

Nurses' knowledge and performance regarding infection control during milk formula preparation and its effect on neonates at El-Minia city hospitals

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Abstract: Milk products are excellent media for multiplication of potentially pathogenic bacteria. Inadequate conditions of production, preparation and handling formula milk may there –fore pose a considerable risk to infants. A number of cases of serious and sometimes fatal infection have been reported in formula fed preterm and term infants. **This work aimed to** assess the effect of nurses' knowledge and performance toward infection control measures that can be used during milk formula preparation on neonates in neonatal intensive care unit (NICU) in Minia University Hospital for obstetrics and pediatrics and in El- Minia General Hospital. The study subjects included 32 of nurses who working in neonatal intensive care units, 18 of them from El- Minia University Hospital for Obstetrics and Pediatrics (MUHOP) and 14 from El- Minia General Hospitals and 50 of neonates(preterm and full term)and receiving artificial feeding, who will be selected randomly. During the period from 15th of September 2009 to 15th of January 2010. This study is divided to three tools used by the researcher: The first tool was structured knowledge assessment questionnaire sheet, included the following, Biosocial data about nurses and Nurses' knowledge related to infection control, second tool **A structured observational check-list**, In order to delineate and collect data related to nurses' performance as regard the application of infection control measures during milk formula preparation in neonatal intensive care unit. The third tool **Assessment sheet for the neonates: which included** Personal and clinical data, Child food consumption pattern, Results of laboratory investigation, Clinical manifestation of neonatal infection. **Obtained results revealed that**, it was observed that the total score of nurses' knowledge and performance who attended training courses about infection control were higher than nurses' who didn't attend. There were a highly statistical significant difference in the + ve CRP, leukocytosis and TLC. Also; found neonates who receiving oral route have the lower score of signs of infection than those who receiving nasogastric tube route (NGT). **It's concluded** that neonates in Minia University Hospital for Obstetrics and Pediatrics (MUHOP) have less signs of infection than those in El –Minia General Hospital, the preterm neonates had more signs of infection than full term neonates, and the neonates receiving nasogastric tube feeding had more signs of infection than those who received bottle feeding.

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Key words: knowledge, performance, infection control, milk formula, neonates.

1. Introduction

Infant formula is a modern artificial substitute for human breast milk. Formulas are designed for infant consumption, and are usually based on either cow milk or soy milk. It is available in powder, liquid concentrate and ready-to-feed forms, which are prepared by the caregiver in small batches and fed to the infant (**Wikipedia, 2008**).

Premature and very-low-birth-weight human infants exposed to *Enterobacter sakazakii* in reconstituted powdered infant formula may develop infections resulting in septicemia, necrotizing enterocolitis, meningitis, hydrocephalus, or death. (**Richardson et al, 2006**).

Pediatric nursing should prepare powdered formula under aseptic techniques and conditions in a designated preparation area following the manufacturer's instructions. The product should be

refrigerated immediately and discarded if not used within 24 hours. The administration hang time for continuous enteral feeds should not exceed 4 hours (**Weir, 2002**).

Appropriate preparation and handling of nutritional products is necessary to reduce the risk of milk becoming a source of nosocomial infection (**Agostoni, et al., 2004**).

Multiplication of the organism in prepared formula feeds can cause devastating sepsis, particularly in the first 2 months of life. In approximately 50 published case reports of severe infection, there are high rates of meningitis, brain abscesses and necrotizing enterocolitis with an overall mortality from 33% to 80% (**Kandhai et al., 2004**).

Health care facilities must implement infection prevention and control policies supported by institutional management such as, hand hygiene,

person protective equipments, isolation precautions, aseptic technique, cleaning and disinfection, sterilization, waste management, antibiotic use protocol, immunization and exposure management (WHO, 2004).

2. Subjects and Method:

Research design: A descriptive research design was utilized to meet the aim of the study.

Study Setting:

This study was conducted in Neonatal Intensive Care Units (NICU) at Minia University Hospital for Obstetrics and Pediatrics (MUHOP) (SMUH previously) and at El-Minia General Hospital.

Subjects:

The study Subjects include 32 of nurses who working in neonatal intensive care units, 18 of them from Minia University Hospital for Obstetrics and Pediatrics (MUHOP) and 14 from El-Minia General Hospitals and 50 of neonates who will be selected randomly. During the period from 15th of September 2009 to 15th of January 2010.

Tools of the study:

Three tools for collecting data were used in this study. Tools were constructed by the investigators and content validity was done, tools were revised by experts in the field of research.

Tool (I): Interview questionnaire sheet:

This developed by the investigator after reviewing of the related literature and guided by (Elizabeth, et al., 2006, American dietetic association & CDC, (2009) to assess the nurse's knowledge toward infection control during milk formula preparation. The questionnaire sheet includes the following:

- A. Biosocial data about nurses as: nurses' names, age, marital status, level of education, residence, qualifications, years of experience, and training program.
- B. Nurses' knowledge related to infection control which include the following; infection (6 items), milk formula preparation (11 items) the total items of nurses' knowledge was 17 items.

Tool (II): A structured Observational check-list:

This checklist was developed by the investigators with guided of (Harkreader, et al., 2007, Agostoni, et al., 2004). In order to delineate and collect data related to nurses' performance as regard the application of infection control measures during milk formula preparation in neonatal intensive care unit. It included; hand washing (9 steps) cleaning and sterilization of artificial feeding equipments (8 steps) so the total steps was 17.

Tool (III): Assessment sheet for the neonates: which include:

- A- Personal and clinical data such as, Diagnosis, Birth weight, sex, gestational age, postnatal age.
- B- Child food consumption pattern such as, number of feeding/ day, amount and type of milk, and route of feeding.
- C- Laboratory investigation that will be made and present in the neonate's sheet such as; W.B.C, C.R.P and culture.
- D- Clinical manifestation of neonatal infection, (Mandell, et al., 2005). Such as poor feeding, breathing difficulty decreased or elevated temperature, skin rash, persistent crying, irritability, vomiting and diarrhea.
- E- Anthropometric measurements: It includes weight, length, head and chest circumference.

Statistical design:

Data entry was done using compatible personal computer. The statistically analysis was done using SPSS-12 statistical software package and Excel for figures. The content of each tool was analyzed, categorized and then coded. Data were presented using descriptive statistics in the form of frequencies and percentages for qualitative variables, 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. For multiple groups F-test or (ANOVA) was used. Qualitative studied variables were compared using Chi-square test. Pearson correlation analysis was used for assessment of the inter-relationships between the total scores of nurses' knowledge and performances about infection control during milk formula preparation. Statistical significance was used at P value < 0.05.

3. Results:

There were highly statistical significant difference between both groups in years of experience, and training courses about infection control where ($p=0.006$ & 0.002 respectively table 1).

The Mean score of nurses knowledge and performance concerning to their qualification, it was found that the mean and \pm SD of nurses knowledge as regarding diploma in nursing, technical institute, and bachelor of science in nursing were (29.5 ± 1.64 , 44.83 ± 3.3 and 43.67 ± 4.7), respectively, for performance the mean score and \pm SD were (36.7 ± 72.25 , 35.6 ± 2 and 38 ± 4.73 table 2), respectively. While the relationship between neonates of MGH group and MUHOP group according to signs of infection, the result shows neonates of MUHOP have less signs of infection than neonates in MGH (figure1), also the Pre-term neonates have higher score of incidence of signs of infection than Full-term neonates (figure2).

There were significant difference between the routes of milk feeding of neonates groups and signs of infection in the items of poor feeding, persistent crying, irritability, vomiting, CRP, leukocytosis and total leukocyte count TLC (P = 0.001, 0.006, 0.003,

0.01, 0.005, 0.003, 0.003), respectively, neonate receiving oral route have the lower score of signs of infection than those who receiving nasogastric tube route (NGT) table 3, fig.3&4.

Table (1): Study characteristics

General Characteristics	Nurses of MGH group (N = 14)	Nurses of MUHOP group (N = 18)	p
Age, n (%)			
Less than 20 years	0(0.0)	2 (11.1)	0.083
20 to 30 years	7(50)	13 (72.2)	
More than 30 years	7(50)	3 (16.7)	
Marital status, n (%)			
Single	2(14.3)	8 (44.4)	0.068
Married	12 (85.7)	10 (55.6)	
Years of experience, n (%)			
Less than 5 years	2 (14.3)	10 (55.6)	0.008*
From 5 to10 years	9 (64.3)	8(44.4)	
More than 10 years	3 (21.4)	0(0.0)	
Training courses about infection control			
No	1 (7.1)	13 (72.2)	*0.0002
Yes	13 (92.9)	5 (27.8)	

MGH: Minia General Hospital , MUHOP: Minia University Hospital for Obstetrics and Pediatrics *Significant p- value<0.05

Table (2): Mean Score of nurses knowledge and performance concerning to their qualification (n=32)

Items	Secondary Nursing Diploma No = 20	Technical Institute of Nursing Diploma No = 6	Bachelor of Sciences in Nursing No = 6	F-test	P
	Mean ±SD	Mean ±SD	Mean ±SD		
Knowledge:					
Infection(17)	15.35±0.7	14.8±1.3	15.3±1.5	0.65	0.53
Milk preparation(33)	29.5±1.64	29.83±3.1	28.67±4.1	0.36	0.7
Total (50)	29.5±1.64	44.83±3.3	43.67±4.7	0.27	0.77
Performance:					
Hand washing(27)	20.1±1.8	19.3±1.37	20.3±2.7	0.48	0.62
Sterilization(23)	16.6±1.1	16.3±1.2	17.67±2.5	1.54	0.23
Total(50)	36.7±2.25	35.6±2	38±4.73	1.05	0.36

One way ANOVA F-test, *Significant p value<0.05

Figure (1): Distribution of signs observed among neonatal groups according to their hospitals

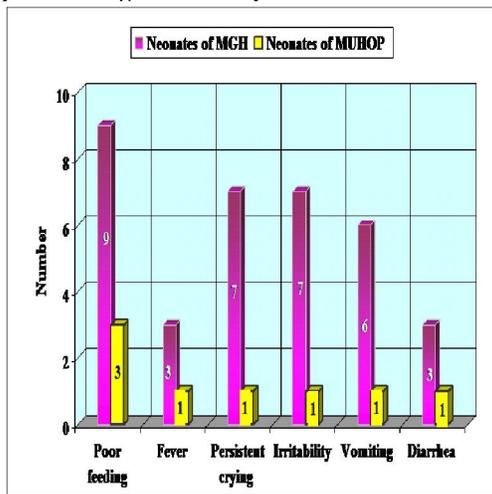


Figure (2): Distribution of signs observed among neonates according to their gestational age

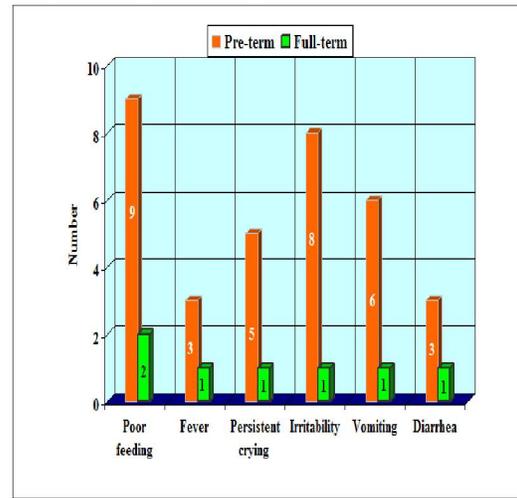
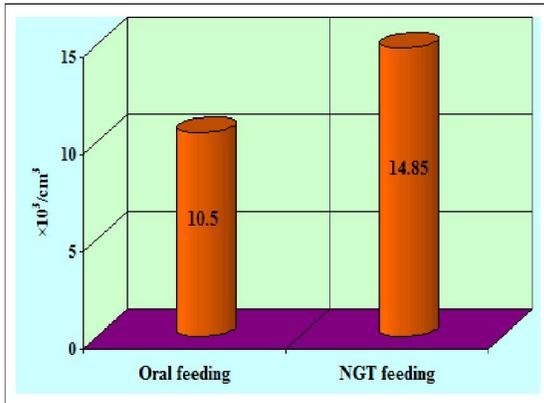
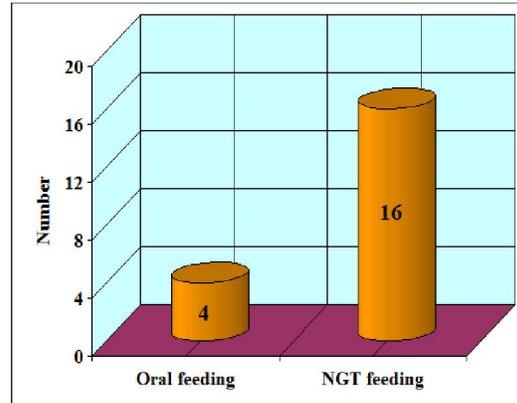


Table (3): Relationship between the routes of milk feeding of neonatal groups and signs of infection

Items	Oral route (N = 22)	NGT route (N = 28)	Test of proportion	p
Poor feeding, n (%)	0(0.0)	11 (39.3)	11.08	0.001*
Fever, n (%)	0(0.0)	4 (14.3)	3.42	0.065
Persistent crying, n (%)	0(0.0)	8 (28.6)	7.48	0.006*
Irritability, n (%)	0(0.0)	9 (32.1)	8.62	0.003*
Vomiting, n (%)	0(0.0)	7 (25)	6.4	0.01*
Diarrhea, n (%)	0(0.0)	4 (14.3)	3.42	0.065
CRP, n (%)	4 (18.2)	16 (18.2)	7.8	0.005*
Leukocytosis, n (%)	3(13.6)	18 (13.6)	12.97	0.003*
TLC $\times 10^3/\text{cm}^3$				
Range	6.9-17	8-28	3.12	0.003*
Mean \pm SD	2.2 \pm 10.5	14.85 \pm 6.2		

CRP: C-reactive protein, TLC: Total Leukocytic Count, **Leukocytosis**: TLC > 11.000 cell $\times 10^3/\text{cm}^3$, Chi-square test, for categorical data (CRP and leukocytosis), Fisher's exact F-test for other signs, Independent t-test for quantitative data (TLC), Significant p value < 0.05.

Figure (3): Total Leukocytic Count (TLC) of neonates groups according to their route of feeding**Figure (4): C-reactive protein (CRP) of neonates groups according to their route of feeding**

4. Discussion:

The present study revealed that total scores of nurses' knowledge and performance who attended training courses about infection control were higher than those who didn't attend. This finding is in accordance with the results of the study conducted by Emam, et al., (2004) who found that the scores of the nurses' who attended training courses were higher than percentages of nurses' who had satisfactory scores knowledge and favorable attitude than those who didn't attend. Abdullah, (1999), who mentioned that there was a positive relation and statistically significant difference between nurses knowledge and performance and their receiving a training course in infection control. As well as Moustafa (2006), who reported that after in- service training program implementation there was a highly significant improvement in total knowledge scores of all nurses subgroups.

The present study revealed that the neonates receiving NGT feeding are more susceptible to infection more than those who received oral feeding. This finding is in accordance with the results of the study conducted by Berthelot et al., (2001) who

proposed a role of enteral feeding in the colonization and infection of premature infants by *K. oxytoca* and a rise in incidence of neonatal infections due to Enterobacteriaceae, which they are the predominant causative agents in NICU outbreaks, as well as Mehall et al., (2002). Who found that neonatal nasogastric enteral feeding tube in NICUs acting as a site of bacterial colonization. Enteral nutrition (EN) tubes have been associated with outbreaks of antimicrobial-resistant organisms. He also stated that the enteral feed administration sets become colonized externally by microbes grown from the enteral tube hub, and therefore serve as a reservoir of organisms that can be cross-transmitted. Bacterial contamination of the nutritive solution with enter toxin-producing bacteria such as coli forms or *Enterobacter cloacae*, at the time of preparation, storage or delivery to the patient, leads to gastroenteritis and/or septicemia. Lee and Polin, (2003), presented that nasogastric tubes and enteral nutrition are factors which provide the basis for bacterial growth or toxin production. Markedly contaminated enteral feed has been reported to cause, not only diarrhea, but also sepsis, pneumonia and

urinary tract infections. Anderton, (2009) stated that it is now widely recognized that enteral feeds may become contaminated with microorganisms during preparation and administration. Evidence is presented illustrating the role of this contamination in the development of infectious complications, including bacteraemia, septicemia, pneumonia, diarrhea and infectious enterocolitis. Details are given of potential sources of microbial contamination including the feed ingredients, inadequately cleaned equipment, personnel and the patients themselves.

This study revealed that the preterm neonates have higher incidence of infection than full term neonates. This finding is in accordance with the result of the study conducted by Schwiertz et al., (2003) who found that the pattern of bacterial colonization in the premature neonatal gut is different from that in the healthy, full-term infant gut. Infants requiring intensive care acquire intestinal organisms slowly. The establishment of bifidobacterial flora is retarded, and delayed bacterial colonization with a limited number of bacterial species tends to be virulent. He also showed an increase in similarity of the bacterial communities in hospitalized preterm infants in contrast to breast-fed, full-term infants. A strikingly high similarity was observed between bacterial communities from different preterm infants regardless of birth weight, feeding regime, and antibiotic therapy as well as Zhang, et al., (2005). Who found that, extremely premature newborns (< 28 weeks gestation) have a 5-to 10- fold higher incidence of microbial infection than even term newborn.

Conclusion

Based on the results of the present study, we concluded that the score of nurses' performance who were working at Minia University Hospital for Obstetrics and pediatrics (MUHOP). were significantly higher than those who working at El-Minia General hospital, the score of nurses' knowledge who were working at El-Minia General Hospital were significantly higher than those who working at (MUHOP) and the score of nurses who attended training courses about infection control were more than the score of nurses' who didn't attend these training courses. In addition the neonates in Minia University Hospital for Obstetrics and Pediatrics (MUHOP) have less signs of infection than those in El -Minia General hospital, the preterm neonates had more signs of infection than full term neonates, the neonates receiving nasogastric tube feeding had more signs of infection than those who received bottle feeding.

Recommendation

Based on the finding of the current study, the following recommendations are suggested:-

- Neonatal nurses should update knowledge and performance through continued nursing education and training and frequently attending seminars and conferences based on their needs assessment. Rules and regulations for hospital visitors must be set and applied.
- Nurses' practices have to be continually monitored, supervised continuously by nursing audits and supervisors.
- Written guidelines for preparation and handling of infant formula should be established for hospitals and other institutions, and their implementation should be monitored.
- The use of sterile liquid formula is encouraged for healthy newborn infants in maternity wards.
- Trained personnel should prepare powdered formula under aseptic technique in a designated preparation room.
- Full training should be given to staff preparing feeds, so that they understand the risks involved with PIF and know what steps to take to ensure these risks are reduced or controlled.

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