Knowledge, Attitude and Practice on Hospital-Acquired Infection Prevention and Associated Factors Among Healthcare Workers at University of Gondar Comprehensive Specialized Hospital, Northwest Ethiopia

Biruk Bayleyegn, Debasu Mehari, Debasi Damtie, Markos Negash

1Department of Clinical Hematology and Immunohematology, College of Medicine and Health Sciences, University of Gondar, Gondar, Ethiopia; 2Department of Medical Laboratory Sciences, Debre-Markos University, Debre Markos, Ethiopia; 3Department of Immunology and Molecular Biology, College of Medicine and Health Sciences, University of Gondar, Gondar, Ethiopia

Background: Hospital-acquired infections can be acquired by a patient or develop among hospital staff, as a more serious problem in low- and middle-income hospital settings. Assessing the level of knowledge, attitude and practice towards hospital-acquired infection prevention among healthcare workers and identifying the associated factors has an unquestionable importance of handling and management of these infections. Thus, in this study, we evaluated the knowledge, attitude and practice towards HAI prevention and associated factors in healthcare workers at the University of Gondar Comprehensive Specialized Hospital, North West Ethiopia.

Methods: Hospital-based cross-sectional study was conducted among healthcare workers towards HAI prevention from January to June 2019. Each study participant was selected by simple random sampling. Data were collected using structured self-administered questionnaires. Descriptive analysis was used to present frequency and percentage of the main findings. The association between independent variables and KAP scores on HAI prevention was calculated using Pearson’s Chi square and p-values less than 0.05 were considered as statistically significant.

Results: A total of 236 participants were included in this study with a 100% response rate; 90% and 57.2% of the participants had good knowledge and positive attitude towards HAI prevention, respectively. Meanwhile, only 36% of the study participants had good practice towards HAI prevention, suggesting less than satisfactory scores in this study. Level of education and work experience were significantly associated with safe-infection prevention attitude and practice (P value <0.005).

Conclusion: Even though the respondents have good knowledge with a sympathetic attitude about HAI prevention, good knowledge did not translate into prudent practices. Level of education and work experience were the independent risk factors towards HAI prevention of attitude and practice. Provision of continual on-job and off-job trainings together with strict implementation of updated standard operational procedures (SOP) may reduce the identified gap.

Keywords: hospital-acquired infection, knowledge, attitude and practice, healthcare workers
during their day-to-day hospital activities. Infections are considered nosocomial if they appear 48 to 72 hours after hospital admission or within 10 days after discharge. Three studies have reported that nosocomial infections develop more frequently among HCWs than non-HCWs. Several studies have reported increased rates of nosocomial infections, particularly among HCWs working in high-income countries, which believed to be 5.7–19.1 times greater than that of developing-world countries. The overall estimate indicated that more than 2.5 million cases of HAI occur each year in the developing and developed world, and about 90% of the infections were occurring in a resource-limited setting. Thus, the incidence of HAIs has increased elsewhere in the world, in high-income countries 5–15% of hospitalized patients acquire HCAs which can affect from 9% to 37% of those admitted to intensive care units. Even though the problems associated HAIs are often hampered by inadequate data, the high burden of HAI in resource-constrained countries like Asia, Latin America and sub-Saharan Africa has been reported to be more than 40%. According to several studies in Ethiopia, HAIs increased by more than two-fold from 5.7% in 2009 to 19.41% in 2018 among patients and may lead to increased occupational risk among HCWs. The study also revealed that there was a high prevalence of both lifetime (28.8%) and one-year (20.2%) HAI exposure among HCWs, which indicated serious concern for both patients and healthcare providers.

Hospital-acquired infection prevention programs are a process of placing a barrier between susceptible host and the micro-organism which are an essential component of delivering safe and high-quality service at the facility level. Hence, HAI associated morbidity and mortality are preventable through infection prevention strategy like established representative infection control committee, good practice and safe procedure in proper waste handling, good sanitation, safety radiation and occupational protection.

However, HAI prevention does not get enough attention in third world countries, including Ethiopia. Therefore, this study was conducted to assess knowledge, attitude, practices and associated factors towards HAI prevention among HCWs at University of Gondar Comprehensive Specialized Hospital, Northwest Ethiopia. Information from this study will be submitted to the responsible body which will potentially assist in filling the gap towards HAI prevention application and indicate the measures to be taken to address the problem among HCWs HAI prevention.

Materials and Methods

Study Design, Period and Setting

Hospital based cross-sectional study was conducted among healthcare workers at the University of Gondar Comprehensive Specialized Hospital (UoGCSH) from January to June 2019. The hospital is found in Gondar town, Amhara region, 748 km from Addis Ababa, the capital of Ethiopia. Despite health service in Ethiopia is provided by governmental and nongovernmental (private) health institutions, the UoGCSH is a governmental teaching hospital, which provides teaching activities to medical and health science students and one of the oldest academic institutions in Ethiopia. It provides medical, surgical, psychiatric, and many other services to more than 5 million people of the Gondar province and the neighboring regions. The hospital has both inpatient, with more than 512 beds, and outpatient services. It also provides HIV/AIDS intervention activities in its ART clinic. The human resource report showed that UoGCSH has about 1200 workers and of these 613 were health related professionals during the study period.

Study Populations and Eligibility Criteria

All HCWs working at UoGCSH and who were potentially at high-risk — including doctors, nurses, health officers,
anesthetics, physiotherapists, radiographers, pharmacists, laboratory scientists, midwives, optometrists and psychiatry – were considered as the source population. From all, HCWs who were full time employees of the hospital and had spent at least one year on the job were recruited in this study. Meanwhile, HCWs who were on annual, maternity and educational leave and those who were seriously ill and working at the administrative office during data collection period were excluded from the study.

Sampling Technique and Sample Size Determination
For this study the required number of study participants was calculated by using single population proportion and the final sample size was estimated to be 236 HCWs. Stratified sampling technique was applied to select the study unit proportionally and study participants were selected from each study unit by using simple random sampling procedure.

Data Collection Procedure and Quality Assurance
Data were collected using structured self-administered questionnaires that had been pre-tested on two health institutions. The questionnaire comprises of four sections that focus on socio demographic characteristics of study participants, seeking to ascertain the level of knowledge, attitude and practice towards HAI preventions. The data collection tool was first prepared in English, translated to Amharic (the local language) and then retranslated into English to check for consistency. Each possible answer was non-overlapping and necessary information was given to participants at the time of data collection. Before actual data collection, data collectors and supervisors were trained as well as supervisors and principal investigators strictly following the data collection process and giving feedback during the data collection period.

Operational Definition
Good knowledge: health workers who answered 70% of knowledge questions correctly. Poor knowledge: health workers who have answered less than 70% of questions concerning knowledge correctly. Favorable attitude: health workers have answered more than 70% of questions concerning the attitude favorably. Unfavorable attitude: health workers who have answered less than 70% of questions concerning the attitude favorably. Good practice: health workers who properly practiced 70% of practice questions. Poor practice: health workers who have practiced less than 70% of practice questions. Based on this cutoff value, a scoring system was used, 1 point was awarded for each correct response to good knowledge, favorable attitudes and good practices. Meanwhile, incorrect knowledge, negative attitudes and poor practices were given 0 points.

Statistical Analysis
The collected data were entered and cleaned using EPI Info 7.2.1 and analyzed by SPSS statistical software version 20. For the purposes of analysis, the outcome variables originally consisting of multiple categories were reduced to two levels. Univariable descriptive analysis was conducted by calculating frequency and percentage of the main findings. The association between independent variables and KAP scores on HAI prevention was calculated using Pearson’s Chi square. For all statistical tests, the decision was significant if the p-value is <0.05.

Result
Socio Demographic Characteristics
A total of 236 healthcare workers were participating in the study with a 100% response rate. Most respondents 143 (60.6%) were males and 102 (43.2%) were in the age range 26–30. Nurses, 148 (62.7%), were the most abundant participants based on their respective discipline and 131 (95.5%) of the HCWs have first Degree. Moreover, from the total 236 HCWs, majority of them (69.5%) have ≤ 5 years of work experience at UOGCSH (Table 1).

Knowledge of Healthcare Workers About HAI Prevention
In this study, the majority of respondents (90.2%) were found to be knowledgeable about HAI preventions. Among the study participants, the majority (96.6%) has better knowledge about the need for implementation of SOP in reduction of HAI. Similarly, (95.3%) of the respondents know how NIs development is favored. Furthermore, more than 92% of study participants answered that hand washing before and after patient care and wearing personal protective equipment (PPE) were vital to prevent HAI (Table 2).

Attitude of Healthcare Workers About HAI Prevention
More than half of the respondents, 135 (57.2%), had a favorable attitude towards HAI prevention. Two hundred seven (91.1%) study participants strongly agreed that use
of antiseptic is necessary to prevent HAIs. A significant number of the respondents did not agree on the importance of changing mask as a measure of HAIs control (disagree plus not sure=46.2%) (Table 3).

**Practice of Healthcare Workers About HAI Prevention**

Regarding infection prevention practice, the majority of the respondents have poor practice, 151 (64%), towards HAI prevention. Half of HCWs (50.4%) always change gloves before handling new patient, whereas 39.4% of respondents never use safety cabinets in the laboratory (Table 4).

**Factors Associated with Attitude and Practice of HCWs Towards HAI Prevention**

Pearson’s Chi square was done to determine the association between independent variables with practice and attitude states of HCWs on HAI prevention. In this study, working experience and educational level of HCWs (P-value 0.021 and 0.037 respectively) was a statistically significant association with attitude towards HAI prevention. Similarly, there was a significant association between practices towards HAI preventions versus educational status and level of experience of HCWs (P-value=0.027 and 0.044, respectively). The finding also showed that the trend of good infection prevention practice was getting better and better as educational level increases from diploma through master’s levels (Table 5). In this study, did not find any associated factors which were significantly associated with knowledge about infection prevention.

**Discussion**

This study found that the majority of the HCWs (90.2%) had good knowledge regarding infection prevention, which is in line with the study conducted in Addis Ababa reported that 90% of healthcare workers had good knowledge. On the other hand, this finding was higher than the study conducted in Bahir Dar, Ethiopia and Gaza city, Palestine were 84.2% and 47.6% of respondents had good knowledge, respectively. This variation may be due to differences in the composition of respondents,

**Table 1** Socio-Demographic Characteristics of Healthcare Workers at UoGCSH, Northwest Ethiopia, 2019

| Variables       | Category       | Frequency | Percentage |
|-----------------|----------------|-----------|------------|
| Age/years       | 20–25          | 65        | 27.5       |
|                 | 26–30          | 102       | 43.2       |
|                 | 31–35          | 41        | 17.4       |
|                 | ≥36            | 28        | 11.9       |
| Sex             | Male           | 143       | 60.6       |
|                 | Female         | 93        | 39.4       |
| Educational status | Diploma        | 78        | 33         |
|                 | First Degree   | 131       | 55.5       |
|                 | Master’s degree| 27        | 11.5       |
| Work experience | ≤5             | 164       | 69.5       |
| in years        | >5             | 72        | 30.5       |
| Profession      | Medical Doctors | 4        | 1.7        |
|                 | Dentists       | 2         | 0.8        |
|                 | Health Officers| 4         | 1.7        |
|                 | Anesthetics    | 3         | 1.3        |
|                 | Physiotherapist| 3         | 1.3        |
|                 | Radiographers  | 5         | 2.1        |
|                 | Pharmacists    | 14        | 5.9        |
|                 | Laboratory     | 26        | 11         |
|                 | Midwives       | 22        | 9.3        |
|                 | Nurses          | 148       | 62.7       |
|                 | Psychiatry     | 3         | 1.3        |
|                 | Optometrist    | 2         | 0.8        |

**Table 2** Knowledge of Healthcare Workers About HAI Prevention at UoGCSH, 2019

| Variables                                                                 | True (%) | False (%) |
|--------------------------------------------------------------------------|----------|-----------|
| Nosocomial infection is an infection whose development is favored by a hospital environment. | 225 (95.3) | 11 (4.7) |
| Nosocomial infections includes Ventilator associated pneumonia (VAP), Tuberculosis, Urinary tract infection, Gastroenteritis. | 160 (67.8) | 75 (31.8) |
| HBV, HCV, Staphylococcus aureus and Pseudomonas aeruginosa are the organisms commonly encountered in nosocomial infections. | 207 (87.7) | 29 (12.3) |
| Gloves should always be worn in contact precautions.                      | 218 (92.4) | 18 (7.6)  |
| Standard precautions should include the use of protective equipment and frequent hand washing. | 228 (96.6) | 8 (3.4)   |
| Diagnosis influences my decision in choosing PPE.                         | 196 (83.1) | 40 (16.9) |
| Patient history will influence my decision in choosing PPE.               | 168 (71.2) | 67 (28.4) |
| Washing hands before and after handling patients helps to prevent infection. | 219 (92.8) | 16 (6.8)  |
| Wearing N95 mask is important when dealing with air born infection.        | 219 (92.8) | 17 (7.2)  |
| Wearing surgical masks when doing surgical procedures are vital to prevent infection. | 221 (93.6) | 15 (6.4)  |
instability of trained staffs in one hospital as well as the frequency of trainings given in infection prevention.

In the study, almost all study subjects, 225 (95.3%), were aware that HAIIs are contracted in hospital environment. This finding is higher than a similar study conducted in Nigeria, which was reported as 80.3%.30 We also found that HCWs at the UOG Hospital have good knowledge on the use of protective equipment and hand washing (96.6%). This finding is similar to that reported among healthcare staff in India (90%).31 But higher than figures reported Cairo in Elgalea Government Hospital (73.1%) and Cleopatra Private Hospital (72.7%).32 It is also much better than the findings at the University of Port Harcourt Teaching Hospital, Nigeria (UPTH) in which more than half of the HCWs (55.4%) lack good knowledge of hand washing.33 This satisfactory level of knowledge by the respondents may be due to the frequent provision of trainings and refreshment seminars regarding infection prevention as well as HCWs know the basics of infection prevention and control measures as it is the foremost portion of their profession.

The need of positive attitudes about infection prevention is unquestionable to prevent HAIIs. More than half of the respondents (57.2%) had a favorable attitude about infection prevention. In spite of this fact, a significant number (42.8%) of HCWs in this study had unfavorable attitude to infection prevention. The attitude level of participants in our study is found to be similar to that conducted in Bahir Dar city of Ethiopia (55.6%).27 On the other hand, this finding was far lower than the study finding in Dessie referral hospital, Ethiopia in which the reported level of favorable attitude was 76.4%.9 This difference might be attributed by the variation in academic background of the study respondents, sample size variation as well as implementation and availability of HAI prevention protocols. As well in many settings, hand washing may be seen as a trivial issue that is not routinely taken seriously, especially in non-surgical and non-invasive procedures. Our study also revealed that statistically significant association between attitude towards HAI prevention and working experience as well as the educational level of HCWs (P value 0.016 and 0.037, respectively), thus good level of knowledge is not accompanied with a positive attitude.

In spite of good knowledge, safe infection prevention practice was low (36%). Educational level and work experience of HCWs are significantly associated with the practice (0.027 and 0.044 respectively) towards HAI prevention. This finding was much lower than similar studies conducted in Bahir Dar, Ethiopia (54.2%) and Mekele (42.9%).27,34 This lower result might be due to differences in availability of sanitary facilities and logistics required for HAI prevention activities at the study sites. The other possible explanation might be experienced HCWs

Table 3: Attitude of Healthcare Workers About HAI Prevention at UoGCSH, 2019

| Variables                                         | Agree N (%) | Disagree N (%) | Not sure N (%) |
|---------------------------------------------------|-------------|----------------|---------------|
| It is necessary to categorize hospital waste before disposal. | 144 (61.0)  | 61 (25.9)      | 31 (13.1)     |
| Hand hygiene after removing gloves is a healthcare associated infection control measure. | 207 (87.7)  | 20 (8.5)       | 9 (3.8)       |
| Use of antiseptic is necessary to prevent nosocomial infection | 217 (91.9)  | 10 (4.2)       | 9 (3.8)       |
| Invasive procedures are risk factor for multi-drug resistant organisms. | 117 (49.6)  | 60 (25.4)      | 59 (25)       |
| Health worker hands are vehicle for transmission of nosocomial pathogen. | 177 (75.0)  | 43 (18.2)      | 15 (6.4)      |
| Changing mask before going to another patient is a nosocomial infection control measure. | 125 (53.8)  | 63 (26.7)      | 46 (19.5)     |

Table 4: Healthcare Workers Practice Towards HAI Prevention at UoGCSH, 2019

| Variables                                         | Practice                |
|---------------------------------------------------|-------------------------|
|                                                   | Always N (%) | Often N (%) | Sometimes N (%) | Not at All N (%) |
| Hand washing before starting work                 | 80 (33.9)    | 63 (26.7)  | 74 (31.4)      | 18 (7.6)        |
| Hand washing before handling new patients         | 68 (28.8)    | 61 (25.8)  | 86 (36.4)      | 20 (8.5)        |
| Changing gloves before starting handling new patient | 119 (50.4)  | 63 (26.7)  | 48 (20.3)      | 6 (2.6)         |
| Wearing mask during handling TB suspected patients | 93 (39.4)    | 62 (26.3)  | 58 (24.6)      | 22 (9.3)        |
| Using safety cabinets in the laboratory.          | 67 (28.4)    | 36 (15.3)  | 33 (14.0)      | 93 (39.4)       |
| Discarding infectious materials and left-over samples according to the guide line | 43 (18.2)    | 28 (8.5)   | 135 (57.2)     | 33 (14.0)       |
transferred to other hospitals in order to take an advantage of living in the capital city of the country.

Our study showed that half of respondents always change gloves before handling new patients. This result was smaller than the study conducted in Naples, Italy in which only 57.3% always change gloves. The possible reason for this might be due to the poor availability of materials (gloves) which enforces the HCWs to use the already available material for multiple patients.

Similarly, 28.8% of the study subjects wash their hands before handling new patients, which are lower than the study conducted in Addis Ababa, Ethiopia. The likely reason might be the differences in logistics and facilities. Other parameters attributed to good practice were also not implemented positively by HCWs which indicates that facilities and materials are poorly accessible. Day to day practice of safe infection prevention is mandatory for both the patients and HCWs consequently reduces HAIs but in

Table 5 Association of Socio-Demographic Variables with Attitude and Practice of Healthcare Workers Towards HAI Prevention at UoGCSH, 2019

| Variable             | Category | Attitude | Practice |
|----------------------|----------|----------|----------|
|                      |          | Favorable N (%) | Unfavorable N (%) | X² | P-value |
| Age/years            |          |          |          |          |          |
|                      |          | 20–25 | 26–30 | 31–35 | ≥36 | Total |
|                      |          | 36 (55.4) | 53 (52) | 30 (73.1) | 16 (57.1) | 135 (57.2) | 29 (44.6) | 49 (48.0) | 11 (26.9) | 12 (42.9) | 101 (42.8) | 0.431 | 0.210 |
|                      |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| Sex                  |          | Male | Female | Total |
|                      |          | 99 (69.2) | 61 (65.6) | 160 (67.8) | 44 (30.8) | 32 (34.4) | 76 (32.2) | 0.342 | 0.559 |
|                      |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| Educational status   |          | Diploma | First-Degree | Masters | Total |
|                      |          | 25 (32.0) | 56 (42.8) | 20 (74.0) | 101 (42.8) | 53 (68.0) | 75 (57.2) | 7 (26.0) | 135 (57.2) | 0.001 | 0.037 |
|                      |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| Level of experience  | ≤ 5 | >5 | Total |
|                      |          | 86 (52.4) | 48 (66.7) | 134 (56.7) | 78 (47.6) | 24 (33.3) | 102 (43.3) | 0.016 | 0.021 |
| Variables            |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
|                      | Practice |          |          |          |          |          |          |          |          |          |          |          |          |          |
|                      |          | Good N (%) | Poor N (%) | X² | P-value |
| Age                  |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
|                      |          | 20–25 | 26–30 | 31–35 | ≥36 | Total |
|                      |          | 27 (41.5) | 33 (32.3) | 13 (31.7) | 12 (42.9) | 85 (36.0) | 38 (58.5) | 69 (67.7) | 28 (68.3) | 16 (57.1) | 151 (64.0) | 0.926 | 0.428 |
|                      |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| Sex                  |          | Male | Female | Total |
|                      |          | 53 (37.1) | 31 (33.3) | 84 (35.6) | 90 (62.9) | 62 (66.7) | 152 (64.4) | 0.342 | 0.559 |
|                      |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| Educational status   |          | Diploma | First-Degree | Masters | Total |
|                      |          | 24 (30.8) | 47 (35.9) | 10 (37.1) | 81 (34.3) | 54 (69.2) | 84 (64.1) | 17 (62.9) | 155 (65.7) | 0.26 | 0.027 |
|                      |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| Level of Experience  | ≤ 5 | >5 | Total |
|                      |          | 58 (35.4) | 27 (37.5) | 85 (36.0) | 106 (64.6) | 45 (62.5) | 151 (64.0) | 0.014 | 0.044 |

Note: NB: Bold numeral in the table indicates significant association.
our study, we found the level of good practice is unsatisfactory.

**Limitation of the Study**
The main limitation of this study was single site which is unable to generalize about the other nongovernmental healthcare workers.

**Conclusion and Recommendation**
Healthcare workers in this study had sufficient knowledge towards infection prevention, but their attitude and implementation of safe practices were substandard. The healthcare workers’ practice was unsatisfactory for the basic elements of the components like hand washing, wearing PPE, discarding infectious materials and leftover samples, which will at some point increases the chance of HAI. Moreover, risk factors like educational level and work experience of HCWs are significantly associated with practice and attitude towards HAI prevention. Therefore, provision of continual on-job and off-job trainings together with strict implementation of updated SOP in clinical specimen handling and disposal are recommended. Additionally, hospitals should provide infection prevention facilities and supplies, continuous water supply, hand washing sinks and all necessary PPE to improve infection prevention practices of healthcare workers.

**Abbreviations**
HAI, Hospital-acquired infections; HCWs, Healthcare Workers; KAP, Knowledge, Attitude and Practice; NIS, Nosocomial Infections; UoGCSH, University of Gondar Comprehensive specialized Hospital; SOP, Standard Operational Procedures; PPE, Personal Protective Equipment.

**Data Sharing Statement**
All data regarding the results of the study is included in the manuscript without restriction.

**Ethics Approval and Consent to Participate**
Ethical clearance was approved by the ethical and review committee (ERC) of the University of Gondar, College of Medicine and Health Sciences. The support letter was submitted to the University of Gondar comprehensive specialized hospital and then permission was obtained from the hospital director and department/section heads. In accordance with the declaration of Helsinki, written informed consent was obtained from each individual respondent after verbal explanation about the purpose and importance of the study before the data collection process. All information from participants was kept confidential by using code numbers and there was no personal identification which is left on the questionnaire.

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**Author Contributions**
All authors made a significant contribution in the conception, study design, execution, acquisition of data, analysis and interpretation. Also, all authors took part in drafting, revising or critically reviewing a manuscript. Finally, all the authors have agreed on the journal to which the manuscript has been submitted and gave final approval of the version to be published as well as agreed to be accountable for all aspects of the work.

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