Management of Hospital-Acquired Infections among Hospitalized Patients at Zewditu Memorial Hospital, Addis Ababa, Ethiopia: A Prospective Study

By: Segen Gebremeskel Tassew (Bpharm)

A Thesis Submitted to

Department of Pharmacology and Clinical Pharmacy, School of Pharmacy in Partial Fulfillment of the Requirements for the Degree of Masters in Pharmacy Practice (Mpharm).

Addis Ababa University

Addis Ababa, Ethiopia

January 11, 2018

Addis Ababa University

School of Graduate Studies

This is to certify that the thesis prepared by Segen Gebremeskel Tassew, entitled: Management of Hospital-Acquired Infections among Hospitalized Patients at Zewditu Memorial Hospital. A case of Zewditu memorial hospital and submitted in partial fulfillment of the requirements for the Degree of Master of Pharmacy in Pharmacy Practice complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

Signed by examining committee:

Advisor: Workineh Shibeshi (PhD)	Signature_____	Date_____
Advisor: Wondwossen Amogne (MD, PhD)	Signature_____	Date_____
Advisor: Minyahil Alebachew (PhD candidate)	Signature_____	Date_____
Internal Examiner: Ephrem Engidawork (PhD)	Signature_____	Date_____
External Examiner: Legese Chelkeba (PhD)	Signature_____	Date_____

_____

Head, Department or graduate program coordinator

Abstract:

Management of Hospital-Acquired Infections among Hospitalized Patients at Zewditu Memorial Hospital, Addis Ababa, Ethiopia

Segen G/meskel Tassew

Addis Ababa University, 2018

Hospital-acquired infections (HAIs) are acquired when the patient is hospitalized. The emergence of multidrug resistant bacteria is a threat for HAIs. In Ethiopia data are scarce in HAIs. Hence, this study aimed to assess the prevalence and management of HAI among patients admitted at Zewditu memorial hospital.

A prospective cross sectional study was conducted in 410 patients who met eligibility criteria. The sample was proportionally allocated among different wards. Data were collected using data abstraction format and supplemented by key informant interview. Management appropriateness was assessed using Infectious disease society of America guideline and experts opinion (Infectious disease specialist). Multivariate logistic regressions was used to identify factors associated with HAIs.

The prevalence of HAIs was 19.8%. Surgical site infection and pneumonia accounted for 24.7% of the infection. Culture and sensitivity was done for 29.6% patients and 29.1% of them show growth (*E.coli, Acinetobacter* and *S.aureus*). Of the 81 patients who developed HAIs, 33.3% and 66.7% of them were treated appropriately and inappropriately respectively. Physicians' response for this discrepancy was information gap, forgetfulness, affordability and availability issue of first line medications. Younger age (AOR=8.53, 95%CI: 2.67-27.30), male gender (AOR=2.06, 95%CI: 1.01-4.22), longer hospital stay (AOR= 0.17, 95%CI: 0.06-0.51), and previous hospital admission (AOR=3.22, 95%CI: 1.76- 5.89) were independent predictors of HAIs.

Inappropriate management and prevalence of HAIs was substantially high in this study. Surgical site infections and pneumonia were the common types of HAIs. Locally conformable guidelines could help to correct such problems.

***Key words*:** Hospital-acquired infection, surgical site Infections, risk factor, Ethiopia.

Table of Contents

Acknowledgements:

My gratitude goes to Addis Ababa University for financial support of the research work and Mekelle University for sponsoring my study.

It is a wave and profound sense of honor to thank my advisors: Dr. Workineh Shibeshi, Dr. Wondwossen Amogne and Mr. Minyahil Alebachew for their continuous follow up and endless support from the inception of this research to this final work.

I am indebted to my family for their endless support from my childhood to this date. All my successes in life would not be factual without their moral and family hood coach.

Last but not least, my heartfelt gratefulness goes to my data collectors, study participants, Zewditu memorial Hospital officers and my colleagues for their cooperation and support during my study time.

List of Figures

List of Tables

List of Abbreviations and Acronyms

ANC	Antenatal Care
AOR	Adjusted Odds Ratio
ASA	American Society of Anesthesiology
BSI	Blood Stream Infection
C&S	Culture and Sensitivity
C/S	Cesarean Section
CAUTIs	Catheter-Associated Urinary Tract Infections
CDC	Center of Disease Control and Prevention
CHF	Congestive Heart Disease
CI	Confidence Interval
CKD	Chronic Kidney Disease
CLABSIs	Central Line Associated Bloodstream Infections
CoNS	Coagulase Negative Staphylococcus
SSTIs	Skin and Soft Tissue Infections
CVC	Central Venous Catheter
DM	Diabetes Mellitus
HAI	Hospital-Acquired Infection
HIV	Human Immune Virus
HTN	Hypertension
ICU	Intensive Care Unit

LP	Lumbar Puncture Procedure
MRSA	Methicilin-Resistant Staphylococcus Aureus
NGT	Nasogastric Tube
NI	Nosocomial Infection
OR	Odds Ratio
P.aeruginosa	Pseudomonas aeruginosa
PPI	Proton Pump Inhibitors
PVC	Peripheral Venous Catheter
RTI	Respiratory Tract Infection
S.aureus	Staphylococcus Aureus
SSIs	Surgical Site Infections
TASH	Tikur Anbessa Specialized Hospital
USA	United States of America
UTI	Urinary Tract Infection
VAP	Ventilator-Associated Pneumonia
WHO	World Health Organization

1. Introduction

1.1 Background

Hospital-acquired infections (HAIs) or nosocomial infections are defined as infections which are not present or not incubating when the patient is hospitalized and are acquired during hospital stay. (1, 2). It is usually defined as an infection that is identified at least 48-72 hours following admission to health institution. Nosocomial comes from the Greek word "Nosokomeian", which means disease is acquired in hospital. Center for disease control (CDC) substitutes the word nosocomial infection by healthcare associated infection (3).

HAIs are caused by viral, bacterial, and fungal pathogens. All hospitalized patients are susceptible to contracting HAIs. Some patients are at greater risk of HAIs than others, including, those who underwent sophisticated procedures, invasive device utilization, use of imunosupressors, prolonged hospitalization, and insufficient application of standard and isolation precautions (4). On the other hand, there are patient-related factors, including existing infection, immunocompromised, older and younger age, obesity, smoking, physiological states including trauma, shock, blood transfusion and malnutrition (5).

HAIs occur worldwide and affect both developed and developing countries. Infections acquired in health care settings are among the major causes of death and increased morbidity among hospitalized patients. A prevalence survey conducted in hospitals of Europe, Eastern Mediterranean, South-East Asia and Western Pacific showed an average of 8.7% of hospital patients had HAIs (6).

It is also recognized as a public health problem world-wide with a prevalence rate of 3.0-20.7% and an incidence rate of 5-10% in tertiary care hospitals (7). At any time, over 1.4 million people worldwide suffer from infectious complications acquired in hospital (8).

The endemic burden of HAIs are significantly higher in low- and middle-income than in high-income countries, in particular in patients admitted to intensive care units (ICU) and in acute surgical wards (9).

Higher prevalence was also observed in the Eastern Mediterranean and South-East Asia Regions (11.8 and 10.0% respectively), with incidence of 7.7 and 9.0% in the European and Western Pacific Regions, respectively (10). In developing countries, especially in Africa, large numbers of people are dying on daily preventable and curable diseases due to inadequate health care services and postoperative HAIs constitute a large proportion of this burden (11).

Data from systematic review done in Africa showed hospital-wide prevalence of HAI varied between 2.5% and 14.8%; in surgical wards (8). The cumulative incidence ranged from 5.7% to 45.8% in studies conducted in Ethiopia (12). The burden of HAI is already substantial in developing countries, where it affects from 5% to 15% of hospitalized patients in regular wards and as many as 50% or more of patients in ICUs (13).

Among patients admitted in medical and surgical wards of a tertiary hospital of developing countries, the prevalence was 17% and 26.1%, respectively. Of the patients infected with HAIs, 41.2% were on ventilator, 29.4% were having diabetes mellitus as co-morbidity (10, 14). In medical ward of tertiary hospital of Pakistan, the prevalence of UTI was 68%, bloodstream infection 38% and respiratory tract infection (RTI) accounts for 26% (15). As the duration of operation extends >30 minutes risk of HAI increases (16).

In Pakistan, it has been reported that due to resistance to first line antibiotics, 70% of hospital acquired neonatal infections could not be successfully treated by using WHO's recommended regimen (17). So the initial choice of antibiotics should depend the severity of the patient's clinical disease, the risk factors for infection, and the likely pathogens associated with the specific intravascular device. The pathogens causing HAIs are frequently resistant to many antimicrobial agents and are often inappropriately treated with antimicrobial agents to which they are resistant (18). Appropriate management of HAIs should focus on the appropriate choice of antibiotics, dose, dosage form, route of administration, frequency, drug interaction and duration of treatment.

Therefore, this study was aimed to assess the management of HAIs among patients admitted in medical, pediatrics, gynecologic/obstetrics and surgical ward of Zewditu memorial hospital, Addis Ababa, Ethiopia.

1.2. Statement of the problem

The highest frequencies of hospital-acquired infections (HAIs) are reported from developing countries hospitals (10). The largest number of studies in Africa focused on SSI whose cumulative incidence ranged from 2.5% to 30.9% (19).

Similarly studies in Ethiopia focusing only on surgical and gynecologic/obstetrics wards showed a prevalence as high as 27.6% (5). The risk of HAIs in relation to surgery is high, since about 77% of death of patients with HAIs was reported to be related with postoperative infections (20). The number of surgical patients in developing countries is also increasing with high prevalence of infection (21). Prevalence of HAI among medical ward admitted patients in developing countries shows as high as 10.5% (22, 23).

The presence of specific devices is associated with higher HAI prevalence even though can be prevented through timely removal of devices. Some studies show excess length of hospital stay (>14 days) and duration of antibiotic treatment (>10 days) attributable to HAIs (24).

HAIs prolong hospital stays, create long-term disability, increased patient morbidity and mortality, increase resistance to antimicrobials, and represent a massive additional financial burden for health systems (10, 25, 26). Such infections annually account for 37, 000 attributable deaths in Europe and they account for 99,000 deaths in the USA. Annual financial losses are estimated at approximately 7 billion in Europe and US$ 6.5 billion in the USA, reflecting 16 million extra days of hospital stay (27, 28).

Bacteria and their susceptibility to drugs is a worldwide concern for both the clinicians and manufacturing companies. HAIs are further complicated by an increasing prevalence of multidrug resistant organisms. Despite adequate antimicrobial treatment the emergence of HAIs is increasing especially in developing countries like Ethiopia (29).

In developing countries prevalence data are often not well established (12). The traditional approach to empiric treatment is to start with an inexpensive narrow spectrum agent, broadening therapy only if a multi-resistant pathogen is identified or the patient deteriorates. However, inadequate empiric therapy has been shown to cost both lives and money (30).

In developing countries, antibiotics are prescribed for 44–97% of hospitalized patients often unnecessarily or inappropriately. Several socio-economic and behavioral factors are thought to contribute to the inappropriate use of antibiotics and, consequently, to the increased incidence of bacterial resistance in developing countries (17). It is therefore crucial that HAIs should be treated early appropriately. Successful treatment is achieved by initial use of the correct antimicrobial agent at the most appropriate dose to optimize the likelihood of clinical and bacteriological success and minimize drug-related toxicities.

In Ethiopia, regardless of the growing burden of various types of HAIs; it continues to receive a relatively low public health priority. HAIs have been remaining a public health issues because of its devastating effect and double burden in inpatients in particular and their families in general, however, it is not given much emphasis. So far there are no researches done focusing on the management appropriateness for HAI. Therefore, there is a clear need to conduct vigorous researches works to explore the prevalence and management of the problem. This research work was being intended to be contributing for the appropriate management of HAIs and benefit both patients and health care professional therefor it will assists physicians in selection of appropriate choice of antibiotics to avoid emergence of multidrug resistant organism in hospitals.

2. Literature review

Hospital-acquired infections are becoming a great concern worldwide especially in developing countries like Ethiopia. Hospital-acquired infections have a negative impact on patients in terms of increasing hospitalization, disability, mortality and morbidity. There are few data regarding the prevalence and management for HAI in Africa as well as in Ethiopia (16).

2.1 Prevalence and site of hospital-acquired infections

Point prevalence of hospital-acquired infections in two teaching hospitals of Amhara region in Ethiopia on 908 patients' shows the overall prevalence of 15.41%. SSI (51.1%), Pneumonia (18.5%), gastrointestinal and SSI account for 3.7% each (31). Similarly a cross-sectional study was conducted on patients who underwent operations from October 2010 to January 2011at Felege Hiwot Referral Hospital, Bahir Dar out of 294 patients, 10.9% were confirmed of bacterial HAIs. SSI and blood stream infection rate was 10.2% and 2.4% respectively (16).

A prospective descriptive study at Jimma University Teaching Hospital on surgical site infection of 770 women who had surgery for delivery from April 1, 2009 to March 31, 2010 in obstetric ward of the Hospital the rate of infection was 11.4%. Patients with wound class of contaminated and dirty at time of surgery and absence of antenatal care follow up were associated with increased severity of SSI (32). Similar prospective study at Hawasa University Referral Hospital from March 2 to May 2, 2015 on 105 patients who underwent major surgical procedure the prevalence of SSI was 19.1% (33).

A prospective observational study conducted during June 2007 to April 2008 in surgical ward and ICU at Tikur Anbessa specialized hospital (TASH) on 251 patients giving overall incidence of HAI 35.8%. Surgical site, urinary tract and blood stream infections comprised 49.4 %, 29.8 % and 20.8 %, respectively (34).

One day cross-sectional prevalence study on 2010 from 318 patients admitted in Uganda hospital indicates that 55(17.0%) of them developed HAIs. Of all HAI 42% were urinary tract infections, 25% were bloodstream infections, 16% were surgical wound infections, 12% were respiratory tract infections and 3.6% were gastrointestinal infections (35).

A one-day prevalence survey was conducted at the Habib Bourguiba University Hospital, Tunisia; the overall prevalence of HAI was 17.9%. The most frequently infected sites were the lungs (32%),

surgical wounds (28%) and the urinary tract (20%) (36). A point prevalence survey on January 2010 at the university medical center of Rabat, Morocco from 1195 patients showed the overall prevalence of HAIs was 10.3%, Medical, surgical and ICU (4.5%, 13.5%and 34.5%) respectively. Urinary tract infections was the highest (35%) followed by surgical wound infection (29.3%), lower respiratory tract infection (10.6%), bloodstream infection (8.1%), skin and soft tissue infection (5.7%) and catheter related infection (4.9%). Advanced age, longer length of hospital stay, presence of comorbidity, invasive devices and use of antibiotics were the predictors of HAIs (22).

A Retrospective cohort study conducted in Nigeria from January 2012 to February 2012 at Olabisi Onabanjo University teaching Hospital from 386 surgical patients showed that incidence rate of SSI was 13.0%(60). Children had the highest infection rate of 22.9%. Longer hospital stay, >21 days(42.5%), 15-21 days (19.2%) and <7 day (2.7%) exposes patients to the development of HAIs (37).

Study done at northern Tanzania showed an overall 14.8% of HAI prevalence. The prevalence of HAI were particularly high in the medical ICU (40%), and one of the general medical wards (22.2%). The most common HAI was urinary tract infection (UTI) (31.1%) followed by RTI (24.3%) and blood stream infection (BSI) (18.2%) (38). According to study done in India overall incidence of HAIs was found to be 26.1%. The prevalence of HAIs was higher among the patients of medical (28%) ward than surgical (24.5%) ward (10). The most commonly observed HAI was pneumonia (50%) (39). Similarly in a study conducted at Karachi, Pakistani, the prevalence of RTIs and UTI were 21% and 44.6% respectively (40). From a retrospective one year analysis of NI in the Medical ICU at Smt. Kashibai Navale Medical College and Hospital, Pune, found to have prevalence of 17.1% (41). In intensive care unit (ICU) NI rate was 20% and approximately 10% of the patients died. Urinary infection was the commonest type of NI with 37.6% cases, followed by pneumonia 25.6%, sepsis 15.1% (4).

Pneumonia was the most common type of infection approximately 70% in study done in Iran. However, urinary tract infections have also been reported as the most common type of infection among patients with HAIs, with prevalence ranging from 28.9% to 43.6%. The most frequent site of infection was respiratory tract (47.95%) followed by UTI (25.3%), BSI (16.4%) (25). The most

common HAIs in study done at Zahedan south west Iran were pneumonia 67.9%, UTI 18.5%, SSI 8.6%, and BSI 4.9% (42).

A point prevalence study done in Lithuania among 731 patients the overall prevalence rate of HAIs was 3.8%. The prevalence of HAIs differed by hospital wards (range 0.0%–19.2%). The lower respiratory tract (32.2%), UTI (28.5%), and SSI (32.1%) were the most common HAIs (43). Similar study done in Italy showed overall prevalence of 9.8%. Prevalence varied considerably between hospitals, ranging from 0 to 24.4% , UTIs (30.0%), RTIs (26.1%) presented the highest relative frequency, followed by BSIs (14.8%), SSI (11.6%) and gastrointestinal infections (6.5%) (44).

Postoperative report in Iran of 4 years period shows UTI as the most common infection (28.9%) among reported cases, pneumonia (28%), SSI (26.8%) and BSI (16.4%). Twenty bacterial isolates were isolate from HAIs. Of these 20% from ventilator associated pneumonia (VAP), from Central line associated blood stream infections (20%), from SSI (25%), and from Catheter associated UTI (35%) (45).

Similarly study done in Benin indicates of the 3130 inpatients surveyed, 972 nosocomial infections were identified among 597 patients, representing an overall prevalence of infected patients of 19.1%. The most frequent infections were related to the urinary tract (48.2%), vascular catheter use (34.7%), and surgical site (24.7%) (46). In Europe a point prevalence survey in acute care hospitals was carried out in 1149 hospitals using the European Centre for Disease Prevention and Control protocol. The prevalence of HAI was 4.2%. Bloodstream infections were the most common type of infection (45%) followed by lower respiratory tract infections 22%, GI infections 64 8%, eye, urinary tract infections 5%, and surgical-site infections 4% (47). The most common site of infection was the respiratory tract 36% followed by the gastrointestinal tract 32% (48).

Among patients admitted in medical and surgical wards of a tertiary hospital of developing countries the prevalence was 17%, 26.1%. Of the patients infected with HAIs 41.2% were on ventilator, 29.4% were having diabetes mellitus as co-morbidity (10, 14). In medical ward of tertiary hospital of Pakistan the prevalence of UTI was 68%, bloodstream infection 38% and respiratory tract infection (RTI) accounts for 26% (15). As the duration of operation extends >30 minutes risk of HAI increases (16).

2.2 Factors associated with development of hospital-acquired infections

A study done at Bahir Dar, in Ethiopia shows the rate of HAIs among clean and clean contaminated operations was 3.3% and 12.8% respectively. HAIs were higher in females 11.6% than males 9.4% , Patients whose age > 51 years were likely to develop postoperative HAIs (27.3%), patients with underlying disease (17%) , patients who smoke (20%), preoperative hospital stay> 11days (66.7%), duration of surgery >90 minutes (33.3%), postoperative hospital stay >15 days (40%) and patients undergoing appendectomy (26.9%) were associated factors for developing HAIs (16). Similarly a study done in Hawasa shows, preoperative hospital stay more than 7 days, Age greater than 40 years and duration of operation more than one hour were independent predictors for surgical site infections (33).

The mean postoperative stay was 19.6 days in patients with SSI compared with 11.3 days in uninfected patients admitted in TASH, in Ethiopia (49). Most RTIs were associated with mechanical ventilation 82.2% and most UTI were associated with prolonged catheterization which accounts for 67.6%. In another study carried out at Hyderabad ,India, the frequency of RTIs and UTIs was 30.1% and 39.1% respectively (50, 51).

As a study from Nigeria reveals male (15.2%) were at high risk of developing HAIs than female (10.4%). Patients with comorbidities were at high risk of developing HAIs, malignancy, HIV/AIDS, obesity, DM, (61.5%, 45.5%, 35.0% and 25.0%), respectively. The mean length of postoperative stay was significantly longer for patients with SSI than for those without these infections (18.2 vs 7.5 days) (37). A study done at university of Morocco indicates as hospitalization increases the risk of HAIs increases, patients whose hospital stay was <5 days were at risk of developing HAIs (18.5%) followed by 6-10 days (26.5%) and > 20days (24.4%) (22).

A study done in a Tertiary-Care Teaching Hospital in Zahedan, Southeast Iran showed that the presence of specific devices was associated with higher prevalence of HAIs, Central venous catheter (CVC 22.2%), Peripheral venous catheter (PVC 12.6%), UTI 19.3% and intubation 25.7% (42). Also non-adherence to rigid insertion and maintenance protocols, leakage of cerebrospinal fluid (CSF), catheter irrigation and the frequency of external ventricular device manipulation are some of the predisposing factors for infection (52).

2.3 Antibiotic susceptibility pattern of bacteria isolated from hospital-acquired infections

A study done in Bahir Dar indicates *Staphylococcus aureus (S. aureus)* was the most frequently detected bacterium (26.2%) followed by Escherichia coli (*E. coli)* and *coagulase negative Staphylococcus* (CoNS) species each 21.4%. *S. aureus* was 100% resistant for Ampicillin and 91% for Chloramphenicol. Relatively, S. aureus showed little resistance (9.1%) to Erythromycin. Similarly, CoNS also showed 100% resistance to Ampicillin but least resistance to Erythromycin (11.1%) and Doxycycline (33%). And study from Lithuania showed 100% resistance to Ceftriaxone, Ampicillin, Amoxacillin, Trimethoprimsulphamethazole, Ciprofloxacin and Gentamycin (2).

Microorganisms that were identified among the HAI patients were *Klebsiella* species (22.44%), *S.aureus* (20.40%), *Pseudomonasaeruginosa* (18.36%), *E.coli* (16.32%), *Enterobacter* species(12.24%),*Streptococcuspneumoniae*(10.20%),*Klebsiellapneumoniae*(4.08%)and*Acinetobacter* species (4.08%) (31).

From study at Mekelle hospital, northern Ethiopia, UTI have high rates of resistance (> 80%) to the commonly used antibiotics such as ampicillin, amoxicillin, chloramphenicol, gentamicin, streptomycin, and Sulfamethoxazole/trimethoprim whereas isolates from surgical site were resistant to amoxicillin and Sulfamethoxazole/trimethoprim (53).

Gram positive isolates, *S. aureus* (18.3%) was predominant while *E. coli* (23.1%), *Acinetobacter* species (22.1%), and *K.penumoniae* (9.6%) and *P. aeruginosa (5.8%)* were the most common isolates. Of the isolates, 94.7%, 89.5%, 78.9%, 75%, 73.7%, 65.8%, 50%, and 46.1% were found to be resistant to ampicillin, cefazolin, cefuroxime sodium, amoxicillin/clavulanic acid, cefotaxime and ceftriaxone (each), ceftazidime, tetracycline, and ciprofloxacin respectively (54).

In a study done in acute care of Europe, the bacterial isolates included *Pseudomonas aeruginosa* (27%), *Acinetobacter baumannii* (22.2%), *E.Coli* (13.5%), *Klebseilla pneumoniae* (9%), *Coagulase negative staphylococcus* (9%). pseudomonas aeruginosa was resistant to piperacillin/tazobactam (88%), ceftazidime (87%), cefepime (86%) and 28% to meropenem and Acenitobacter resistance pattern to piperacillin/tazobactam (81%), Ampicillin (95%), cefepiem (26%) and Meropenem (26%) (55).

The most frequently isolated bacteria from Nigeria were S.aureus, 32.7% and E. Coli 34.7% (37). From study done at Tunisia, the most frequently isolated organisms were Gram-negative rods (80.8%) (36). Most frequently reported microorganisms from point prevalence study of ICU admitted patients of different hospital of Europe were, Enterobacteriaceae (34.4%), *Staphylococcus aureus* (30.1%; [60% resistant to methicillin]), *Pseudomonas aeruginosa* (28.7%), CoNS(19.1%), and fungi (17.1%) (56).

2.4 Management appropriateness of hospital-acquired infections

From 525 hospitalized adults treated with intravenous antibiotics for complicated skin and soft tissue infections (cSSTIs), 22.5% received inappropriate initial antibiotic treatment. Pathogens were exclusively gram-positive in 68% of patients, exclusively gram-negative in 13%, and mixed in 19%. *Staphylococcus aureus* was the most frequently isolated pathogen (in 65%), 54% of which were methicillin-resistant (57). A retrospective cohort study at a single academic medical center among patients hospitalized in Chicago, Illinois indicates that among 717 patients hospitalized with a cSSSI, 38.2% of these received inappropriate empiric therapy (58).

A cohort study including all patients hospitalized with incident bacteremia during 2007–2008 in the Copenhagen City and County areas and the North Denmark Region shows 58% received appropriate empiric antibiotics for HAIs and 20% of them received inappropriate treatment and 22% of patient's status was unrecorded. Patients aged 65-79 were inappropriately treated (37%) and appropriately treated (34%) (59).

A retrospective study carried out to evaluate the effect of inappropriate initial antimicrobial therapy on survival, indicated a total of 286 patients with antibiotic-resistant gram-negative bacteremia.

Of the 286 patients, 135 (47.2%) received appropriate initial empirical antimicrobial therapy, and the remaining 151 (52.8%) patients received inappropriate therapy (60).

A retrospective cohort study was conducted in the ICU of a university hospital in USA. The data from 760 patients with severe sepsis or septic shock associated with gram-negative bacteremia was analyzed. Among this cohort, 238 (31.3%) patients received inappropriate initial antimicrobial therapy (61). From 108 community and university-affiliated hospitals in the United States ,Canada and Europe 468 patients (52%) had documented bloodstream infection, and 211 patients (23%) received inappropriate initial antimicrobial therapy(62).

Study done at Sokuluk Territorial Hospital, Central Asian, showed inappropriate antibiotic therapy proved for 184 patients (73.3%). The most common reason given for inappropriateness was the unjustified (not indicated) use of antibiotics in 143 (48.6%) cases, in adequate dose 6.1%, inappropriate duration 2.4% and improper dosage interval 9.9%. The second most common reason was the use of ineffective antibiotics against the bacterial infections to be expected 97 (32.9%) infections. There was a significantly higher inappropriate choice of antibiotics in gynecology as compared to other wards. Antibiotics were administered postoperatively until discharge even to patients without signs of infection after clean and clean-contaminated surgeries, or even to dirty types where the choice of antibiotics was incorrect(63).

Inappropriate intravenous therapy increases the cost of care while also exposing the patient to the risk associated with intravenous catheters (64). “Switch therapy”, i.e., the change from i.v. to oral treatment, has been studied by several investigators over the past few years, and has been shown to save costs, shorten the length of hospital stays and decrease the adverse reactions of i.v. administration (65). Other studies also show as many as 41% to 91% of all antibiotic prescriptions in hospitals are inappropriate (66).

Similar findings were also reported by another study from Brazil were 27% of patients received inadequate treatment. Patients with respiratory tract infection (31%) were treated inappropriately. Treatment of skin infections was considered incorrect in 30% of the patients, because of inadequate coverage for Staphylococcus aureus (30%). The treatment of gastrointestinal and of biliary tract infections was incorrect in 37% of the patients. All UTI were treated correctly (67). In Indonesia,

only 21% of prescriptions were considered to be clearly appropriate, 15% were inappropriate regarding choice, 42%were inappropriate in dosage or duration (68).

Appropriateness of treatment varied among the departments pediatrics ward takes the higher proportion followed by internal medicine and surgical ward 92%, 83% and 81% respectively. Patients with respiratory tract infection (84%), followed by UTI (80%), sepsis (88%) and SSI (64%) were appropriately treated(69).

3. Objectives

3.1. General objective

To assess the Management of Hospital-Acquired Infections among Hospitalized Patients at Zewditu Memorial Hospital, Addis Ababa, Ethiopia

3.2. Specific objectives

To determine the prevalence of hospital-acquired infections.

To identify factors associated with the development of hospital-acquired infections.

To examine management appropriateness of hospital-acquired infections.

4. Methodology

4.1 Study Setting

This study was conducted at Zewditu memorial hospital. Zewditu memorial hospital was established by Imperial Haileselase and the 7th Adventist missionary besides "Fil-weha" in 1933. Zewditu Memorial Hospital is a teaching and general referral hospital affiliated with college of health sciences, Addis Ababa University. It is located in Addis Ababa, the capital city of Ethiopia. It has one hundred fifty six beds, in which patients are admitted in medical, pediatrics, Gyn/obs and surgical wards. It has also dialysis center and regional laboratory.

4.2 Study design and period

A hospital based prospective study design was conducted from March 1, 2017 through August 30, 2017. Both quantitative and qualitative methods were used.

4.3 Source and study population

4.3.1 Source population

The source population included all patients admitted in medical, pediatrics, Gyn/obs and surgical wards of Zewditu memorial hospital between March 1, 2017-August 30, 2017.

4.3.2 Study population

The study population was all patients admitted to medical, Pediatrics, Gyn/Obs and surgical wards of Zewditu memorial hospital between March1, 2017-August 2017 and who fulfilled inclusion criteria.

4.4 Eligibility criteria

4.4.1 Inclusion criteria

Patients admitted to medical, Pediatrics, Gyn/Obs and surgical wards of Zewditu memorial hospital and who have stayed in the hospital for at least 48 hours

Patients readmitted within 30 days of discharge after surgery

For those who did not undergo surgery readmission within 3 days of discharge.

4.4.2. Exclusion criteria

Admitted patient whose medical records are found incomplete to the outcome variables in this study.

4.4 Sample size and sampling techniques

To calculate the sample size to determine the prevalence and management of HAIs, the following single proportion formula was used:

$$n = z^2 p (1-p) / d^2$$

Where; n= sample size

d= maximum allowable error (margin of error) = 0.05

Z = value of standard normal distribution (Z-statistic) at 95% confidence level (z=1.96).

P = is anticipated prevalence or proportion

Using this formula sample size is calculated to be 384 and with contingency level of 10% it became 423. Therefore, the sample size was allocated to the wards using proportion to size allocation (Medical 54, pediatrics 88, Gyn/obs 156 and surgical ward112).

Patients admitted and stayed for more than 48 hours were used as research participants. Plus key informant interview with the help of semi-structured open ended questionnaire focusing on the experience and practice of practitioners (Eight physicians) regarding management and guidelines they used to treat HAIs. Microbiologists were also interviewed regarding the laboratory concerns (Four personnel). The qualitative data were done after the results to enrich the results obtained from patient's chart.

4.5. Study variables

4.5.1 Dependent variable

Hospital-acquired infections (HAP, HAIs, SSI, UTI, Meningitis, Sepsis, Ventriculitis, Diarrhea and Bedsore).

Management appropriateness (Right choice of medication and dosage form, Route of administration, Dose, Frequency, Duration and drug interaction)

4.5.2. Independent variable

Age, gender, ward type, patients on immunosuppressive agents, length of hospital stay, previous hospital admission, exposures to invasive devices (urinary catheter, central intravascular catheter, peripheral intravascular catheter and mechanical ventilator), presence of chronic disease, Type and duration of procedure , previous surgery, proton Pump inhibitors, antacid use, use of Steroids, culture and sensitivity test, indication for use, dose, frequency of administration and duration of treatment.

4.6 Data collection tools and techniques

The data abstraction format was prepared in English which is adopted from previous studies and some modifications were done by infectious disease specialist and pharmacists. Data was collected by four nurses from the respective wards using structured data abstraction format from patient medical charts (Annex 1). The data collectors were given training course of a day by the principal investigator. The data collectors reviewed each patient's medical records after two days of admission and daily thereafter during the entire inpatient stay for any new medical records. The data abstraction was designed to record socio demographic and clinical characteristics of study participants, types of HAIs, culture and sensitivity and medications given.

Appropriateness of the management was assessed using expert's opinion and infectious disease society of America guidelines focusing on the medication, dosage form, dose, frequency, rout of administration, duration of treatment for HAIs. Micromedex was used to check drug interactions (70-72).

Interview of professionals using key informant interview using semi-structured open ended questionnaire (Annex 2) was used to assess the experience and practice of the practitioners regarding the diagnosis and management of HAIs was done by principal investigator.

The interview assessed back ground information including education level and current responsibilities and question regarding patient assessment, medication choice and specific guidelines they follow if there is any.

Finally, issues on barriers to optimal treatment of HAIs from the physicians' perspective were assessed. Microbiologists were interviewed focusing on the quality of the laboratory and the time required for the results (Annex 3).

4.7 Data quality assurance

Data was collected by data collectors, to ensure the validity and accuracy of the data pretest was done in 5% of the sample. The pretest provided additional information that was not included in the data collection format prior to the actual data collection was commenced. The collected data was supervised by principal investigator every day and corrected immediately (if any). Double data entry was conducted by principal investigator to minimize errors.

4.8 Data analysis and interpretation

The collected data were coded, entered into EpiData Manager Version 4.0.2.101 and analysis was done using the SPSS version 21. Descriptive analysis was made to describe the study variables and presented using percentages and median. Logistic regression was used to assess factors associated with the development of HAIs. Adjusted odds ratio with its 95% CI was used to assess the prevalence of association between each of the independent variable and outcome of interest. Variables with $p \leq 0.20$ in bivariate analysis were taken for multivariate analysis. Significance was declared at p-value ≤ 0.05.

4.9 Ethical considerations

Ethical clearance was obtained from Ethics Review Board of the School of Pharmacy; college of Health Sciences, Addis Ababa University. Permission was also obtained from hospital administration of Zewditu memorial hospital to conduct this study and to access the medical record. Informed consent was prepared to insure patients understanding and willingness to participate in the study.

Consent was obtained from care givers for those severely ill patients and children. Every patient have equal chance of being selected as a participant. Maltreatment was not done for those not interested to participate. Any patient has the right to withdraw at any point during the data collection. Personal identifier in the data collection format were anonymous. A code was given for every patient in the survey and his/her data was registered only under this code. The data was analyzed by principal investigator to guarantee privacy of the study participants.

4.10 Operational definitions

Appropriate: The indication for use, dose, and frequency of administration, duration of treatment, no or mild drug interaction and Culture and sensitivity (C&S) investigation were according to guidelines recommendations for treating HAIs.

Chronic illness: Disease where patients took medications for life time.

Confirmed diagnosis: Diagnosis made by the judgment of clinicians‟ team based on adequate evidences such as imaging and/or laboratory findings and clinical manifestations.

Empirical treatment: Antibiotic administration initiated before or without identification of sensitive profile of bacterial pathogens.

Hospital-acquired infections: an infection is defined as hospital-acquired infections when it originated in the hospital environment after 48 hours or more of admission to hospital.

Immunosuppressive agents: are drugs that are being used by the patients such as cyclosporine, steroids and cancer chemotherapy medications.

Inappropriate: The indication for use, dose, frequency of administration, duration of treatment and culture and sensitivity investigation were not according to guidelines recommendations for treating HAIs.

Specific treatment: Antibiotic administration initiated after identification of pathogens sensitive profile.

Surgical site infection: is a proliferation of pathogenic microorganisms which develops in an incision site.

Suspected diagnosis: Diagnosis made by the judgment of physicians without adequate evidences of laboratory findings, imaging and clinical manifestations.

5. Results

5.1 Socio demographic characteristics

A total of 410 patients were included in this study with a 97% response rate. The median age of the patients was 28 years and 199 (48.5%) of them were aged between 15-34 years. More than half of the participants were female accounting for 277 (67.6%). Majority of the patients 156 (38.0%) were form GYN/Obs ward (Table 1).

Table 1. The socio-demographic characteristics of patients admitted in Zewditu memorial hospital from March 1, 2017 -August, 2017

Characteristics	Number of patients	Percent
Sex		
Male	133	32.4
Female	277	67.6
Age (years)		
<1	35	8.5
1-14	55	13.4
15-34	199	48.5
35-55	79	19.3
>56	42	10.2
Ward type		
Medical	54	13.2
Surgical	112	27.3
Pediatrics	88	21.5
Obstetrics and gynecology	156	38.0

5.2 Clinical characteristics of patients

Majority 136 (33.2%) of admitted patients stayed in hospital for five- ten days. Of the 410 patients who participated in the study 83(20.2%) of them had chronic illness. Patients who are HIV positive had higher proportion 27(6.6%) followed by HTN 26(6.3%). A total of 264 patients underwent surgery of which 67 (25.4%) had clean and 176 (66.7%) patients had clean contaminated operations during the study period. More than half 150(56.6%) of the procedures were scheduled surgery. Preoperative hospital stay of most patients were less than seven days accounting for 52.2%. Majority of procedures took 31-60 minutes. From patients who had surgery the average duration of surgical procedure was 42.7minutes. Almost all 254 (95.8%) of the patients had received preoperative antibiotics prophylaxis. Three hundred eighty two patients (93.2%) had peripheral line inserted for different purposes. Nasogastric tube was inserted in 59 (14.4%) of the patients. Urinary catheter was inserted in 174 (42.4%) of the participants.

From 156 patients admitted in GYN/OBS ward, 18(22.2%) of patients had developed HAIs and five patients were readmitted within 7 days of discharge with diagnosis of SSI. Majority of 28(17.9%) the patient's reason for admission were to have Cesarean section (C/s) which were elective, and 24(15.4%) of them had one previous C/S history followed by development of severe preeclampsia 25(16%). Majority of the participants were primiparous 66(42.3%) followed by multiparous 47(30.1%) and nulliparous 42(26.9%). Of the participants 75(48.1%) were at term followed by post term and preterm each accounting 34(21.8%). All of the participants had antenatal care (ANC) follow up (Table 2).

Table 2. Clinical characteristics of patients admitted in Zewditu memorial hospital from March 1, 2017-August 30, 2017

Characteristics	Number of patients	Percentage
Hospital stay(days)		
<5	124	30.2
5-10	136	33.2
11-15	64	15.6
16-21	38	9.3
>21	48	11.7
Chronic illness		
Yes	97	23.7
No	313	76.3
HIV	27	6.6
DM	15	3.7
HTN	26	6.3
CKD	9	2.2
CHF	15	3.7
Asthma	5	1.2
Peripheral line inserted		
Yes	382	93.2
No	28	6.8
Catheterized		
Yes	174	42.4
No	236	57.6
NGT inserted		
Yes	59	14.4
No	351	85.6
Mechanical ventilation		
Yes	14	3.4
No	396	96.6
Use of PPI		
Yes	8	2.0
No	402	98.0
Use of antacid		
Yes	14	3.4
No	396	96.6
Lumbar puncture done		
Yes	15	3.7
No	395	96.3
Surgery		

Yes	264	64.4
No	146	35.6
Elective	150	56.8
Emergency	114	43.2
Pre-operative prophylaxis		
Yes	253	95.8
No	11	4.2
Wound class		
Clean	67	25.4
Clean contaminated	176	66.7
Contaminated	17	6.4
Dirty	4	1.5
Preoperative hospital stay (days)		
<7	138	52.2
>7	126	47.8
Previous surgery(n=264, yes)	42	15.9
Duration of procedure (minutes)		
<30	60	22.7
31-60	124	46.9
61-90	34	12.8
91-150	36	13.8
>150	10	3.8

CKD: Chronic kidney disease, HTN: Hypertension, HIV: Human immune virus, DM: Diabetes mellitus, CHF: Congestive heart failure, PPI: Proton pump inhibitors

5.3 Proportion of specific site infections among hospital-acquired infections

A total of 19.8% patients experienced HAI. In addition, 27.2% patients suffered from more than one types of HAIs. Majority of infections 24.7% were SSI and pneumonia followed by UTI 19.8% that were recorded in this survey. According to key informant respondents result majority (six respondents) of the physician's agree on poor infection prevention practice in the setup due time and sometimes due to negligence. There is lack of supportive laboratory evidences for supporting the diagnosis which can overestimate the prevalence of the infection diagnosis made clinically. Most of the patients were treated empirically (Table 3).

"*I treat patients empirically with lack of supportive laboratory evidences which overestimate the infection prevalence"* (One of the year 3 Resident)

"*Patient flow and inadequate beds especially GYN/OBS ward patients are sleeping on corridors predisposing them for infections. Surprisingly patient readmitted after C/s for the diagnosis of SSI she is being treated on the corridor due to lack of bed".* (One of the year 2 Residents).

"We are doing procedures in dirty environment with full of flies in the operation room even we are forced to give preoperative prophylaxis in case of clean surgery due to fear of infection development"(One of year 4 resident).

Table 3. Proportion of specific site infections among patients admitted in Zewditu memorial hospital from March 1, 2017-August, 2017

Characteristics[a]	Number of patients (ward)				Percentage
	Medical	Pediatrics	Surgical	Gyn/obs	
Surgical site infections	-	9	5	6	24.7%
Pneumonia	14	4	2	-	24.7%
Urinary tract infections	6	4	3	3	19.8%
Sepsis	4	4	3	5	17.5%
Ventriculitis	3	4	3	2	15%
Diarrhea	4	6	-	-	12.7%
Meningitis	-	8	-	-	10%
Hospital-acquired infections	4	3	-	-	8.8%
Bedsore	4	-	-	-	5.1%

[a] One patient can have more than one infection

5.4 Associated factors for the development of hospital-acquired infections

Bivariate analysis indicate that patients admitted in pediatrics ward were relatively at risk of developing HAIs as compared to gynecological ward (p=0.000). Patients whose duration of procedure from 30-60 minutes have relatively less risk of developing HAIs (12%) and it was statically significant (p=0.001) as compared to duration of procedure >150 minutes. Patients who had clean contaminated surgery were at higher risk of developing HAIs as compared to patients who undergo clean surgery. Patients with chronic illness were relatively at risk (27.2%) of developing HAIs compared to these who did not have chronic illness but were not statistically significant (P=0.08). Being HIV positive was a risk (8.6%) for the development of infection when compared to other chronic illnesses but statistically significant association were not observed (P=0.41). Peripheral line insertion puts patients at risk (96.3%) of developing HAIs as compared to these who did not have any peripheral line insertion but there was no statistically significant association (P=0.22). Catheterized patients had more infection risk (42.0%) as compared to these not catheterized but not statistically significant (P=0.92).

Emergency surgery puts patients more at risk (65%) of infection as compared to these patients who had elective surgery and statistically significance were observed (p=0.004). Patients who took preoperative prophylaxis had less risk (13.8%) of developing HAIs as compared to these who didn't took preoperative prophylaxis (P=0.009).

Preoperative hospital stay of <7 days makes patients to be in less risk(52.2%) of developing infections as compared to patients who stayed more than 7 days but not statistically significant (P=0.21). Other variables (Duration of procedure, Preoperative prophylaxis, Emergency surgery) were not included in multivariate analysis as they subject in shifting to one side due to their number of cases were too small.

Multivariable logistic regression analyses were conducted to explore the association between dependent and independent variables. Independent variables were younger age, male gender, longer hospital stay and previous admission. The chance of developing HAIs among patients less than one year was 8.5 times higher as compared to age 56 and above (AOR=8.53,95%CI: 2.67-27.30). Compared to females males had 2.07 higher odds of developing HAIs (AOR=2.06, 95%CI: 1.01-4.22).

Patients admitted for less than five days had 96.8% less risk of developing hospital-acquired infections as compared to these who stayed for greater than 21days (AOR=0.32, 95%CI: 0.01-0.10). The odds of developing hospital-acquired infections among patients who had lumbar puncture procedure were 24.98 times higher than patients who didn't had lumbar puncture as a procedure (AOR=24.98,95% CI: 4.17-149.28). Patients who had history of previous admission were 3.22 times at risk of developing hospital-acquired infections as compared to patients who had no any history of previous admission (AOR=3.22, 95%CI: 1.76- 5.89) (Table 4).

Table 4. Associated factors for hospital-acquired infections among patients admitted in Zewditu memorial hospital, March 1,2017 -August, 2017

Characteristics		HAIs		COR (95% CI)	pvalue	AOR (95% CI)	pvalue
		Yes	No				
Sex	Male	38(28.6)	95(71.4)	0.45(0.27-0.75)	**0.002**	2.06(1.01-4.22)	**0.047**
	Female	43(15.5)	234(84.5)	1		1	
Age	<1	19(54.3)	16(45.7)	7.12(2.39-21.20)	0.130	8.53(2.67-27.30)	**0.000**
	1-14	15(27.3)	40(72.7)	2.25(0.78-6.41)	0.772	2.46(0.83-7.33)	0.104
	15-34	32(16.1)	167(83.9)	1.15(0.44-2.95)	0.812	1.78(0.64-4.96)	0.266
	35-55	9(11.4)	70(88.6)	0.77(0.25-2.33)	0.646	1.01(0.32-3.16)	0.978
	>56	6(14.3)	36(85.7)	1		1	
Ward	Medical	17(31.5)	37(68.5)	3.52(1.65-7.50)	0.001	2.05(0.77-5.46)	0.148
	Surgical	12(10.7)	100(89.3)	0.92 (0.42-1.99)	0.833	0.78(0.30-2.05)	0.626
	Pediatrics	34(38.6)	54(61.4)	4.82(2.51-9.26)	**0.000**	0.40(0.12-1.30)	0.130
	Gyn/obs	18(11.5)	138(88.5)	1		1	
Hospital stay(days)	<5	5(6.2%)	119(36.2%)	0.23(0.08-0.06)	**0.000**	0.03(0.01-0.10)	**0.000**
	5-10	17(21.0)	119(36.2)	0.78(0.03-0.17)	0.000	0.09(0.03-0.23)	**0.000**
	11-15	18(22.2)	46(14.0)	0.21(0.09-0.48)	0.000	0.27(0.11-0.67)	**0.005**
	16-21	10(12.3)	28(8.5)	0.19(0.07-0.49)	0.001	0.17(0.06-0.51)	**0.001**
	>21	31(38.3)	17(5.2%	1		1	
Previous admission	Yes	27(38.6)	43(61.4)	3.32(1.89-5.83)	**0.000**	3.22(1.76-5.89)	**0.000**
	No	54(15.9)	286(84.1)	1		1	

CKD: Chronic kidney disease, HTN: Hypertension, HIV: Human immune virus, DM: Diabetes mellitus, CHF: Congestive heart failure, PPI: Proton pump inhibitors

5.5. Management of hospital-acquired infections

Culture and sensitivity was done for 24(5.9%) patients who developed HAIs. About half of the specimens taken were from CSF and blood 50.0%, 33.3% respectively. Majority of the culture and sensitivity results show no bacterial growth accounting for 17(70.8%). From the microorganism identified among HAI, *E.Coli* accounted 4(16.7%), *S.aureus* 2(8.7%) and *acinetobacter* 1(4.2%) (Table 6).

Key informant interview result indicated that almost all of the physicians hesitate to send culture and sensitivity test often because its time taking.

"*I did not send culture and sensitivity test for patients because most of patients will be discharged while waiting for result so I personally prefer to treat empirically also there is shortage of culture material we can't request when we need it* " (One of the residents).

"*For patients especially admitted during night time and in the weekends I send sample after treating the patient empirically because the laboratory is closed during night time and in the weekends*"(Three of the resident).

"*Sometimes I seek for sending samples after initiating patients on antibiotics when patients didn't improve"* (five of the residents).

"*The samples received will go through appropriate procedure based on guidelines and with quality control with 98% sensitivity but am doubting the technique of sample collection sometimes skin contaminants are found in blood samples. Regarding the time for culture and sensitivity result on average it took 24-72 hours but sometimes 5-7 days because maximum day for possible fungal or bacterial growth is considered*" (four of the laboratory personnel).

Table 5. Responses of the interviewed physicians and microbiologists regarding the management of hospital-acquired infections among patients admitted in Zewditu memorial hospital from March 1, 2017 -August, 2017

Variables	Categories	Comments	No (%)
Patient related factors for inappropriateness of management	Compliance	Patients prefer PO than injections	3
	Affordability	Patients can't afford from private pharmacies	8
Drug related	Availability	Drugs like vancomycin, ceftazidem and cefepime are not available in the hospital pharmacy all the time.	8
	Side effects	Vancomycin fear of nephrotoxicity in both extreme ages.	2
Institution related	Guideline	No specific guideline including STG for Ethiopia doesn't have treatment protocol for HAIs	8
	Clinic setup	Limited laboratory reagents and disks. More Patient flow and limited number of beds. Culture will take several days difficult to manage patients.	6
Physician related	Information gap	This inappropriateness could be due to information gap on updated recommendation.	8
	Antibiotics initiated before culture	For these patients admitted at night and weekends culture is sent after initiation of antibiotics because the laboratory is closed at that time	
	Forgetfulness	Patients took antibiotics for longer duration because they are treated	4

	Inadequate sample	empirically most of the time patients remain on initiated antibiotics while adding other antibiotics on top of that. Forget to discontinue it. The sample sent are not adequate to detect particular pathogen like in case of hospital-acquired infections pneumonia if sent sputum.	2
Laboratory personnel	The quality of the laboratory is optimal to detect any growth.	The negative result may be due to Inappropriate sample collection Failure to request appropriate laboratory test Improper use of transporting medium. Sample collected after antibiotics use	4
	On average, how long does it take for culture and sensitivity result to come back (in day)?	Mostly 3 days Some cultures (eg. blood culture requires 7-14 days	

Table 6. Susceptibility pattern of Bacterial pathogens isolated from hospital-acquired infections among patients admitted in Zewditu memorial hospital from March 1, 2017 -August, 2017

Susceptibility Pattern	Bacterial isolate (n=7)								
	E.Coli n=4(%)			*S.aureus* n=2(%)			*Acinetobacter* n=1(%)		
	S	R	Not done	S	R	Not done	S	R	Not done
Ampicillin	-	4(100)		-	-	4(100)	-	1(100)	
Amoxacillin	-	-	-	-	-	4(100)	-	-	
Cefroxime		4(100)		-	-	4(100)	-	-	
Ceftriaxone	2 (50)	-	2 (50)	-	-	4(100)	-	-	
Ciprofloxacin	1(25)	2 (50)	1(25)	2(100)	-	-	1(100)	-	-
Clindamycin	-	-	4(100)	1(50)	1(50)	-	-	-	1(100)
Erythromycin	-	-	4(100)	1(50)	1(50)	-	-	-	1(100)
Gentamycin	1(25)	3(75)	1(25)	1(50)	1(50)	-	1(100)	-	-
Nitrofurantoin	-	1(25)	3(75)	-	-	2(100)	-	-	1(100)
Sulfometoxazo	1(25)	-	3(75)	-	-	2(100)	-	-	1(100)
Agumentin	-	4(100)	-			2(100)	-	1(100)	-
Ceftazidime	-	3(75)	1(25)	1(50)	-	1(50)	1(100)	-	-
Chloramphenic	1(25)	1(25)	2(50)	1(50)	1(50)	-	1(100)	-	-
Doxycyclin	-	3(75)	1(25)	1(50)	1(50)	-	-	-	1(100)
Oxacillin	4(100)	-	-	1(50)	1(50)	-	-	-	1(100)
Meropenem	3(75)	-	1(25)	-	-	2(100)	1(100)	-	-
cefepime	1(25)		3(75)	-	-	2(100)	1(100)	-	-
Erythromycin	-	-	4(100)	1(50)	1(50)	-	-	-	1(100)

R=Resistant, S=Sensitive

5.5.1 Management inappropriateness of hospital-acquired infections

Among the 81 patients who developed hospital-acquired infections, 54(66.7%) were inappropriately treated (not according to IDSA guidelines) while the rest 27(33.3%) were appropriately treated. Wrong choice of medications accounts the higher proportion 45(53.6%) followed by longer duration of antibiotics administration 16(19.0%). Using Micromedex as interaction checker no drug interaction was encountered in this study. Fifteen (18.5%) patients had change of medication the reason for change of their medication was due to poor response 46.7% followed by IV to Po change 20%, after culture and sensitivity result 20% and medication unavailability 13.3%.

Most of the respondents to key informant interview indicated that they use international guidelines and standard text books to treat HAIs. They all agree that standard treatment guideline for Ethiopia lacks clear protocol for treatment of HAIs and they did not prefer to use it as a reference. Most of the physicians consider several factors like affordability, availability, patient compliance and possible side effects to choose medications to their patients.

"We treat empirically and there is irrational antibiotics use that predispose patients for farther HAI development" (all of the respondents).

"*There is knowledge gap on treating patients I give medication to may patient, if there is no improvement will consult senior physician and sometimes found it that it was not the right choice from the beginning. I tried to check new updates but did not do it regularly due to time constraints*" (five of the residents).

"*Patients sometimes took antibiotics for a long period of time because medications will be added one on top of the other when there is no improvement and we forget to discontinue medications on time*" (two of the residents).

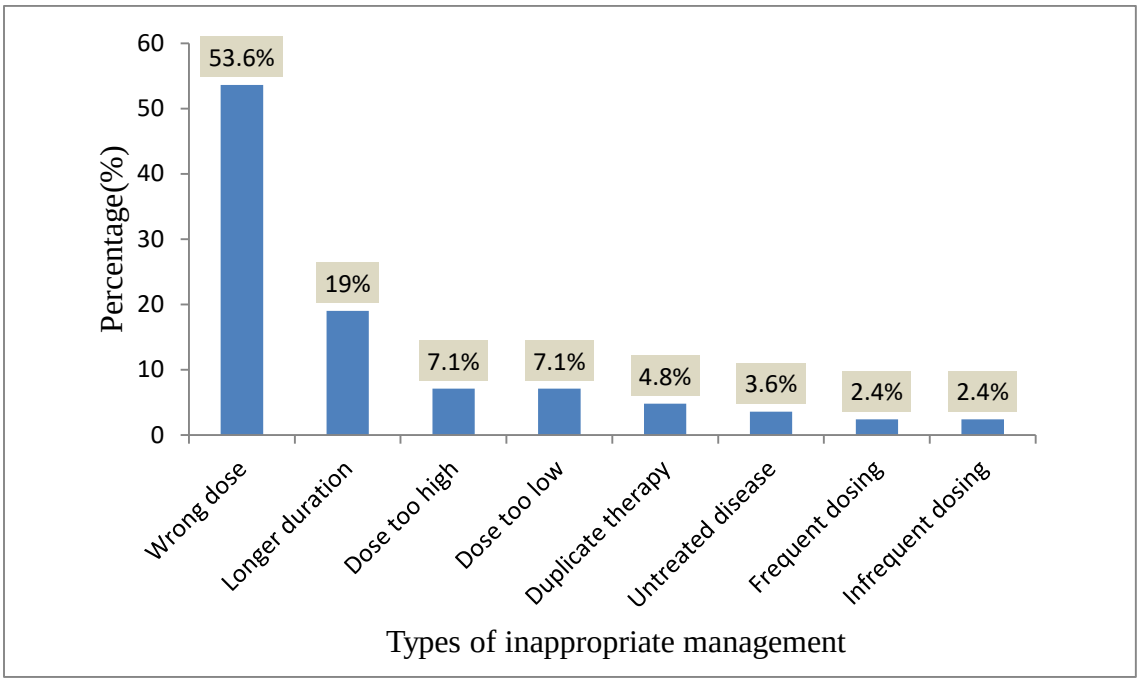

Figure 1. Management appropriateness of hospital-acquired infections among patients admitted in Zewditu memorial hospital, March-August, 2017

5.5.2 Frequency of management appropriateness for different hospital-acquired infections

The highest inappropriate management were from pediatrics ward 23(42.6%) followed by medical ward 13(24.1%); surgical ward 11(20.4%); and gynecology and obstetrics ward 7(13.0%). From the 264 patients who underwent surgery 67(25.4%) of patients took inappropriate prophylaxis for clean surgery and longer duration of postoperative prophylaxis in GYN/Obs on patients who undewent C/S 104(39%) were observed. Among patients who developed hospital-acquired pneumonia 17(31.5%) of them were inappropriately treated followed by urinary tract infection 16 (29.6%). “I gave prophylaxis because the procedure room is dirty with full of flies and I prefer giving prophylaxis to reduce the risk of infection” (Majority of the respondents)

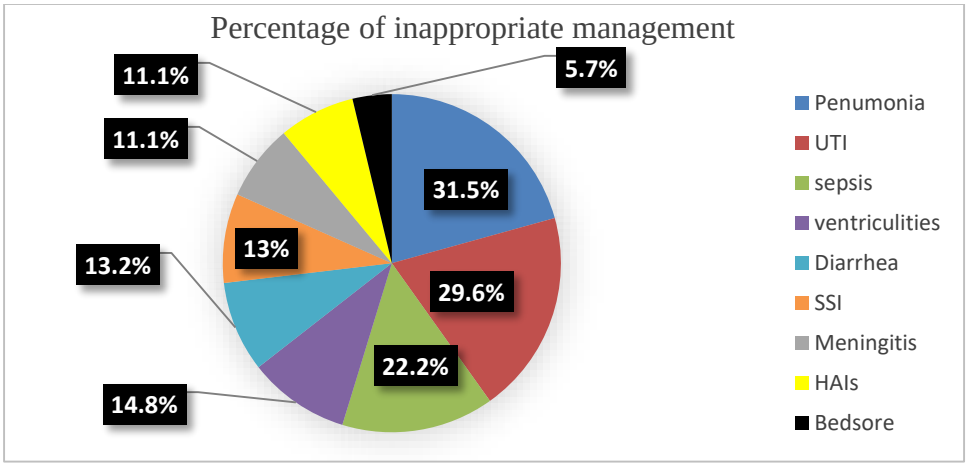

Figure 2. Frequency of inappropriate management for different hospital-acquired infections among patients admitted in Zewditu memorial hospital, March 1, 2017 -August, 2017

6. Discussion

The aim of this research is to assess the prevalence and management of HAIs among patients admitted in selected wards of Zewditu memorial hospital. The prevalence of hospital-acquired infections were 19.8%. 54(66.7%) were inappropriately treated (Not according to IDSA 2016, 2017 guidelines and surviving sepsis campaign) while the rest 27(33.3%) were appropriately treated. Wrong choice of medications accounts the higher proportion 45(53.6%) followed by longer duration of antibiotics administration 16(19.0%). Using Micromedex as interaction checker no drug interaction was encountered in this study. Key informant interview of physicians showed the discrepancy in the management may be due to lack of information on updated guidelines. Microbiologists didn't doubt the quality of the laboratory and do procedures based on standard guidelines.

The prevalence of HAIs in this study is 19.8%. Younger age, male gender, ward type, longer hospital stay and previous hospital admission were associated factors for the development of HAIs. The prevalence of HAIs in this survey was higher than previously conducted surveys in Ethiopia, Uganda and Tunisia (15.41%, 17%, and 17.9% respectively) (35, 36, 73). This discrepancy may be due to the difference in their methodology. This was also higher than studies done in Lithuania 3.8% and Italy 9.8%. (43, 44). This may be due to better infection prevention procedures in the hospitals and sterile working environment. This prevalence study was similar to study done in Benin 19.1% (46). This prevalence was lower than study done in India (26.1%) this may be due to their study was contacted in some specific wards (10).

The prevalence of HAIs vary by specific sites of infection and indwelling devices used (31, 74, 75). The most common type of HAIs in this survey was Pneumonia and surgical site infection which was 24.7% each from the total hospital-acquired infections. This finding was lower than the prevalence of SSIs found in other studies conducted in Ethiopia and Tunisia 51%, 28%, 75%, 49.4% , respectively (31, 34, 36, 76). Unlike our study they use cross sectional study this study may involve unsettled diagnosis which can overestimate the prevalence. Higher than study done in Hawassa, Jimma and Nigeria (32, 33, 37, 76), respectively. This may be due to the difference in inclusion criteria unlike our study they only include patients with contaminated and dirty wound. The finding from current study was higher compared with studies done in Egypt 9.2% and Sudan 9% (77, 78), USA 7.2%, France 2.5% (79, 80). The higher SSIs rate in present study compared to

developed countries might be due modern instruments, rooms and adequate trained manpower in developed countries. Studies done in Egypt and Sudan included only elective surgery but in our study both elective and emergency surgeries were included. This might be the reason why we found high prevalence rate of SSIs compared to studies done in both developing countries.
Pneumonia constituted highest proportion of HAIs according to studies in India 50% (81) and Saudi Arabia 28.9% (82). Our finding was lower than thus study this may be due to the fact that the studies were conducted in intensive care units only. Similar to study done in Amhara region ,Ethiopia, (31). This study was also similar with study done in Iran where pneumonia account for 70% of cases (42).

The second most common infection encountered in our study was UTI 19.8% which is in line with study done in Morocco 35%, Tanzania 31.1%, Lituania 28.5%, and Benin 48.2% (22, 38, 43, 46). This could be as a result of more urinary tract catheter was used in their study. A systematic review on UTI showed that 79.3% of UTI can be prevented, if catheterization was not performed in hospitals (83).

Risk factors for HAIs are dynamic and multipart phenomenon. The availability of waste management materials is believed to reduce exposure of waste to patients and health care workers. A study in Ethiopia showed that waste management in health care facilities is in poor conditions (84).

This study showed that males were vulnerable to HAIs. This was also supported by other studies done in Nigeria where male had higher risk of infection as compared to female and study conducted by the European Centre for Disease Prevention and Control (ECDC) pilot point prevalence survey and (37, 85). This could be due to that male underwent more contaminated type of procedures unlike females. This was in contrary with study done in Felege Hihowt Hospital (16). This may be due to the difference in methodology and unlike this study the study was done among postoperative patients only.

In our study pediatric ward admitted patients were relatively at risk of developing HAIs this was in contrary with study done at pune, India, A study from developing countries has reported that rates of neonatal infections were 3-20 times higher than those reported for hospital-born babies in industrialized countries (86).

Patients aged less 14 were 72.7% high likely to develop HAIs compared to older age >56 years and above which is in contrary with previous study done in Ethiopia and Russia (31, 87). Our study have relatively more patients aged less than 14 years and also there was more neurosurgical procedures unlike their study. This result was supported by study done in Nigeria and Rangpur were younger patients were more at risk (37, 88).

Patients whose duration of procedure from 30-60 minutes have relatively less risk of developing hospital-acquired infections and as compared to duration of procedure >150 minutes. This study was supported by other studies in Ethiopia (16, 33, 37).

Patients who had clean contaminated surgery were at higher risk of developing hospital-acquired infections as compared to patients who undergo clean surgery. This was similar with the study done in Jimma (32).

Catheters can be a route of the transmission of microorganisms to patients. Hospital-acquired infections can also take place with the devices used in medical procedures. Infections can be minimized by avoiding unnecessary use and to discontinue as soon as clinically feasible (89). Non adherence to insertion and maintenance protocols, and frequent EVD manipulation can predispose patients for further infection (52).

In this study there is positive correlation between intravascular devices use and risk of developing HAIs this was similar to previous studies done in Morocco and Benin (22, 46, 90). The high risk of central vascular catheter may be due low implementation of a multidimensional infection control strategy in the study setting. Literature from developing countries to the implementation of Nosocomial Infection Control Consortium (INICCE) education, performance feedback, and outcome and process surveillance of CLABSI rates significantly improved infection control adherence, reducing the CLABSI incidence by 54% (91).

Sepsis is the third common infection observed in this study which is in line with study done at Tanzania, Iran and Pune (25, 38, 42). In contrary to our study blood stream infections were the most common infections encountered in study done in Europe (47). This may be due to unlike our study their study was conducted in pediatrics wards in which higher risk of BSI is expected.

Emergency surgery was one of the determining factors for HAIs in this study. This was also supported by study done in Ethiopia in which the infections rate was two times higher compared to that of elective surgery (32, 92).

Shorter hospital stay puts patients at less risk of developing HAIs as compared to those who stayed for longer period our study was supported by study done in Ethiopia and India (31, 86) . This is also supported by study done at Morocco and Nigeria the longer the hospital stay the higher the risk a patient to develop infections (22, 37).

Among the 81 patients which developed HAIs 54(66.7%) were inappropriately treated according to IDSA guideline. This was higher than study done by Chelo et-al. (59, 60). This may be due to their study was done on specific illness which is on patients with BSI unlike our study that was done in all HAIs. Similarly this finding was higher than study done in USA on severe sepsis or septic shock associated with gram-negative bacteremia (58).

The result from this study was lower than study done in Sokuluk territory hospital, central Asian, in which 73.3% of patients were inappropriately treated. In our study wrong choice of antibiotics followed by longer duration of antibiotic use was observed which is in line with this study (63). Similarly study done in Indonesia showed higher inappropriate dosage and duration of treatment (68). Unlike our study in which UTI was the second most commonly inappropriately treated disease, in Brazil all UTI were appropriately treated (67). This discrepancy may be in the study setup almost all patients who are diagnosed with benign prosthetic hyperplasia (BPH) were getting antibiotics due to fear of infection. So it is difficult to give the right medication without knowing the susceptibility profile of the pathogen.

This finding was also higher than studies done in North America and Europe. This difference may be due to difference in patients and there is accessibility of first line medications in developed countries (62). Our result was also higher than study done at Copenhagen City and County areas and the North Denmark Region (59). This is because it was done on patients who had bacteremia only and 22% of patient’s status of treatment was not recorded.

Highest inappropriate management of HAIs were seen in the department of pediatrics in our study. This was in contrary with study done at Jerusalem were patients admitted in the department of pediatrics were appropriately managed as compared to other wards (69). This may be due to the availability of more effective first line medications with better safety profile.

7. Limitation of the study

Variables related to health professionals, antiseptics used for patient preparation, methods used for equipment sterilization and type of anaesthesia used were not included due to resource shortage. We were unable investigate the relationship between the adequacy or inadequacy of treatments and clinical outcomes. Comparison with other studies were difficult due to difference in hospital environment and settings.

8. Conclusion and recommendations

8.1. Conclusion

It was observed that the prevalence of HAI was high in this hospital. Surgical site infections and pneumonia were the most common types of HAIs followed by urinary tract infection. Also the percentage of inappropriate management was relatively high. With the limitation in the development of new generations of antibiotics, restrictive and appropriate use of antibiotics is needed to ensure the availability of an effective treatment of microbial infections.

8.2. Recommendation

Based on the current finding, the following recommendations are suggested

- ✓ Annual point-prevalence surveys should be introduced so that results will be presented for the units and the administration of the hospital.
- ✓ Limiting the indication and duration of invasive devices and change indwelling catheters after four days. Change intravascular cannulas after five days.
- ✓ Develop local antibiogram programs and promote rational use of antibiotics using guidelines.
- ✓ Adoption of an international standard and locally conformable guidelines of antibiotic use can help correct such problems.
- ✓ Pharmacists have a remarkable role in rational use of drugs by dissemination of drug information to guide patients and physicians so it is better to involve clinical pharmacists in all the wards.

References

1. Nigatu E. susceptibility patterns in surgical wards and surgical Intensive care unit (SICU) of Tikur Anbessa University Hospital Addis Ababa, Ethiopia: aau; 2008.
2. Mulu W, Kibru G, Beyene G, Damtie M. Postoperative nosocomial infections and antimicrobial resistance pattern of bacteria isolates among patients admitted at Felege Hiwot Referral Hospital, Bahirdar, Ethiopia. Ethiopian journal of health sciences. 2012;22(1):7-18.
3. Horan TC, Andrus M, Dudeck MA. CDC/NHSN surveillance definition of health care–associated infection and criteria for specific types of infections in the acute care setting. American journal of infection control. 2008;36(5):309-32.
4. Oliveira ACd, Kovner CT, Silva RSd. Nosocomial infection in an intensive care unit in a Brazilian university hospital. Revista latino-americana de enfermagem. 2010;18(2):233-9.
5. Cheadle WG. Risk factors for surgical site infection. Surgical infections. 2006;7(1):s7-s11.
6. Ducel G, Fabry J, Nicolle L, Organization WH. Prevention of hospital-acquired infections: a practical guide. 2002;10(7):13-9 .
7. Samuel S, Kayode O, Musa O, Nwigwe G, Aboderin A, Salami T, et al. Nosocomial infections and the challenges of control in developing countries. African journal of clinical and experimental microbiology. 2010;11(2).
8. Allegranzi B, Nejad SB, Combescure C, Graafmans W, Attar H, Donaldson L, et al. Burden of endemic health-care-associated infection in developing countries: systematic review and meta-analysis. The Lancet. 2011;377(9761):228-41.
9. Organization WH. Health care-associated infections fact sheet. WHO [homepage on the Internet]. 2013:c2013.
10. Ginawi I, Saleem M, Sigh M, Vaish A, Ahmad I, Srivastava V, et al. Hospital acquired infections among patients admitted in the medical and surgical wards of a non-teaching secondary care hospital in northern India. Journal of clinical and diagnostic research: JCDR. 2014;8(2):81.
11. Messele G, Woldemedhin Y, Demissie M, Mamo K, Geyid A. Common causes of nosocomial infections and their susceptibility patterns in two hospitals in Addis Ababa. Ethiop J Health Biomed Sci. 2009;2:3-8.
12. Sepideh Bagheri Nejad, Benedetta Allegranzi, Shamsuzzoha B Syed, Benjamin Ellisc , Pittetd D. Health-care-associated infection in Africa: a systematic review

Bull World Health Organ. 2011;89(757-765).

13. Vincent J-L, Rello J, Marshall J, Silva E, Anzueto A, Martin CD, et al. International study of the prevalence and outcomes of infection in intensive care units. Jama. 2009;302(21):2323-9.
14. vidya Gs, Norendranath v, Asha, rajan B. Epidemiology of Hospital Acquired Infections among Patients Admitted in a Tertiary Care Hospital, Bangalore. MSRUAS-JMC. 2014; 1(1):15-7.
15. Devrajani B, Shah S, Devrajani T, Qureshi GA. Nosocomial infections in medical ward (Four months descriptive study in a tertiary care hospital). World J Med Sci. 2009;4(1):13-7.
16. Mulu W, Kibru G, Beyene G, Damtie H. Associated risk factors for post operative nosocomial infections among patients admitted at Felegehiwot referral hospital, Bahir Dar, Northwest, Ethiopia. Clin Med Res. 2013;2(6):140-7.
17. Abdulah R. Antibiotic abuse in developing countries. Pharm Regul Aff. 2012;1(2):1000e106.
18. Mermel LA, Allon M, Bouza E, Craven DE, Flynn P, O'Grady NP, et al. Clinical practice guidelines for the diagnosis and management of intravascular catheter-related infection: 2009 Update by the Infectious Diseases Society of America. Clinical infectious diseases. 2009;49(1):1-45.
19. Nejad SB, Allegranzi B, Syed SB, Ellis B, Pittet D. Health-care-associated infection in Africa: a systematic review. Bulletin of the World Health Organization. 2011;89(10):757-65.
20. Mulu A, Moges F, Tessema B, Kassu A. Pattern and multiple drug resistance of bacterial pathogens isolated from wound infection at University of Gondar Teaching Hospital, Northwest Ethiopia. Ethiopian medical journal. 2006;44(2):125-31.
21. Nejad SB, Allegranzi B, Syed SB, Ellis B, D. P. Health-care-associated infection in Africa: a systematic review. Bulletin of the World Health Organization. 2011;89(10):757-65.
22. Razine R, Azzouzi A, Barkat A, Khoudri I, Hassouni F, Chefchaouni A, et al. Prevalence of hospital-acquired infections in the university medical center of Rabat, Morocco. International archives of medicine. 2012;5(1):1.
23. Miller RS, Norris PR, Jenkins JM, Talbot III TR, Starmer JM, Hutchison SA, et al. Systems initiatives reduce healthcare-associated infections: a study of 22,928 device days in a single trauma unit. Journal of Trauma and Acute Care Surgery. 2010;68(1):23-31.
24. Gosling R, Mbatia R, Savage A, Mulligan J-A, Reyburn H. Prevalence of hospital-acquired infections in a tertiary referral hospital in northern Tanzania. Annals of Tropical Medicine & Parasitology. 2013;67(21):23-9.

25. Asl HM, editor The National Nosocomial Infections Surveillance in Iran. A 4 years report. BMC Proceedings; 2011: BioMed Central.
26. Assar S, Akhoundzadeh R, Aleali AM, Latifi SM, Salemzadeh M. Survey of nosocomial infections and causative bacteria: A hospital-based study. 2012.
27. Colpan A, Akinci E, Erbay A, Balaban N, Bodur H. Evaluation of risk factors for mortality in intensive care units: a prospective study from a referral hospital in Turkey. American journal of infection control. 2005;33(1):42-7.
28. Dayanand M, Rao S. Prevention of Hospital Acquired Infections: A practical Guide. Medical Journal Armed Forces India. 2004;60(3):312.
29. Doshi RK, Patel G, MacKay R, Wallach F. Healthcare-associated Infections: Epidemiology, Prevention, and Therapy. Mount Sinai Journal of Medicine: A Journal of Translational and Personalized Medicine. 2009;76(1):84-94.
30. Masterton R, Drusano G, Paterson D, Park G. Appropriate antimicrobial treatment in nosocomial infections—the clinical challenges. Journal of Hospital Infection. 2003;55:1-12.
31. Yallew WW, Kumie A, Yehuala FM. Point prevalence of hospital-acquired infections in two teaching hospitals of amhara region in ethiopia. Drug, Healthcare and Patient Safety. 2016;8:71.
32. Amenu D, Belachew T, Araya F. Surgical site infection rate and risk factors among obstetric cases of Jimma University Specialized Hospital, Southwest Ethiopia. Ethiopian journal of health sciences. 2011;21(2):91-100.
33. Laloto TL, Gemeda DH, Abdella SH. Incidence and predictors of surgical site infection in Ethiopia: prospective cohort. BMC infectious diseases. 2017;17(1):119.
34. Endalafer N, Gebre-Selassie S, Kotiso B. Nosocomial bacterial infections in a tertiary hospital in Ethiopia. Journal of Infection Prevention. 2011;12(1):38-43.
35. Ogwang M, Paramatti D, Molteni T, Ochola E, Okello T, Salgado JO, et al. Prevalence of hospital-associated infections can be decreased effectively in developing countries. Journal of Hospital Infection. 2013;84(2):138-42.
36. Kallel H, Bahoul M, Ksibi H, Dammak H, Chelly H, Hamida CB, et al. Prevalence of hospital-acquired infection in a Tunisian hospital. Journal of Hospital Infection. 2005;59(4):343-7.
37. Amoran O, Sogebi A, Fatugase O. Rates and Risk Factors Associated with Surgical Site Infections in a Tertiary Care Center in South-Western Nigeria. 2013;11(2): 102-110.

38. Moyo S, Aboud S, Kasubi M, Maselle S. Bacteria isolated from bloodstream infections at a tertiary hospital in Dar es Salaam, Tanzania: antimicrobial resistance of isolates. SAMJ: South African Medical Journal. 2010;100(12):835-8.
39. Singh S, Chaturvedi R, Garg S, Datta R, Kumar A. Incidence of healthcare associated infection in the surgical ICU of a tertiary care hospital. Medical journal armed forces India. 2013;69(2):124-9.
40. . MI. Pattern of nosocomial infection in two intensive care units of a tertiary care hospital in Karachi. Journal of the College of Physicians and Surgeons--Pakistan. 2008;2(18):134.
41. Pradhan NP, Bhat S, Ghadage D. Nosocomial infections in the medical ICU: a retrospective study highlighting their prevalence, microbiological profile and impact on ICU stay and mortality. J Assoc Physicians India. 2014;62(10):18-21.
42. Tabatabaei SM, Pour FB, Osmani S. Epidemiology of Hospital-Acquired Infections and Related Anti-Microbial Resistance Patterns in a Tertiary-Care Teaching Hospital in Zahedan, Southeast Iran. International Journal of Infection. 2015;2(4).
43. Vizujė G, Gierasimovič Z, Petruševičienė D, Macijauskiene A. The Prevalence of health care-associated infections and risk factors in a University Hospital. Medicina. 2012;48(8):399-403.
44. Durando P, Icardi G, Ansaldi F, Crimi P, Sticchi C, Compagnino F, et al. Surveillance of hospital-acquired infections in Liguria, Italy: results from a regional prevalence study in adult and paediatric acute-care hospitals. Journal of Hospital Infection. 2009;71(1):81-7.
45. Hussein K, Sprecher H, Mashiach T, Oren I, Kassis I, Finkelstein R. Carbapenem Resistance Among Klebsiella pneumoniae Isolates Risk Factors, Molecular Characteristics, and Susceptibility Patterns. Infection Control & Hospital Epidemiology. 2009;30(07):666-71.
46. Ahoyo TA, Bankolé HS, Adéoti FM, Gbohoun AA, Assavèdo S, Amoussou-Guénou M, et al. Prevalence of nosocomial infections and anti-infective therapy in Benin: results of the first nationwide survey in 2012. Antimicrobial resistance and infection control. 2014;3(1):17.
47. Zingg W, Hopkins S, Gayet-Ageron A, Holmes A, Sharland M, Suetens C, et al. Health-care-associated infections in neonates, children, and adolescents: an analysis of paediatric data from the European Centre for Disease Prevention and Control point-prevalence survey. The Lancet Infectious Diseases. 2017;17(4):381-9.

48. Pourakbari B, Rezaizadeh G, Mahmoudi S, Mamishi S. Epidemiology of nosocomial infections in pediatric patients in an Iranian referral hospital. Journal of preventive medicine and hygiene. 2012;53(4).
49. Kotisso B, Aseffa A. Surgical wound infection in a teaching hospital in Ethiopia. East African medical journal. 1998;75(7):402-5.
50. Richards MJ, Edwards JR, Culver DH, Gaynes RP. Nosocomial infections in combined medical-surgical intensive care units in the United States. Infection Control & Hospital Epidemiology. 2000;21(08):510-5.
51. Aly NYA, Al-Mousa HH, Al Asar ESM. Nosocomial infections in a medical-surgical intensive care unit. Medical Principles and Practice. 2008;17(5):373-7.
52. Beer R, Lackner P, Pfausler B, Schmutzhard E. Nosocomial ventriculitis and meningitis in neurocritical care patients. Journal of neurology. 2008;255(11):1617-24.
53. Tesfahunegn Z, Asrat D, Woldeamanuel Y, Estifanos K. Bacteriology of surgical site and catheter related urinary tract infections among patients admitted in Mekelle Hospital, Mekelle, Tigray, Ethiopia. Ethiopian medical journal. 2009;47(2):117-27.
54. Dessie W, Mulugeta G, Fentaw S, Mihret A, Hassen M, Abebe E. Pattern of Bacterial Pathogens and Their Susceptibility Isolated from Surgical Site Infections at Selected Referral Hospitals, Addis Ababa, Ethiopia. International Journal of Microbiology. 2016;2016.
55. Endimiani A, DePasquale JM, Forero S, Perez F, Hujer AM, Roberts-Pollack D, et al. Emergence of blaKPC-containing Klebsiella pneumoniae in a long-term acute care hospital: a new challenge to our healthcare system. Journal of antimicrobial chemotherapy. 2009;64(5):1102-10.
56. Vincent J-L, Bihari DJ, Suter PM, Bruining HA, White J, Nicolas-Chanoin M-H, et al. The prevalence of nosocomial infection in intensive care units in Europe: results of the European Prevalence of Infection in Intensive Care (EPIC) Study. Jama. 1995;274(8):639-44.
57. Lipsky BA, Napolitano LM, Moran G, Vo L, Nicholson S, Kim M. Inappropriate initial antibiotic treatment for complicated skin and soft tissue infections in hospitalized patients: incidence and associated factors. Diagnostic microbiology and infectious disease. 2014;79(2):273-9.
58. Zilberberg M, Micek ST, Kollef MH, Shelbaya A, Shorr AF. Risk factors for mixed complicated skin and skin structure infections to help tailor appropriate empiric therapy. Surgical infections. 2012;13(6):377-82.

59. Gradel KO, Jensen US, Schønheyder HC, Østergaard C, Knudsen JD, Wehberg S, et al. Impact of appropriate empirical antibiotic treatment on recurrence and mortality in patients with bacteraemia: a population-based cohort study. BMC infectious diseases. 2017;17(1):122.
60. Kang C-I, Kim S-H, Park WB, Lee K-D, Kim H-B, Kim E-C, et al. Bloodstream infections caused by antibiotic-resistant gram-negative bacilli: risk factors for mortality and impact of inappropriate initial antimicrobial therapy on outcome. Antimicrobial agents and chemotherapy. 2005;49(2):760-6.
61. Micek ST, Welch EC, Khan J, Pervez M, Doherty JA, Reichley RM, et al. Empiric combination antibiotic therapy is associated with improved outcome against sepsis due to Gram-negative bacteria: a retrospective analysis. Antimicrobial agents and chemotherapy. 2010;54(5):1742-8.
62. Harbarth S, Garbino J, Pugin J, Romand JA, Lew D, Pittet D. Inappropriate initial antimicrobial therapy and its effect on survival in a clinical trial of immunomodulating therapy for severe sepsis. The American journal of medicine. 2003;115(7):529-35.
63. Baktygul K, Marat B, Ashirali Z, Harun-Or-Rashid M, Sakamoto J. An assessment of antibiotics prescribed at the secondary health-care level in the Kyrgyz Republic. Nagoya journal of medical science. 2011;73(3-4):157.
64. Finch RG, Metlay JP, Davey PG, Baker LJ. Educational interventions to improve antibiotic use in the community: report from the International Forum on Antibiotic Resistance (IFAR) colloquium, 2002. The Lancet infectious diseases. 2004;4(1):44-53.
65. Vogtländer NP, van Kasteren ME, Natsch S, Kullberg B-J, Hekster YA, van der Meer JW. Improving the process of antibiotic therapy in daily practice: interventions to optimize timing, dosage adjustment to renal function, and switch therapy. Archives of internal medicine. 2004;164(11):1206-12.
66. Hogerzeil HV. Promoting rational prescribing: an international perspective. British journal of clinical pharmacology. 2000;39(1):1-6.
67. Fonseca LG, Conterno LdO. Audit of antibiotic use in a Brazilian University Hospital. Brazilian Journal of Infectious Diseases. 2004;8(4):272-80.
68. Hadi U, Duerink D, Lestari ES, Nagelkerke N, Keuter M, Huis in't Veld D, et al. Audit of antibiotic prescribing in two governmental teaching hospitals in Indonesia. Clinical microbiology and infection. 2008;14(7):698-707.

69. Raveh D, Levy Y, Schlesinger Y, Greenberg A, Rudensky B, Yinnon A. Longitudinal surveillance of antibiotic use in the hospital. Qjm. 2001;94(3):141-52.
70. Kalil AC, Metersky ML, Klompas M, Muscedere J, Sweeney DA, Palmer LB, et al. Management of adults with hospital-acquired and ventilator-associated pneumonia: 2016 clinical practice guidelines by the Infectious Diseases Society of America and the American Thoracic Society. Clinical Infectious Diseases. 2016;63(5):e61-e111.
71. Tunkel AR, Hasbun R, Bhimraj A, Byers K, Kaplan SL, Scheld WM, et al. 2017 Infectious Diseases Society of America's Clinical Practice Guidelines for Healthcare-Associated Ventriculitis and Meningitis. Clinical Infectious Diseases. 2017;64(6):e34-e65.
72. Cohen SH, Gerding DN, Johnson S, Kelly CP, Loo VG, McDonald LC, et al. Clinical practice guidelines for Clostridium difficile infection in adults: 2010 update by the society for healthcare epidemiology of America (SHEA) and the infectious diseases society of America (IDSA). Infection Control & Hospital Epidemiology. 2010;31(5):431-55.
73. Razine R, Azzouzi A, Barkat A, Khoudri I, Hassouni F, Chefchaouni A, et al. Prevalence of hospital-acquired infections in the university medical center of Rabat, Morocco. International archives of medicine. 2012;5(1):26.
74. Li C, Wen X, Ren N, Zhou P, Huang X, Gong R, et al. Point-prevalence of healthcare-associated infection in China in 2010: a large multicenter epidemiological survey. Infect Control Hosp Epidemiol. 2014;35(11):1436-7.
75. Owens C, Stoessel K. Surgical site infections: epidemiology, microbiology and prevention. Journal of Hospital Infection. 2008;70:3-10.
76. Mengesha RE, Kasa BG-S, Saravanan M, Berhe DF, Wasihun AG. Aerobic bacteria in post surgical wound infections and pattern of their antimicrobial susceptibility in Ayder Teaching and Referral Hospital, Mekelle, Ethiopia. BMC research notes. 2014;7(1):575.
77. Wassef M, Hussein A, El-Sherif R. A prospective surveillance of surgical site infections: Study for efficacy of preoperative antibiotic prophylaxis. African journal of microbiology research. 2012;6(12):3072-8.
78. Elbur AI, Yousif M, ElSayed A, AbdelRahman M. Prevalence and predictors of wound infection in elective clean and clean/contaminated surgery in Khartoum Teaching Hospital, Sudan. International journal of infection control. 2012;8(4).

79. Miliani K, L'hériteau F, Astagneau P. Non-compliance with recommendations for the practice of antibiotic prophylaxis and risk of surgical site infection: results of a multilevel analysis from the INCISO Surveillance Network. Journal of Antimicrobial Chemotherapy. 2009;64(6):1307-15.
80. Garey KW, Dao T, Chen H, Amrutkar P, Kumar N, Reiter M, et al. Timing of vancomycin prophylaxis for cardiac surgery patients and the risk of surgical site infections. Journal of Antimicrobial Chemotherapy. 2006;58(3):645-50.
81. Singh S, Chaturvedi R, Garg S, Datta R, Kumar A. Incidence of healthcare associated infection in the surgical ICU of a tertiary care hospital. Medical journal, Armed Forces India. 2013;69(2):124.
82. Balkhy HH, Cunningham G, Chew FK, Francis C, Al Nakhli DJ, Almuneef MA, et al. Hospital- and community-acquired infections: a point prevalence and risk factors survey in a tertiary care center in Saudi Arabia. International journal of infectious diseases. 2006;10(4):326-33.
83. King C, Alvarez LG, Holmes A, Moore L, Galletly T, Aylin P. Risk factors for healthcare-associated urinary tract infection and their applications in surveillance using hospital administrative data: a systematic review. Journal of Hospital Infection. 2012;82(4):219-26.
84. Tadesse ML, Kumie A. Healthcare waste generation and management practice in government health centers of Addis Ababa, Ethiopia. BMC public health. 2014;14(1):1221.
85. Zarb P, Coignard B, Griskeviciene J, Muller A, Vankerckhoven V, Weist K, et al. The European Centre for Disease Prevention and Control (ECDC) pilot point prevalence survey of healthcare-associated infections and antimicrobial use. Euro Surveill. 2012;17(46):20316.
86. Nair V, Sahni A, Sharma D, Grover N, Shankar S, Chakravarty A, et al. Point prevalence & risk factor assessment for hospital-acquired infections in a tertiary care hospital in Pune, India. The Indian Journal of Medical Research. 2017;145(6):824.
87. Hajdu A, Samodova O, Carlsson T, Voinova L, Nazarenko S, Tjurikov A, et al. A point prevalence survey of hospital-acquired infections and antimicrobial use in a paediatric hospital in north-western Russia. Journal of Hospital Infection. 2007;66(4):378-84.
88. Zaman M, Ferdouse S. Hospital Acquired Infections in a Selected Tertiary Level Hospital of Rangpur City. Bangladesh Journal of Dental Research & Education. 2014;4(2):49-52.
89. Nicolle LE. Catheter associated urinary tract infections. Antimicrobial resistance and infection control. 2014;3(1):23.
90. Al-Mousa HH, Omar AA, Rosenthal VD, Salama MF, Aly NY, Noweir ME-D, et al. Device-associated infection rates, bacterial resistance, length of stay, and mortality in Kuwait:

International Nosocomial Infection Consortium findings. American journal of infection control. 2016;44(4):444-9.

91. Rosenthal VD, Maki DG, Rodrigues C, Álvarez-Moreno C, Leblebicioglu H, Sobreyra-Oropeza M, et al. Impact of International Nosocomial Infection Control Consortium (INICC) strategy on central line–associated bloodstream infection rates in the intensive care units of 15 developing countries. Infection Control & Hospital Epidemiology. 2010;31(12):1264-72.
92. Liu J, Wu Y, Cai M, Zhou C. Point-prevalence survey of healthcare-associated infections in Beijing, China: a survey and analysis in 2014. Journal of Hospital Infection. 2016;93(3):271-9.

Addis Ababa University

School of graduate studies

Department of pharmacology and clinical pharmacy

Study on the assessment of the management of hospital-acquired infectionsin selected wards of Zewditu memorial hospital.

Informed consent

Hello my name is _____ I am working as a data collector for Miss segen G/meskel from Addis Ababa University, College of Health Sciences, School of Pharmacy, Department of Pharmacology and Clinical pharmacy, Post graduate program. The purpose of this study is to assess the prevalence management of hospital-acquired infectionsin selected wards of Zewditu memorial hospital. Those infections will expose patients to prolonged hospitalization, increased morbidity and mortality. This study may provide information for better control of infections so might benefit you and the society in general through implementing standard procedure to minimize infections. Your participation in this research is entirely voluntary. It is your choice whether to participate or not, all the services you receive at this clinic will continue and nothing will change. And your information will be anonymous. I am kindly inviting you to be part of the research. The research will continue till your discharge period. Also you have a full right to withdraw at any time of the data collection period. If you have any concern you can contact any time through my address.

- Yes
- No Skip to the next person

Sign _____ Date_____

Address of PI

Segen G/meskel

Email: segengm@gmail.com

Phone: 251-914031220

Annexes

Annex 1

Data collection tool

Table 1 **Socio-demographic and clinical characteristics of the study participants**

Patient card NO_____Sex: 1. Male 2. Female Age (years)_____ Departme_____
Ward _____ Admission date_____ Discharge date_____

Reason for admission _____ Previous medical admission 1.Yes 2. No

If yes to the above question, how long was the patient admitted? _____

Outcome: Discharge_____ Death_____

Table 2. Risk factors for hospital-acquired infections. Instruction put × in the provided space

No	Variables		Yes	No	Duration
1	Peripheral intravenous line inserted				
2	Urinary catheter inserted				
3	Nasogastric Tube inserted				
4	Use of proton pump inhibitors				
5	Use of Mechanical ventilator				
7	Lumbar puncture				
8	Empiric antibiotic administration other than prophylaxis (specify)				
9	Chronic illness(Asthma,HTN,DM,IHD) specify				
10	Use of steroids				
11	Preoperative prophylaxis(specify)				
12	If yes, for how long does it continued postoperative?				
13	Surgery	Elective surgery			
		Emergency surgery(Day, Night)			
14	Preoperative hospital stay				
15	Type of procedure (specify)				
16	Duration of procedure				
17	Others				

Table 3. Type of infections due to hospital-acquired infections

No	Variables	Yes	No
1	Pneumonia		
2	Urinary tract infection		
3	Surgical site infections		
4	Diarrhea		
5	Bone and joint infection (specify)		

6	Blood stream infection(Sepsis, Meningitis)	
7	Others specify_____	

Table 4. Common hospital organisms and their antibiotic susceptibility pattern

Culture and sensitivity	Drug and susceptibility test (R=Resistant, I=Intermidate, S=Sensitive)																					
	Ampicillin	Amoxacillin	Cefroxime	Ceftriaxone	Ciprofloxacin	Clindamycin	Erythromycin	Gentamycin	Nitrofurantoi	Sulfometoxaz	Vancomycin	Agumentin	Nalidixio	Ceftazidime	Chloramphen	Norfloxacin	Tetracyclin	Doxycyclin	Oxacillin	Kanamycin	Rifampicin		

Table 5. Pattern of antibiotic usage for treating hospital-acquired infections

DX		
Medication PX(full regimen)	1. 2. 3. 4.	
Change of Medication (Full regimen)	After culture	Yes (Specify)
		No
	Other reasons(specify)	

Annex 2

Key informant interview on management of hospital-acquired infections for Physicians.

First of all, thank you for agreeing to participate on this interview. My name is Segen G/meskel. I will be talking with you today regarding the management of hospital-acquired infections. The main purpose of this interview will be to learn more about the professionals' existing experience and practice in the wards of Zewditu memorial hospital. The confidentiality regarding the following interview will be strictly maintained. At any time during our interview, please feel free to let me know if you have any questions or we can stop the interview at any time for any reason. The interview will take about 30minutes.

Back ground information

1. Can you tell me your current educational level?
2. How do you manage hospital-acquired infections? Do you follow a specific guideline? If yes, please specify?_____
   _____
   _____
3. Will you prefer using standard treatment guideline of Ethiopia as a reference? If no why not?_____
   _____
   _____
4. How did you choose medications to your patients?_____
   _____
   _____
5. What are the possible reasons for inadequacy of treatment?_____
   _____
   _____
6. Why did not you send culture and sensitivity to all patients?_____
   _____
   _____

7. What is the reason most of culture results did not show any growth?
   _____
   _____
   _____
8. Would you depend on results of culture & sensitivity testing for prescription of antimicrobials?_____
   _____
   _____
9. Why are you giving prophylaxis for most of the procedures?_____
   _____
   _____
10. Any other points you wish to communicate regarding hospital-acquired infections and its management?_____
    _____
    _____

Annex 3

Key informant interview for laboratory technicians

1. What can you say about the quality of microbiology laboratory?
   _____
   _____
2. Why is most culture & sensitivity tests end up with negative result?
   _____
   _____
3. Who will take the bacteriology test result after it is done?
   _____
   _____
4. On average, how long does it take for C&S result to come back (in day)?
   _____
   _____

Thank you very much for you time and willingness to answer these question.