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Original Article

Prevalence of hospital-acquired infections and associated factors among patients admitted to Hawassa University Comprehensive Specialized Hospital, southern Ethiopia

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Abstract

Background: Healthcare-associated infections (HAIs) are more prevalent in developing countries and impact worsened health outcome. Therefore, routine surveillance of infection is an important part of infection prevention and quality assurance in hospitals. The objective of this study was to determine the prevalence and associated factors of HAIs among inpatients in Hawassa University Comprehensive Specialized Hospital (HUCSH).

Methods: An institution-based cross-sectional study was used to determine the prevalence and associated factors of HAIs among 413 patients of all ages admitted to all inpatient wards and intensive care units (ICUs) of HUCSH from 28 June 2021 to 23 August 2021. All admitted patients with three days of inpatient stay on the day of survey were eligible for the study. Data were collected by five trained nurses from patients' medical records using an observational checklist. The Environmental factors were assessed with two environmental health professionals. Coded and cleaned data from EpiData version 3.5 were transferred to IBM SPSS version 23 for analysis. Univariate and multivariable logistic regression analyses were used to determine the prevalence of HAIs and determinant factors, respectively.

Results: A total of 413 patients were included in this survey. The median age of the participants was 26 years (interquartile range: 3 month to 80 years). A total of 352 (85.2%) patients were diagnosed with non-fatal disease during the survey. There were 49 patients with HAI with a prevalence of 11.9 %. Coagulate negative staphylococcus (27.27 %), and E. coli (27.27%) were the most frequently reported pathogens from the result of culture. Patients admitted with rapidly fatal disease (adjusted odds ratio [AOR] =3.689) and ultimately fatal disease (AOR=3.791), length of hospital stay (AOR=2.056) and absence of running tap water at patient's room (AOR=3.49) were statistically significant factors associated with the occurrence of HAIs.

Conclusion: Surgical site infections and blood stream infections constituted the highest proportion of HAIs. Besides, the proportion of HAIs among wards indicated a large variability. Consequently, severity of underlying medical conditions such as admission with rapidly fatal disease, admission with ultimately fatal disease, length of hospital stay for more than five days, and absence of hand washing facilities were the three independent predictors of HAI. Therefore, Hospital management and health care workers (HCWs) should give more attention on the severity of admission diagnosis and the practice of hand washing protocol in order to achieve a reduced prevalence of HAIs.

Key words: hospital acquired infection, patients, prevalence, risk factors, Ethiopia

Introduction

Hospital-acquired infections (HAIs) are localized or systemic conditions resulting from adverse reaction to the presence of infectious agent or its toxins acquired from health care settings that was not incubating or symptomatic at the time of admission to the healthcare facility (1). Epidemiologically, infections that are related to surgical or other medical and/or procedural interventions and those that are caused by multidrug-resistant organisms are linked to healthcare setting (2). Infections that originate in a hospital or other healthcare institution and first manifest 48 hours or more after hospital admission or within 30 days of getting care are referred to as health care-associated infections (HAIs) (2). HAIs occur in all settings of care and the most common clinical focus of infection ranged from relatively mild cases of localized or upper respiratory infections to more systemic or disseminated infections of life-threatening bloodstream infections (3). Of the multitude of HAIs that can occur in a clinical settings, many of the highest proportions are associated with bacterial pathogens (4).

All hospitalized patients are susceptible to HAIs; however, patients with long hospital stays, invasive medical device exposure and surgical complications and overuse of antibiotics are more likely to get an infection (3). HAI can lead to prolonged hospital stays, mortality and additional costs to patients and health care delivery system. For example, in American hospitals alone, the Centers for Disease Control (CDC) estimates that HAIs account for an estimated 1.7 million infections and 99,000 associated deaths each year, where patients with HAIs, who spend an additional 6.5 days in the hospital, are twice as likely to die. Surgical infections are believed to account for up to ten billion dollars annually in healthcare expenditures (2).

According to the findings from different studies, low- and middle-income countries experience a greater burden of HAIs than developed countries (2). Consequently, the prevalence of HAIs was seen to be high in teaching hospitals such as in Uganda (28%) (5), Ghana (14%) (6), and Ethiopia (7.4% to 19.4%) (7-9). On top of that, extended-spectrum beta-lactamase producing gram-negative bacilli (1.9% to 53.0%) were the most reported antimicrobial resistant pathogens for causing HAIs (10). Hence, these pathogens are considered priority pathogens for research and development of new antibiotics (11).

According to the Centre for Disease Control/National HealthCare Safety Network (CDC/NHSN) there have been advances in healthcare systems and technology pertaining to prevention of HAI among the public and policymakers (3). Despite this fact, HAIs remains a great threat to the quality of healthcare delivery systems particularly in Africa, which is due to poor infection control, lack of centralized guidelines and resources and poor surveillance of HAI prevalence from most hospitals in Africa (12).

Studies also identified the contributing factors for HAI and revealed that, patients' underlying medical conditions (13-15), history of previous hospitalization (8, 15), and severity of illness (16) and demographic characteristics such as age less than 14 years, male gender (17) and type of ward such as ICU (17) to be important factors associated with increased risk of HAI. However, the burdens of HAIs can be giant with regard to complex routes of transmission (3), dynamic nature of HAI with respect to infection-control procedures in the healthcare environment (18). Hence, routine surveillance of HAIs at inpatient ward is an integral part of infection prevention and quality assurance in hospitals (19).

Therefore, this study aimed to determine the prevalence and determinant factors for HAIs among patients admitted to all inpatient wards and intensive care unit (ICUs) at HUCSH, Ethiopia in 2021. The results might help to encourage the greater adoptability of infection prevention practices.

Methods and materials

Study setting

According to Ethiopia's three-tier healthcare delivery system, Hawassa University Comprehensive Specialized Hospital (HUCSH), designed to cover 3.5-5 million people in the country, is one of the healthcare delivery systems, located in Hawassa city, in the Sidama regional state, southern Ethiopia. HUCSH is the only biggest comprehensive specialized referral and teaching hospital in the region. It is giving inpatient and outpatient services to more than 25 million people from the surrounding zones and nearby regions. The hospital has a total 16 inpatient wards with 400 beds, intensive care unit (ICU) with 11 beds, and 11 outpatient departments. The study particularly was conducted among patients admitted to intensive care units (ICUs), gynecology and obstetrics, pediatrics, surgical, ophthalmology, and medical wards with 233 inpatient beds, which is stratified as 69 pediatrics, 32 internal medicine, 32 gynecology, 76 surgery departments, 13 ophthalmology, and 11 intensive care unit (ICU) services. According to the 2020 annual report of HUCSH the annual admission were 13,051. The average monthly flow of inpatients treated at the selected inpatient wards were 1088 (pediatrics=322, internal medicine=149, gynecology=150, surgery=356, ophthalmology=72, and ICU=39).

Study design and period

Since data was collected from secondary data sources, a weekly based data collection plan were preferable than daily basis while getting or investigating different sources of patients data, required to determine the prevalence and associated factors of HAI such as blood sugar, microbial (blood test) results required for care, service level such as waiting times, outcomes, collated feedback of patient experience, organization level such as staff experience of IPC. Therefore, a weekly based prospective cross-sectional study design was conducted to determine the prevalence and associated factors of healthcare-associated infections. This study was conducted from 28 June 2021 to 23 August 2021.

Source and Study population

The target populations were all inpatients admitted to surgical, obstetrics and gynecology, internal medicine, pediatrics, ophthalmology wards and ICUs of HUCSH during the study. The study populations were all admitted patients who fulfilled the inclusion criteria of this study.

Eligibility criteria

All patients who were admitted for more than 48 hours in the selected inpatient wards of HUCSH and all transferred-in cases from other hospitals were included in the study. Due to the different nature of denominator for determining the prevalence of HAI in neonates, the possibility of short period of stay at emergency and recovery, and outpatient follow-up of patient at oncology units, all neonates admitted at neonatal intensive care units (NICU), and patients who stayed only at emergency, recovery and oncology units were excluded from the study. On top of that admitted patient with incomplete medical records were excluded from the study.

Sample size determination

The sample size was calculated by using a single population proportion formula, $n=z^2pq/d^2$, where n = the required sample size, z = critical value for standard normal distribution (z-statistic) at 95% confidence level (z = 1.96), p = expected prevalence of HAIs (taken to be 50%, i.e., 0.5), and $q = 1 - p$. After considering 10 % contingency for nonresponse, a sample size of 423 was estimated.

Sampling procedures

Based on the Health Management Information System (HMIS) of HUCSH obtained from 2021, the overall number of patients admitted per month was expected to be 1088. Hence, considering the average monthly admission flow and 70% bed occupancy of the hospital, two months of data collection was expected to produce the sample size (n=423) required to address the prevalence of HAI in the selected inpatient wards. Therefore, the sample size was allocated to the wards using proportion to size allocation using the respective size of beds distribution: pediatric department (n=125), surgery departments (n=138), internal medicine department (n=58), gynecology ward (n=58), intensive care units (n=15) and ophthalmology department (n=28). However, the clinical information obtained from 9 participants' medical records was incomplete, and were excluded from the analysis. Hence, the complete data obtained from the 413 patients (97.86%) were included for final analysis.

Finally, the first study participant was selected randomly from the first room of each inpatient ward then all the remaining eligible participants were selected through systematic random sampling of every two other eligible patients bed interval and independently in each ward. As a result, the prevalence of HAI was determined based on the United States CDC checklist used to confirm HAI.

Data collection tools and procedures

Data were collected by using a pretested observation checklist having two parts (clinical and environmental parts). The sources of data were secondary sources. The tool were adapted from a previous study (8), and modified based on CDC standard (20). Two days training was given for all data collectors and supervisor. Medical records and consultation with the person in charge of the patients were used for the identification of infections.

Data were collected by five trained nurses (clinical and demographic data from medical charts) and three trained environmental health professionals reviewed infection prevention data from the wards weakly infection prevention follow-up reports, which is assessed every morning at 10:00 AM on Mondays. Data for prevalence of HAI were collected based on the documented signs and symptoms of specific site infection criteria, or based on United States CDC checklist on HAI. When incomplete data were encountered from the eligible participant, it was replaced by the preceding eligible participant in the same ward.

After getting permission letters, two day training was given for data collectors regarding the definitions and the study protocol prior to starting the study. The tools were pretested among 12 patients selected from three wards (gynecology, pediatric and orthopedic wards) of the same setting and the pretested patients were not included in the calculated sample size. Intensive supervision was of the data collection process was undertaken and corrective discussion among all the research team members was conducted at the end of each day. As a result, missed and incomplete responses in the questionnaire were corrected accordingly.

Data entry and analysis

Data were entered using EpiData version 3.5. Then the data was exported into IBM SPSS version 23 for analysis. Descriptive statistics were used to calculate the prevalence of HAI. The prevalence of HAI was calculated by number of infections divided by the total number of patients comprising the study population. Bivariate logistic regression was conducted to determine the crude association between the presence of HAI and independent variables. Finally, independent variables that have a bivariate relationship of significance with $p < 0.20$ were entered into multivariate binary logistic analysis. In the multivariable binary logistic regression analyses variables with $p < 0.05$ and whose 95% confidence intervals (CIs) do not include 1 were considered the independent predictor of HAI.

Model fitness was checked by using omnibus tests of model coefficients in which *-2LL* is significantly different from the base model Hosmer-Lemeshow's goodness-of-fit test greater than 0.05 was considered as good model fit for final prediction. Cox and Snell and the Nagelkerke R-square (pseudo R square statistics) were also observed to model prediction (0 to 1 scale), in which the higher value indicated that the model predicts well.

Operational Definitions

Hospital-acquired infection (healthcare-associated infection): is defined as infections which are not present or incubating at time of admission, acquired while a patient is under hospital care or occurring on or after the third calendar day of admission to an inpatient location where a day after admission date is calendar day one (20). Hence, infections occurring on or after the third calendar day of admission are confirmed by using the Centers for Disease Control and Prevention (CDC) definition and if it occurs:

- up to 48 hours after the episode of care or
- up to 3 days after discharge or
- up to 30 days after an operation or
- up to 1 year after an operation with an implant

McCabe score: used to classify severity of medical conditions (9).

- *Nonfatal disease:* expected survival ≥5 years; includes diabetes mellitus (DM), inflammatory disease and obstetric cases.
- *Ultimately fatal:* expected survival 1-5 years; chronic leukemia, lymphomas, metastatic carcinoma, end-stage kidney disease, multiple sclerosis.
- *Rapidly fatal:* expected survival <1 years; heart failure, multiple organ failure, pulmonary disease with cor pulmonale.

Previous hospital admission: patients who had a history of hospital admission within a month.

Antibiotic use: all oral, rectal, intramuscular (IM) and intravenous treatment for the diagnosis other than HAI and it may be prescribed for prophylaxis or therapeutic purpose (20).

Length of hospital stay (LOS): were duration of inpatient care (in days), which was counted from the patient's admission date to date of first laboratory test or examination or procedure if patient had HAI or date of admission up through date of survey if patient had no HAI; where a day after admission date is counted as calendar day one (20).

Sufficient ventilation system: were defined if the ratios of total openable area of window (m^2) opposite to door to floor area (m^2) ≥10%, with or without mechanical or other artificial ventilation system in the patient's room (21).

Results

Prevalence of HAIs

Participants enrolled from surgical (32.69%) and pediatric (30.27%) wards constituted the highest proportion of HAIs, whereas the least proportion (8.96%) was from mixed wards (ICU and ophthalmology wards). The mean (± SD) age of participant in years was 27 (± 18.7) years. The median age of the participants was 26 years (varied from 3 months to 80 years) and the higher proportions (36.8%) of them were aged between 15–34 years. Of the total respondents, more than half (55.2 %) of the participants were females (Table 1).

According to the criteria for severity of underlying medical condition (McCabe scores) or admission diagnosis, the majority (85.2%) of the study participants were diagnosed with non-fatal disease. The mean length of hospital stay in days was 6.37. The median length of stay of the total participant was 5 days. About 54.2% of the participants stayed below or equals to five days (median length of treatment).

Almost half (51.6%) of the study participants underwent surgical procedures. Most (80%) of the participants received antibiotic therapy (either prophylaxis or therapeutic) for their diagnosis after admission (95% CI: 76.5-84.0).

The overall prevalence of HAI was 11.9 % (n=49) (95% CI: 8.7-15.7%). None of the participants were identified with more than one episode of HAIs. Surgical-site infection (SSI) (38.8%) and blood-stream infection (BSI) (34.7%) were the most frequently reported HAIs. In addition, coagulate negative staphylococcus (CONS) (27.27%), and E. coli (27.27%) were the most frequently isolated pathogens from HAIs. The remaining highest proportions (22.73 %) of pathogens were not differentiated by specific genus level. In contrast, the least proportion of pathogens were constituted by staphylococcus aureus (13.6%), and Klebsiella species (9.1%).

Infection prevention and control facilities

As shown in Table 2, 66.3% of the patient's rooms had hand washing facilities (running tap water). Besides, most (78.7%) patient rooms had a bin for separating contaminated waste (marked in yellow), and also almost all (99.8%) patient rooms had a bin for separating uncontaminated waste (marked in black). Further, most (91.3%) rooms had adequate ventilation systems. In contrast, none of the rooms had waste bins for segregating biomedical hazards (waste).

Factors associated with HAIs

There was a significant difference in mean length of hospital stay between participants with HAI and those without HAI (mean difference=3.383; 95% CI: 2.291-4.474, p < 0.001 at t=6.090). After conducting multivariate analysis, severity of underlying medical condition such as admission with rapidly fatal disease (p = 0.001), admission with ultimately fatal disease (p = 0.022); length of hospital stay of more than five days (p = 0.028) and absence of hand washing facilities (p < 0.001) were the three independent predictors of HAI. Patients who were admitted with rapidly fatal disease were significantly at high risk for developing HAI as compared to those admitted with non-fatal disease. The odds of patients admitted with ultimately fatal disease to develop HAI were significantly higher than their counterparts (P=0.001). The findings from this study also revealed, absence of hand washing facilities in the patients ward to be strongly associated with HAI. The odds of developing HAIs among patients who stayed for more than five day (median hospital stay) were 2.056 times higher than those who stayed for less than five days (AOR=2.06, 95% CI: 1.08-3.91) (Table 3).

Table 1: Demographic and clinical characteristics of patients admitted at inpatient wards in HUCSH, June – August 2021 (n=413)

Variable	Characteristics	Number	Percent
	Male	185	44.8
Sex	Female	228	55.2
Age (years)	<1	15	3.6
	1-14	114	27.6
	15-34	154	37.3
	35-55	88	21.3
	≥56	42	10.2
Ward type	Internal medicine	58	14
	Surgery ward	135	32.7
	Pediatric ward	125	30.3
	Gynecology ward	58	14
	General ward (ICU and ophthalmology unit)	37	9
Severity of underlying medical condition (McCabe scores)	Non-fatal disease	352	85.2
	Ultimately fatal disease	40	9.7
	Rapidly fatal disease	21	5.1
Previous hospital admission	Yes	298	72.2
	No	115	27.8
Surgical procedure on current admission	Yes	213	51.6
	No	200	48.4
Wound other than procedure	Yes	15	3.6
	No	398	96.4
Naso-gastric tube inserted	Yes	31	7.5
	No	382	92.5
Peripheral catheter inserted	Yes	361	87.4
	No	52	12.6
Urethral catheter inserted	Yes	63	15.3
	No	350	84.7
Fracture fixative inserted	Yes	38	9.2
	No	375	90.8
Antibiotic therapy	Yes	331	80.1
	No	82	19.9
Length of stay	above median (5 days)	189	45.8
	below or equals to median (5 days)	224	54.2

Table 2: Characteristics of infection prevention and control facilities at inpatient wards in HUCSH, June – August 2021

Variable	Characteristic	Number	Percent
Availability of hand washing facilities (running tap water)	Yes	274	66.3
	No	139	33.7
Availability of waste bin labeled by black color for segregation of non-contaminated waste in room	Yes	412	99.7
	No	1	0.3
Availability of waste bin labeled by yellow color for segregation of contaminated waste in room	Yes	325	8.7
	No	88	21.3
Is there sufficient ventilation system	Yes	377	91.3
	No	36	8.7
Availability of waste bin labeled by black color for segregation of non-contaminated waste in room	Yes	412	99.8
	No	1	0.2

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Discussion

This study aimed to determine the prevalence of HAI and its associated factors among patients admitted for at least three days in HUCSH inpatient ward. The overall prevalence of HAI was 11.9%.

The overall prevalence (11.9%) obtained from this cross sectional study was comparable to a similar study conducted in Amhara regional state, Ethiopia (14.9%) (9) and Ghana (14.4%) (6). In contrast, the prevalence obtained from the current study (11.9%) was higher than the prevalence reported from a cross sectional study in eastern Ethiopia (7.4%) (22). This higher prevalence of HAIs could be due to poor adherence to aseptic procedures, which favor the transmission and emergence of health-related infections.

Similarly, the overall prevalence identified in the current study (11.9%) was high compared to the prevalence reported from a point prevalence study in the USA (3.2%) (3), and china 4.26% (23). However, it is low when compared to research conducted in Uganda (28%) (5). The discrepancy of the result could be due to differences in time interval between these studies. This is supported by a meta-analysis study, conducted on infection prevention practice of HCWs (12) and a cross sectional study on compliance with standard safety precaution done at the study setting (24). In line with this evidence, a meta-analysis study in sub-Saharan Africa revealed the impact of HAI in resource-poor countries was attributed with overstretched health workforce and a high burden of community-acquired infection, variability of compliance with hand hygiene and scarcity of resource within the region (12).

In the current study, the prevalence of HAIs at major inpatient wards indicated a large variability that ranges from 2% in general wards to 36.7% in pediatric wards. The reason for high proportion of infection at pediatric ward could be due to their admission diagnosis that admission with fatal disease was associated with HAI. Thus, pediatric patients are more prone for infection due to the immune susceptibility of pediatric population. This was supported by a cross-sectional study in Addis Ababa and southeast Ethiopia, which found that patients under the age of 14 were 72.7% more likely to develop HAI than older patients and children with underlying disease conditions have the higher risk to develop HAIs (8).

Consecutively, there was a significant difference in length of hospital stay between patients developing HAI and those who did not develop HAI. Thus, the high proportion of infection observed at orthopedic wards could be due to the type of surgery. This was also supported by studies in the UK, where patients having orthopedic surgery were at high risk of infection, were associated with longer duration of hospital stay (2) and also in Uganda, given that the higher proportion of infection (47%) were reported from surgery ward (5).

Table 3: Predictive factors associated with the occurrence of HAI among patients admitted at HUCSH

Variable [a]	Category	HAI		COR(95% CI)	AOR (95%CI)
		Yes n (%)	No n (%)		
Sex	Male	27 (55.1)	158 (43.4)	1	1
	Female	22 (44.9)	206 (56.6)	0.63 (0.34-1.14)	0.697 (0.36-1.34)
Peripheral catheter inserted	Yes	46 (93.9)	315 (86.5)	2.39 (0.71-7.97)	1.90 (0.55-6.59)
	No	3 (6.1)	49 (13.5)	1	1
Urinary catheter inserted	Yes	11 (22.4)	52 (14.3)	1.74(0.84-3.61)	1.33(0.59-2.98)
	No	38 (77.6)	312 (85.7)	1	1
Fracture fixative inserted	Yes	8 (16)	30 (8.2)	2.172(0.93-5.06)	1.44(0.56-3.66)
	No	41 (83.7)	334 (91.8)	1	1
Severity of underlying medical condition (McCabe scores)	Non-fatal disease	33 (67.3)	319 (87.6)	1	1
	Ultimately fatal disease	11 (22.4)	29 (8)	3.67(1.68-8.01)*	3.79(1.67-8.60)*
	Rapidly fatal disease	5 (10.2)	16(4.4)	3.02(1.04-8.77)*	3.69(1.21-11.27)*
Length of hospital stay	Below or equals to median (≤days)	18 (36.7)	206 (56.6)	1	1
	Above median (>5 days)	31 (63.3)	158 (43.4)	2.25(1.21-4.16)*	2.06(1.08-3.91)*
Availability of hand washing facilities (running tap water)	Yes	20 (40.8)	56 (69.8)	1	1
	No	29 (59.2)	110 (30.2)	3.35(1.86-6.34)**	3.49 (1.85-6.62)**
Availability of waste bin labeled by yellow color for segregation of contaminated waste	Yes	33 (67.3)	292 (80.2)	1	1
	No	16 (32.7)	72 (19.8)	1.97 (1.03-3.77)*	1.63 (0.81-3.27)
Is there sufficient ventilation system	Yes	42 (85.7)	335 (92)	1	1
	No	7 (14.3)	29 (8)	1.93(0.79 4.67)	0.71(0.23-2.17)

Note [a] Candidate variables for multivariable analysis at p-value ≤0.20;*Statistically significant association, *p*<0.05;**highly statistically significant association, *p*<0.001; 1=Reference category; AOR, adjusted odds ratio; COR, crude odds ratio; CI, confidence interval

The finding from multivariate analysis showed, more than five days of inpatient stay, severity of underlying medical condition (McCabe score), and absence of hand washing facilities (running tap water) were the three independent variables predicting for HAI. Thus, length of treatment in a given ward was significantly associated with the occurrence of hospital acquired infections, where the odds of developing hospital acquired infection among patients who stayed for more than five day (median hospital stay) were 2.06 times higher than those who stayed for less than five days. This is in line with the findings of a cross sectional study in Eastern Ethiopia (22) and China (16).

Similarly, the odds of patients admitted with ultimately fatal disease to develop HAI were significantly higher. Besides, patients who were admitted with rapidly fatal disease significantly higher odds to develop HAI as compared to those admitted with non-fatal disease. The possible reason for observed association in the current study might be due to multiple comorbidity and immunosuppression effects of these diseases. This is in line with the findings from studies in Adama (15) where renal disease and type 2 diabetic mellitus were significantly associated with HAI. It was consistent with a study conducted in China where patients admitted with rapidly fatal disease were significantly associated with the occurrence of HAI (16).

In the current study, availability of hand washing facilities (running tap water) was also inversely associated with HAI. Hence, patients admitted in an inpatient room without hand washing facilities were at higher risk of acquiring of infection. This result was supported by a case control study in Ethiopia which revealed that presence of hand washing facilities in rooms resulted in 19% lesser odds to acquire infection at hospital (25).

The present stud has strengths and limitations. The strength of this study is that availability of laboratory data and good documentation of patients' medical records and conducting pre-test enabled the researcher to get sufficient information while determining HAI and make comparisons between wards, patients, and other relevant studies. The limitation of this study is that the NICU was not included, which may represent a different type of HAI than other types described here. The other limitation of this study is that the microbiological assessment was limited to bacterial HAI without considering other causes such as fungal infections.

Conclusion

The most frequently reported specific sites of HAIs were SSI and BSI (septicemia). The prevalence of HAI showed variation between wards. Hence, the higher proportions were revealed from surgical wards. In addition, severity of admission medical condition, more than five days of hospital stay and absence of hand washing facilities (running tap water) were the three independent predictors of HAI. The hospital managers should consider the availability of hand washing water and need to motivate the use of standard infection prevention protocols to achieve a reduced rate of HAI at HUCSH. Health care providers and stakeholders working on health policy should consider that patient safety in the hospital is a major concern, and as revealed in this study, HAI was associated with increased hospital stay and severity of patient's medical condition. Therefore, healthcare providers and stakeholders working on health policy should increase the integrated effort on the prevention of both communicable and non-communicable disease burden on HAI. Furthermore, to minimize the longer duration of hospital stay, all health care workers should follow the appropriate treatment protocol. A future longitudinal study is recommended for strong analytical investigations.

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Ethical considerations

The study was approved by the Institutional Review Board of the College of Medicine and Health Sciences of Hawassa University. Hawassa University Comprehensive Specialized Hospital granted permission for data collection. Codes rather than patient identification numbers were used to protect patients' data.

Data Availability statement

The data that support the findings of this study are available on request from the corresponding author via getishmelak@gmail.com.

Conflicts of Interest

The authors declared no conflicts of interest exist.

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