



Knowledge, attitude, and practice of infection prevention and control among health care workers in the neonatal and pediatric intensive care unit of Saint Paul Millennium Medical College

Saron Estifanos (MD)

Advisor: Atinafu Mekonnen (MD, MPH)

Thesis Submitted to the Department of Pediatrics and Child Health in Partial Fulfillment of the Requirements of Specialty Certificate in Pediatrics and Child Health, Saint Paul Hospital Millennium Medical College

Addis Ababa, Ethiopia

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Acronyms and Abbreviations

CDC: Center of Disease control

HAI: Hospital acquired infection

HCW: Health-care workers

HH: Hand hygiene

ICAT: Infection Control Assessment Tool

ICU: Intensive care unit

IPC: Infection prevention and control

NICU: Neonatal intensive care unit

PICU: Pediatric intensive care unit

PPE: Personal protective equipment

SPHMMC: Saint Paul Hospital Millennium Medical College

WHO: World Health Organization

Abstract

Background: Hospital-acquired infections (HAI) are infections that are acquired after admission to a health care facility for another reason. HAI causes a longer stay in the hospital, a greater financial load on the health-care system, a poor impact on health, and a higher mortality rate. Each employee working in a health facility has a role to play in preventing HAI. Implementation of infection prevention and control methods can reduce HAI by up to 70%.

Objectives: To examine health care staff working in the PICU and NICU at Saint Paul Hospital `Millennium Medical College's awareness, attitude and compliance with universal infection prevention practices.

Methods and Materials: Institution based cross- sectional study design was used to assess the knowledge, attitude and practice of health care workers working in NICU and PICU of SPHMMC. The study used questionnaires adopted from similar studies and checklist from Infection Control Assessment Tool (ICAT).

Results: A total of 171 health professionals responded with response rate of 96.06%. The overall mean score of knowledge 15.28 ± 1.82 with 53.2% scoring above the mean. The mean attitude score was 3.89 with 46.8% having negative attitude. Based on ICAT, the overall reported practice was 40.63% in neonatal and 44.6% in pediatric ICU; however the observed hand hygiene practice was 14.96% in neonatal and 3.33% in pediatric ICU. Profession was found to be statistically significant in having IPC knowledge ($p = 0.023$), attitude ($p = 0.006$), and in observed practice of hand hygiene in NICU ($p = 0.000$).

Conclusions: Healthcare workers had low level of knowledge, attitude and practice towards infection prevention. The awareness level differed based on age and professional level. Although the response in hand hygiene module was reported as usually being followed, the observation revealed a different outcome. Gaps were identified in all the five hand hygiene moments.

Key Words: Hospital acquired infection, hand hygiene, infection prevention and control

1. Introduction

1.1. Background

Hospital-acquired infections (HAI) are infections that are acquired after admission to a health care facility for another reason [1]. These are infections that weren't incubating at the time of admission. It includes infections noticed after 48 hours of admission, after discharge, and occupational infection among the staff of the institution. [2, 3] HAI causes a longer stay in the hospital, a greater financial load on the health-care system, a poor impact on health, and a higher mortality rate. [4] In affluent countries with acute care, HAI complicates 5-10% of hospital admissions. According to the World Health Organization, the risk of HAI in impoverished nations is 20 times higher than in developed countries. [5, 6]

Each employee and working unit in a health facility has a role to play in preventing HAI. It requires national and regional programs, as well as hospital-based initiatives such as a multidisciplinary infection control committee that encourages surveillance, staff training, and hiring infection control professionals. The hospital management, physicians, nursing staff, microbiologists, pharmacists, laundry service, sterilization service, food service, housekeeping service, maintenance, and infection control team all play a critical role in preventing HAI. [7]

In impoverished countries, only one out of every ten health personnel practices hand cleanliness while caring for ICU patients. [8] In Ethiopia, a meta-analysis showed that only half of the healthcare workers adopted safe infection prevention methods and 15.3%–46.3% of healthcare workers were unaware about infection prevention practices. [9-12]

Infection prevention and control methods that are implemented well can reduce HAI from 50 to 70%. This strategy has also been shown to reduce three out of every four antimicrobial resistance-related deaths. Investing in effective IPC techniques can also pay out a significant financial return. [13, 16, 17]

1.2. Statement of the Problem

Hospital acquired infections are a major public health hazard that affects both industrialized and underdeveloped countries. Proper infection prevention techniques are needed to prevent HAI. Inappropriate or insufficient infection prevention strategies can have major effects for a patient's life, as well as the formation of drug-resistant organisms and an increase in financial burden. Because infection prevention strategies receive less attention in developing nations, the burden of HAI is high.

In a research conducted in the pediatric population at a tertiary hospital in South Africa, 20.4 and 15.3 HAIs per 100 admissions in the PICU, and 23.9 and 21.6 HAIs per 100 admissions in the NICU, respectively, developed HAI in 2013 and 2014. [14]

Higher frequencies of HAIs result in increased antibiotic use and the growth of antibiotic-resistant bacteria. [9] Overall, HAIs are thought to be responsible for 11% of pediatric mortality. [15] With the right deployment of infection prevention and control strategies, HAI can be decreased by up to 70%. [13,16, 17]

Ethiopia, as a low-income country, is affected by HAI. The purpose of this study is to determine the level of awareness, perception, and practice of infection control measures among SPHMMC health care personnel.

1.3. Rationale of the Study

A meta-analysis done in Ethiopia to assess the burden of health-care associated infections revealed 16.96% rate of Hospital acquired infections in Ethiopia. Infection prevention and control is one strategy to decrease the number of neonates and children facing this problem. HAI can be decreased by up to 70% by implementing proper IPC.

Assessment of the infection prevention technique helps us evaluate the quality of care delivered to children in the PICU and NICU. The findings of this study can be utilized to develop

a guideline for infection prevention and control approaches. The findings will also assist neonatologists, pediatric intensivists, pediatricians, residents, interns, and nurses working in the department of pediatrics and child health in providing feedback and direction. This study will lay the groundwork for future research with a larger group of people. [13, 16, 17]

2. Literature Review

Hospital-acquired infections, also known as nosocomial infections, are infections that are acquired after admission to a health care facility for another reason. These infections appear 48 hours after being admitted to the hospital [1]. HAI is a huge public health and worldwide issue that affects both industrialized and developing countries.

In developed countries, HAI complicates 5-10% of acute care hospital admissions. According to WHO, the risk of HAI in impoverished nations is up to 20 times higher than developed ones. [5, 6]

Hospital-acquired infection leads to a prolonged hospital stay, increased health system burden, poor impact on health, and a higher rate of mortality. [4] Hospital-acquired infections include catheter-associated urinary infections, central-line-associated bloodstream infections, surgical site infections, ventilator-associated pneumonia, hospital-acquired pneumonia, and *Clostridium difficile* infections. [18]

Risk factors for HAI include immunosuppression, prolonged hospital stay, multiple underlying comorbidities, need for intubation and mechanical ventilation, intensive unit admission, repeated blood sampling, prolonged central line venous access, urinary catheterization, prolonged indwelling devices, invasive procedures, intrinsic immunological deficiency and inadequately developed barrier mechanism in preterm neonates. [19, 20] The source of these infections can be the health care workers, other patients, and the hospital facility itself. [19]

HAI incidence in NICU ranges from 6% to 50%, with rates 3-20 times higher in developing nations than in industrialized countries. Depending on the risk factors, the total mortality rate varies between 20% and 80%. [21, 22] In impoverished nations, 10 out of every

100 hospitalized patients will contract at least one HAI at some point during their hospitalization. [23]

In the United States, the National Nosocomial Infection Surveillance System recorded 14.1 nosocomial infections per 1000 PICU patients, compared to 19.3 per 100 in India. In Europe HAI accounts for 23.6% of PICU admitted patients. [24-26]

The frequency of HAI in underdeveloped countries ranges from 5.7 to 19.1 per 100 patients, with an average prevalence of 10.1 per 100 patients, according to a systematic review. [27]

In the non-ICU ward of a tertiary hospital in South Africa, a study of the pediatric population showed 7.1 and 7.0 HAIs per 100 admissions in 2013 and 2014, respectively. In 2013, and 2014, there were 20.4 and 15.3 HAIs per 100 admissions in the PICU, respectively, and 23.9 and 21.6 HAIs per 100 admissions in the NICU. [14]

The higher rate of HAIs leads to more antibiotic usage and higher emergence of antibiotic-resistant microorganisms. [28] The overall estimated mortality in the pediatric population due to HAIs is 11%. [15]

A multistate point-prevalence survey done in the United States in 2014 revealed that the prevalence of 4% of 11282 patients had one or more HAI. The most common types were hospital-acquired pneumonia (21.8%), surgical site infections (21.8%), and gastrointestinal infections (17.1%), and device-associated infections (25.6). [29]

In both PICU and NICU, bloodstream infections and ventilator associated pneumonia are the most common causes of nosocomial infections. In PICU, catheter-associated urinary tract infection is a common cause, while it is less common in NICU. [16, 30]

Coagulase negative *Staph aureus*, *S. aureus*, *Klebsiella pneumoniae*, *Enterococcus spp.*, *Enterobacteriaceae spp.*, *Pseudomonas aeruginosa*, and *Acinetobacter baumannii* are among the most often isolated pathogens at PICU. Although Coagulase negative *Staph aureus* and *S. aureus* are widespread in NICU, gram-negative infections such as *E. coli*, *Klebsiella*, *Acinetobacter*, and *Pseudomonas* are the most common pathogens responsible for HAI in resource-limited nations. [31- 33] These infections are spread by direct or indirect contact, droplet or airborne transmission. [34]

The cost of treating these infections outweighs the cost of preventing them. Annually America losses 55 billion Euro and Europe losses 1.6 billion Euro. [35] HAI not only costs us money, but also the resistance of first-line drugs. In 2019, the CDC has announced that we are in the post-antibiotic era [36]. In 2017, WHO stratified pathogens into three: medium, high and critical priority groups based on the need for a new antibiotic. The critical list consists of *Acinetobacter*, *Pseudomonas*, *Enterobacteriaceae* whereas the high priority risk consists of *Enterococcus*, *S. aureus*, *H. pylori*, *Campylobacter*, *salmonella*, and *Neisseria*. [35] When comparing the WHO list to the most common cause of HAI in the PICU and NICU, the majority of the organisms fall into the critical priority category.

Infections acquired in hospitals are complicated, and preventing them requires various interventions. IPC is an evidence-based and practical strategy to prevent infections in patients as well as health care workers. Before Louis Pasteu's grasp of germ theory the first infection prevention strategy was created by Ignaz Semmelweis in 1846. He discovered that moms delivered by doctors had a higher rate of puerperal fever than mothers delivered by midwives. He came to the conclusion that cadaverous materials on the hands of physicians who came straight from the autopsy room to the obstetric clinic produced a higher risk of puerperal fever. So then

hand hygiene was instituted at Austrian maternity hospital's obstetric ward. The introduction of hand washing reduced the rate of puerperal fever and avoided the transmission of *Group A Streptococcus* through the hands. [37]

In impoverished countries, only one out of every ten health personnel practices hand cleanliness while caring for ICU patients. [8] Only half of Ethiopian healthcare professionals adopted safe infection prevention methods, according to a meta-analysis, and 15.3 percent–46.3 percent of healthcare workers were unaware of infection prevention practices. [9-12]

Effective implementation of infection prevention and control practices can decrease half of HAI. This practice can also decrease 3 out of 4 antimicrobial resistance-related deaths. Investing in effective IPC strategies can also yield a significant financial return. [13]

This study will aid in assessing the knowledge, attitude and practice of infection prevention and control among health care professionals working in NICU and PICU of SPHMMC. This research will also assist in identifying the gaps and serve as a ground to develop subsequent interventions.

3. Objectives

3.1. General Objective: To examine the health care staff working in the PICU and NICU at SPHMMCs' awareness, attitude and compliance with universal infection prevention practices.

3.2. Specific objectives:

- To assess knowledge of health care workers towards IPC
- To evaluate the attitude and experience of the health care workers in PICU and NICU towards universal IP strategies
- To evaluate the extent of health care professionals working in PICU and NICU follow IPC

4. Methods

4.1. Study Setting

This research took place in the pediatric and neonatal ICU of Saint Paul Hospital Millennium Medical College. SPHMMC is based in Addis Ababa, Ethiopia's capital city. The college has more than 2500 clinical, academic and admin staff. It has a capacity of 700 inpatients beds. There are 29 nurses, 2 residents per month, 1 intensivist, and 1 pulmonologist and critical care working in PICU and 57 nurses, 9 residents per month, 2 fellows, 2 neonatologist working at NICU. It features six pediatric ICU beds and around fifty neonatal ICU beds. Monthly it serves an average of 215 neonates and 25 children in ICU. [38]

4.2. Study Period and Design

A cross-sectional institutional research was conducted from March 15 to August 14, 2022 to assess knowledge, attitude, and practice of infection prevention and control among healthcare workers in neonatal and pediatric ICU, SPHMMC.

4.3. Study Population

The study population included nurses, interns, residents, fellow and seniors working at neonatal and pediatric ICU of SPHMMC.

4.4. Eligibility Criteria

Inclusion Criteria

- All hired health care employees, nurses, interns, residents, fellows and consultants who consented to participate in the study during data collection were included.

Exclusion Criteria

- A health practitioner who worked in the unit for less than one month
- Health care workers who refused to participate in the study.

4.5. Sample Size and Sampling Procedure:

All health care workers who were working in the pediatric and neonatal ICU during the data collection period were included in the study.

4.6. Measurement

4.6.1. Study Variables:

Independent Variable:

- Age
- Gender
- Service year
- Level of profession
- Working unit
- Training on infection prevention and control

Dependent Variable:

- Knowledge and attitude of infection prevention
- The practice of infection prevention

4.6.2. Instruments

This study used a questionnaire to assess knowledge and attitudes. The questionnaire used in this study has been used in similar study. It is modified for the current setting. Seven modules from the Infection Control Assessment Tool (ICAT) were used: ICU, airway suctioning, hand hygiene, intravenous catheter, urinary catheter, intravenous fluids and medications, and sterilization and disinfection. Each module in the ICAT has sections of related questions that can be answered either by yes/ no, multiple choice or checklist responses. Healthcare workers were also observed using observational checklist on hand hygiene practice which was modified from ICAT [41].

4.7. Data Collection and Procedures:

Two kind of instruments were used; questionnaire and checklist. The questionnaire was used to assess the knowledge and attitude. It was taken and modified from two previous studies.

The questionnaire was pre-tested in 10% of health professionals to determine its applicability and adjustment of the instrument was made based on the results. [39-41]

The questionnaire had three parts. The first part assessed the independent variables such as age, sex, profession, year of service, and IPC training. The second part assessed the knowledge regarding standard precaution, hand hygiene and hospital acquired infections. The third section assessed the attitude of respondents using 5 point Likert scale.

The practice of healthcare workers was assessed using two methods from ICAT. Selected seven modules were used and administered by the principal investigator who interviewed the nursing manager of each ICU. The modules covered questions on ICU, airway suctioning, hand hygiene, intravenous catheter, urinary catheter, intravenous fluids and medications, and sterilization and disinfection. The second was an observational checklist to assess the hand hygiene practice that was modified from ICAT. Table 1

After the data collection, each data was checked for completeness. Then it was entered to SPSS version 26. Descriptive statistics was used to describe the independent variables. Cross tabulation was used to identify the relation between independent and dependent variables. A confidence limit of 95% and p-value < 0.05 was considered statistically significant.

Table 1 Modules and sections of ICAT used.

Module	Section	Aspects assessed
ICU	ICU Staffing General practices	Nursing staff-to-bed ratio Cleaning of the ICU Staff HH
	Mechanical ventilation	Handling of ventilator circuits and humidifiers
Hand hygiene (HH)	Equipment and supplies	Availability of equipment and supplies for good HH practices
	Practices	HH practices
Airway suctioning		Airway suctioning fluids Changing and storage of suction catheters General infection control practices
IV catheters		Type of catheters used Frequency of changing IV catheter Type of skin antiseptic used
IV fluids and medications		Preparation of intravenous fluids Handling and changing infusion tubing Procedures for using single or multi-dose vials of injectable fluids
Urinary catheters	Procedures for use of indwelling urinary catheters	Procedures for changing urinary catheters Supply of catheters
	Procedures for insertion & maintenance of urinary catheters	Use of gloves; type of antiseptic used; placement of bag
Sterilization and Disinfection	Sterilization and Disinfection: Equipment and IV Fluids	Procedures
		Decontamination and Cleaning of Instruments and Equipment

4.8. Operational Definitions:

Knowledge is described as a clear awareness and understanding of infection prevention efforts by healthcare staff when caring for patients.

Good knowledge: A score of more than mean value on the knowledge questions indicated good knowledge.

Poor knowledge: Getting a score less than mean value on the knowledge questions.

Attitude- The term "attitude" refers to a health care worker's personal perspective on infection prevention efforts while caring for patients.

Positive attitude: Participants with a positive attitude are those who will answer more than mean value on the attitude questions.

Negative attitude: Participants with a negative attitude are those who will answer less than mean value on the attitude questions.

Practice- is a health-care worker's act or skill in infection-prevention efforts while caring for patients.

Safe practice: Participants who practice correctly more than 75%.

Unsafe Practice: Participants who practice less than 75%. [41]

4.9. Data Quality Control and Management

The questionnaire was pretested in 10% of the projected sample size to determine its reliability. The findings of the pre-tested data were not included in the analysis of this study. The lead investigator supervised the data collection, and the acquired data was checked for accuracy and completeness on a regular basis.

4.10. Data Analysis Procedures

Each data set was checked for its completeness after collection, cleaned manually, coded, and entered into SPSS windows version 26 for analysis. In tables and graphs, descriptive statistics such as frequency and percentages were used to describe the study participant's characteristics. Statistical significance is defined as a confidence level of 95% and a p-value of less than 0.05.

4.11. Ethical Consideration

Ethical clearance was provided from the Institutional Review Board (IRB) of Saint Paul Hospital Millennium Medical College after submission of the proposal. The study's aim was described, and each responder was provided with written informed permission. In order to protect the confidentiality and privacy, code numbers rather than personal identifiers were used in the data collection.

4.12. Dissemination of Results:

The findings of this study will be reported to the Saint Paul Hospital Millennium Medical College department of pediatrics and child health. It will also be reported to Infection Prevention Committee, Infection Control Team, Quality Management Office, Disease prevention and Health Promotion Office, IRB office of SPHMMC. The results will also be presented at other professional society meetings and conferences. The results will be published in a peer-reviewed journal and made widely available online. The information can also be used as a starting point for future intervention and research.

5. Results

5.1.Socio-demographic Characteristics

A total of 171 respondents completely filled the questionnaires with response rate of 96.06%, of which 102 (59.6 %) were females. The mean (SD) age of respondents was 27.75 ± 3.5 years. Most respondents were nurses 74 (43.3%) followed by residents 70 (40.9%), interns 22 (12.9%), and consultants and fellow 5 (2.9%). Table 2

The minimum work experience was 1 month and maximum was 29 years, making the mean 3 years and 8 months. Majority of respondents were from NICU 94 (57.4%) followed by those working in both units 51 (29.8%) and PICU 26 (15.2%). Table 2

Among the respondents, 60% of nurses, 75 % residents, 100% of intern doctors and 20% of consultants and fellow, and overall 70.8% (121) did not have training on IPC. (Figure 1 and Table 2)

Figure 1: IPC training among healthcare workers

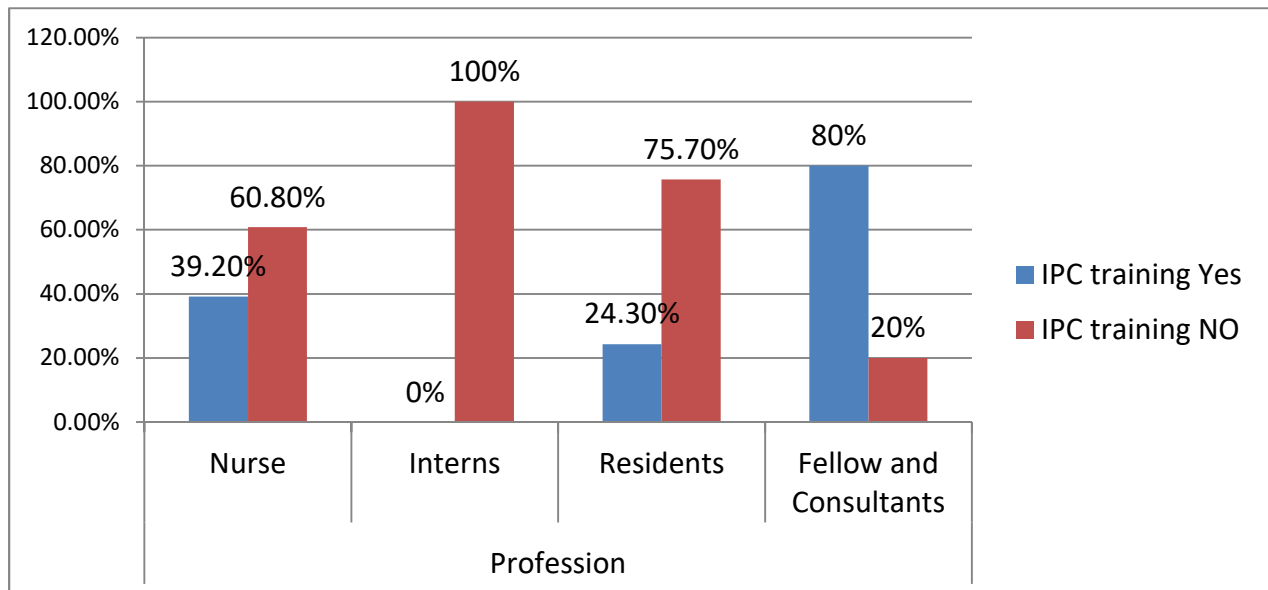


Table 2 Demographic characteristics of study participants (N = 171)

Demographics	Number of Respondents n (%)
Gender	
Male	69 (40.4)
Female	102 (59.6)
Age	
18-24	20 (11.7)
25-34	143 (83.6)
35-44	7 (4.1)
> and = 45	1 (0.6)
Profession	
Nurse	74 (43.3)
Intern Doctor	22 (12.9)
Resident Doctor	70 (40.9)
Fellow	5 (2.9)
Work Experience	
<1 year	22 (12.9)
1-5 years	124 (72.5)
6-10 years	15 (8.8)
> 10 years	10 (5.8)
Working Unit	
PICU	26 (15.2)
NICU	94 (55)
Both	51 (29.8)
IPC Training	
Yes	50 (29.2)
No	121 (70.8)

5.2.Infection Prevention and Control Awareness

There were 19 questions assessing the awareness of respondents. The mean overall awareness score ($\pm SD$) was 15.28 ± 1.82 . Among the respondents 53.2% (91) scored above the mean, whereas 46.8% (80) scored below the mean. The overall response to awareness questions is displayed on Table 3.

Binary logistic regression was used to test if age, gender, profession, work experience, working unit, IPC training affected the knowledge in IPC. Age, gender, work experience, working unit and IPC training weren't statistically significant, whereas profession was statistically significant ($R^2 = 23.3\%$, $F = 1$, $p = 0.023$), 95% CI [1.07, 2.49]) with mean awareness score 14.66 in nurses, 15.64 in interns, 15.67 in residents, 17.4 in fellow and consultants.

5.3.Perception of Health-care workers towards IPC

The mean attitude score of the study participants was 3.89. Among the study participants 91 (53.2%), and 80 (46.8%) had favorable and unfavorable attitude scores, respectively. The response to the attitude questions is shown in Table 4.

Binary logistic regression was used to test if age, gender, profession, work experience, working unit, IPC training had effect on attitude of IPC. Age, gender, work experience, working unit and IPC training weren't statistically significant, whereas profession was statistically significant ($R^2 = 18.7\%$, $F = 1$, $p = 0.006$), 95% CI [1.19, 2.89]). Nurses had lower perception 35.13%, followed by residents 64.29%, interns 72.72% and consultants and fellow (80%).

Table 3 Infection prevention and control awareness response

Questions	Nurse	Interns	Resident	Fellow and Cons.	Total
1. Health care associated infections					
A. The environment (air, water, inert surface) is the major source of bacteria responsible for nosocomial infection.	6 (8.1)	3 (13.6)	10 (14.3)	2 (40)	21 (12.3)
B. Advanced age or very young age increases the risk of nosocomial infection	46 (62.2)	21 (95.5)	63 (90)	5 (100)	135 (78.9)
C. Invasive procedure increase the risk of nosocomial infection	62 (83.8)	22 (100)	70 (100)	5 (100)	159 (93)
2. Standard Precautions					
A. Standard precautions include the recommendations to protect only the patients	69 (93.2)	22 (100)	67 (95.7)	5 (100)	163 (95.3)
B. Standard precautions include the recommendations to protect the patients and healthcare workers	71 (95.9)	20 (90.9)	69 (98.6)	5 (100)	165 (96.5)
C. Standard precautions apply for all patients	60 (80.1)	21 (95.5)	66 (94.3)	4 (80)	151 (88.3)
D. Standard precautions apply for only healthcare who have contact with body fluids	66 (89.2)	22 (100)	67 (95.7)	5 (100)	160 (93.6)
3. Hand Hygiene					
A. Hand Hygiene should be practiced before or after contact with a patient	37 (50)	16 (72.7)	37 (52.9)	3 (60)	93 (54.38)
B. Hand Hygiene should be practiced before and after contact with a patient	58 (78.4)	17 (77.3)	49 (70)	4 (80)	128 (74.9)
C. Practice of hand hygiene is recommended in between patient contacts	62 (83.8)	22 (100)	67 (95.7)	5 (100)	156 (91.2)
D. Practice of hand hygiene is recommended after removal of gloves	66 (89.2)	21 (95.5)	61 (87.1)	4 (80)	152 (88.9)
4. When there is a risk of splashes of blood and body fluids, the health workers must wear					
A. Mask only	74 (100)	22 (100)	70 (100)	5 (100)	171 (100)
B. Eye protection only	74 (100)	22 (100)	70 (100)	5 (100)	171 (100)
C. Gown only	72 (97.3)	21 (95.5)	70 (100)	5 (100)	168 (98.2)
D. Mask, goggles and gowns	72 (97.3)	21 (95.5)	70 (100)	5 (100)	168 (98.2)
5. What are the indications for the use of alcohol-based hand rub (on unsoiled hands)?					
A. Instead of a traditional hand washing (30s)	54 (73)	16 (72.7)	53 (75.7)	5 (100)	128 (74.9)
B. Instead of an antiseptic hand washing (30s)	61 (82.4)	21 (95.5)	63 (90)	5 (100)	150 (87.7)
C. Instead of surgical hand washing (3 min)	53 (71.6)	11(50)	50 (71.4)	5 (100)	119 (69.9)
D. A traditional hand washing must be done before hand washing with alcohol-based hand rub	19 (25.7)	3 (13.6)	25 (35.7)	5 (100)	52 (30.4)

Table 4 Perception of Health-care workers towards IPC

No.	Questions	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
1	Using PPE affects patients psychologically so it should not be used	123(71.9)	39 (22.8)	4 (2.3)	4 (2.3)	1 (0.6)
2	Using standard precautions for a patient with suspected infectious diseases is waste of resources	121(70.8)	33 (19.3)	1 (0.6)	11 (6.4)	5 (2.9)
3	Using PPE are protective from exposure to body fluids which can be anticipated during provision of care	11 (6.4)	4 (2.3)	12 (7.0)	69 (40.4)	75 (43.9)
4	Hand washing is protective from exposure to body fluids which can be anticipated during provision of care	27 (15.8)	57 (33.3)	15 (8.8)	43 (25.1)	29 (17.0)
5	When I use PPE, it would affect my ability to deliver care.	51 (29.8)	76 (44.4)	16 (9.4)	21 (12.3)	7 (4.1)
6	I find the use of standard precautions for all patients to be far too idealistic.	29 (17.0)	55 (32.2)	30(17.5)	43 (25.1)	14 (8.2)

5.4.Practice of Standard Precaution in HCW

The overall scores obtained by the NICU was 50 – 75% in one of the seven modules and < 50% for six of the seven modules, whereas in PICU 50 – 75% in two of the seven modules and < 50% for five of the seven modules. Using the ICAT tool the overall practice score was 40.63% in neonatal and 44.6% pediatric ICU. Table 5

The lower score obtained by the NICU for general practices was due to nurse-to-patient ratio, use of gown or apron when entering the NICU and the requirement to perform thorough hand hygiene prior to entering the ICU. In the section on mechanical ventilation, the NICU scored 33.3% while PICU scored a borderline 50%. The low scores were due to the use endotracheal suction catheter for more than one episode, variation in ventilator circuit handling, use of distilled water for humidifiers, and the use of in-line bacterial filters.

With regard to airway suctioning the score was 41.67% in PICU and 50% in NICU and both ICUs didn't consistently and thoroughly follow the recommended practice. They did not

comply to the recommended frequency of changing the airway suction catheter (at least once every shift) and they used distilled water which was taken from a multi-dose container. The suction catheters were stored in uncovered container in between use. In NICU medication nebulizers were reprocessed daily, whereas in PICU, it's only reprocessed when used for another patient.

PICUs didn't consistently and thoroughly follow the recommended practice regarding hand hygiene and scored 31.25% whereas in NICU recommended practices were usually followed and scored 66.67%. In both ICUs, there is less than one hand washing station per two beds, dry air is used for drying hands after hand washing, waterless alcohol-based hand antiseptics are available, but they don't contain emollients; there is no policy in covering skin lesions with waterproof dressings, hand lotions aren't available after hand washing. The lower scores in PICU is attributed to the absence of functional hand washing stations in patient care areas, absence of protocol regarding use of artificial nails and shortening of nails, and the routine use of hand antiseptics.

Both ICUs didn't consistently and thoroughly follow the recommended practice regarding intravenous catheters thus scored 37.9% in NICU and 38.5% in PICU. The lower score was due to use of noncommercial use of intravascular catheters, like feeding tubes, variation in changing peripheral IV catheters, not using gown and large sterile drape in inserting central venous catheter, not practicing the use of antiseptics at the site of a hub connection and placing of disconnected IV fluids in sterile fluid.

Both ICUs didn't consistently and thoroughly follow the recommended practice regarding intravenous fluids and thus scored 35 % in PICU and 40 % in NICU. In PICU admixture of standard IV fluids was at the patient bedside, whereas in NICU there was a separate

designated area, but the ICAT recommendation was at the pharmacy. Both ICUs reported changing the infusion tubing of blood products only when the infusion was complete and for dextrose/ saline fluids when IV fluids were disconnected. There was also shortage of single-dose vial injectable medications and fluids. All multi-dose vials had rubber, silicone or latex diaphragm covering, but they were not disinfected with antiseptics prior to use. In both units, medications intended for single patient use were used for multiple patients.

NICUs didn't consistently and thoroughly follow the recommended practice regarding Urinary catheter and scored 31.25% whereas in PICU recommended practices were usually followed and scored 52.6%. In NICU the indication for using an indwelling catheter was to obtain urine specimen and only feeding tube was used as urinary catheter. Both units responded taking sample by disconnecting of the catheter from collection tubing when obtaining sample from a patient..

Both ICUs didn't consistently and thoroughly follow the recommended practice regarding sterilization and disinfection, and thus scored 30 %. The lower score is due to the processing of soiled and clean items together, use of rinsing for cleaning soiled instruments, use of one layer to wrap items to be sterilized and use of canvas as a wrapping material.

Table 5 Practice of Infection prevention and control practice in NICU and PICU

Modules	Neonatal ICU		Pediatric ICU	
	Safe Practice	Unsafe Practice	Safe Practice	Unsafe Practice
ICU	28.57%	71.43%	71.43%	28.57%
Airway suctioning	50%	50%	41.67%	58.33%
Hand Hygiene	66.67%	33.33%	43.30%	56.70%
Intravenous Catheters	37.90%	62.10%	38.50%	61.50%
Intravenous Fluids & Medication	40%	60%	35%	65%
Urinary Catheters	31.25%	68.75%	52.60%	47.40%
Sterilization and Disinfection	30%	70%	30%	70%
Overall Practice	40.63%	59.37%	44.60%	55.40%

5.5.Observation of Hand Hygiene in NICU

There were 127 patient contact encounters observed in NICU, of which 100 (78.7%) was with nurses, 12 (9.45%) with residents, 6 (4.72%) with Interns, 9 (7.08%) with consultants and fellow.

From the 127 encounters only in 19 encounters (14.96%) hand hygiene was practiced. Alcohol based hand rub was used in 12 (63.12%) and hand washing in 7 (36.88%). The antiseptic used wasn't palm-full and they practiced the hand rub for less than 10 sec.

Binary logistic regression was used to test if profession and moment of hand hygiene affected the observed practice of hand hygiene in NICU. Moment of hand hygiene wasn't statistically significant, whereas profession was statistically significant ($R^2 = 54.1\%$, $F = 1$, $p = 0.000$), 95% CI [2.65, 8.73]) in NICU. Nurses were observed performing hand hygiene in 4%, while 50% in interns, 33.3% in residents and 100% in seniors (Figure 2). (Table 6)

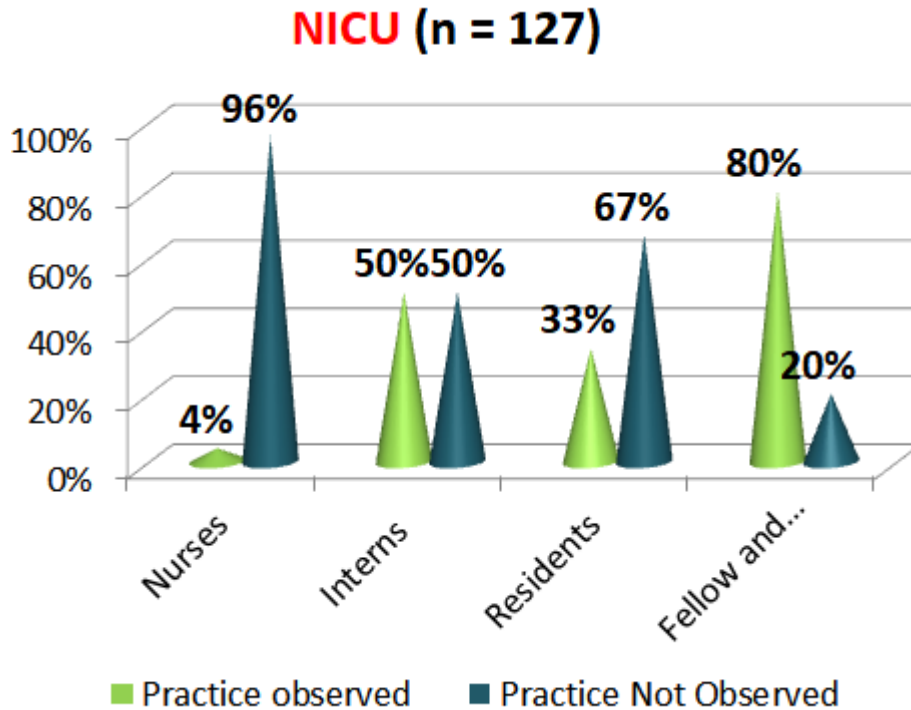


Figure 2 Observed hand hygiene practice among health professionals in NICU

Table 6 Observation of hand hygiene practice in NICU

Observation of hand hygiene practice in NICU	Performed	Not Performed
Before patient contact (n=39)	9 (23.08%)	30 (76.92%)
After Patient contact (n=38)	8 (21.0%)	30 (79.0%)
After body fluid contact (n=16)	0 (0.0%)	16 (100.0%)
After patient surrounding contact (n=20)	0 (0.0%)	20 (100.0%)
Before aseptic procedure (n=14)	2 (14.3%)	12 (85.7%)
Total	19 (14.96%)	108 (85.0%)

5.6.Observation of Hand Hygiene in PICU

There were 120 patient contact encounters observed in PICU, of which 67 (55.8%) encounters was with nurses, 48 (40%) with residents and 5 (4.17 %) with seniors. From the 120 encounters only in 4 encounters (3.33%) hand hygiene was practiced. (Table 7)

Binary logistic regression was used to test if profession and moment of hand hygiene affected the observed practice of hand hygiene in PICU and both weren't statistically significant. (Figure 3 and Table 7)

Table 7 Observation of hand hygiene practice in PSICU

Observation of hand hygiene practice in PICU	Performed	Not Performed
Before patient contact (n=33)	3 (9.09%)	30 (90.91%)
After Patient contact (n=26)	1 (3.85%)	25 (96.15%)
After body fluid contact (n=13)	0	13 (100.0%)
After patient surrounding contact (n=29)	0	29 (100.0%)
Before aseptic procedure (n=19)	0	19 (100.0%)
Total	4 (3.33%)	116 (96.67%)

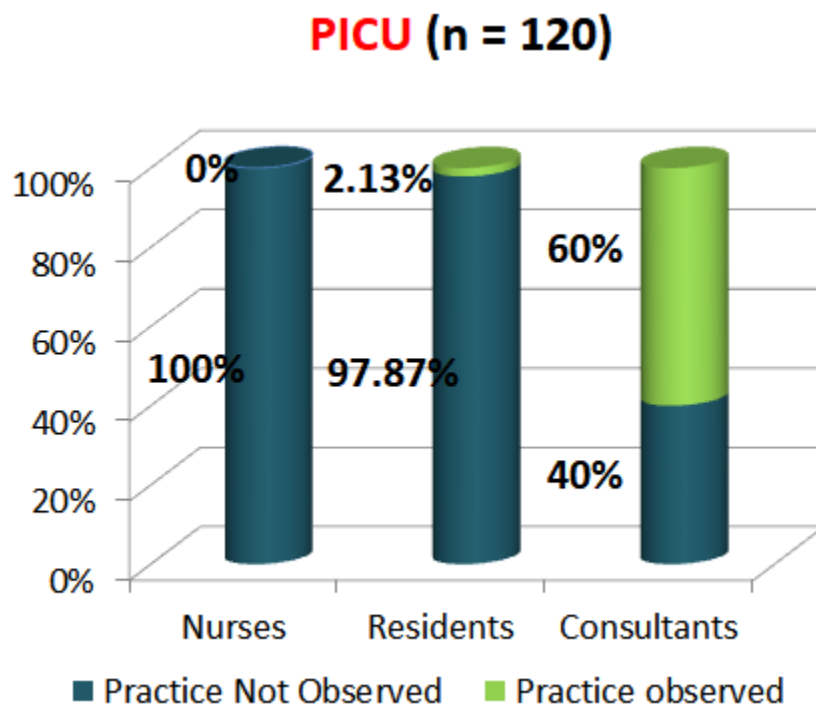


Figure 3 Observed hand hygiene practice among health professionals in PICU

6. Discussion

This study evaluated the knowledge, attitude and infection prevention and control practices of the healthcare staff in the neonatal and pediatric ICU at Saint Paul Hospital Millennium Medical College, Addis Ababa, Ethiopia. The participants' average awareness score (15.28 ± 1.82) was similar to a study conducted in Hungary (16.55 ± 2.69), but lower than Italy (18.1 ± 3.2) and France (21.5 ± 2.84) [40, 42, 43]. When compared to national researches, the mean score in knowledge was better than Debre Markos (5.29) and Gonder (10.69) [10, 11].

On the other hand, majority (29.8%) had IPC training, which is lower than the results in France, Italy, Hungary, Gonder, and Mizan Aman. This shows that the hospital isn't regularly implementing IPC training in accordance with the CDC's recommendations. In subgroup analysis fellow and consultants had higher percentage regarding IPC training which was discordant to previous study and this can be explained by the lower number of fellow and consultants in this study [10, 40, 42- 45].

The mean awareness score varied significantly across educational levels; with consultants and fellows having a higher mean than nurses, interns and residents. This could be explained by the fact that consultants and fellows have more training coverage, but nurses actually have the lowest mean score despite having the third highest training coverage. As a result nurses, interns and resident-focused interventions should be put into place.

Among the respondents 53.2% had positive attitude towards infection prevention and control. This result is lower than those studies from Gonder (64.2%), Dubti (69.23%), and North Shewa Oromia region (59.3%), however it is similar to a study from Bahir Dar (55.6%). This variation can be attributable to the difference in the instruments used, sampling technique and sample size between studies [10, 46-48].

This institutional investigation proved that neonatal and pediatric ICU infection control procedures are subpar. Using the ICAT tool the overall practice score was 40.63% in neonatal and 44.6% pediatric ICU. These findings were lower than a meta-analysis done in Ethiopia with findings of safe practice 66.2% in Addis Ababa. [9]

In contrast to pediatric ICU, where everyone is expected to do an alcohol-based hand massage prior to entering the ICU, the current practice in NICU is that staff and family don't practice hand hygiene before entering the unit. The South Africa study is contradictory to the results of this study. [49]

The National Reference Manual and American Association for Respiratory Care guidelines advice against using saline or any other fluid during suction and to only use single dose vials if absolutely necessary. In contrast, the study's findings showed that the suction catheters were used more than once, kept in an open container between uses, and were suctioned with distilled water. Gloves were worn during Suctioning as per the recommended procedure [50, 53].

Clinicians and other healthcare professionals are able to quickly wash their hands if sinks are available nearby. One sink per patient bed would be ideal, especially in places where critical care is provided. In contrast to the findings of this study, a research conducted in South Africa utilizing the ICAT hand hygiene module found that 100% of the ICUs (6 Public and 5 Private ICUs) met the standard of having at least for every bed [41, 49].

In stagnant water, microorganisms can thrive and grow. When water is scooped, it is likely done using a ladle, which in the ladle being dropped on a potentially dirty surface before being placed into the water for the next use. Freely flowing water reduces the development of

bacteria and guards against reinfection of hands. Running water is the only source of water accessible in the neonatal and pediatric ICU of SPHMMC. [41]

Using soap while washing hands eliminates not only dirt, but also microbes on hands. Soap dispensers may become contaminated by microorganisms on the user's hands because liquid soap is dispersed before hands have been thoroughly cleaned. Contact with contaminated hands can be minimized or avoided by using pump dispensers. In liquid soap, microorganisms can develop and survive. Bacteria can exist in antibacterial soaps as well. Containers should always be totally empty and cleaned before refilling to avoid contamination from bacteria in leftover soap. Dispensers of soap should be emptied, thoroughly cleaned, and dried before being used again to avoid contamination. An adequate amount of soap needs to be available at all times because it should be used before and after patient visit. The neonatal and pediatric ICUs at SPHMMC employ liquid soap, which is in-line with the findings of the South Africa study. It is always available and not reused after the dispenser is empty. [41, 49]

To reduce the recolonization of infectious microorganisms and eradicate any remaining bacteria, hands should be dried after washing using hot air driers, single-use paper towels, or cloth towels. Contrary to the guidelines, the findings of this study indicate that air drying is employed. The result of this study was lower than those of the South African study. [41, 49]

The appropriate use of alcohol-based hand antiseptics removes hand flora and they are quick and practical. Glycerin, propylene glycol, and sorbitol are examples of emollients that soothe, soften and protect skin. Additionally, it increases adherence to alcohol-based hand antiseptics. The ability to consistently practice good hand hygiene will be ensured by a sufficient supply of alcohol-based antiseptics. The accessibility of alcohol-based antiseptics will make it easier to use. Compliance will be made easier if there are enough dispensers conveniently

located in the patient care area. The critical care units in SPHMMC use alcohol-based hand antiseptics, which are constantly accessible at every bedside in both neonatal and pediatric ICU, in line with ICAT's recommendation. [41]

Gloves are helpful at keeping healthcare workers' hands from becoming contaminated, but they don't offer full hand contamination protection. Therefore, using gloves does not eliminate the requirement for good hand hygiene. In this investigation, donning gloves or performing hand hygiene were not done. These findings go against the advice from the WHO and are poor in comparison to the research in South Africa where performing it is a common practice. [5, 49]

The lack of routine practice of rotating or changing IV catheter every 72 – 96 hours, use of adequate aseptic technique during central catheter insertion, changing of infusion system, and proper storage of infusion system contributed to the poor findings of this study regarding intravenous catheter.

This study's finding on IV fluids and medication in the neonatal and pediatric ICU is 40% and 35% respectively, which is less than the South African study's result of 65%. [49]

In comparison to the South Africa study, which scored 67%, this study's findings regarding the use of urinary catheters are poor. [49]

Both neonatal and pediatric ICU received 30% because they didn't regularly and properly implement the advised procedure for sterilization and disinfection. The combined processing of dirty and clean materials, the use of rinsing to clean dirty instruments, the use of one layer of wrapping for things destined for sterilization, and the use of canvas as a wrapping material were the factors for lower score.

The observed hand hygiene compliance of each of the five suggested points is significantly lower than the adherence reported in systematic review in ICU settings, including several ICUs in Japan, a tertiary hospital in India, and 11 public and private ICUs in South Africa. When compared to a study done in Uganda (9.2%), the result of this study is higher in NICU, but lower than PICU. [49, 54- 57]

7. Conclusion

In this study, healthcare workers had low level of knowledge, attitude and practice. Profession was statistically significant in knowledge and attitude of IPC, and observation of hand hygiene in NICU. Although the response in hand hygiene indicated that it is usually followed, the observation revealed a different outcome. Gaps were identified in all the five hand hygiene moments.

8. Implication for clinical practice

Improvements in infection prevention and control can provide clear instructions for healthcare workers, which will help prevent antimicrobial resistance, decrease economic burden, hospital acquired infections and duration of hospital stay, and improve patient outcome. This study pointed out the need for continuous education of healthcare workers, regular monitoring and audit including giving feedback, having clear processes and policies, and creating a cleanliness culture.

9. Recommendations

Infection prevention and control methods should be integrated into health institutions, and on-the-job and off-the-job trainings on infection prevention and control should be continued with strict implementation. In addition, hospitals should provide infection prevention facilities and supplies, such as continuous water supply, hand washing sinks, and essential PPE to improve healthcare professionals' infection prevention habits. Infection prevention and control practices of healthcare workers should be monitored on a regular basis.

10. **Strength and Limitation of the Study**

10.1. Strength of the Study

- Questionnaires and observational checklist were used to collect data
- The sample size was sufficient
- Prospective study

10.2. Limitation of the Study

- It was a single center study, which makes generalization to other healthcare facilities difficult

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Annex I: Questionnaire

Part I: Socio demographic Data

1. Age in years _____
2. Gender A. Male B. Female
3. What is your profession?
 A. Nurse B. Intern doctor C. Resident doctor
 D. Fellow E. Consultant
4. Work experience in years
5. Which unit are you currently working at right now
 A. PICU B. NICU
6. How long have you worked in the unit (in years) _____
7. Have you been trained in infection prevention and control/standard precaution?
 A. Yes B. No

Part II: Assessment of Knowledge

1. The environment (air, water, inert surface) is the major source of bacteria responsible for nosocomial infection
 A. True B. False C. I don't know
2. Advanced age or very young age increases the risk of nosocomial infection
 A. True B. False C. I don't know
3. Invasive procedure increase the risk of nosocomial infection
 A. True B. False C. I don't know
4. Standard precautions include the recommendations to protect only the patients
 A. True B. False C. I don't know
5. Standard precautions include the recommendations to protect the patients and healthcare workers
 A. True B. False C. I don't know
6. Standard precautions apply for all patients
 A. True B. False C. I don't know
7. Standard precautions apply for only healthcare who have contact with body fluids
 A. True B. False C. I don't know
8. Hand hygiene should be practiced before or after contact with a patient
 A. True B. False C. I don't know
9. Hand hygiene should be practiced before and after contact with a patient
 A. True B. False C. I don't know
10. Practice of hand hygiene is recommended in between patient contacts
 A. True B. False C. I don't know
11. Practice of hand hygiene is recommended after removal of gloves
 A. True B. False C. I don't know
12. When there is a risk of splashes of blood and body fluids, the health workers must wear masks only

- A. True B. False C. I don't know
13. When there is a risk of splashes of blood and body fluids, the health workers must eye protection only
- A. True B. False C. I don't know
14. When there is a risk of splashes of blood and body fluids, the health workers must wear gown only
- A. True B. False C. I don't know
15. When there is a risk of splashes of blood and body fluids, the health workers must wear masks, goggles and gowns
- A. True B. False C. I don't know
16. Alcohol based hand-rub (on unsoiled hands) can be used instead of a traditional hand washing (30s)
- A. True B. False C. I don't know
17. Alcohol based hand-rub (on unsoiled hands) can be used instead of antiseptic hand washing (30s)
- A. True B. False C. I don't know
18. Alcohol based hand-rub (on unsoiled hands) can be used instead of surgical hand washing (3min)
- A. True B. False C. I don't know
19. A traditional hand washing must be done before hand washing with alcohol-based hand rub
- A. True B. False C. I don't know

Part III: Questions on Attitude

Instructions: Answer the following questions as you were using the named precautions. Please circle the **only one** number that best tells how you feel about each statement.

s.no	Questions	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
11	Using PPE affects patients psychologically so it should not be used	(1)	(2)	(3)	(4)	(5)
12	Using standard precautions for a patient with suspected infectious diseases is waste of resources	(1)	(2)	(3)	(4)	(5)
13	Using PPE are protective from exposure to body fluids which can be anticipated during provision of care	(1)	(2)	(3)	(4)	(5)
14	Hand washing is protective from exposure to body fluids which can be anticipated during provision of care	(1)	(2)	(3)	(4)	(5)
15	When I use PPE, it would affect my ability to deliver care.	(1)	(2)	(3)	(4)	(5)
16	I find the use of standard precautions for all patients to be far too idealistic.	(1)	(2)	(3)	(4)	(5)

Annex II: Check List

What is the name of this ICU?

Staffing

1. This ICU has
 - ☐ Adults only
 - ☐ Children only
 - ☐ Both adults and children
2. What is the total number of beds in this ICU? _____
3. On weekdays, how many nurses provide care to patients in this ICU during a typical day shift that includes 12 noon? _____
Calculate the number of beds per nurse: _____
Then mark the answer that applies
 - ☐ More than five beds per nurse
 - ☐ 1 Three to five beds per nurse
 - ☐ 2 Two or less beds per nurse

General Practices in the ICU

4. How frequently are immediate patient care areas in this ICU thoroughly cleaned? (Mark one answer)
 - ☐ Less than daily
 - ☐ 1 At least daily
 - ☐ 2 At least daily and between patients
5. Are staff required to wear cover gowns or special shoes to enter the ICU?
 - ☐ 1 No requirement
 - ☐ Gown required
 - ☐ Special shoes required
6. Are staff and visitors required to perform thorough hand hygiene prior to entering the ICU?
 - ☐ No
 - ☐ 1 Yes
7. What method is used for the hand hygiene? (Mark all that apply)
 - ☐ None required
 - ☐ Dip in disinfecting agent
 - ☐ Brushes with soap or antiseptic agent
 - ☐ 1 Sponges or very soft brushes with soap or antiseptic agent
 - ☐ 1 Waterless alcohol hand antiseptic

Mechanical Ventilation

8. The following questions cover mechanical ventilation in the ICU, including the handling of ventilator circuits and humidifiers. What percentage of patients in this unit require mechanical ventilation?
 - ☐ None

- ☐ Less than 25 percent
 - ☐ 25–50 percent
 - ☐ More than 50 percent
9. Is the same suction catheter used for more than one episode of endotracheal suctioning in patients receiving positive pressure ventilation?
- ☐ Yes
 - ☐2 No
10. How often are ventilator circuits changed? (Mark one answer)
- ☐ Every day
 - ☐1 Every three to six days
 - ☐1 Less frequently than once a week
 - ☐1 Never when used for an individual patient
11. What type of humidifier is used in the ventilator circuit? (Mark one answer)
- ☐ No humidifier used
 - ☐1 Mechanical ventilator
 - ☐1 Bubbling humidifier
 - ☐1 Wick humidifier
 - ☐1 Passover humidifier
 - ☐1 Cascade humidifier
 - ☐1 Hygroscopic condenser or heat-moisture exchange humidifier
12. What type of water is used to fill the humidifier?
- ☐1 Sterilized water
 - ☐ Distilled water
 - ☐ Tap water
13. Are in-line bacterial filters used in ventilator circuits?
- ☐1 No
 - ☐ Yes

Airway Suctioning

1. What type of fluid is instilled for airway suctioning? (Mark one answer)
- ☐ Tap water
 - ☐ Distilled or filtered water
 - ☐ Sterile water
 - ☐ Non-sterile saline
 - ☐1 Sterile saline
2. How is this fluid dispensed? (Mark one answer)
- ☐ Single dose drawn from a multi-dose container
 - ☐1 Commercially manufactured single dose vial
 - ☐1 Locally made single dose vial
 - ☐1 Container made for individual patient use and discarded or reprocessed at least daily
3. How frequently are airway suction catheters changed? (Mark the description that best applies)

- ☐ Suction catheters not used
 - ☐ Approximately every day
 - ☐1 Approximately once every shift
 - ☐1 More frequently than once per shift
4. Are suction catheters and masks used for more than one patient without reprocessing?
- ☐ Yes
 - ☐2 No
5. Does the person performing suctioning wear gloves on one or two hands? If gloves are not worn, skip question 6.
- ☐ Gloves not worn
 - ☐ Gloves worn on one hand
 - ☐2 Gloves worn on two hands
6. If gloves are worn, are they sterile or not sterile? (Mark one answer)
- ☐ Gloves not worn
 - ☐ 1 Sterile reused surgical gloves
 - ☐ 1 Not sterile, but clean (new) examination gloves
 - ☐ 1 Both sterile and non-sterile
7. How frequently is there a sufficient supply of gloves for use during suctioning? (Mark answer that best applies)
- ☐ Never
 - ☐ Sometimes
 - ☐ Usually
 - ☐1 Always
8. How are suction catheters stored between uses? (Mark the answer that best applies)
- ☐1 In-line suctioning is available so no external storage is necessary
 - ☐ In a bottle containing sterile or distilled water
 - ☐ In a bottle containing filtered or tap water
 - ☐1 In a paper or cloth wrap
 - ☐1 Covered in a dry container
 - ☐ Uncovered container
9. If medication nebulizers are used, how often are they changed or reprocessed for use in the same patient? (Mark one answer)
- ☐ Nebulizers not used
 - ☐1 After every treatment
 - ☐1 Approximately every day
 - ☐ Only changed for use in another patient
10. What type of cuff is used on endotracheal tubes? (Mark one answer)
- ☐1 Low pressure cuffs
 - ☐ High volume-low pressure cuffs

Hand Hygiene

1. How many hand washing stations and how many beds are on this unit? Enter numbers for each in the space to the right, then mark one answer below.
/
 - ☐ None
 - ☐1 Fewer than one hand washing station per six beds if General Ward (per two beds if Intensive Care Unit)
 - ☐2 One or more hand washing station per six beds if General Ward (per two beds if Intensive Care Unit)
2. What is the usual source of water for hand washing? (Mark one answer)
 - ☐ No water is usually available
 - ☐ Water is scooped from a basin and poured over hands
 - ☐1 Water is usually poured over hands from a basin
 - ☐1 Water is usually available from a cistern or container with gravity flow
 - ☐2 Running water from sink
3. How frequently is running water available?
 - ☐ Never
 - ☐ Sometimes
 - ☐1 Usually
 - ☐2 Always
4. What type of soap is most frequently available for hand washing? (Mark one answer)
 - ☐ No soap is available
 - ☐ Plain bar soap stored in a receptacle that does not allow water to drain
 - ☐1 Plain bar soap stored in a receptacle that allows water to drain
 - ☐1 Plain liquid soap
 - ☐1 Soap powder, leaves, or flakes
 - ☐1 Soap with antimicrobial agent
5. How frequently is soap available? (Mark one answer)
 - ☐ Never
 - ☐ Sometimes
 - ☐1 Usually
 - ☐2 Always
6. What types of dispensers are used on this unit for liquid soaps? (Mark one answer)
 - ☐ Liquid soaps are not used
 - ☐ Handheld pour bottle or squeeze dispenser
 - ☐1 Hand operated pump dispenser
 - ☐1 Foot pump dispenser
7. How are liquid soap dispensers usually cleaned? (Mark one answer)
 - ☐ Liquid soaps are not used
 - ☐ Dispensers are topped off or refilled without cleaning
 - ☐1 Dispensers are emptied, washed, and dried before refilling
 - ☐1 Dispenser or dispenser insert is disposed of when empty and new one is used
8. What method is usually available for drying hands after hand washing? (Mark one answer)
 - ☐ None (air dry)

- ☐ Multiple-use cloth towel
 - ☐1 Single-use cloth towel
 - ☐1 Paper towels
 - ☐1 Hot air dryer
9. Is a waterless alcohol-based hand antiseptic used for hand hygiene? (Mark one answer)
- ☐ No
 - ☐1 Yes, alcohol-based antiseptic without emollient
 - ☐3 Yes, alcohol-based antiseptic with emollient
10. How frequently is there a sufficient supply of waterless alcohol-based hand antiseptic? (Mark one answer)
- ☐ Alcohol-based hand antiseptic is not available
 - ☐ Supply of alcohol-based antiseptic is never sufficient
 - ☐ Sometimes
 - ☐1 Usually
 - ☐2 Always
11. How many dispensers of waterless alcohol-based antiseptic are available on the ward? (Mark one answer)
- ☐ Alcohol-based hand antiseptic is not available
 - ☐1 Fewer than one for every four beds
 - ☐2 One or more for every four beds
12. In which of the following situations do health care personnel such as doctors and nurses routinely wash their hands with soap and water or a waterless alcohol-based hand antiseptic? (Mark all answers that apply)
- ☐1 Before contact with patients
 - ☐1 After contact with individual patients or their immediate environment
 - ☐1 Before manipulating medical devices such as intravenous catheters, urinary catheters, or endotracheal tubes, or before handling wound dressing
 - ☐1 After touching potentially contaminated objects or surfaces
 - ☐1 After removing gloves
 - ☐1 After using bathroom, toilet, latrine
13. Is there a policy on covering skin lesions and cuts with waterproof dressings?
- ☐ No
 - ☐1 Yes
14. Is there a policy on keeping finger nails short and/or not using artificial nails or nail extenders?
- ☐ No
 - ☐1 Yes
15. Is it usual practice to wear gloves instead of washing hands for contact with patients or potentially contaminated environmental surfaces? (Mark one answer)
- ☐1 No
 - ☐ Yes

16. Is hand lotion (emollient) usually available for staff to use after hand washing? (Mark one answer)

- ☐ No
- ☐1 Yes, hand lotion in disposable containers
- ☐1 Yes, hand lotion in reusable containers

17. When a hand lotion container is empty, what usually happens? (Mark one answer)

- ☐ Hand lotion is not usually available
- ☐ Container is refilled or topped off without cleaning
- ☐1 Container is emptied, washed, and dried before refilling
- ☐1 Container is disposed of when empty and new container is used

Intravenous Catheters

1. What proportion of patients in this unit receive peripheral intravenous catheters? (Mark one answer)

- ☐ None
- ☐ Some
- ☐ Most
- ☐ All

2. What types of catheters are usually used for peripheral intravenous access? (Mark one answer)

- ☐ Short rigid metal catheters (“butterfly”)
- ☐1 Short flexible polyethylene catheters (needle)

3. What type of skin antiseptic is used for inserting intravenous catheters? (Mark all that apply)

- ☐ None
- ☐ Thiomersal
- ☐ Benzalkonium chloride
- ☐1 Chlorhexidine
- ☐1 Iodine
- ☐1 Iodophor (povidone-iodine)
- ☐1 Alcohol
- ☐1 Chlorhexidine + alcohol
- ☐1 Iodine + alcohol

4. How often is there a sufficient supply of skin antiseptic for use during intravenous catheter insertion procedures? (Mark the answer that best applies)

- ☐ Never
- ☐ Sometimes
- ☐1 Usually
- ☐1 Always

5. What proportion of patients in this unit requires central venous catheters?

- ☐ None
- ☐ Some
- ☐ Most

If NONE, skip the rest of this module

6. How often are noncommercial intravascular catheters used (e.g., feeding tubes or locally assembled catheters)? (Mark answer that best applies)
- ☐ 2 Never
 - ☐ Sometimes
 - ☐ Usually
 - ☐ Always
7. Which of the following intravascular catheters are routinely changed? (Mark all that apply)
- ☐ No catheters routinely changed
 - ☐ Umbilical venous catheter
 - ☐ Umbilical artery catheter
 - ☐ Catheters inserted peripherally into an arm or leg vein and threaded into central veins (PICCs)
 - ☐ Percutaneous central venous catheter (e.g., inserted in subclavian, jugular, femoral vein)
 - ☐ 1 Peripheral metal (“butterfly”) or short Teflon®, polyethylene, or other plastic catheter changed after 72 hours
 - ☐ 2 Peripheral metal (“butterfly”) or short Teflon, polyethylene, or other plastic catheter changed within 72 hours
8. How often are intravenous catheters inserted by cut-down? (Mark number that best applies)
- ☐ 2 Never
 - ☐ 1 Sometimes
 - ☐ Usually
 - ☐ Always
9. What type of dressing is used to cover the catheter insertion site? (Mark the most common)
- ☐ None
 - ☐ No dressing used, covered, or secured with sterile tape
 - ☐ No dressing used, covered, or secured with non-sterile tape
 - ☐ 1 Sterile gauze
 - ☐ 1 Transparent dressing (specify type): _____
 - ☐ 1 Sterile gauze covered with transparent dressing
10. What type of antimicrobial ointment or cream is applied to the site of insertion of an intravenous catheter? (Mark all that apply)
- ☐ Bacitracin
 - ☐ Neomycin, polymyxin B, and bacitracin (Neosporin®)
 - ☐ Polysporin
 - ☐ Mupirocin
 - ☐ Iodophor
 - ☐ 1 No ointment or cream used
11. Are intravenous catheters reprocessed for use in another patient?
- ☐ Yes
 - ☐ 2 No
12. What types of catheters are used for central venous access? (Mark all that apply)
- ☐ Percutaneous, central venous catheter (CVC) (e.g., inserted into subclavian, jugular, or femoral vein)—stiff polyurethane

- ☐ Umbilical venous/arterial catheter in newborn—stiff polyurethane
- ☐1 Percutaneous, CVC (e.g., inserted into subclavian, jugular, or femoral vein)—flexible Teflon, polyurethane
- ☐1 Umbilical venous/arterial catheter in newborn—flexible Teflon, polyurethane
- ☐1 Pliable plastic catheters inserted peripherally into an arm or leg vein and threaded into the central veins (PICCs)

13. What barriers are used for central venous catheter insertion? (Mark all that apply)

- ☐ Non-sterile gloves
- ☐ Mask
- ☐ Hair cover (cap)
- ☐ Small sterile drape
- ☐1 Sterile gloves
- ☐1 Gown (sterile or non-sterile)
- ☐1 Large sterile drape (such as used in surgery)

14. When the intravascular infusion system is disconnected at the site of a hub connection, is the inside of the connection cleaned with sterile water, sterile saline, or alcohol prior to reconnection?

- ☐ No
- ☐1 Yes

15. When an injection is made into a port in the intravascular infusion system, is the port covering (e.g., latex membrane) cleaned with alcohol or an iodinated disinfectant?

- ☐ No
- ☐1 Yes

16. When the intravenous infusion system is disconnected, are the ends placed in a sterile fluid?

- ☐ No
- ☐1 Yes

Intravenous Fluids and Medications

1. Where are standard IV fluids used in this unit admixed (e.g., addition of KCL)? (Mark the description that applies best)

- ☐ Where patient care is performed
- ☐2 In the pharmacy
- ☐1 In a designated “clean” area (e.g., within the operating room area, ICU, or in a room specifically designated for this purpose).

2. What is the source of premixed IV fluids available in this unit? (Mark all that apply)

- ☐ None are used
- ☐ Prepared on ward
- ☐2 Commercial source
- ☐1 Prepared centrally in facility

3. How frequently is commercial IV infusion tubing available with connections that are compatible with the bottles or bags used in this unit? (Mark one answer)

- ☐ Never
- ☐ Sometimes
- ☐1 Usually
- ☐2 Always

4. How frequently is IV infusion tubing changed in this unit for each of the following? (Mark one check box in each column)

Infusion tubing is changed

Blood products

Nutrition fluids (Total parenteral, Dextrose/saline fluids)

- ☐ When infusion is complete ☐ When IV is discontinued ☐ Every 12-24 hours
- ☐ Every 48 hours ☐ Every 72 hours ☐ More than 72 hours

5. How frequently are single-dose vials used for injectable fluids/medications? (Mark one answer)

- ☐ Never
- ☐ Sometimes
- ☐2 Usually
- ☐2 Always

6. When multi-dose vials are used for injectable fluids/medications, how often do they have rubber, silicon, or latex diaphragms? (Mark one answer)

- ☐ Never
- ☐ Sometimes
- ☐1 Usually
- ☐2 Always

7. If vials with latex/silicon diaphragms are used, is the diaphragm disinfected with alcohol or iodinated disinfectant prior to access?

- ☐ No
- ☐1 Yes

8. Is there a written hospital policy for handling and storage of multi-dose vials? If not, skip question 9.

- ☐ No
- ☐2 Yes

9. Does the policy state that opened vials should be marked with the date and time of expiration? (Mark one answer)

- ☐ No policy
- ☐ No
- ☐1 Yes

10. Are medications manufactured or intended for use in a single patient used for multiple patients?

- ☐ Yes
- ☐2 No

Urinary Catheters

1. Are straight (i.e., “in-out,” no indwelling) urinary catheters used in this unit?
☐ No
☐1 Yes
2. Are straight urinary catheters reused?
☐ Straight urinary catheters are never used
☐ Yes, they are reused
☐1 No, they are not reused
3. How frequently are indwelling urinary catheters used in this unit? (Mark one answer)
☐2 Never
☐1 Only occasionally
☐ Frequently
☐ Always
4. What are the indications for using indwelling urinary catheters? (Mark all that apply)
☐1 Urine drainage during surgery and immediate post-operative period
☐1 Acute urethral obstruction
☐1 Monitor urine output in critically ill patients
☐ To obtain urine specimens
☐ Incontinence
☐ Routine irrigation
☐1 Irrigation for bleeding or blood clots
☐ Prevent/manage bedsores
☐ Clamped or plugged catheters
5. What types of indwelling urinary catheters are used? (Mark all that apply)
☐ Feeding tube
☐1 Commercially manufactured indwelling urinary catheter impregnated with antimicrobials (e.g., silver)
☐1 Commercially manufactured indwelling urinary catheter without antimicrobials
6. Is the supply of indwelling urinary catheters adequate and reliable? (Mark one answer)
☐ Never
☐ Sometimes
☐1 Usually
☐1 Always
7. Is there is a policy to routinely change indwelling urinary catheters?
☐ Yes
☐1 No
8. How frequently are indwelling urinary catheters reused?
☐2 Never
☐1 Sometimes
☐ Usually
☐ Always
9. What are the indications for opening an indwelling catheter system? (Mark all that apply)
☐ Routine irrigation
☐ Obtaining urine for analysis or culture
☐1 Not draining

- ☐ 11 Irrigation for bleeding/clots
- ☐ 11 Never opened
- 10. If a urine sample must be obtained from a patient with an indwelling urinary catheter for analysis or culture, how is this accomplished? (Mark all that apply)
- ☐ Disconnection of catheter from collection tubing
- ☐ From collection container
- ☐ 1 Aspirate through special aspiration port
- ☐ 1 Aspirate through catheter or collection tubing

STERILIZATION AND DISINFECTION—EQUIPMENT AND IV FLUIDS

1. Are there written facility policies and procedures for sterilizing materials and equipment?
 - ☐ No written policies or procedures
 - ☐ Policies/procedures communicated verbally only
 - ☐ 1 Written policies/procedures available in an operations manual but not generally available for daily practice
 - ☐ 2 Written policies/procedures in a manual but also posted on walls in clinical or support areas
2. Do the written policies explicitly identify the items that require sterilization?
 - ☐ No written policies
 - ☐ No, items not explicitly identified
 - ☐ 1 Yes
3. . . What is the required procedure when sterilizer failures are detected? (Mark all that apply)
 - ☐ No written procedure
 - ☐ 1 Reporting of failure
 - ☐ 1 Recall potentially contaminated items from clinical units
4. Is there a written hospital policy regarding the decontamination of instruments before cleaning?
 - ☐ No written policies or procedures
 - ☐ Policies/procedures communicated verbally only
 - ☐ 1 Written policies/procedures available in an operations manual but not generally available for daily practice
 - ☐ 2 Written policies/procedures in a manual but also posted on walls in clinical or support areas
5. How are soiled and clean items separated from each other? (Mark one answer)
 - ☐ Processed in the same work area
 - ☐ Same room, separate areas
 - ☐ 1 Separate utility rooms for soiled and clean items
6. Which disinfectant is usually used to decontaminate used items? (Mark the one that is most commonly used)
 - ☐ Not all used items are decontaminated
 - ☐ 1 Iodophor
 - ☐ 1 Formaldehyde
 - ☐ 1 Ethyl or isopropyl alcohol
 - ☐ 1 Glutaraldehyde
 - ☐ 1 Phenolic
 - ☐ 1 Hydrogen peroxide

- ☐1 Paracetic acid
☐2 Sodium hypochlorite or other chlorine compound
7. Does decontamination occur before cleaning or any other handling of used items?
☐ No
☐1 Yes
8. How are soiled instruments usually cleaned? (Mark all that apply)
☐ Rinsing
☐1 Vigorous scrubbing with brush
☐1 Mechanical dishwasher
☐1 Ultrasonic cleaner
9. Which of the following solutions is used to remove organic material from soiled instruments?
 (Mark one answer)
☐ Water
☐1 Water with detergent
☐1 Protein-dissolving (enzyme) solution
10. What material is usually used to package items for sterilization? (Mark one answer)
☐ No wrapping
☐ Canvas
☐1 Cotton
☐1 Muslin
☐1 Paper
☐1 Newsprint
11. How many layers are used to wrap items to be sterilized? (Mark one answer)
☐ One layer
☐1 Two layers

12. Which methods are used to disinfect and sterilize equipment? (Mark all that apply in each row). Leave blank if equipment not sterilized.						
Equipment	Steam (autoclave)	Dry heat	Chemical sterilization	High-level disinfection	Wet heat /pasteurize	Other method**
Scalpel blades	☐ 1	☐ 1	☐ 1	☐	☐	☐
Metal urinary catheters	☐ 1	☐ 1	☐ 1	☐ 1	☐ 1	☐
Plastic urinary catheters	☐	☐	☐ 1	☐ 1	☐ 1	☐
IV catheters/tubing	☐	☐	☐	☐	☐	☐
Oxygen mask/tube	☐	☐	☐	☐	☐ 1	☐
Laryngoscope blades	☐ 1	☐ 1	☐ 1	☐ 1	☐ 1	☐
Surgical/obstetric instruments	☐ 1	☐ 1	☐	☐	☐	☐

Endotracheal tubes	☐	☐	☐ 1	☐ 1	☐ 1	☐
Fiber-optic endoscopes	☐	☐	☐ 1	☐ 1	☐	☐

Ambu-bags	☐	☐	☐ 1	☐ 1	☐ 1	☐
Respiratory suction catheters	☐	☐	☐ 1	☐ 1	☐ 1	☐
Nebulizers	☐	☐	☐ 1	☐ 1	☐ 1	☐
Ventilator circuits	☐	☐	☐ 1	☐ 1	☐ 1	☐

13. Which methods are used for equipment sterilization? (Mark all that apply)

- ☐ Flash steam sterilization (autoclave)
- ☐ Microwave
- ☐1 Ethylene oxide
- ☐1 Plasma/gas sterilization
- ☐1 Low temperature steam formaldehyde sterilization
- ☐1 Steam/pressure sterilization (autoclave)
- ☐1 Dry heat sterilization (oven)
- ☐1 Chemical sterilization
- ☐1 High-level chemical disinfection
- ☐1 High-level disinfection using pasteurization

14. Are biological and/or chemical indicators used to monitor the success of sterilization? (Mark one answer)

- ☐ Neither is used
- ☐1 Biological indicators only used
- ☐1 Chemical indicators only used
- ☐2 Both indicators are used

15. How often are monitoring indicators used? (Mark one answer)

- ☐ Indicators not used
- ☐ Once a week
- ☐ Once a month
- ☐1 Every day
- ☐2 Every cycle

16. How frequently are autoclaves checked by a service or maintenance person? (Mark one answer)

- ☐ No autoclaves available in hospital
- ☐ Only when serviced as needed for repairs
- ☐1 Only when serviced by maintenance per service contract
- ☐1 Once a month
- ☐1 Several times a year

17. How are sterile instrument packs stored? (Mark all that apply)

- ☐ Directly on shelves or carts
- ☐ In cardboard boxes
- ☐ In paper bags
- ☐1 In enclosed plastic or metal boxes
- ☐1 In plastic bags
- ☐1 In sterilized acceptor bags

18. Is the date of sterilization written on sterile packs?

- ☐ No
- ☐1 Yes

19. In what order are sterile supplies removed from storage for use? (Mark one answer)

- ☐ Newest sterile packs are used first
- ☐ Randomly or as convenient
- ☐1 Oldest sterile packs are used first

20. Is there a written policy regarding shelf-life after which unprotected items must be resterilized? (Mark one answer)

- ☐ No written policy or procedures
- ☐ Policy/procedures communicated verbally only
- ☐1 Written policy/procedures available in an operations manual but not generally available for daily practice
- ☐2 Written policy/procedures in manual but also posted on walls in clinical or support areas

SCORING SHEET

Date completed:

	1	2	3	4
Module Section	Assessment Total	Possible Total	Percent Score	Rating Based on Percent Score
Total for Module			%	

Column Notes:

9. **Assessment Total**—Sum of points for all marked responses

10. **Possible Total**—Sum of all possible points for the question

11. **Percent Score**—(Column 1/Column 2) $\times$ 100

12. **Rating**—

More than 75% of possible points: A—recommended practices are followed consistently and thoroughly

50–75 % of possible points: B—recommended practices usually followed

Less than 50 % of possible points: C—training and follow-up needed on recommended practices

Annex III: Observation

Moments of hand hygiene	Profession	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Type of health worker	Nurse	☐	☐	☐	☐	☐			☐	☐	☐			☐	☐	☐
	Intern															
	Resident															
	Fellow															
	Consultant															
Type of Hand washing before patient contact	Hand wash															
	Alcohol															
	Palm full															
	Duration															
	None	☐														
Type of hand washing after patient contact	Hand wash															
	Alcohol															
	Palm full															
	Duration															
	None		☐											☐	☐	☐
Type of hand washing after body fluid contact	Hand wash															
	Alcohol															
	Palm full															
	Duration															
	None															
Type of hand washing after patient surrounding	Hand wash															
	Alcohol															
	Palm full															
	Duration															
	None															
Type of hand washing	Hand wash															
	Alcohol															

before antiseptic procedure	Palm full															
	Duration															
	None															