

## Knowledge, Attitudes and Sources of Information among Nursing Students toward Infection Control and Standard Precautions

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**Abstract:** Infection Control (IC) and standard precautions (SPs) is evidence-based practices that can reduce the risk of transmission of microorganisms. IC education is a fundamental component of the nursing curriculum. The present study **aimed** to Assess knowledge, attitudes and sources of information among nursing students toward infection control and standard precautions. **Subjects and methods** A convenient sample consisted of 96 nursing students. **Setting:** The study was conducted in Umm Al-Qura University, Faculty of Nursing, Saudi Arabia. **One tool** was used comprised three parts. Part 1: General data. Part 2: Knowledge assessment questionnaire about 5 different domains of IC and SPs. Part 3: Attitude assessment questionnaire used towards current curricular sufficiency, and training needs related to IC and SPs. **Results** The current study revealed the total score for knowledge was  $38.71 \pm 7.02$  (out of 53 points) with a total of 44 out of 96 students (45.83%) of students scored  $\geq 40$  out of 53 points which is considered to be acceptable. Sharp injuries, indications and the use of gloves and alcohol-based hand rub, showed the least knowledge scores. It is **concluded** The main source of information for students was the curriculum. Nursing students were satisfied with the current curricular content although they reported there need for further training and education regarding IC & SPs. It was **recommended** that teaching must be strengthened, curricular reform and training are required to fulfill students' knowledge deficiencies related to in IC & SPs to protect students and their patients.

[Mn. Huson Amin Ghalya, Yousreya Ibrahim. **Knowledge, Attitudes and Sources of Information among Nursing Students toward Infection Control and Standard Precautions.** *Life Sci J* 2014;11(9):249-260]. (ISSN:1097-8135). <http://www.lifesciencesite.com>. 35

**Keywords:** standard precautions, infection control, nursing students.

### 1. Introduction

Infection Control (IC) is evidence-based practices and procedures that, when applied consistently in healthcare settings, can prevent or reduce the risk of transmission of microorganisms to healthcare providers, other patients and visitors.<sup>[1]</sup>

The history of IC practices begins to take place in hospitals in 1840 when the importance and influence of hand-washing was brought to the forefront of the medical area after independent studies by Semmelweis who established a link between the hands of healthcare workers (HCWs) and the spread of hospital-acquired infection. Then in 1854, Florence Nightingale was the first to suggest that environmental factors effected health (often called the environment theory). She linked health with five environmental factors: pure fresh air, pure water, efficient drainage, cleanliness and light, it was found that by implementing the improved patient care measures such as cleanliness and ventilation, the mortality rate dropped from 42.7% in early 1855 to 2.2% in June 1855.<sup>[2]</sup>

The Gulf Co-operation Council (GCC) states health ministers mandated the development of IC programs in all its states in 1980. The first Saudi Ministry of Health (MOH) IC manual was developed in 1984 with one of its main objectives being to monitor

wards and clinics for infections and to implement other IC standards. By 1987 infection control programs were extended to all MOH hospitals in the kingdom of Saudi Arabia.<sup>[3,4]</sup>

The World Health Organization (WHO) in 2007 defined standard precautions (SPs) as meant to reduce the risk of transmission of blood borne and other pathogens from both recognized and unrecognized sources. They are the basic level of IC precautions which are to be used, as a minimum, in the care of all patients.<sup>[5]</sup>

SPs have two objectives: to protect HCWs from percutaneous injuries and to prevent transmission of nosocomial infection.<sup>[6,7,8]</sup> SPs practices as a minimum include proper hand hygiene, appropriate work practices, and use of personal protective equipment (gloves, gown, mask, eye protection, or face shield, depending on the anticipated exposure) and safe injection practices.<sup>[7,8]</sup>

Blood and body fluid precautions were recommended first In 1983 by the US Centre for Disease Control (CDC) for patient who was known or suspected to be infected with blood-borne pathogens.<sup>[9,10]</sup>

In 1987, the CDC recommended that regardless of patients infection status, the precautions must be

consistently used. This extension of blood and body fluid precautions to all patients is referred to as “universal blood and body fluid precautions” or simply “universal precautions”<sup>[11,12]</sup> these precautions include set of precautions devised to prevent transmission of all known blood-borne pathogens including HIV, hepatitis B virus, and hepatitis C virus to/from HCWs when providing first aid or other health care services. This applies to blood and other body fluids containing visible blood and also to vaginal secretions and semen.<sup>[13]</sup>

In 1996, the CDC included the universal precautions in a new prevention concept the so-called “standard precautions”<sup>[14]</sup>

Infection is a major problem for health care systems in many countries.<sup>[15]</sup> Infections cause deaths, longer lengths of stay and a lot of money. According to the U.S. Centers for Disease Control (CDC) more than 2 million infections start every year in a hospital, nursing home or another healthcare setting, 70,000 people die every year as the result of getting an infection in a hospital, nursing home or another healthcare setting, every infection that is caught in a hospital, nursing home or other healthcare setting costs over \$ 30, 000, the United States spends more than \$ 45 billion every year for the extra care and treatment that is needed when infections start in a hospital, nursing home or another healthcare setting.<sup>[16]</sup>

Nosocomial infections (NCI) are the most frequently reported adverse events in health care delivery.<sup>[17]</sup> As the incidence of nosocomial infection has increased globally,<sup>[18]</sup> more than 1.4 million people worldwide acquire infectious complications in hospitals annually.<sup>[19]</sup>

In the USA where roughly 1.7 million hospital-associated infections, from all types of micro organisms, including bacteria, combined, cause or contribute to 99,000 deaths each year.<sup>[20]</sup> Statistics confirmed that the incidence of nosocomial infections in developed countries ranges between 5 to 10 per cent of all admissions to hospitals and health institutions, and this percentage will increase in developing countries to about 10 to 20 per cent.<sup>[20,21]</sup>

Researchers found that strict adherence by HCWs and healthcare students (HCSs) to SPs may prevent a percentage of these risks.<sup>[22]</sup> Other researchers have noted that the incidence of blood borne pathogen exposure among HCWs has decreased after education was provided on the transmission of these pathogens.<sup>[23]</sup> They also found that education about IC is important at early stage in student nurses’ pre clinical experience to protect patients and reduce risks of occupational exposure to infection.<sup>[17]</sup> IC education is a fundamental component of the nursing curriculum, but little is understood about nursing students’

experience of IC in the clinical setting when they are learning by observing qualified practitioners.<sup>[24]</sup>

In Saudi Arabia, it was reported that there was a lack of knowledge and compliance of IC measures by health care providers in hospitals as well as at primary level of care. This was partially explained by the deficiency of the curricular content of medical and nursing schools in Saudi Arabia as well as in many other developing countries where the role of SPs and infection control is not emphasized and SPs are often practiced incompletely.<sup>[8]</sup>

Student nurses are often exposed to various infections during their clinical education,<sup>[18]</sup> and as health care workers, nursing students have a huge responsibility to protect themselves, their families, and their patients from danger because they work in an environment that encourages infections, and health care is always facing new dangers from incurable infections.<sup>[25]</sup>

Until recently, the education of health care professionals across the continuum has predominantly focused on knowledge, with the assessment of skills and attitudes being far less sophisticated or consistent. As the accreditation council for graduate medical education and, increasingly, the liaison committee on medical education have emphasized learner evaluation, undergraduate and graduate health professions schools have required that trainees “know how,” “show how,” and actually “do” what they previously only had to “know”<sup>[26,27]</sup> These performance-based assessments have revealed new evidence about learners’ skills and the gaps in the educational continuum.<sup>[28]</sup> Advocates for improving patient safety education have called for standardization of approach and team training to be woven into health professions education.<sup>[29,30]</sup> Recommendations further stress that teaching should be undertaken in an interdisciplinary fashion and capitalize on application of simulation as a teaching tool. Adding new curricular material to an overcrowded program is challenging. When the curriculum requires not only new knowledge but psychomotor skills and a change in attitude it is even harder.<sup>[31]</sup>

In Umm AL-Qura university teaching of nursing program, IC is a 3-4 hour curriculum module designed for the bachelor nursing students as a part of fundamental nursing course and clinically applied throughout their clinical education and emphasized as a part of their evaluation under subjects of patient safety to be employed in a variety of health care settings during their clinical training as ensuring the use of safe, effective and ethical infection prevention and control measures is an important component of nursing care. This practice standard is evidence-based and outlines practice expectations for all nurses in all roles and practice settings.<sup>[32]</sup>

However, there is limited number of studies that have been performed to assess nursing students' knowledge and attitude towards infection control and SPs. Thus, the present study was conducted to assess knowledge, attitudes and sources of information among nursing students toward infection control and standard precautions to change curriculum if needed.

It is hypothesized that there is positive relationship between students academic year progress and level of knowledge about infection control.

## 2. Subjects and Methods

### The aim of this Study is to:

Assess knowledge, attitudes and sources of information among nursing students toward infection control and standard precautions.

### Hypothesis:

There is positive relationship between students academic year progress and level of knowledge about infection control.

### Study design:

A Descriptive research design was utilized to accomplish this study.

### Subjects:

A convenient sample consisted of 96 nursing students 33 students in third level, 27 students in fourth level, and 36 students in intern year.

### Inclusion Criteria:

- Nursing students from third level to intern.
- Have previous contact with patients in hospitals in at least on course.

### Exclusion Criteria:

- Second year nursing students as they don't have previous contact with patients in hospitals.

### Setting:

The study was conducted in Umm Al-Qura University, Faculty of Nursing, Makkah Al-Mukammah, Saudi Arabia.

### Study Tools:

One tool was used in the present study. It comprised three parts:

#### Part 1: General data:

It was developed by researchers to collect the following data: year of study at the college, received previous training or educational materials about IC and SPs, sources of information about infection control and SPs.

#### Part 2: Knowledge assessment questionnaire about different domains of IC and SPs:

It is modified by researchers and adopted from (Tavolacci *et al.*, 2008; Amin & Al Wehedy, 2009)<sup>[33,34]</sup> and it was used to assess nursing students knowledge toward 5 domains of IC and SPs with a total of 53 items of closed ended questions in multiple choice or true or false, such as:

general concepts of IC and SPs (7 questions), nosocomial infection (7 questions), hand hygiene (19

questions), personal protective equipment (PPE) (14 questions), sharps disposal and injuries (6 questions).

#### Part 3: Attitude assessment questionnaire:

It is modified by researchers and adopted from (Tavolacci *et al.*, 2008; Amin & Al Wehedy, 2009)<sup>[33,34]</sup>

and it was used to assess nursing students attitude towards current curricular sufficiency, and training needs related to infection control and standard precautions using template consist 5 questions. Students have to answer on attitude questionnaire with either agree or disagree.

### Methods:

- Administration acceptance was obtained from vice dean of faculty of Umm Al-Qura University to collect data.

- Study Tools was adopted from available literature about nursing students knowledge toward IC& SPs (Tavolacci *et al.*, 2008; Amin & Al Wehedy, 2009)<sup>[33,34]</sup> and modified by researchers then translated to Arabic language and was reviewed by expert.

- The tools were reviewed for clarity, feasibility, applicability, and the content validity and all the necessary modifications were done.

- Official permission from students was obtained after explanation of purpose of the study.

- Data was collected through self administered questionnaire, confidentiality of any obtained information, autonomy to take decision of participation was explained.

### Duration of the Research:

- Data collection take approximately one week from 10<sup>th</sup> to 14<sup>th</sup> November 2013.

### Pilot Study

Pilot study was done on 10% of students, 10 students, 3-4 students from each level to test the clarity and feasibility of research tool, the necessary modifications were done.

### Procedure of data collection:

- Questionnaire was distributed for third and fourth year nursing students after explanation of the purpose of study following compulsory class for each target group of study at the break time.

- For data collection from intern students year, researchers communicated with the coordinator in Al Noor specialist, AL Hira'a, King Faisal, King Abdulaziz and Maternity and children Hospital in Makkah Al-Mukammah to coordinate researchers visit time to hospitals in order to assure the presence of all intern students at the time of data collection, then they visit the clinical area according to predetermined schedule and distribute the questionnaire to the intern students at break time.

- Students was briefly informed by one of the researchers concerning the purpose of the study, and

was asked to work individually. Completion of the survey is considered imply consent of study participation.

- The duration spent by students on answering the questionnaire range from 20-30 minutes.

#### Statistical design:

- Data were coded, tabulated and analyzed using the numbers frequency and percentage distribution by using Statistical Package for Social Science. (SPSS) Version 16.

- Appropriate statistical methods tests (multiple regression analysis) was used to calculate the relation between:

#### Dependent variable:

Satisfactory students knowledge (answering  $\geq$  75% of questions correctly  $\geq$  40 out of a total of 53 points).

#### Independent variables:

Year of study, previous training on infection control(IC) / standard precautions, Received educational materials/instructions on IC/SP, source of information and student attitude toward current curriculum information related to IC/ SP. A significant *P*. value was considered when *P*. value was less than 0.05 and highly significant when *P*. value was less than 0,01.

#### Limitations of the study:

- From the limitations of this study include the generalizability of the study, there were only 96 participants who participated in the complete study.
- Lack of prior research studies on the topic.
- Difficulty to collect data from intern student whose there training were outside Makkah, Jeddah and Al taif.

### 3.Results

**The results of the present study are categorized as follows:**

- Previous training and source of information about IC& SPs (Tables 1&2).

- Assessment of nursing students knowledge about IC& SPs (Tables 3, 4, 5, 6, 7).

- Assessment of nursing students attitude toward current curriculum sufficiency in relation to IC& SPs (Table 8).

- Correlation between students scores of knowledge and year of study, previous training, source of information, attitude (Table 9, Figure 1).

- Correlation between students scores of knowledge and source of information (Figure 2)

**Table (1):** Ninety six nursing (96) students were included in the study 33(35.4%) third year, 27(27.1%) fourth year, 36(37.5%) intern students. This table shows that 39.4%, 25.9% and 47.2% of the third year, fourth year and intern students respectively has a pervious training on IC & SPs. Also we can observe that 84.8%, 77.8% and 94.4% of the third year, fourth year and intern students respectively received educational materials/instructions on IC & SPs.

**Table (2):** Shows that curriculum is the main source of information for 81.8%, 88.89%, 80.5 % of third years, fourth year and intern students respectively. It also shows that bed side practice considered the least source of information among nursing students with 7.3% for the total number of students.

**Table (3):** Shows that 69.69%, 62.96%, 77.78% of the third year, fourth year, intern students respectively agree that all patients are sources of infection regardless of their diagnoses. It also shows that highest score 70.37 % from fourth year, and only 27.27% of the third year, 58.3% of the intern students sample thinks that all body fluids except sweat should be viewed as sources of infection . Regarding the application of SPs by health care workers 60.6%, 62.96%, 61.1% of the third, fourth and intern students respectively answer correctly that SPs should not be applied only to health care workers who have contact with body fluids. The total score for this domain was acceptable (5.4 $\pm$ 1.35 out of 7 points).

**Table (1) Distribution of nursing students response about previous training and received educational materials related to IC & SPs .**

Items		Third year No. (33)		Fourth year No.(27)		Interns No. (36)		Total No.(96)	
		N	%	N	%	N	%	N	%
Previous training on infection control(IC) / standard precautions (SP)	Yes	13	39.4	7	25.9	17	47.2	37	38.5
	No	20	60.6	20	74.1	19	52.8	59	61.45
Received educational materials/instructions on IC/SP	Yes	28	84.8	21	77.8	34	94.4	83	86.45
	No	5	15.2	6	22.2	2	5.6	13	13.54

**Table (2) Distribution of nursing students response about their main source of information related to IC & SPs .**

Items	Third year No. (33)		Fourth year No.(27)		Interns No. (36)		Total No.(96)	
	N	%	N	%	N	%	N	%
Curriculum	27	81.8	24	88.89	29	80.5	80	83.3
Self learning	9	27.27	8	29.63	1	2.8	18	18.75
Bedside practices	2	6.1	0	0.0	5	13.89	7	7.3
course training	5	15.15	9	33.3	22	61.1	36	37.5

**Table (3) Distribution of nursing students correct responses about general concepts of IC & SPs.**

Items	Third year		Fourth year		Interns		Total		
	N	%	N	%	N	%	N	%	
1	All patients are sources of infection regardless their diagnoses. <b>(True)</b>								
2	All health providers are at risk of occupational infections. <b>(True)</b>								
3	All body fluids except sweat should be viewed as sources of infection. <b>(True)</b>								
4	Standard precautions (SP) Include the recommendations to protect only the patients. <b>(False)</b>								
5	SP Include the recommendations to protect the patients and the healthcare workers. <b>(True)</b>								
6	SP Apply for all the patients. <b>(True)</b>								
7	SP Apply for only healthcare workers who have contact with body fluid. <b>(False)</b>								
Mean ± S.D		4.73±1.3		5.63±0.9		5.7±1.6		5.4±1.35	

**Table (4)** : Shows that 82.29% of the total nursing student recognized that nosocomial infections are infections acquired in the hospital , it also shows that 87.5% of nursing students respond correctly that nosocomial infections are occurred at 48 hours after hospital admission. While most of the students answer incorrectly that the environment (air, water, inert surfaces) is the major source of bacteria responsible for nosocomial infection only 5% of the total number of

students answer this question correctly. About half of the students in all years of study assumed that nosocomial infection has a prevalence of 25% in developing countries and nearly three quarters of the study sample believes that nosocomial infections are responsible for approximately 44% deaths per year in the world from hospital admissions. The total score for this domain was (4.88±1.46 out of 7 points).

**Table (4) Distribution of nursing students correct responses about nosocomial infection.**

Items	Third year		Fourth year		Interns		Total		
	N	%	N	%	N	%	N	%	
1	Nosocomial infections are Infections acquired in the hospital <b>(True)</b>								
2	Nosocomial infections are Infection that occurred at 48 hours after hospital admission <b>(True)</b>								
3	The environment (air, water, inert surfaces) is the major source of bacteria responsible for nosocomial infection. <b>(False)</b>								
4	Advanced age or very young age increases the risk of nosocomial infection. <b>(True)</b>								
5	Invasive procedures increase the risk of nosocomial infection. <b>(True)</b>								
6	Nosocomial infection has a prevalence of developing countries 25%. <b>(True)</b>								
7	Nosocomial infections are responsible for approximately 44% deaths per year in the world from hospital admissions. <b>(True)</b>								
Mean±S.D		4.8±1.7		4.96±1.4		4.9±1.3		4.88±1.46	

**Table (5):** This table shows that only 44.4% of nursing students were able to respond correctly about the standard duration of hand washing. According to recommended indications for hand washing 91.67% of students respond correctly that hand washing is recommended before and after a contact with (or care

of) a patient. while 65.63% of students answer that hand washing is recommended after the removal of gloves. The lowest score for students were in items related to indications of alcohol based hand rub as 24% of nursing students answered correctly that alcohol-based hand rub is indicated instead of a antiseptic hand

washing (30 s) and only 10.4% of nursing students answered correctly that alcohol-based hand rub is indicated instead of surgical hand washing (3 min). The

total score for this domain was high (14.3±1.5 out of 19 points). With least score achieved by third year students (12.9±1.1 out of 19 points).

**Table (5): Distribution of nursing students correct responses about hand hygiene.**

Items		Third year		Fourth year		Interns		Total	
		N	%	N	%	N	%	N	%
1	Hand washing minimizes microorganisms acquired on the hands if soiled. (True)	29	87.87	27	100	35	97.2	91	94.8
2	Hand washing reduces the incidence of healthcare-related infections. (True)	26	78.78	26	96.3	35	97.2	87	90.6
3	Standard hand washing includes washing of both hands and wrists. (True)	24	72.72	25	92.6	33	91.66	82	85.42
4	Alcohol hand rub substitutes hand washing even if the hands are soiled. (False)	24	72.72	25	92.6	33	91.66	82	85.42
5	Hand washing is indicated between tasks and procedures on the same patient. (True)	28	84.84	24	88.88	31	86.1	83	86.46
6	Use of gloves replaces the need for hand washing. (False)	24	72.72	22	81.5	33	91.66	79	82.3
7	Hand washing is indicated after removal of gloves. (True)	30	90.90	24	88.88	33	91.66	87	90.6
8	Hand washing is needed with patients with respiratory infections. (True)	30	90.90	22	81.5	34	94.4	86	89.6
9	In standard hand washing: minimum duration should be From 40-60 seconds. (True)	11	33.33	13	48.15	19	52.8	43	44.8
10	In standard hand washing: minimum duration should be: Less than 15 seconds.(False)	30	90.90	27	100	34	94.4	91	94.8
11	In standard hand washing: minimum duration should be: Form 20-30 seconds.(False)	24	72.72	21	77.78	24	66.67	69	71.88
12	In standard hand washing: minimum duration should be: From 10-15 seconds(False)	23	69.69	22	81.5	34	94.4	79	82.29
13	Hand washing is recommended before and after a contact with (or care of) a patient. (True)	29	87.87	25	81.5	34	94.4	88	91.67
14	Hand washing is recommended between patient contacts. (True)	23	69.69	23	85.2	20	55.56	66	68.75
15	Hand washing is recommended after the removal of gloves. (True)	21	63.63	21	77.78	21	58.3	63	65.63
16	Hand washing is recommended between the procedure to the same patient(True)	25	75.75	18	66.67	25	69.4	68	70.8
17	Alcohol-based hand rub is indicated instead of a traditional hand washing (30 s). (True)	9	27.27	18	66.7	19	52.7	46	48
18	Alcohol-based hand rub is indicated instead of an antiseptic hand washing (30 s). (True)	9	27.27	8	29.6	6	16.7	23	24
19	Alcohol-based hand rub is indicated instead of surgical hand washing (3 min). (True)	6	18.18	1	3.7	3	8.33	10	10.4
Mean±S.D		12.9±1.1		14.5±1.6		15.7±1.4		14.3±1.5	

**Table (6):** shows the correct responses to items related to the domain of Personal Protective Equipment (PPE) by clinical years included. Of the surveyed students 98.9% believed that PPE such as masks and head caps provides protective barriers against infection. Also 91.67% answered correctly that use of PPE eliminates risk of acquiring occupational infections. While only 45.8% of students answered that used PPE should not be discarded through regular municipal disposal systems. Most of the students 83% answered incorrectly that SPs recommend use of gloves for each procedure. Also 55.21% of students recognize that SPs

recommend use of gloves when there is a risk of contact with the blood or body fluid. 42.7% of students answer that SPs recommend use of gloves when there is a risk of a cut. The total score for this domain was (10.03±1.35 out of 14 points).

**Table (7):** This table shows the correct responses towards sharp disposal and sharp injuries.

51.51%, 77.78% and 80.55 % of the third, fourth and intern students respectively correctly responded to the false statements that used needles should be recapped after use. Only 18.75% of student answered correctly that Soiled sharps objects should be shredded

before final disposal. 84.4% of students knows that Sharps injuries should be managed with the need of

reporting. The total score of this domain was (4.1±1.36 out of 6 points).

**Table (6) : Distribution of nursing students correct responses about PPE.**

Items	Third year		Fourth year		Interns		Total		
	N	%	N	%	N	%	N	%	
1	32	96.96	27	100	36	100	95	98.9	
2	26	78.78	26	96.3	36	100	88	91.67	
3	23	69.69	25	81.5	32	88.9	80	83.3	
4	27	81.81	24	88.88	32	88.9	83	86.45	
5	28	84.84	22	81.5	34	94.4	84	87.5	
6	13	39.39	16	59.3	15	41.67	44	45.8	
7	22	66.67	24	88.88	33	91.66	79	82.3	
8	18	54.54	17	62.9	20	55.56	55	57.3	
9	24	72.72	25	81.5	27	75	76	79.17	
10	9	27.27	6	22.22	2	5.56	17	17.71	
11	22	66.67	14	51.9	17	47.2	53	55.21	
12	21	63.63	11	40.7	9	25	41	42.7	
13	21	63.63	12	44.44	14	38.9	47	48.9	
14	29	87.87	27	100	36	100	92	95.8	
Mean±S.D		9.5±0.9		10.2±1.4		10.4±1.2		10.03±1.35	

**Table (7): Distribution of nursing students correct responses about sharps disposal and sharp injuries.**

Items	Third year		Fourth year		Interns		Total		
	N	%	N	%	N	%	N	%	
1	17	51.51	21	77.78	29	80.55	67	69.8	
2	21	63.63	23	85.2	32	88.9	76	79.17	
3	9	27.27	4	12.12	5	13.88	18	18.75	
4	23	69.69	24	88.88	34	94.4	81	84.4	
5	20	60.60	22	81.5	31	86.1	73	76.04	
6	29	87.87	23	85.2	29	80.55	81	84.36	
Mean±S.D		3.6±1.2		4.3±1.3		4.4±1.6		4.1±1.36	

**Table (8):** Shows the attitudes of nursing students towards their satisfaction with the current curricular content and the received training towards IC and SPs. Of the included students 78.82%, 74.02% and 80.5% of

third, fourth and intern nursing students respectively agreed that the current curriculum provides them with enough information on IC and SPs. 48.48%, 70.4% and 41.67% of third, fourth and intern nursing students

respectively disagreed about the availability of training and/or orientation sessions towards infection control and SPs at the college, 81.81%, 88.9% and 80.6% of third, fourth and intern nursing students respectively agreed about the role of their tutors and faculty in providing them with necessary information on how to avoid health facilities related infections before their entrance into clinical training at hospitals. 66.6%, 52.8% of fourth and fifth year respectively disagreed that they received adequate training on how to avoid health related infections through scenarios and simulations. Almost 93.93%, 92.5% and 86.1% of third, fourth and intern nursing students respectively agreed about their need to receive training and orientations towards IC and SPs.

**Table (9):** The cut off for being knowledgeable towards IC and SPs with scores that  $\geq$  the 75<sup>th</sup>

percentile ( $\geq 40$  out of a total of 53 points). This table shows that all the independent variables have an effect on the dependent variable through the value of P as shown in the table is less than the value of  $\alpha = 0.05$  (95%). Table shows that the value of R<sup>2</sup> ( the coefficient of determination ) for the years of study with students who got more than 75% and more is 8.5 % and this indicates a positive relationship. As well as with Previous training 8.7% is a direct correlation , but very weak. The sources of information with 64% very strong relationship , as well as with Attitude score 44% weak relationship. This indicates that the sources of information have a significant impact on the students get to 75% and more of correct answer to the questions. The attitude score have an effect on students score but the effect also very weak.

**Table (8): Distribution of nursing students attitude toward current curricular sufficiency and their training needs for IC & SP.**

NO.	Item	Third year				Fourth year				Intern			
		Agree		Disagree		Agree		Disagree		Agree		Disagree	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Current curriculum provides enough information on IC and SPs.	26	78.82	7	21.21	20	74.02	7	25.9	29	80.5	7	19.4
2	Training/orientation sessions about IC and SPs are provided to nursing students.	17	51.51	16	48.48	8	29.62	19	70.4	21	58.3	15	41.67
3	Tutors and faculty provided us with enough information on how to avoid health facilities related- infections before clinical rotations.	27	81.81	6	18.18	24	88.9	3	11.1	29	80.6	7	19.4
4	I received hands on training on how to avoid health facilities-related infections using case scenarios and simulations.	24	72.72	9	27.27	9	33.3	18	66.7	17	47.2	19	52.8
5	I need to receive training on IC and SPs.	31	93.93	2	6.1	25	92.5	2	7.4	32	86.1	4	13.9

**Table (9): Multiple regression analysis model for the possible correlates of higher knowledge toward I.C & S.P among the included nursing students (n = 96).**

Independent Variable	P Value	R <sup>2</sup>
Year at the college	0.002	0.085
Previous training on infection control(IC) / standard	0.002	0.087
Received educational materials/instructions on IC/SP.	0.000	0.437
Source of information.	0.000	0.640
Attitude score.	0.000	0.440

#### 4. Discussion

In the present study the total score for knowledge was  $38.71 \pm 7.02$  (out of 53 points) with a total of 44 out of 96 students (45.83%) of students scored  $\geq 40$  out of 53 points which is considered to be acceptable, students' knowledge differed according to the specific areas, the highest scores was noticed along the domain of hand hygiene while sharp management and injuries showed the least scores. Tanwir F (2012) [35] reported

that highest scores was noticed in his study along the domain of hand hygiene, and care of the health care providers, while sharp management and injuries and PPE showed the least scores. While Tavolacci *et al.* (2008) [33] reported in their study that the highest scores were achieved for knowledge of standard precautions and hand hygiene, and the worst score was for knowledge of NCI, which support current study results



Findings of the present study indicated that student nurses were knowledgeable concerning general concept of IC and SPs (total mean  $5.4 \pm 1.35$  out of 7 points. Labrague *et al.* (2012)<sup>[18]</sup> reported that nurses knowledge concerning SPs was high among nursing students. Kim *et al.*,<sup>[36]</sup> also reported that knowledge of standard precautions was better among nursing students than among medical students. Additionally Tavolacci *et al.* (2008)<sup>[33]</sup> also agree with this study result. This is in complete disagreement with that of Bamigboye and Adesanya (2006)<sup>[37]</sup> study, where in only 46.2% of student nurses had very good knowledge. Studies among nursing population also showed similar result to this study. Vaz *et al.* (2010)<sup>[38]</sup> also reported that 90.0% of nurses had knowledge of SPs. Good knowledge of standard precautions among student nurses may be due to inclusion of the concepts of standard precautions in the nursing curriculum.

Result of the present study showed that 88.5 % of students agree that SPs include recommendation to protect patient and health care workers (HCWs), this is disagree with Sreedharan *et al.* (2011)<sup>[39]</sup> who reported that less than half of nursing students agreed that SPs aimed to protect both health care workers as well as patients (45.9%). On the other hand half of study sample answered incorrectly that all body fluids except sweat should be viewed as source of infection, also 61.5 % of nursing students answered incorrectly that SPs applied only to worker who have contacts with body fluids. Which highlights a need to implement a program to improve knowledge on SPs.

For NCI results of the present study showed that knowledge about NCI was acceptable ( the mean score of students response  $4.88 \pm 1.46$  out of 7 points ). On the contrary Leodoro *et al.* (2012) and Tavolacci *et al.* (2008)<sup>[18,33]</sup> studies shows that the worst score was for knowledge of NCI among nursing students. 82.29 % of students recognized the definition of NCI. The result of the present study shows that students did not know exactly what or who were the main sources of bacteria responsible for NCI since vast majority of them thought that the environment was the primary source of bacteria this is similar with Leodoro *et al.* (2012).<sup>[18]</sup> About half of the students in all years of the present study assumed that NCI has a prevalence of 25% in developing countries and nearly three quarters of the study sample believes that NCIs are responsible for approximately 44% deaths per year in the world from hospital admissions which reflect students perception on the importance of NCI prevention. This reinforces the need to intensify and strengthen teachings regarding NCI in classrooms.

For hand hygiene, only 44.8% were able to respond correctly about the standard duration of hand washing. Students knowledge regarding the

indications of alcohol based hand rub was extremely low as the majority of students didn't believe that alcohol hand rub is indicated instead of traditional hand washing , anticipating hand washing and surgical hand washing. Also nearly third of the sample of the students didn't know that hand washing is recommended after removal of gloves, between procedure to the same patient, and between patients contacts. And also shows similar studies that only few nursing students knew duration of hand hygiene Ariyaratne *et al.* (2013).<sup>[40]</sup>

The present study shows that 90.6% of nurses had knowledge of hand washing is indicated after removal of gloves, while Tavolacci *et al.* (2008) and Ariyaratne *et al.* (2013)<sup>[33,37]</sup> shows in their study that student didn't sufficiently understand the fact that hand hygiene should be performed after the use of gloves. It is important to address hand hygiene duration and alcohol hand rub indication during future clinical training sessions. Hand hygiene training sessions may need to be conducted more frequently with continuous monitoring and performance feedback to encourage them to follow correct hand hygiene practices.

For PPE The total score for this domain was acceptable ( $10.03 \pm 1.35$  out of 14 points). Shows the correct responses to items related to the domain of (PPE) by clinical years included. Of the surveyed students 98.9% believed that PPE such as masks and head caps provides protective barriers against infection. Also 91.67% answered correctly that use of PPE eliminates risk of acquiring occupational infections. While only 45.8% of students answered that used PPE should not be discarded through regular municipal disposal systems.

Most of the students 83% answered incorrectly that SPs recommend use of gloves for each procedure, similar studies that shows the result with Leodoro *et al.* (2012).<sup>[18]</sup> Also 55.21% of students recognize that SPs recommend use of gloves when there is a risk of contact with the blood or body fluid , similar result was low with Leodoro *et al.* (2012).<sup>[18]</sup> 42.7% of students answer that SPs recommend use of gloves when there is a risk of a cut, while in other study Tavolacci *et al.* (2008)<sup>[33]</sup> reported that the result was high. And some studies found the use of PPE increased with years, Vaz *et al.* (2010)<sup>[38]</sup> similar with results of the present study.

For sharp disposal and sharp injuries the total score of this domain was ( $4.1 \pm 1.36$  out of 6 points). 69.8% responded to the false statements that used needles should be recapped after use. This is unlike this studies Janjua *et al.* (2007)<sup>[41]</sup> they are finding the highest percentage of the participants were of the opinion that the used syringes should be disposed after recapping. Only 18.75% of student answered correctly

that soiled sharps objects should be shredded before final disposal. This indicates that students need more education about sharp objects management.

Another key finding was that the attitude toward nursing students was high percentage towards their current curricular content and the received training towards IC and SPs. The present study included students 78.82%, 74.02% and 80.5% of third, fourth and intern nursing students respectively agreed that the current curriculum provides them with enough information on IC and SPs. These results are consistent with studies carried out in more developed countries where teaching during the curriculum was the main source of information, and the information about SPs was emphasized more during the curriculum for nursing students Tavalacci *et al.* (2008).<sup>[33]</sup>

48.48%, 70.4% and 41.67% of third, fourth and intern nursing students respectively disagreed about the availability of training and/or orientation sessions towards infection control and SPs at the college, 81.81%, 88.9% and 80.6% of third, fourth and intern nursing students respectively agreed about the role of their tutors and faculty in providing them with necessary information on how to avoid health facilities related infections before their entrance into clinical training at hospitals. Furthermore nurse educators may need to provide an environment that models and promotes standard precaution practices by positive role modeling (Tavalacci *et al.*, 2008).<sup>[33]</sup>

Almost 93.93%, 92.5% and 86.1% of third, fourth and intern nursing students' attitude respectively agreed about their need to receive training and orientations towards IC and SPs. That's approved with the study Wang *et al.* (2008).<sup>[42]</sup> The training and education have been found to be of paramount importance to developing awareness among health care workers, as well as improving adherence to good clinical practice.

In the present study, teaching during the curriculum was the main source of information. This result is consistent with (Tavalacci, 2008).<sup>[33]</sup> While for amin 2013 reported that self-learning and informal bed side clinical practices were the main sources.<sup>[8]</sup> this indicates that Most of the information necessary to answer this questionnaire was given during the curricula. Also Training courses appeared to be a significant source of knowledge for students . although in the present study bed side practice and self-learning found to have significant effect on students' knowledge related to IC and SPs.

Present study express that the level of knowledge was significantly correlated with year at college; this can be explained by the fact that those at intern years are more exposed to clinical practices with substantial exposures to patients, clinical practices and senior clinical staff in hospital wards compared to third and

fourth years. Teaching infection control to nursing students is a challenge both with respect to developing a cohesive program and encouraging students to adopt correct attitudes early in their careers. Amin 2013 found also that there is positive correlation between students' knowledge and year of information.<sup>[8]</sup>

In this study previous training on SPs and infection control was a positive predictor for higher knowledge and this could be referred to nature and contents of these training . Studies showed that specific training of SPs can quickly improve students' knowledge of IC in a short period of time. Some authors recommended that future educational approaches should include rigorous curricular reform with pragmatic presentation of effective hand hygiene and SPs, feedback from teachers at the bedside, and inclusion of IC&SPs scores for students in all clinical training courses (Tavalacci *et al.*, 2008; Amin & Al Wehedy, 2009)<sup>[33,34]</sup>

### Conclusion

The overall knowledge scores for nursing students toward IC & SPs was acceptable, students achieved the highest score in hand hygiene domain and the lowest score in sharp disposal & sharp injuries. There was significant relation between students' knowledge score and their year of education, intern students achieved the highest score among all. The main source of information for students was the curriculum, although courses training in hospitals have significant effect on students' knowledge especially for interns. The attitude of nursing students were satisfied with the current curricular content and the received training towards IC and SPs. However, they reported there need for further training and education regarding IC& SPs. Teaching must be strengthened, particularly with respect to the application of standard precautions for every patient, hand hygiene after use of gloves, the benefit of using alcohol-based hand rub to decrease the transmission of NCI in addition to safe handling of needles and sharp objects. curricular reform and training are required to fulfill students' knowledge deficiencies related to in IC & SPs.

### Recommendations

**Based on the findings of the study the researchers recommends the following:**

1. Periodic refresher training courses should be provided in order to keep nurses of updating knowledge and attitude regarding to infection control and standard precautions.
2. There should be qualifying exams regarding IC & SPs for students before sending them to practice in clinical duties.
3. Educational programs regarding standard precautions should be organized for students at the

time of commencement of their training and before they graduate the course.

4. The involvement of students in different activities regarding standard precautions should be encouraged and events such as exhibitions, poster making, quizzes, debates and other competitions regarding standard precautions and infection control should be organized consistently.

5. Development of a written program for about NCI and hand hygiene health that includes policies, procedures and guidelines on education and training, exposure prevention, and post-exposure management

6. Safe methods for dealing with sharp subjects practice in addition to post-injury management should be emphasized throughout nursing curriculum and practice.

7. Further studies are also recommended with regard to the IC & SPs, in order to gain more understanding. These studies should be done qualitatively rather than quantitatively, because they could then focus more on the perceptions of students.

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5/22/2014