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Intensive Care Nurses' Knowledge & Practices regarding Infection Control Standard Precautions at a Selected Egyptian Cancer Hospital

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Abstract

Critical care nurses are the health care professionals who have the obligation to protect critically ill patients against infection especially those who are immune compromised, in order to enhance their recovery, prevent deterioration in their health, and achieve high quality nursing care. Therefore critical care nurses should have sound knowledge and strict adherence to infection control standard precautions. **Aim of the study:** to assess nurses' knowledge and evaluate their practice regarding infection control standard precautions**. Research design:** A descriptive research design was utilized in this study. **Sample:** A sample of convenience including 77 ICU nurses was recruited in the current study. **Setting:** The study was carried out at the Intensive Care of a selected Cancer Hospital in Egypt. **Tools of data collection:** Two tools were developed, tested for clarity and feasibility, and then used to collect data pertinent to the current: **a- Structured Interview Questionnaire** to assess nurses' knowledge regarding infection control standard precautions. **b-Nurses' Performance Observational Checklist** to evaluate nurses' practice / utilization of infection control standard precautions. **Results:** the current study revealed that, approximately two thirds (63.6%) of the studied sample had unsatisfactory knowledge level (<75%) with a mean total knowledge score of 102.5 $\pm$ 13.7. However, more than half (57.1%) of the studied sample had satisfactory performance level (>75%) with a mean total performance scores of 77.3$\pm$4.4. Negative significant correlations were found between: mean knowledge scores, and age; mean knowledge scores and years of experience (r = -.323 & r = -.325 at P $\leq$ 0.004 respectively); between mean practice scores and age; and mean practice scores and years of experience (r = -.235 & r =-.291 at P $\leq$ 0.39, 0.010 respectively). However, positive correlations were found between mean knowledge scores and mean practice scores; age and years of experience (r = 0.318 & 0.794 at P $\leq$ 0.005 & 0.000 respectively). **Conclusion:** Based on findings of the current study, it can be concluded that inspite of having satisfactory performance level regarding infection control standard precautions, critical care nurses had unsatisfactory knowledge level. **Recommendation:** updating knowledge and performance of ICU nurses through continuing in-service educational programs; emphasizing the importance of following the latest evidence-based practices of infection control in continuing education / training programs; strict observation of nurses' performance/ utilization of infection control standard precautions and correction of poor practices by the infection control team are required; and providing training programs for newly joined ICU nurses about infection control standard precautions and at regular intervals.
Key Words: Infection control (IC), Standard precautions (SP), Intensive care unit (ICU), Knowledge, Practices

1. Introduction

Nosocomial infection (NI), or hospital-acquired infection or Health-care-associated infection (HCAI) refers to infection that is acquired during the process of care and not manifested at the time of admission to a hospital or other health-care facility (Nejad, et al, 2011, Bhutta, et al, In Qayyun, Sattar &Waqas, 2010, and Sandokji, et al, 2009). About 5% –10% of patients admitted to acute care hospitals in developed countries acquire HCAI at any given time, and the risk of acquiring infection is 2 – 20 times higher in developing countries (WHO, 2010). It constitutes a global health problem, and is considered as one of the leading causes of increased morbidity and mortality; longer duration of hospital / ICU stay; increased severity of the underlying illness; increased utilization of devices for monitoring and treatment; increased cost of treatment in both developed and resource-poor countries; and impairment of the quality of patient's and family's life (Uwaezuoke & Obu, 2013, and Elting & Escalante, 2008). HCAI accounts for higher rates of morbidity and mortality among critically ill patients, due to severity of illness and thus increased susceptibility to acquire more micro-organism related to their presence in the intensive care unit (ICU).

The risk of acquiring HCAI is especially significant in the ICUs. As indicated by Louis, (2011) a huge number of immune compromised patients are admitted to ICUs. Approximately 30% of ICU patients are affected by one or more episodes of HCAI (Allegranzi, Bagheri Nejad, Chraiti, Combescure, Attar, Pittet, 2011). Among those are pediatric cancer patients, particularly those who have blood dyscrasias such as leukemia and lymphoma, which require aggressive management through diagnostic and therapeutic treatment modalities such as chemo or radiotherapy (Macher et al, 2010). These patients are faced with increased risks of nosocomial infections, and so life-threatening conditions (Al-Tonbary et al., 2011). In attempt to evaluate the prevalence of nosocomial infections in 27 hospitals in the Mediterranean region, studies done by Amazian, et al, (2010) at some countries including Egypt, Jordan, Lebanon, Morocco and Tunisia revealed that, the its prevalence was 10.5%; among young adults as compared to 11.3% among pediatrics. Therefore, nurses have a professional and moral obligation to protect the health of their patients and share the responsibility to sustain and protect the natural environment (ICN, 2009).These principles of nursing practice provide an overarching framework for achieving quality nursing care and clarifying nursing's contribution to improve health care outcomes and patient experiences (Currie et al., 2011).

Infection control (IC)/prevention is the responsibility of critical care nurses, and represents an integral element of patients' safety programmes (Royal College of Nursing RCN, 2012). It encompasses the processes and activities which identify and reduce the risks of acquiring and transmitting endemic or epidemic infections among individuals (Talaat et al., 2006, David, & Famurewa, 2010). IC and

prevention refer to the clinical application of microbiology in practice. It is also a quality standard which is essential for the well-being and safety of patients, staff and visitors in hospitals' environment. It affects most departments of the hospital that are involved in issues of quality, risk management, health and safety (Cole, 2007& Famurewa, 2010). As well, standard precautions are designed to protect healthcare professionals and patients from exposure to potentially infected blood and body fluids by applying the fundamental principles of infection prevention (Okechukwu & Motshedisi, 2012, Ganczak & Szych, 2007, Motamed, et al 2006). Knowledge of clinical infection control practices is continually growing and changing. While the principles of infection control (prevention, transmission and control) do not change, specific clinical practices may evolve as a result of new evidence (College of Nurses of Ontario "CNO", 2009).

All standards of care provide a guide to the knowledge, skills, judgment and attitudes that are needed to practice safely. They describe what each nurse is accountable and responsible for in practice. The aim of standard IC precautions is to prevent HCAI.

Infection control standards become an integral part of the accreditation program for all medical settings in Egypt, where the National Guidelines for Infection Control" (NGIC) are produced and established by the infection control team at the Ministry of Health & Population (MOHAP) since the year 2003 (Ibrahim, Said, Hamdy, 2011, MOHAP 2007, and Pittet, Hugonnet & Harbarth 2006). Infection control standard precautions include certain measures such as hand hygiene, sharps safety, staff health, use of personal protective equipment (PPE), equipment safety, single use policy, waste management and environmental cleaning. Many infection control measures, such as appropriate hand hygiene and the correct application of basic precautions during invasive procedures are simple and of low-cost, but require staff accountability and behavioral change, in addition to improving staff education, reporting and surveillance systems (Bouallègue, et al, 2013). To utilize these precautions, the human element plays an important role in increasing or decreasing the chances of catching HCAI (Cole, 2007). Therefore, adequate nursing staff is necessary because a higher patient-to nurse ratio increases the risk of nosocomial infection (Hugonnet, Chevrolet, & Pittet, 2007).

Nurses are likely to be exposed to microorganisms during their daily practice due to their close and frequent direct contact with patients (Maltezou et al., 2008). This could be one of the main causes of transmitting infection to the patients. Surveillance for infection in the data collection setting in the current study revealed that central line infection were the most frequent among other sites where it represented 24.2 %. So, reflecting inadequate compliance to infection control measures. This proportion of infection was found inspite of attending preparatory courses about infection control standards. Therefore, nurses should demonstrate the ability to effectively utilize principles of infection control, which was described by French, (2007), to be highly cost effective. The costs of infection control and staffing are less when compared to that of HCAI. Therefore, nurses should have professional and ethical responsibilities to make sure that their knowledge and skills regarding infection control are up-to-date and they practice safely and competently at all times (Royal College of Nursing, 2012). Thus, education about infection prevention and control was targeted as one of the main objectives of the infection control programs especially where nurses represent the largest group of workers within the healthcare system (Rasslan, 2011 & WHO, 2008). However, few studies about the incidence of nosocomial infections in pediatric patients and comparative data from pediatric oncology units are rarely reported (Al-Tonbary et al., 2011). As well, studies that assess nurses' knowledge & practice of infection control standards in ICUs are scares and needed. Therefore the present study aim to reveal to what extent nurses perform their role regarding infection control standards, hoping to develop and emphasize their role performance in the near future.

2. Subjects and Method

2.1. Aim of the study: to assess nurses' knowledge, and evaluate their practices regarding infection control standard precautions at the ICU of a selected cancer hospital– Egypt.

2.2. Research questions: the following two research questions were formulated to achieve the aim of the current study:

2.3.1. What are levels of nurses' knowledge about infection control standard precautions at the ICU of a selected cancer hospital – Egypt?

2.3.2. What are levels of nurses' practices of infection control standard precautions at the ICU of a selected cancer hospital – Egypt?

2.3. Research design: A descriptive research design was utilized in the current study. This design is concerned with description of a phenomenon of interest and focused on a single group or population characteristics without trying to make interference.

2.4. Setting: The current study was conducted at the intensive care unit of Children Cancer Hospital (57 – 3 -57) – Egypt.

2.5. Subjects: A Sample of convenience including 77 nurses, representing all those who work in the ICU of Children Cancer Hospital – Egypt, was included in the current study.

2.6. Tools of data collection: Two tools were developed and utilized by the researcher to collect data pertinent to the current study: a structured interview questionnaire and nurses' performance observational checklist.

2.6.1. A Structured Interview Questionnaire was developed to assess nurses' knowledge regarding infection control standards. Development of this questionnaire was guided by Standards of infection control in Children Cancer Hospital, Standard of Joint Commission on Accreditation of Health Care Organizations, (2009), and Policies and Procedures of Children Cancer Hospital in (2009). This questionnaire consists of two parts: a- Sociodemographic characteristics such as gender, age, education, work place, years of experience, and attendance of training programs about infection control; and b- a list of infection control standard precautions (76 items). The tool's items were categorized under 11 main domains which were related to knowledge about infection; nosocomial infection; sharp devices & needle stick injuries; body fluid spillage & linen management & waste disposal, hand hygiene; personal protective equipment; isolation precaution; sterilization & disinfection; standard precaution; blood born diseases and methods used to prevent infection.

Scoring system: One score was allocated to each right answer and zero to the wrong answer. Scores of less than 75% are considered unsatisfactory, however scores of 75 % -100% are considered satisfactory.

2.6.2. Nurses' performance Observational Checklist: was designed to evaluate nurses' practice / utilization of Infection control standard precautions. It covers 13 main items with 95 sub-items related to: hand hygiene; personal protective devices;

sharp devices; linen management; intravenous infusion therapy; visitors and isolation; wound care; central line care, endotracheal suctioning procedure; urinary catheter care; chest tube care; and waste disposal. Each nurse's performance was recorded in the checklist as either done or not done.

Scoring system: One score was allocated to each correct performance and zero to incorrectly done, incompletely done, and not done performance. Scores less than 75% are considered un satisfactory practices & scores from 75 % -100% are considered satisfactory.

3. Tools validity and reliability: designed tools were examined for content validity by a panel of five experts in the field of Critical Care Medicine, and Critical Care and Emergency Nursing to test their clarity and objectivity and if they are suitable to achieve the aim of the study.

4. Pilot study: A pilot study was carried out on 7 staff nurses working in the intensive care unit to test feasibility, objectivity, and applicability of the data collection tools. Carrying out the pilot study gave the investigators experience to deal with the included subjects, and to use the data collection tools. Based on results of the pilot study needed refinements and modifications were done. Because modifications were minor and didn't affect the main data, subjects who shared in the pilot study were included in the actual study sample.

5. Protection of human rights: The current study was approved by human research, and ethical committee at the faculty of nursing–Cairo University. Official permissions were obtained from medical and nursing directors of the ICU at Children Cancer Hospital. As well written consents were obtained from critical care nurses after explaining the purpose and nature of the study. Each nurse was free to either participate or not in the current study and had the right to withdraw from the study at any time without any rational.

Also, nurses were informed that obtained data will be used only for research purpose and not for their evaluation. Confidentiality and anonymity of each subject were assured through coding of all data.

6. Procedure:

The current study was conducted on two phases: the designation phase and implementation phase. As regards to the designation phase; it was concerned with construction and preparation of different data collection tools, in addition to obtaining managerial agreement to carry out the study. This phase lasted for about two months. Concerning the implementation phase; it was carried out after obtaining official permissions to carry out the study. Data of the current study were collected over a period of 6 months starting from March 2012 to August 2012. The selected ICU was visited on daily basis, and nurses were approached during the morning and afternoon shifts, where the purpose and nature of the study were explained and written consents were obtained from those who accepted to share in the study. Then involved nurses were submitted with the first data collection tool (Structured Interview Questionnaire). The researcher was available at the ICU during the time of filling the data collection sheet to answer any question, and to provide the needed explanations. Then the researcher revised the questionnaire to be sure that there are no missing data/ items. Filling this sheet required about 25- 35 minutes from each nurse. Observation of nurses' was carried out utilizing the second tool (Nurses' performance Observational Checklist). Participants' direct observation was done so that the nurses were observed during their practice/ provision of care and carrying out different procedures. Each nurse was observed on three different occasions while performing each procedure of the observational checklist. Obtained data were converted into numeric data, and the average of the three observations was calculated.

7. Results:

7.1. Table (1) presents demographic characteristics of the studied sample. It clarifies that most of the studied nurses were in the age group of 20-29, had bachelor degree and work as staff nurses in percentages of (76.6%, 66.2%, & 81.8%) respectively. However, more than half was females, single, and had less than five years of experience, in percentages of (53.2%, 57.1% & 50.6%) respectively. Regarding attendance of training courses, around two thirds of the studied sample (63.6%) never attends any continuing education courses about infection control.

7.2. Figures (1 and 2): shows percentage distribution of the studied sample according to received vaccinations. It clarifies that, the majority (80.5%) of the studied sample received vaccination which in common was against hepatitis B viral infection among 74%.

7.3. Figure (3): shows percentage distribution of the studied sample according to their knowledge about infection control standard precautions. It clarifies that approximately two thirds (63.6%) of the studied sample had unsatisfactory knowledge level (<75%).

7.4. Table (2) shows frequency distribution of the studied sample as regards to their total & subtotal knowledge scores. It reveals that, the majority of the group who had unsatisfactory knowledge, especially about isolation precautions, sterilization & disinfection, nosocomial infection, blood born disease, administration of intravenous solution, and antibiotic resistance organism in percentages of (90.9%, 90.9%, 75.3%, 75.3%), respectively, with a subtotal mean knowledge scores of 12.4 $\pm$ 3.4, 3.9 $\pm$ 1.2, 14.8 $\pm$3.9, & 6.5+1.4 respectively and a mean of total unsatisfactory knowledge score of 102.5 $\pm$ 13.7.

7.5. Figure (4): clarifies percentage distribution of the studied sample according to their performance regarding infection control standard precautions. It indicates that, more than half (57.1%) of the studied sample had satisfactory performance

level (>75%).

7.6. Table (3) shows frequency distribution of the studied sample as regards to total & subtotal performance scores. It clarifies that, most of the group who had satisfactory performance level was regarding urinary catheter care, suctioning procedure, personal hygiene and care of chest tubes, in percentages of (89.6%, 88.3%, 79.2% & 77.9%) respectively with subtotal mean performance scores of 6.9±0.9, 6.0+0.9, 3.2 ± 0.6, 4.3 ± 0.5 respectively and a mean total performance score of 77.3±4.4.

7.7. Table (4) displays correlation between personal characteristics of the studied sample, mean scores of knowledge and practice of infection control standard precautions. It reveals negative correlations between: mean knowledge scores, and age; mean knowledge scores and years of experience (r = -.323 & r = -.325 at P ≤ 0.004 respectively); between mean practice scores and age; and mean practice scores and years of experience (r = -.235 & r =-.291 at P ≤ 0.39, 0.010 respectively). However, positive correlations were found between mean knowledge scores and mean practice scores; age and years of experience (r = 0.318 & 0.794 at P ≤ 0.005 & 0.000 respectively).

7.8. Table (5) shows comparison of mean knowledge scores in relation to socio-demographic characteristics of the studied sample. It displays that high mean knowledge scores were found among those who were at the age group of 20-29 years, males, single, have years of experience less than ten years, attended training courses and had long day shifts with means of (115.2 ± 16.0, 113.8±19.0, 115.3 ± 15.9, 115.3 ± 15.9, 115.2±16.7, 118.8±13.5) respectively. Significant statistical differences were found in mean knowledge scores only in relation to age, years of experience and work shift (t = 2.526, 2.408 and F = 4.673) at p ≤ 0.05 (0.014, 0.018, 0.012) respectively.

7.9. Table (6) shows comparison of mean performance scores in relation to socio-demographic characteristics of the studied sample. It displays that, high mean performance scores were found among the studied sample who were at the age group of 20-29 years, females, single, have years of experience less than ten years, attended training courses and had long day shift with means of (73.4 ± 7.9, 72.8±8.5, 73.8 ± 6.7, 73.5 ± 8.0, 72.6±8.7, 76.0±5.5) respectively. Significant statistical differences were found in mean performance scores in relation to age, years of experience and work shift (t = 3.226, t = 2.993 and F = 5.478) at p ≤ 0.05 (0.002, 0.004, 0.006) respectively.

7.10. Table (7) shows comparison of the studied sample mean knowledge scores in relation to their qualification. It reveals that nurses who had bachelor degree displayed higher mean knowledge scores as compared to the other two groups (diploma & diploma with specialty). This was observed for all assessed items except for that related to sharp devices and needle stick injuries. High significance statistical differences were found between the three groups in relation to infection, sharp devices and needle stick injuries, hand hygiene, personal protective equipments, standard precaution, blood born disease and administration of intravenous solution, antibiotic resistance organism, and methods used to prevent infection and overall scores of knowledge (F=7.422, F=4.826, F=3.179, F=4.678, F=4.639, F=5.246, F=3.970, F=6.083) respectively at p ≤ 0.05.

7.11. Table (8) shows comparison of the studied sample mean performance scores in relation to their qualifications. It clarifies that nurses who had bachelor degree displayed higher mean performance scores as compared to the other two groups (diploma & diploma with specialty). High significant statistical differences were found between the three groups in relation to sharp devices, personal protective equipment (gloves, gowns &masks), care of intravenous infusion therapy, central line care and urinary catheter care (F=4.594, F=7.982, F=5.539, F=4.471, F=15.310, F=4.345) respectively at p ≤ 0.05.

7.12. Figure (5) shows frequency distribution of obstacles to utilization of infection control standards as reported by the studied sample. It reveals that the most frequently reported obstacles to apply infection control standards were lack of supplies, shortage of staff, more duties and emergency situation such as cardio-pulmonary arrest in percentage of (79.2%, 64.9%, 63.6% & 62.3%) respectively.

8. Discussion:

Hospital acquired infection is a common problem all over the world. Therefore, up to date knowledge and refined practical nursing skills can play important roles in preventing infection. Nurses should have the opportunity to practice infection control on a day-to-day basis as an integral part of patients' care. That is why the current study was carried out. As revealed from the current study, nearly two thirds of the studied sample aged between 20 to 30 years old. This finding is in concordance with that of Sreedharan, Muttappillymyalil & Venkatramana (2011) which studied knowledge about standard precautions among university hospital nurses in the United Arab Emirates and that of Efstathiou, Papastavrou, Raftopoulos & Merkouris (2011), which studied compliance of Cypriot nurses with standard precautions to avoid exposure to pathogens, and reflected approximately the same picture.

As well, Labrague, Rosales, Tizon (2012), found in their study about knowledge and compliance with standards precautions that the mean age was slightly lesser. This could reflect the young age of the studied sample and so the ability to acquire knowledge and change their behaviors based on submission of up to date knowledge. In this regards Alwutaib et al (2012) revealed that older age is an important determinant of lower knowledge levels. Concerning gender, the current study demonstrated the dominance of females than males, who were in common single. This finding is in agreement with that of Labrague, Rosales & Tizon (2012); Vaz et al (2010), and Hamid, Aziz, Anita, Norlijah (2010), who revealed the dominance of females among more than most of their studied samples. As well, Labrague, Rosales, Tizon (2012) found the great majority of their studied sample single.

Assessment of nurses' knowledge revealed unsatisfactory levels among more than two thirds of the studied nurses while approximately one third had a satisfactory level. In attempt to identify areas of knowledge deficit among the majority who

had unsatisfactory knowledge level, it was found that: the concept of infections and nosocomial infection; isolation precautions; sterilization; disinfection; blood born diseases; administration of intravenous solutions; and antibiotics were the main areas of knowledge deficit. On the same line with this finding was, Qayyum, Sattar, Waqas (2010) who found poor knowledge about nosocomial infections and their routes of spread among their studied sample. However, contradicting findings were revealed by Ibrahim, Said & Hamdy (2011), who found the majority of their studied group aware with, what infection is, and how it is transmitted. In this regards Perry and Potter (2002) revealed that by understanding how infection is transmitted or spread, the nurse can intervene to prevent infections from developing.

Concerning the group who obtained high knowledge scores in the current study, they were acquainted with sharp devices and needle stick injuries; personal protective equipments; hand hygiene; standard precaution and methods used to prevent infection. This of special concern especially where approximately one third of the studied sample attended training courses about infection control.

This goes in the same line with Kable, Guest, & McLeod (2011) who found that just one-third of their studied nurses attended in-service training courses about infection control. Also Ebied, (2011) found that more than half of nurses attended infection control courses. Attending continuing nursing education courses and training programs (from the researchers' point of view) have the benefits of keeping nurses up-to-date and refining their practices especially in carrying out procedures that require strict aseptic techniques.

As revealed from the current study, the majority of the studied sample knows techniques used in recapping syringes' needles and knows that needles should be discarded (without removing the syringes) in sharps' container as one unit. Many studies such as that done by Kermode et al. (2005), revealed that healthcare professionals always are concerned with avoiding percutaneous injuries through utilizing infection control standard precautions (in relation to sharp devices, and needle stick injuries). In this regards, Schmid et al. (2007), and Efstathiou et al (2011) recommended that needles never should be recapped, as this could poses a serious danger through needle-stick injuries. That is why needles always should be discarded without removing them from the syringe. Nurses in the current study attributed this to be due to fear from acquiring blood transmitted diseases such as viral Hepatitis (B & C) infection, and this could be the rationale of why the majority of the studied sample received vaccination against Hepatitis B Virus. The same finding was revealed by Efstathiou et al. (2011) who found the majority of nurses had been vaccinated against Hepatitis B virus (HBV). In this regards, Di Giuseppe et al. (2007) revealed that, the most efficient method of preventing several hospital-acquired infections such as HBV is pre-exposure immunization.

Unsatisfactory knowledge was found among around two thirds of the studied sample in relation to body fluid spillage; linen management; and waste disposal. However, satisfactory knowledge level regarding hand hygiene was noticed among most of the studied sample. In this regards Siegel et al., (2007) & Apostolopoulou et al., (2010) emphasized the importance of hand hygiene to be carried out in different situations concerned with patients (before and after attending to a patient; before performing invasive procedures; after contact with blood, body secretions; etc..) as it reduces microorganisms, and protects both healthcare professionals and patients from the spread of infection.

As well, the great majority in the current study had satisfactory knowledge level about personal protective equipment (PPE). This is an expected finding. It reflects the positive role of the infection control team in orientating newly joined staff about wearing of PPE, and thus reducing the risk of exposing skin or mucous membranes to potentially infectious materials such as blood and other body fluids. Among these barriers are head gear, masks, goggles, specialized boot, gowns, and gloves (Vaz, et al., 2010). Concerning isolation precautions, a minority of the studied sample had unsatisfactory knowledge level. This could reflect nurses' poor knowledge about disease transmission through air, droplet and contact methods. This finding is in concordance with that of Qayyum, Sattar and Waqas (2010) who studied knowledge about hospital acquired infection and its prevention, and revealed poor knowledge about the common types of nosocomial infections and their routes of spread.

Consequently, satisfactory knowledge was noticed in the current study regarding: standard precautions; transmission of blood borne diseases; and methods used to prevent infection such as rules of eating and drinking in the intensive care unit; and immunization against disease among majority of the studied sample.

These findings are in agreement with that of Alwutaib et al (2012) who reported acceptable knowledge level regarding modes of transmitting diseases. However, Ahmed; Hassan & Abd Alla.(2008) illustrated that, the minority of their studied nurses and laboratory technicians had unsatisfactory knowledge about mode of transmitting blood born diseases and their signs and symptoms. That is why Hindley (2004), revealed that frequent updating of nurses knowledge coupled with regular surveillance, help to give the most recent and best care to the patients. This from the researcher's point of view could direct the attention toward continuing education of critical care nurses about methods of utilizing infection control standard precautions especially where the studied sample had various educational background (two thirds had bachelor degree, and one third had diploma nursing degree), and had years of experience of less than 10 years, so require periodical update of their knowledge.

However, unsatisfactory knowledge was found among approximately two thirds third of the studied sample

regarding reasons of utilizing infection control standards, blood born disease, administration of intravenous solution and antibiotic resistance organism. Approximately the same findings were noticed by Kermode et al (2005) who found around half of respondents aware of standard precautions. As well, Abou El-Enein & El Mahdy (2010) found poor knowledge level among slightly less than half of nurses who indicated that they heard about standard precautions. Also Lopez et al. (2006) reported a high degree of confusion and a lack of knowledge regarding standard precautions. Inspite of having unsatisfactory total knowledge scores, the great majority of the studied sample submitted the correct answers about definition of hepatitis B viral infection, mode transmitting hepatitis A, and sterility of intravenous solutions.

Concerning assessment of nurses' performance regarding infection control standard precautions, the current study demonstrates that, more than half of the studied sample had satisfactory performance level. As well, the majority had satisfactory performance regarding personal hygiene through: removing their jewelries during handling/caring for patients; keeping finger nails short and clean; and wearing clean and tidy unit uniforms. What nurses do in the current study could be based on what explained by Yildirim et al., (2008) regarding wearing rings, where they increase the total bacterial colonization of the hands and reduce the success of alcohol-based hand disinfection. As well, findings of the present study reflect the ICU nurses' emphasis on following general rules and regulations of the hospital and the effectiveness of the infection control team, and constructive supervision.

In this regards Gijare, (2012), revealed that providing feedback is necessary to improve knowledge, attitude, practices and so compliance to infection control standard precautions. Findings of the current study are of great concern especially where most of the group who had satisfactory performance showed their adherence to universal precautions especially in relation to urinary catheter care, suctioning procedure, personal hygiene, care of chest tubes, wound care, waste, and sharp devices / needles disposal. Concerning urinary catheter care, around two thirds of studied sample followed steps of catheter care: they maintained keeping the urinary bag and tubing below the level of the bladder; changed the Foley's catheter every 7 days and the silicon catheter every one month. However, the main problem was in missing/ infrequent use of chlorhexidine for cleaning skin before using povidone iodine. This from the researchers' point of view breaks principles of asepsis which require cleaning or disinfection before sterilization.

As regards to suctioning procedure, the majority of studied sample adhered to standard precautions which may be due to their awareness that intubation interfere with respiratory defenses, thus is a common precursor of entry of pathogens and so establishment of HCAI. This was explained by Johnstone & McLain & Spence (2010) who revealed that endotracheal tube (ETT) provides a pathway for bacteria into intubated children's lungs. However, continuous aspiration of subglottic secretions appears to significantly decrease the risk of ventilator associated pneumonia (Bouza, et al., 2008). Therefore, following strict aseptic is a must. Nurses in the current study followed standard precautions regarding performance of endotracheal suctioning through using one suction catheter for each patient, changing irrigation solution every 24 hours, using sterile fluid for nebulization and flushing the catheter with sterile normal saline solutions and discarding suction catheter after each use. Moreover, the study sample showed acceptable performance in surgical wound care, especially in relation to dressing frequency, and following principles of aseptic techniques during dressing. This could be due to availability of sterile gloves, surgical instruments, and antiseptic solutions. In this regards Najeeb & Taneepanichsakul, (2008) revealed that nursing practice is not only influenced by knowledge, but also by organizational factors such as nursing staff to patients'ratio and sufficient supplies that help to achieve the goal of infection prevention.

Concerning chest tube care, most of the studied sample had satisfactory performance. They maintained closed system, used sterile saline or distal water in the water seal bottles; protected the insertion site with sterile dressing; and kept the bottles below patients' chest level at all times. These actions are based on what emphasized by Allibone (2005) who announced about the importance of always keeping chest drains below the level of the patient's chest to prevent back flow of fluid in to the pleural space so prevent infection. However, the current study revealed that nurses don't strictly follow principles of aseptic technique during care and change of chest tubes. This requires efforts of the infection control team to protect patients against infection. In this regards Sullivan (2008) revealed that infection stemming from the chest drain posses a potential problem. Therefore the emphasis should be on following strict aseptic techniques to minimize the risk of infection, and monitor the drain site for signs of inflammation and redness which could indicate bacterial colonization.

In relation to wastes and sharp disposal, nurses used sharp container for needles and sharp devices, used red bags for infamous and pathologic waste and black bags for general wastes. In this regards, Abdel-Razik and Abdel- Rahman, (2011) reported that most needle-stick injuries occurred during syringe recapping or bending after use. As well, needle sticks were found to be correlated with nurses daily working hours. That is why WHO, (2004) strongly recommended that all health care workers with infections should report their needle-stick incidents for further evaluation and management. Giving more concerns to these items (from the researcher's point of view) could be due to nurses' fear from injury, pain, and/or having contaminated wound. In this regards, Cheng et al. (2010) in his study about sequential role of single room isolation and hand hygiene campaign in the control of Methicillin-Resistant Staphylococcus Aureus in the intensive care unit, mentioned that compliance with infection control measures relies largely on a personal commitment, which may increase when personal safety is threatened.

As regards to care of intravenous infusion therapy, the current study shows unsatisfactory performance which was

noticed in changing the administration sets used for Total Parenteral Nutrition, as well as central line site care. IV accesses are considered important route of entrance of microorganisms.

In this regards Ingram and Murdoch (2009) categorized sources of infection in IV therapy into intrinsic and extrinsic. Intrinsic infection occurs as a result of contamination or faulty sterilization of fluids or equipment during manufacturing and extrinsic infection occurs as a result of contamination of the peripheral cannulas during insertion, administration of IV medication and fluids or from the hands of the healthcare professional inserting or manipulating the device, covering the insertion site, decontaminating hands before and after removing dressing and wearing sterile gloves. Therefore, strict adherence to infection control standard precautions is necessary. According to the infection control standard precautions, all fluid administration sets and connectors need to be changed when the venous access device is replaced. IV solution bags should be changed every 24 hours; all infusion set tips should be caped when not in use; blood and blood products administration sets must be discarded when the transfusion episode is complete; Cannulas should be routinely changed every 72-96 hours; all IV sets must be labeled with data and time of commencement of IV therapy.

As regards to skin care, the present study shows that nurses disinfected patients' skin using alcohol 70%. As well, different approaches were described to be closely followed to clean and disinfect skin, of these are cleansing the skin around the cannulas' site with alcohol and povidone-iodine and allowing it to dry for one minute. The best choice for broad-spectrum sterilization of the skin before an invasive procedure seems to be 0.5% chlorhexidine (Hospital at West mead 2005, and Ibrahim, Said & Hamdy 2011). In addition, the current study sample had low performance scores in relation to hand hygiene, using personal protective equipments (gloves, gowns & masks), central line care and care of intravenous infusion therapy, handling specimens and their containers. This finding is in concordance with that of Kim et al, (2005) who reported reduced compliance with hand hygiene. In this regards, Gould, (2007) attributed infrequent hand hygiene to heavy clinical workload which results in increased rates of infection. However, Gammon et al., (2008), contradicted the current study's finding and revealed compliance with hand hygiene by more than half of their studied sample.

In attempt to identify why critical care nurses in the current study don't adhere to standard precautions; nurses attributed their lack of adherence to infection control standard precautions to: shortage of nursing staff as compared to workload; and difficulty of frequent hand washing after each intervention. This finding is in agreement with that of Ibrahim, Said & Hamdy (2011), who assessed infection control practices in a neonatal intensive care unit, and emphasized the importance of compliance to infection control standards to reduce in-hospital neonatal morbidity and mortality. The same authors attributed lack of compliance to infection control standards to lack of knowledge about standard procedures of infection control; poor design of the intensive care unit; high work load; lack of sustainable resources and arrangements; time of contacts (daytime or night shift), and lack of training and constructive supervision. Therefore, efforts are needed to correct unacceptable nurses' performance, especially where certain mismatching was noticed between what nurses know and what they actually do in the current study. However, statistically significant positive correlation was found between knowledge and practice in the current study. This finding reflects that nurses' performance is based on their knowledge. In agreement with the current study finding was that of Gijare, (2012), Hamid et al (2010), and Ndikom & Onibokun (2007) who revealed statistically significant positive correlation between knowledge and practice of universal precautions.

However, lack of adherence to infection control standard precautions in the current study when carrying out certain tasks could reflect the gap between knowledge, and practice. In this regards Askarian et al (2007), found no correlation between knowledge and practice.

Also Najeeb & Taneepanichsakul (2008) reported a weak, negative relationship between knowledge and practice regarding infection control among nurses and doctors. Moreover, age and years of experience of the studied group, were negatively correlated with their knowledge and practice of infection control. In this regards Alwutaib et al (2012), revealed that older age is an important determinant of lower level of knowledge score. However, Hamid et al (2010), had contradicting findings and indicated that, factors such as age and years of experience did not contribute to acquisition of knowledge about blood-borne illnesses or the practice of universal precautions. As well Gijare, (2012) reported no significant statistical difference in pre and post test knowledge & practice scores of various age groups and different years of experience.

Concerning the relationship between knowledge, practice and nursing qualification, the present study revealed that inspite of having higher scores than the other two nursing qualifications, bachelor degree nurses didn't reached the satisfactory knowledge score. Consequently, the studied sample had satisfactory performance score which were significantly higher among bachelor degree nurses than the other two nursing qualifications. This reflects the need for enhancing knowledge of all nursing qualification categories, and could emphasis the need for continuous training programs about infection control to facilitate adherence to infection control measures. In this regards RCN, (2012) emphasized that work places should have written policies about methods of utilizing infection control standard precautions to provide guidance on all aspects of critically ill patients' care. As well, continuing education regardless of age can significantly improve infection control practices and reduces rates of infection.

9. Conclusion:

Based on the findings of this study, it can be concluded that critical care nurses in the current study have satisfactory performance level regarding infection control standard precautions. However, inspite of having knowledge about

infection control standard precautions, their overall knowledge didn't reach the satisfactory level.

10.a. Recommendations: The current study recommends the following:

- Updating knowledge and performance of ICU nurses through continuing in-service educational programs.
- Emphasizing the importance of following latest evidence-based practices of infection control in continuing education / training programs.
- Strict observation of nurses' performance/ utilization of infection control standard precautions and correction of poor practices by the infection control team are required.
- Providing training programs for newly joined ICU nurses about infection control standard precautions and at regular intervals.
- Availability of all facilities and equipments required for applying infection control standard precautions.

10.b. Recommendations for further researches:

- Replication of the study on a large probability of sample from different ICUs is required.
- Identification of factors predisposing to lack of compliance with standard precautions in the ICUs.
- Exploring the relationship between knowledge, previous exposure, and compliance to standard precaution guidelines.

11. Acknowledgement:

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Notes: List of tables and figures:

Table (1): Frequency Distribution of Studied Sample as Regards to Socio Demographic Characteristics (N=77).

Socio demographic data	No	%
Age (years) 20- 30- 40-49	 59 17 1	 76.6 22.1 1.3
M± SD	27.8182± 4.64737	
Gender : Males Females	44 33	57.1 42.9
Marital status: Married Divorced Single	35 1 41	45.5 1.3 53.2
Level of Education: Baccalaureate Technical institute Diploma (3 years)	51 8 18	66.2 10.4 23.4
Job Categories: Supervisor nurse In Charge nurse Staff nurse	1 13 63	1.3 16.9 81.8
Work Experience <5 5- -10 15-35 years	 39 18 13 7	 50.6 23.4 16.9 9.1
M± SD	6.3776 ± 5.39767	
Work Shifts long day Night shift Alternating shifts	 23 23 31	 29.9 29.9 40.3
Attendance of training course Yes No	 28 49	 36.4 63.6
Duration of courses (N=28) One weak Two weak One month	 9 6 13	 32.1 21.4 46.4

Figure (1): Percentage Distribution of the Studied Sample According to Received Vaccinations (N= 77).

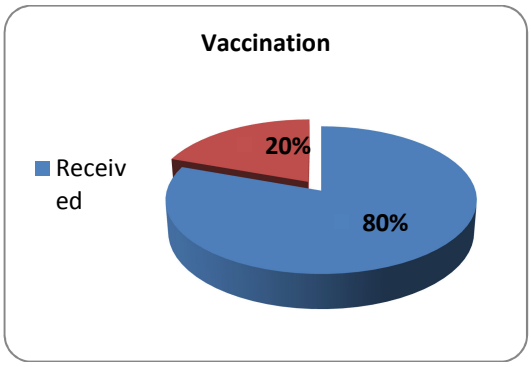

Figure (2): Percentage Distribution of the Studied Sample as Regards to Types of Received Vaccinations (N= 77).

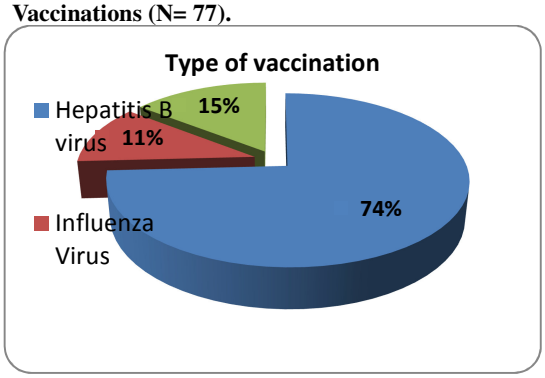

Figure (3): Percentage Distribution of the Studied Sample According to their Knowledge about Infection Control Standard Precautions (N= 77).

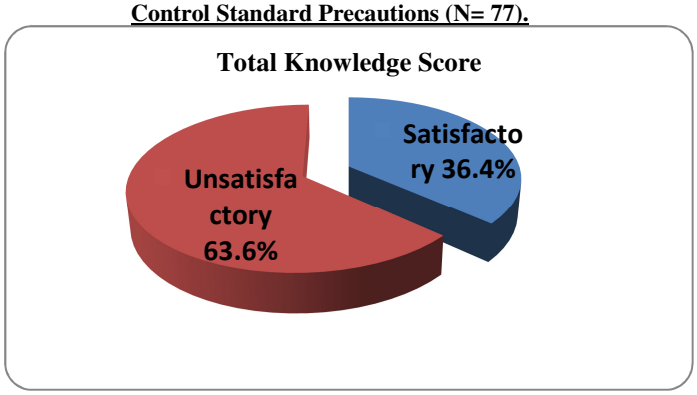

Figure (4): Percentage Distribution of the Studied Sample according to their Performance Level Related to Infection Control standard Precautions (N= 77).

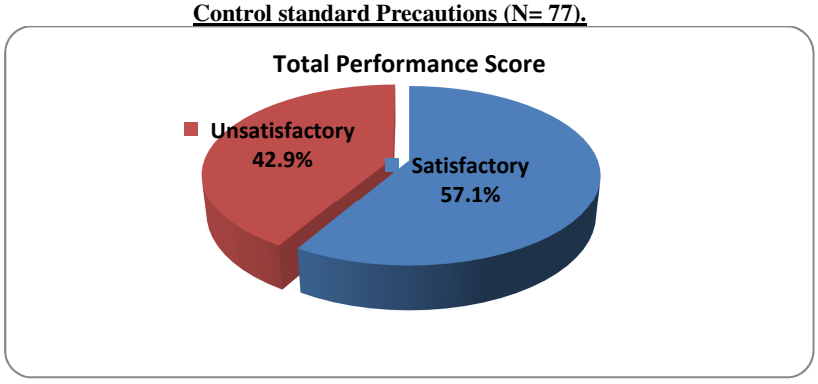

Table (2): Frequency Distribution of the Studied Sample as Regards to Total & Subtotal Knowledge scores (N=77).

Variables		N=77				Mean scores
		Satisfactory		Unsatisfactory		X±SD
		No.	%	No.	%	
Infection (definition, mode of transmission,……etc)		22	28.6	55	71.4	18.4±4.5
Nosocomial infection.		19	24.7	58	75.3	14.8 ±3.9
Sharp devices and needle stick injuries.		63	81.8	14	18.2	6.2+1.2
Body fluid spillage and linen management and waste disposal.		29	37.7	48	62.3	5. 0±1.0
Hand hygiene.		57	74.0	20	26.0	13.7+2.8
Personal protective equipment.		73	94.8	4	5.2	12.8+1.4
Isolation precaution.		7	9.1	70	90.9	12.4+3.4
Sterilization and disinfection		7	9.1	70	90.9	3.9+1.2
Standard precaution.		39	50.6	38	49.4	11.2+2.9
Blood born disease, administration IVF, and antibiotics		19	24.7	58	75.3	6.5+1.4
Methods used to prevent infection.		47	61.0	30	39.0	7.9+1.5
Total	**N**	28	36.4	49	63.6	77 (100%)
	X±SD	129.4±6		102.5±13.7		112.6+17.4

Table (3): Frequency Distribution of the Studied Sample as Regards to Total & Subtotal Performance Score (N=77).

Infection control measures	N=77				Mean scores
	Satisfactory		Unsatisfactory		X±SD
	No.	%	No.	%	
Hand Hygiene.	16	20.8	61	79.2	7.8+1.6
Sharp Devices	49	63.6	28	36.4	6.9+0.9
Linen Management.	30	39.0	47	61.0	3.7+0.7
Waste Disposal	47	61.0	30	39.0	1.6+0.3
Personal Protective Equipment (gloves &gown &mask)	33	42.9	44	57.1	9.6+1.3
Personal hygiene	61	79.2	16	20.8	3.2+0.6
Visitors & Isolation	45	58.4	32	61.6	6.0+0.7
Care of intravenous infusion therapy	32	41.6	45	58.4	6.7+1.0
Care with suction of respiratory tract	68	88.3	9	11.7	6.0+0.9
Wound care	54	70.1	23	29.9	4.1+0.8
Central line care	18	23.4	59	76.6	5.1+1.1
Urinary catheter care	69	89.6	8	10.4	6.9+0.9
Care with chest tubes	60	77.9	17	24.7	4.3+0.5
Total	44	57.1	33	42.9	71.7+9.0
X+SD	77. 3 + 4.4		64+8.1		

Table (4) Correlation between Personal Characteristics and Total Knowledge and Practice Scores of the Studied Sample, (N=77).

Variables	Knowledge		Practice		Age	
	r	(p-value)	r	(p-value)	r	(p-value)
Practice	.318**	.005				
Age	-.323**	.004	-.235*	.039		
Years of experience	-.325**	.004	-.291*	.010	0.794**	.000

** Significant at p≤ 0.01. * Significant at p. ≤ 0.05.

Table (5) Comparison of Mean Knowledge Scores in Relation to Socio-demographic Characteristics of the Studied Sample (N = 77).

Demographic variable	Knowledge score	
	M±SD	Test statistic (p-value)
Age: 20-	115.2 ± 16.0	t= 2.526 (.014)*
30-40	103.5 ± 19.5	
Gender : Male	113.8±19.0	t=0.545 (0.587)
Female	111. 7±16.1	
Marital status: Single	115.3 ± 15.9	t=1.479 (0.143)
Married	109.5 ± 18. 6	
Years of nursing experience : Less than 10years	115.3 ± 15.6	t=2.408 .(018)*
10years or more	104.8 ± 20.0	
Attendance of training course : Yes	115.2±16.7	t=1.000 (.320)
No	111.1±17.7	
Work shift: Long day shift	118.8±13.5	F=4.673 (.012)*
Night shift	104.3±19.3	
Multiple shifts	114.2±16.4	

* Significant at p. ≤ 0.05

Table (6) Comparison of mean Performance Scores in Related to Socio-demographic Characteristics of the Studied Sample (N = 77).

Demographic variable	Performance score	
	M±SD	Test statistic / p-value
Age : 20-	73.4 ± 7.9	**t= 3.226 (.002)***
30-40	65.9 ± 10.5	
Gender: Male	70.4±9.7	**t= -1.134 (0.260)**
Female	72.8±8.5	
Marital status: Single	73.8 ± 6.7	**t=2.165 (0.034)**
Married	69.4 ± 10.7	
Years of nursing experience: Less than 10years	73.5 ± 8.0	**t=2.993 (.004)****
10 years or more	66.8 ± 20.0	
Attendance of training course: yes	72.6±8.7	**t=0.610 (.544)**
No	71.3±9.3	
Work shift: Long day shift	76.0±5.5	**F=5.478 (.006)***
Night shift	67.7±9.2	
Multiple shifts	71.6±9.8	

** Significant at p. ≤ 0.005 * Significant at p. ≤ 0.05

Table (7) One way ANOVA for Comparison of the Studied Sample Mean Knowledge Scores in Relation to their Qualification (N=77).

Variables	Bachelor (n=51)	Diploma + specialty (n=8)	Diploma (n=18)	ANOVA P-value
Infection (definition, mode of transmission…etc	19.7±3.7	16.0±5.2	15.8±4.7	F=7.422 (.001)*
Nosocomial infection.	15.3±3.7	13.8±4.9	13.8±4.1	F=1.279 (.284)
Sharp devices & needle stick injuries.	6.3±1.0	6.9±0.3	5.6±1.4	F=4.826 (.011)*
Body fluids, linen management & waste disposal.	5.0±1.0	4.6±0.9	5.0±1.2	F=0.500 (.609)
Hand hygiene.	14.2±2.3	13.6±2.1	12.4±3.6	F=3.179 (.047)*
Personal protective equipment.	13.1±1.1	12.1±1.7	12.1±1.7	F=4.678 (.012)*
Isolation precaution.	12.7±3.4	11.9±4.5	11.7±2.9	F=0.682 (.509)
Sterilization and disinfection	4.1±1.1	3.3±1.0	3.7±1.3	F=2.550 (.085)
Standard precaution.	11.8±2.7	10.9±3.3	9.5±2.7	F=4.639 (.013)*
Blood born disease & administration of antibiotics	6.8±1.3	5.5±1.3	5.9±1.2	F=5.246 (.007)*
Methods used to prevent infection.	8.2±1.5	6.9±1.4	7.4±1.5	F=3.970 (.023)*
Total scores	117.2±15.1	105.4±21.7	102.8±17.1	F=6.083 (.004)*

* Significant at p. ≤ 0.05

Table (8) One way ANOVA for Comparison of the Studied Sample Mean Performance Scores in Relation to their Qualification (N=77).

Variables	Bachelor (n=51)	Diploma + specialty (n=8)	Diploma (n=18)	ANOVA P-value
Hand Hygiene.	8.0+1.5	7.3±2.7	7.3±1.3	F=2.034 (.137)
Sharp Devices	7.2±0.7	6.7±1.5	6.5±0.7	F=4.594 (.013)*
Linen Management.	3.8±0.5	3.0±1.5	3.6±0.7	F=5.367 (.007)
Waste Disposal	1.6±0.3	1.5±0.5	1.5±0.3	F=2.655 (.007)
Personal Protective Equipment	10.0±1.0	9.1±2.3	8.7±1.0	F=7.982 (.001)**
Personal hygiene	3.3±0.5	2.9±0.7	2.9±0.7	F=5.539 (.006)**
Visitors & Isolation	6.1±0.6	5.6±1.2	5.9±0.6	F=0.993 (.376)
Care of intravenous infusion therapy	7.0±0.7	6.2±1.9	6.3±0.8	F=4.471 (.015)*
Care with suction of respiratory tract	6.2±0.8	5.8±1.6	5.8±0.7	F=1.391 (.255)
Wound care	4.2+0.6	3.8+1.6	3.8+0.7	F=2.856 (.064)
Central line care	5.5+0.8	4.0+1.6	4.4+0.8	F=15.31 (.000)*
Urinary catheter care	7.1+0.7	6.4+1.9	6.5+0.8	F=4.34 (.016)*
Care with chest tubes	4.4+0.5	4.3+0.8	4.0+0.5	F=3.001 (.056)
Total score	74.3+6.6	65.8+17.7	67.1+6.9	F=7.052 (.002)**

** Significant at p. ≤ 0.005 * Significant at p. ≤ 0.05

Figure (5) Obstacles to Utilization of Infection Control Standard Precautions as Reported by the Studied Sample (N=77).