scores have all increased at the post program phase reached statistical significant difference endotracheal intubation (*P*0.03), umbilical vessel catheterization (*P*. 0.04), peripheral intravenous line placement (*P*0.03) and blood sampling (*P*. 0.000). The mean scores of total knowledge about invasive procedures 14.2±3.8 (*P*. 0.03).

Table (5) illustrates the relation between the

studied sample practice about infection control and their characteristics. It is evident that higher percentages of satisfactory practice were observed among nurses' age 20 years old to 30 years old or more (35%), nurses with years of experience from 5 to 10 years or more had higher percentage of satisfy practice (20%); respectively. Meanwhile, a higher percentage of nurses with no previous attendance of training courses (27.5%), compared to those who had attended such courses (7.5%). Nonetheless, as the table shows, none of these differences was statistically significant, at (*P*. > 0.05), but nurses' qualification difference was statistically significant, at (*P*. > 0.05).

Table (4): The mean scores of the nurses' knowledge related to invasive procedures pre/post educational program n= 40

Items	Knowledge		T. test	P. value
	Pre Mean ± SD	Post Mean ± SD		
Invasive procedure	1.5±.7	3.3±1.0	14.6	.08
Endotracheal (ET) intubation	1.3±1.1	3.4±1.0	9.2	.03*
Suctioning	3.0±1.1	3.1±1.2	7.6	.58
Umbilical vessel catheterization	1.6±1.2	3.7±1.2	6.8	.04*
Peripheral intravenous line placement	1.4±.7	3.8±1.5	9.8	.03*
Blood Sampling	1.8±.7	3.0±0.0	9.5	.00*
Nasogastric tube insertion	3.6±.7	4.0±0.0	19.5	.80
Total knowledge of nurses' about invasive procedures	14.2±3.8	24.3±6.9	5.7	.03*

*= Significant

Table (5): The relation between the studied sample practice about infection control and their characteristics n= 40

Items	Practice				X ²	P. value
	Satisfactory		Unsatisfactory			
	No	%	No	%		
Age in years:					0.60	0.74
< 20	2	5	4	10		
20 < 30	14	35	14	35		
30 < 40	1	2.5	5	12.5		
Years of experience:					0.34	0.93
< 5	2	5	6	15		
5 < 10	8	20	18	45		
10 < 15	2	5	4	10		
Qualification of nurses:					0.71	0.05*
Bachelor in Nursing Sciences	4	10	6	15		
Diploma of Technical Nursing Institute	3	7.5	4	10		
Diploma of Secondary Nursing School	10	25	13	32.5		
Previous attendance of training courses:					0.53	0.25
Yes	3	7.5	1	2.5		
No	11	27.5	25	62.5		

*= Significant

Table (6) shows the relation between the studied sample practice about invasive procedure and their characteristics. It is evident that higher percentages of satisfactory practice were observed among nurses' age 20 years old to 30 years old or more (10%), nurses with years of experience from 5 to 10 years or more had higher percentage of satisfy practice (12.5%), nurses who having Diploma of Secondary Nursing School (22.5%); respectively. Meanwhile, a higher percentage of nurses with no previous attendance of training courses (15%), compared to those who had

attended such courses (10%). The table shows that nurses' qualification difference was statistically significant, at (*P*. > 0.05).

Table (7) shows nurses' practice scores related to infection control pre/post educational program. It indicates increases in practice scores in all practice areas at the post- program phase. However, this increase reached statistical significance for nurses' practice about hand washing (*P*. 0.003), gloving (*P*. 0.01) and gowning (*P*. 0.01), while only in masking

(*P*. 0.001). The total means scores of practice about universal precautions 27.7 ± 11.08 (*P*. 0.03).

Table (8) illustrates nurses' practice scores related to invasive procedure pre/post educational program. It indicates increases in practice scores in all practice areas at the post- educational program phase.

However, this increase reached highly statistical significance for nurses' practice about suctioning and venipuncture (*P*. 0.00). While statistical significance for nurses' practice about peripheral intravenous line and total score of invasive procedure (*P*. 05), capillary blood sampling (*P*. 04).

Table (6): The relation between the studied sample practice about invasive procedures and their characteristics n= 40

Items	Practice				X ²	P. value
	Satisfactory		Unsatisfactory			
	No	%	No	%		
Age in years:						
< 20	0	0	6	15	0.65	0.25
20 < 30	4	10	24	60		
30 < 40	2	5	4	10		
Years of experience:						
< 5	3	7.5	5	12.5	0.90	0.54
5 < 10	5	12.5	21	52.5		
10 < 15	0	0	6	15		
Qualification of nurses:						
Bachelor in Nursing Sciences	3	7.5	7	17.5	0.76	0.05*
Diploma of Technical Nursing Institute	2	5	5	12.5		
Diploma of Secondary Nursing School	9	22.5	14	35		
Previous attendance of training courses:						
Yes	4	10	0	0	0.78	0.22
No	6	15	30	75		

*= Significant

Table (7): The mean score of the nurses' practice related to infection control pre/post educational program n= 40

Items	Practice		T. test	P. value
	Pre Mean \pm SD	Post Mean \pm SD		
Hand washing.	15.7 \pm 9.2	33.8 \pm 4.0	11.3	.003*
Gloving.	10.1 \pm 7.6	15.1 \pm 2.6	3.9	.01*
Masking.	0.7 \pm 1.4	2.7 \pm 1.7	6.3	.001*
Gowning.	1.2 \pm 2.3	7.2 \pm 2.16	11.5	.01*
Total scores of universal precautions	27.7 \pm 11.08	58.8 \pm 12.6	11.2	.003*

*= Significant

Table (8): The mean scores of the nurses' practice related to invasive procedure pre/post educational program n= 40

Items	Practice		T. test	P. value
	Pre Mean \pm SD	Post Mean \pm SD		
Suctioning	19.4 \pm 5.6	28.6 \pm 5.6	11.1	.00*
Peripheral intravenous line placement	30.6 \pm 11.1	41.8 \pm 7.2	6.1	.05*
Capillary blood sampling	13.6 \pm 8.1	24.0 \pm 3.6	8.3	.04*
Venipuncture (phlebotomy)	23.3 \pm 3.3	30.3 \pm 8.4	4.1	.00*
Nasogastric tube	18.6 \pm 3.4	21.7 \pm 2.0	5.0	.86
Total score of invasive procedure	124.9 \pm 32.6	203.2 \pm 25.9	10.0	.05*

*= Significant

4. Discussion

The neonatal mortality rates (NMR) in Egypt was 25 per 1000 live births. Half the deaths occurred in the first two days of life. Death of 55% of all infant occurred during the neonatal period. Neonatal causes were pre-maturity (21%) and infections (20%) (Oona, et al., 2006).

The majority of the studied sample were in the age group from 20<30 years old. Most of them have Diploma of Secondary Nursing School, current job experience from 5<10 years. Additionally, about 10% of the studied sample had previous attendance training courses about infection control of invasive procedure. This indicates that a considerable proportion

of the nurses in the present study had no long experience, especially in current job. Added to this is their qualification, which was mostly at the diploma level. These factors might have their repercussion of the levels of their knowledge and practice. These results are in an agreement with **Meltany (2006)** who reported that, the studied sample had higher mean scores of knowledge of nurses who had medium experience and have Secondary Nursing Diploma.

The age of nurses had its effect on their baseline pre/post program level of knowledge and practice. The results have indicated that knowledge was better among older nurses over 20 and less than 30 years compared to those less than 20 years, older than 30 and fewer than 40. This difference was statistically significant. Regarding practice, younger nurses had higher percentage of satisfactory practice compared to the older nurses; this difference was not statistically significant. This may be because maturity may play role in gaining and integrating knowledge. Moreover, as the nurses grows older, nurses is more responsible for administrative and managerial activities, while younger ones have more practical work in direct neonatal care. This finding is in accordance with the results of the study conducted by **Gamal, et al. (2006)** who found that, the highest scores of knowledge and practices was found among nurses who were younger, those with the least experience and those have Secondary Nursing Diplom. **Hassan and Aboulazm (2007)** stated that, the highest mean scores of knowledge and practice was found among nurses have Secondary Nursing Diplom, and also found that there were improvement of scores of knowledge and practice in post program related to invasive procedure.

Regarding, the nurses' knowledge and practices and their qualifications, the present study revealed statistically significant differences regardless nurses who had Bachelor in Nursing Sciences, Diploma of Technical Nursing Institute and Diploma of Secondary Nursing School (P.0.05). These results are in an agreement with those of **Abolwafa (2009)** who found that, the total scores of nurses' knowledge that having Diploma of Secondary Nursing School had significantly higher scores than those who having Bachelor in Nursing Sciences. In this respect **Ahmed (2007)** reported that, education increases knowledge and practice of nurses having Diploma of Secondary Nursing School.

After the program, the post-test, had shown statistically significant improvement for the total knowledge, in relation to infection control (cleaning and disinfection, sterilization, universal precaution) and total scores of nurses' knowledge about infection control. Also it was found by **Adinma et al. (2009)** that, knowledge of universal precautions measures was good for nurses. In relation to invasive procedure

(endotracheal intubation, umbilical vessel catheterization, peripheral intravenous line placement and blood sampling). **Paudyal et al., (2008)** most of nurses had good scores of knowledge regarding universal infection control precautions. **Badr (2004)** cited that, without clear orientation and enough training for nurses, no clear outcomes could be achieved.

This present findings of improvement of nurses' knowledge and practice after exposure to an educational program, is in congruence with **Rance and Trent (2005)** who stat that, improvement of nurses' knowledge and practice was found for the majority of nurses after implementation of the training program about infection control.

Conclusion

Based on result of the present study the nurses' in neonatal units at El-Minia University and General Hospitals were lacking the necessary basic knowledge and practices related to infection control of invasive procedure so, training program was based on nurses' needs of knowledge and practices, this came from pre-test results. By the implementation of the program there was remarkable improvement of nurses' knowledge and practices, it was clear in post-test results. By the end of the program there was successful in correcting the deficiency in nurses' knowledge and practices regardless to their age, qualification and years of experience.

Recommendations

Based on results of the present study are: The developed program should be applied and repeat again every 6 months in the same study setting and adopted in other similar settings with required modifications, provision of continuing education programs on regular basis is suggested in order to refresh and update nurse's knowledge, as well as reinforce proper practices related to infection control of invasive procedures in neonatal units, continuous supervision and evaluation for nurses' is needed to determine any defect related to knowledge or practices, rules and regulation for hospital visitors must be setting and applied and provision of adequate resources and facilities, (such as protective barriers, sinks, soap, towels, etc.) and equipment related to invasive procedures in neonatal units.

Correspondence author name:

Eman Sayed Masoed

Pediatric Nursing, Faculty of Nursing, Minia University.

magdy5871@yahoo.com.

References

1. Abolwafa N.F., (2009): Assessment of Nurses' Knowledge and Performances Related to Infection Control in Neonatal Units at El Minia City Hospitals, Unpublished Master Thesis in Pediatric Nursing, Faculty of Nursing, Assuit University.
2. Adinma E.D., Ezeama C., Adinma J.I. and Asuzu M.C., (2009): Knowledge and Practice of Universal Precautions against Blood Borne Pathogens amongst House Officers and Nurses in Tertiary Health Institutions in Southeast Nigeria. *Niger J Clin Pract*; 12(4):398-402.
3. Ahmed A.D., (2007): Assessment of Nursing Care Provided for Children Undergoing Haemodialysis, Unpublished Master Thesis, Faculty of Nursing, Alexandria University.
4. Badr O.E., (2004): Assessment of the Clinical Evaluation Process of the First Year Nursing Students, Unpublished Master Thesis, Alexandria Faculty of Nursing, Alexandria University.
5. Chemaly H.J., (2007): Nosocomial Blood Stream Infections in a Neonatal Intensive Care Unit of a Medical Centre, *J Microbiol Immunol Infect*; 35(3):168-72.
6. Elizabeth J.M., Judith A.S. and Patricia C., (2006): Manual of Nursing Practice, Infectious diseases, Lippincott Williams & Wilkins, New York, London Hong Kong, 8th ed., 1030-1047.
7. Emam EA, Hassan S.A., El-Moghazy D. and Mohamed N.S., (2005): Effect of Educational Program of Paramedicals Knowledge and Attitude toward Infection Control in El-Minia City Hospitals. Doctorate Thesis, Faculty of Nursing, Assiut University.
8. Gamal L.M., Mohamed K.G., Mohamed R.A. and Shawer O.A., (2006): Establishing Standards for Prevention of Nosocomial Infection in the Recovery Rooms and Surgical Ward at El-Minia University Hospital. Doctorate Thesis, Faculty of Nursing, Assiut University.
9. Hassan H.E. and Aboulazm S.F., (2007): Infection Control Education, the New Egyptian Journal of Medicine, 36(1): 67-73.
10. Heath J.E. and Zerr D.M., (2005): Infections Acquired in the Nursery: Epidemiology and Control, *Pediatric Infectious Diseases Journal of the Fetus and Newborn Infant*, Philadelphia, Elsevier Saunders; 23(2):1179-1205.
11. Marilyn J.H., David W.J. and Marilyn L.W., (2010): Essentials of Pediatric Nursing, Elsevier Mosby, U.S.A., 7th ed., 734-736.
12. Meltany L.K., (2006): National Infection Control Epidemiology of Needle Stick and Sharps Injuries in a Tertiary Care Center in Saudi Arabia. *Am J Infect Control*, 30(2):234-41.
13. Milligan D.W., Carruthers P.L., Mackley B.J. and Ward Platt M.P., (2011): 'Nursing Workload in UK Tertiary Neonatal Units' in *Archives of Disease in Childhood Published*, 5(114):1341 - 1347.
14. National Institutes of Health (2009): National guidelines for infection control, part 1, standard precautions.
15. Oona C., Reginald G. and Ayman E.M., (2006): The Egypt National Perinatal/Neonatal Mortality Study in Cairo, Egypt. *Journal of Perinatology*, 24: 284-289.
16. Paudyal P., Simkhada P. and Bruce J., (2008): Infection Control Knowledge, attitude and Practice among Nepalese Health Care Workers. *American Journal of Infection Control*, 36(8):595-597.
17. Potter P. and Perry A., (2004): *Fundamental of Nursing Concepts: Process and Practice*, St Louis, Mosby, 5th ed., 835-869.
18. Patricia A.P. and Anne G.R., (2005): *Fundamentals of Nursing*, Mosby, London, Sydney, 5th ed., 835-879.
19. Rance K.S., Trent C.A., (2005): Profile of a primary care practice of invasive procedure program: improved neonatal outcomes in a high-risk population, *J Pediatr Health Care*; 19(1):25-32.
20. Terese and Marlene (2010): Intravenous Infusion by superficial vein in the Neonate, *Journal of Infusion Nursing*, 13(2):122-128.
21. Terri K., Kyle T., (2008): *Essentials of Pediatric Nursing, Nursing Care of the child with an infection or communicable disorder*, Lippincott Williams & Wilkins; 418-422.
22. Vicky R.B. and Cindy S.G., (2008): *Pediatric Nursing Procedures*, Lippincott Williams & Wilkins, 3rd ed., 342-346
23. White L., Lois W., (2007): *Basic Nursing Foundations of Skills & Concepts, Infection Control*, Delmar Thomson Learning, Australia and Spain, 6th ed., 427-449.
24. Wikimedia Foundation (2006): November http://en.wikipedia.org/wiki/Neonatal_intensive_care_unit