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SCHOOL OF ALLIED HEALTH SCIENCE

DEPARTMENT OF MEDICAL LABORATORY SCIENCES

Health Care Associated Infection at Adama Hospital Medical College, Adama, Oromia, Ethiopia

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This is to certify that the thesis prepared by Adinew Zewdu Chernet, entitled:

Healthcare associated infection at Adama Hospital Medical College, Adama,Oromia, Ethiopia and submitted in partial fulfillment of the requirements for Master of Science degree in Clinical Laboratory Sciences (Diagnostic and Public Health Microbiology Specialty) complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

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Abbreviations

AA-CDI: Antibiotic associated *Clostridia difficile*infection

AAD: Antibiotic associated diarrhea

AST: Antibiotic suceptability test

BSI: Bloodstream infection

CAUTI: Catheter-associated urinary tract infections

CDC: Centers for Disease Control and Prevention

CL: Central line

CLABSI: Central line-associated bloodstream infections

CR-BSI: Catheter-related bloodstream infection catheter-related

CR-UTI: Catheter-related urinary tract infection

CTSN: Cardiothoracic Surgical Trials Network

ECDC:European Centre for Disease Prevention and Control

EPIC:European Prevalence of Infection in Intensive Care

HAI/HCAI: Health care-associated infections

HAP: Health care-associated pneumonia

HHS:Health and Human Services

HIV:Human Immunodeficiency Virus

ICU: Intensive care unit

LIA: Lysin Iron agar

LOS: Length of stay

MDR: Multidrug resistance

MRSA: Methicillin-resistant Staphylococcus aureus (MRSA)

NSAID: Non-steroidal anti-inflamatory

SIM: Sulfide indole motility

SSI: Surgical site infection

TSI: Triple suger iron agar

USA:United States of America

UTI: Urinary tract infection

VAD: Ventricular assisted device

VAP: Ventilator associated pneumonia

WHO: World Health Organization

XDR: Extensive drug resistance

Operational definition

Health care–associated infection:defined as a positive culture obtained from a patient at the time of hospital admission or within 48 hours of admission if the patient fulfilled any of the following criteria:

- Received intravenous chemotherapy
- Received indwelling intravenous catheter within 90 days of hospitalization
- Received wound care or specialized nursing care through a health care agency; or had self-administered intravenous medical therapy in the 30 days before the bloodstream infection.
- Received Respirator during hospitalization
- Received indwelling urinary catheter or instant use of urinary catheter
- Received hemodialysis in the 30 days, before the bloodstream infection.
- Resided in long-term care facility, or hospital.

Nosocomial infection: definedas a positive culture obtained from patients who have been hospitalized for 48 hours or longer

Community-acquired infection: definedasa positive culture obtained at the time of hospital admission or within the 48 hours after hospital admission for patients who did not fit the criteria for a health care– associated infection

Clinical evaluation: is an evaluation of whether a Patient has symptoms of a disease, is responding to treatment, orhaving adverse reactions to therapy.

Colitis: inflammation of the colon

Endoscopy: a procedure in which a thin, lighted instrument inserted into the interior of a hollow organ, such as the rectum and used to visually inspects the inner intestinal lining.

Toxic mega colon: acute enlargement or dilation of the large intestine

Surgical site infection: infection Occurs within 30 days after an operative procedure

Antibiotic-associated diarrhea: diarrhia occur usually four to ten days after anyone who takes an antibiotic.

Urinary Catheter associated infection: infection of urinary tract after the Patient had an indwelling urinary catheter that had been in place for > 2 days on the date of event

Ventilator-associated pneumonia (VAP): defined as pneumonia that occurs 48–72 hours or thereafter following endotracheal intubation or ventilator use.

Non-surgicalskin breaks infection: infection occurs after a skin break occur due to pressure sore, diabetic ulce, abscess ete during hospital admission

Central Line Associated Blood Stream Infection (CLABSI): is a laboratory-confirmed bloodstream infection in a patient where the central line was in place for > 2 calendar days (48 hours).

Multidrug resistance bacteria: organism non-susceptible to one or morthan one antibiotic agent in three or morthan three antimicrobial categories

Extensive drug resistance bacteria: the bacteria is non-susceptible to one or more than one agent in all category but not two or less than two antibiotic category.

Suscepsion of extensive drug resistance: A bacterium which full fill beyond thecriteria of MDR but not surely XDR due to lack of all necessary antibiotic

Emergency: a patient is obliged to admit for survival, due to dangerouse situation that need immidate assistance.

Elective: a patient chosen to admitted but not essential for survival

Abstract

Background:Infections acquired during health care delivery, are more appropriately called health care-associated infections. The spectrum of health care associated infections ranges from simple common colds to life threatening sepsis with MDR or XDR organism.

Objective: The objective of this research was todetermine the incidence rate of healthcare associated infection and associated factors at Adama hospital Medical College.

Methods: It was a prospective cohort study techniques and the data collected and analyzed using Epinfo7 and SPSS 20. The patients' clinical conditions were collectedusing structured interview, observation, clinical evaluation and laboratory methods. The collected clinical sampleswereprocessed and cultured on standard microbiological media and the organismidentified using different biochemical tests. For all isolated organism a disk diffusion antibiotic susceptibility test done based on the CLSI guideline (2015). The studywasconducted from February to May 2017 G.C. at Adama hospital medical college, Adama, Ethiopia.

Results: The pooled incident rates of health care associated infection at Adama hospital were 9.7 case /1000 persons-days with a 95% CI (7.1, 12.9). Moreover, the Incident rate of surgical site infection, cather associated urinary tract infection, catheter associated blood stream infection, ventilator associated pneumonia, non surgical skin break infection, and antibiotic associated diarrhea were 10.4, 60.2,1.4, 14.1,73.5 and 0.6case per 1000 persons-days, respectively. About 90.2% of the infection wasdue to gram-negative bacteria, among these bacteria, E.*coli*,Citrobacter *fruindi,*Proteus *mirabilis*, Klebsella *pneumonia*and Pseudomonas *aeroginosa* were the most frequent isolate organism.The antibiotic profile of these organisms were varies as the site of infection varies. Citrobacter *fruindii*and E.*coli*were the most drug resistance bacteria.Based on their resistance characteristic 53.9%of E.*coli*, and 50% of C.*fruindii*were multidrug resistance (MDR)andP.*mirabilis*was the most susceptible organism for antibiotics.Generally, patients with HCAI, the average length of stays and health service cost increased by 2.1 and 2.8 time than non-infected patients, respectively.

Conclusion: The major risk factor for HCAI in Adama hospital were, surgery, non-surgical skin break, using of urinary catheter, and ventilator. Patients pains due to HCAI inflated by the presence of renal disease, diabetics, and major surgery.

Keyword: HCAI, SSI, CAUTI, CABSI, VAP, NSSBI, MDR

1. Introduction

1.1. Background

Infections acquired during health care delivery, more appropriately called health care-associated infections (HCAIs)(1)(2)(3)(4).Health care associated infections were formerly called hospital or nosocomial infections(5). Nosocomial infections can defined as those occurring within 48 hours of hospital admission, 3 days of discharge or 30 days of an operation. They affect 1 in 10 patients admitted to hospital. HCAIs may be caused by bacteria, fungi or viruses(1). The spectrum of health care associated infections ranges from simple common colds to life threatening sepsis with multidrug resistant organisms(5).HCAI is acquired most often but not necessarily in a hospital for another condition(1).

There are different type health care associated infection, some of the selected HCAIs, are catheter-associated urinary tract infection, *Clostridium difficile* infection (CDI), central line–associated bloodstream infection(CLABSI), ventilator- associated pneumonia/events(VAP), post procedure pneumonia, methicillin-resistant *Staphylococcus aureus,* and surgical site infections (SSIs)(6).Health care associated infections are determined by a number of risk factors such asAge, immunization history, prior illnesses, level of nutrition, pregnancy, coexisting illness, and perhaps emotional state all have some impact on the risk of infection after exposure to a potential pathogen organism(7).The risk of infection also related to the degree of debilitation of the patient and various factors concerning the design and management of the device(8). The other is Lifestyle factors such as poor quality food, lack of exercise, and tobacco and alcohol abuse also play a role(5).

Health care associated infections acquired in different way,oneof this way is acquiring organisms from their own normal flora on skin and mucous membranes called self-infection.The other is through medical devices, mostly used in modern medicine to support or monitor basic body functions of the patient like catheters and respirators that may carry a risk of nosocomial infection(5)(8),many specific host factors also influence the likelihood of acquiring an infectious disease(7). In addition,Health care workers, they play a key role in transmitting organisms from one patient to another(8) as a result of failure to perform hand hygiene whichis the single most important factor in transmission of health care associated infections(5).

1.2. Statement of the problem

HCAI possibly Couse 100,000 deaths and $20 billion in health care costs each year(1).The Infections also lead to more serious illness, prolong hospital stays, induce long-term disabilities, add high costs to patients and their families, contribute to a massive, additional financial burden on the health-care system and, critically, often result in tragic loss of life(4)(9)(10).For instance, Central line associated blood stream infection occurs up to 80,000 times per year resulting in 28,000 deaths among patients in the Intensive Care unit (ICU)(11). Catheter-associated urinary tract infection (UTI) is also a common device-associated infection in hospitals(12).

Despite decades of dramatic progress in their treatment and prevention, infectious diseases remain a major cause of death and disability and they are responsible for worsening the living conditions of many millions of people around the world(7). There is clear evidence that hundreds of millions of patients are affected every year worldwide(4)(9), the burden of disease much higher in low- and middle-income countries(4). About 5%–10% of patients admitted to acute care hospitals in developed countries acquire health care-associated infections at any given time but the risk of acquiring infection is 2–20 times higher in developing countries(3).

In the USA, approximately 99 000 deaths were attributed to HCAI in 2002 and the annual economic impact was estimated at approximately US$ 6.5 billion in 2004(4).In Europe also, HCAIs cause 16 million extra-days of hospital stay, 37 000 attributable deaths, and contribute to an additional 110 000 every year. Annual financial losses are estimated at approximately € 7 billion, including direct costs only which shows there is a growing challenge to quality care service in the region(4)(13).The Eastern Mediterranean Region accounts the highest frequencies (11.8%) of health care-associated infections in the world(3).

In low- and middle-income countries, pooled cumulative incidence densities of CR-BSI were 12.2 per 1000 CL per days, CR-UTI were 8.8 per 1000 urinary catheter per days, and VAP were 23.9 per 1000 ventilator per days(4). Approximately one in seven patients entering South African hospitals are at risk of acquiring an HCAI. Lower respiratory tract infections, urinary tract infections, bloodstream infections and post-surgical infections account for the majority of HCAIs(14). HCAIs represent a major threat to patient safety and quality healthcare in developing

countries(15). In addition Information is very scanty from low- and middle-income countries and no data are available at national or regional levels(4).

So, both antibiotic resistance and HCAI are serious international threats to the health and wellbeing of mankind(16). Likewise, Patients with resistant healthcare-associated infections had a significantly higher death rate than community acquired infection(17).The Emergence of drug resistant strains especially methicillin resistant *Staphylococcus aureus* is a serious problem in hospital environments(18). So ,The problem of healthcare-associated infections (HCAI) has a high profile in both public health and political terms, with much attention being focused particularly on attempts to reduce the occurrence of infections due to methicillin-resistant *Staphylococcus aureus* and *Clostridium difficile*(19).

The transmission of these infections in the hospital settings through healthcare workers can be avoided by the use of infection control practices(20) and they should alsoreduce the risk of transmitting germs from client to client(21). In addition,training of HCWs about the importance and proper practice of hand hygiene along with improving hand sanitizer options may also improve patient safety(22).Therefore, HCAI must treated as a priority patient safety issue within comprehensive approaches to be tackled effectively.

Generally,Infection were alsoobserved in Adama hospital after an operation or health care delivery, most of the bacteria isolated were resistance for new generation cephalosporin, aminoglycoside and majority of the antibiotic that available in the hospital pharmacy(From Adama Regional Laboratory archieved data). So study in this area at Adama hospital medical collegewillhelps to know the magnitude of the disease and drug resistance organism that are commonly emerging in the health care facility. Besides,it contributes as a source of data for the development of health care policy and guideline for the overcoming of health care related challenge in Ethiopia. The other reasonis majority of study were a cross sectional which does not tell us the possible source of infection and the incident rate, rather it indicate the prevalence of the infection. Therefore, such kind of study in Ethiopia will help to determine the incident rate and the possible source of the infection in the hospital, up on that what kind of measure or on which area of the health care systemwe should take an appropriate action for the prevention.

1.3. Significanc of the study

Healthcare-associated infections (HCAIs) cause significant morbidity and mortality so that it becomes a serious problem in the health care facilitythroughout the world due to the emerging of antibioticresistance organism and the increasing of financial cost for treatment and staying of admission in the hospital.So, study in this area in Ethiopiawill helps to know the magnitude of the disease , the type of antibiotic resistance organism that cause infection and the possible source of health care related infection.Up on that itprovidesinformation for Adama hospital medical college,to takeappropriate measure to prevent the infection, andthe type antibiotic that used to treat the commonly existing bacteriain the hospital.Generally, recognition of the burden, cost, and preventability of HCAIs has resulted in new initiatives to encourage adherence to recommended infection prevention practices and new research to understand the pathogenesis of HCAIs and develop novel approaches to prevention.Besides, it contributes as a source of data for the development of health care policy and guideline for the overcoming of health care related challenge as a country.

2. Literature review

Health care-associated infections (HAIs) are a significant public health problem around the world. According to published national or multicenter studies of systematic reviews of the literature on endemic HCAI from 1995 to 2010 in high- and low/ middle-income countries were done. A pooled HCAI prevalence in mixed patient populations was 7.6% in high-income countries(4).

In 2002, in U.S. hospitals, adjusted to include federal facilities, the estimated number of HCAIs was approximately 1.7 million: 33,269 HCAIs among newborns in high-risk nurseries, 19,059 among newborns in well-baby nurseries, 417,946 among adults and children in ICUs, and 1,266,851 among adults and children outside of ICUs. The estimated deaths associated with HCAIs in U.S. hospitals were 98,987 of these, 35,967 were for pneumonia, 30,665 for bloodstream infections, 13,088 for urinary tract infections, 8,205 for surgical site infections, and 11,062 for infections of other sites(23).

The second study also conducted in USA Between February 2010 and October 2010, a prospective, multicenter, observational study was conducted by the National Heart, Lung, and Blood Institute to assess the occurrence of HCAIs after cardiac surgery. Among 4,320 cardiac surgery patients, 119 (2.8%) experienced a major HCAI during the index hospitalization. The most common HCAIs were pneumonia (48%), sepsis (20%), and Clostridium *difficile* colitis (18%). The incremental LOS was 14 days. Overall, there were 849 readmissions; among these, 8.7% were attributed to major HCAIs. The cost of readmissions due to major HCAIs was, on average, nearly threefold that of readmissions not related to HAIs(10).

Another study in a community hospital in the USA between 1 October 2008 and 30 April 2010, a total of 2228 patients had indwelling urinary catheters placed, of these, 33 developed a CAUTI. One of the 33 patients had two CAUTIs, while the other 32 patients each had one CAUTI (24).

The European Centre for Disease Prevention and Control (ECDC) estimated that 4 131 000 patients are affected by approximately 4 544 100 episodes of HCAI every year in Europe(4). Data were obtained from the 2006 national database in France; they included information on 358 353 patients from 2337 healthcare facilities. The participating facilities including regional hospitals, general hospitals, university hospitals, local hospitals and medicine-surgery and

obstetrics clinics. Among 336 858 patients, the overall prevalence of patients with at least one HAI was 4.0%. The average number of patients per facility was 147 (min 5, max 2278). At a regional level, the HAI prevalence ranged from 2.1% (Corse) to 4.8% (Haute-Normandie), whereas at a facility level, the HAI prevalence ranged from 0 to 60% (3 HAI among 5 hospitalized patients) with a median of 4.1% (first and third quartiles: 1.4 and 6.8%, respectively)(25).

Prospective, quasi-experimental study was condacted covering all acute care units (27 general wards, 4 ICUs, overall 819 beds) at the Jena University Hospital in Germany. During the first surveillance period, 30.631 patients were admitted to the participating departments. According to CDC, definitions,from 1,637 HAIs, were resulting in an overall incidence of 5.3 %. Based on clinical evaluation, irrespective of the CDC definitions, an additional 944 HAIs were detected (overall HAI rate, 8.4 % [n =2581]). A substantial proportion of patients had HAI associated severe sepsis or septic shock (lower respiratory tract infection, n = 279 [37 %]; surgical site infection, n = 114 [25 %]; primary sepsis, n = 110 [32 %]; urinary tract infection, n = 46 [8 %]; other, n = 87 [22 %]) (26).

The other study in Asia, retrospective cohort study of patients with E. coli bacteremia who visited Samsung Medical Center at Seoul 135-710, Republic of Korea from February 2002 to December 2005 aimed to identify the risk factors for mortality and association between healthcare-associated (HCA) infection and mortality. A total of 508 patients with E. *coli* bacteremia were enrolled (mean age, 61.8+14.3 years; male/female, 191:317). The HCAI E. *coli* bacteremia had significantly higher severity of illness and higher antimicrobial resistance rate than CA bacteremia. The overall 30-day mortality rate was 13.6% (69/508) and the mortality of HCA infections was significantly higher than that of CA infections (26.4% versus 9.6%, $P < 0.001$). In multivariate analysis, high Charlson's co-morbidity index (OR 4.84, 95% CI 2.14–10.95, $P < 0.001$), high Pitt bacteremia score (OR 32.03, 95% CI 13.08–74.43, $P < 0.001$), presentation with acute renal failure (OR 4.11, 95% CI 1.90–8.89, $P < 0.001$) and HCA bacteremia (OR 2.34, 95% CI 1.09–5.01, P5 0.030) were found to be the significant risk factors for 30-day mortality in E. coli bacteremia(27).

A systematic literature review and meta-analysis of the burden of healthcare-associated infections (HAIs) in Southeast Asia was performed on 41 different studies, of which initially 14

089 records were identified. The pooled prevalence of overall HCAIs was 9.0% (95% confidence interval [CI], 7.2%–10.8%), whereas the pooled incidence density of HCAI was 20 cases per 1000 intensive care unit per days. The pooled incidence density of ventilator-associated pneumonia, central line–associated bloodstream infection, and catheter-associated urinary tract infection were 14.7 per 1000 ventilator-days, 4.7 per 1000 catheter-days, and 8.9 per 1000 catheter-days, respectively. The pooled incidence of surgical site infection was 7.8%. The attributed mortality and excess length of stay in hospitals of infected patients ranged from 7% to 46% and 5 to 21 days, respectively(28).

Many studies conducted in health-care settings with limited resources, From 29 June – 2 July 2011, a biomedical databases of a published studies from 1995 to 2009 in African countries, a Hospital-wide HAI prevalence was varied between 2.5 and 14.8 per 100 patients; in surgical wards, the cumulative incidence ranged from 5.7 to 45.8 per 100 patients. Among specific types of infection, the largest number of studies focused on surgical site infection with a cumulative incidence ranging from 2.5 to 30.9 per 100 operated patients(29). Surgical site infection (SSI) is the most surveyed and most frequent type of infection in low- and middle- income countries with incidence rates ranging from 1.2 to 23.6 per 100 surgical procedures and a pooled incidence of 11.8%. By contrast, SSI rates vary between 1.2% and 5.2% in developed countries(4).

In Ethiopia health care associated infection studies are rare, however, there are several cross sectional nosocomial infection studies conducted. One of the studies From November 2005 to April 2006 a prospective cross sectional study was conducted at Mekelle Hospital, Tigray region, North Ethiopia. The study population comprised of a total of 246 informed and consented adult patients hospitalized for surgical (n = 212) and Gynecology and Obstetrics cases (n = 34). Of the 246 admitted patients, 68 (27.6%) developed nosocomial infections (SSI and/or nosocomial UTI) based on the clinical evaluations, and positive wound and urine culture results. Gram negative bacteria were predominantly isolated with a rate of 18/34 (53%) and 34/41 (83%) from SSI and UTI respectively. Most of the isolates from UTI have high rates of resistance (> 80%) to the commonly used antibiotics(30).

A second cross sectional study was conducted on patients under gone operation from October 2010 to January 2011 and followed for development of clinical signs and symptoms of surgical site and blood stream infection until the time of discharge among patients admitted at Felege

Hiwot Referral Hospital, Bahirdar, Ethiopia. Out of 294 patients who had clean and clean-contaminated operation, 10.9% were confirmed of bacterial nosocomial infections. The rate of nosocomial infections among clean and clean- contaminated operations was 3.3% and 12.8% respectively. Nosocomial surgical site and blood stream infection rate was 10.2% and 2.4% correspondingly. A total of 42 bacterial pathogens were identified of which S. aureus was the leading isolates accounting 26.2% followed by E. coli and Coagulase negative Staphylococcus species each 21.4%. Nearly 100% of Gram positive and 95.5% of Gram negative bacterial isolates showed resistance against two or more antimicrobial drugs(31).

Another a repeated cross-sectional study was conducted in two teaching hospitals. All eligible inpatients admitted for at least 48 hours on the day of the survey were included. The survey was conducted in March to April and July 2015. A total of 908 patients were included in this survey, the median age of the patients was 27 years (interquartile range: 16–40 years). A total of 650 (71.6%) patients received antimicrobials during the survey. There were 135 patients with HAI, with a mean prevalence of 14.9% (95% confidence interval 12.7–17.1). Culture results showed that Klebsiella spp. (22.44%) and Staphylococcus aureus (20.4%) were the most commonly isolated HAI-causing pathogens in these hospitals(32). As we understand from different study at different country there is high rate of infection and it is also varies from hospital to hospital. Even though study in our country is rare, it is expected to be higher in Ethiopia even based on different studies result finding in Affrican countries. So such kind of studies at different hospital to determine the type of infection and the burden of infection is needed for as source of data to take the appropriate action.

3. Objective

3.1. General objective

- To determine the incidence rate of healthcare associated infection and associated factors at Adama hospital Medical College.

3.2. Specific objective

- To determine the magnitude of infection due to hospitalization
- To determine thevarious associated risk factorsof infection among differentstudy group
- To determine the commonly isolated bacteria that couse health care associated infection
- To determine the antibiotic profile of the commonly isolated bacteria

3.3. Hypothesis

“The burden of HCAI is not different among patients who receive healthcare devices and patients not receiving healthcare devices”

4. Material and Method

4.1. Study area

Adama town is98 kmfar from Addis Ababa to the East on the main road to Harar. The City forms a Special Zone of Oromia and surrounded by Misraq Shewa Zone. It is located at 8.54°N 39.27°E at an altitude of 1712 meters. The city sits between the base of an incline to the west, and the Great Rift Valley to the east. Its annual average temperature and rainfall is 20.5^{o}C and 809mm respectively.Its population size is 228,623 based on figures from the Central Statistical Agency in 2005 and the population is amulti-ethnic group and mixed cultures.In Adamatown, nine government, and eighteenprivate health facilities are available. From government health Facility, one Teaching referral Hospital and eight areHealth center. There is also one regional Laboratory where different referred sample are tested with in the region.

So, this research washeld at Adama regional laboratory and Adama Hospital Medical College, the hospital has a total of 184 beds and its admission rate was 173 patients per weeks and itsaverage outpatient flow was 856, its annual outpatient flow is 226000. Bothare founded at the same vicinity at Kebele 12 Ketena 1. The regional laboratory and the Hospital work many task together cooperatively for better life of the customer who need advanced laboratory service from the regional laboratory like Bacteriological culture and AST and some HIV molecular test that are not tested in the Hospital.

4.2. Study design and period

A prospective observational comparative cohort study at Emergency, surgical, obstetrics, gynecology, medical and ICU ward in which patients admitted with HAI due to bacterial infection.

This study was conducted from February to April 2017 G.C. the first week the pretest was checked and the main study were begin on February

4.3. Study population and subject

4.3.1. Source Population

All patient who admitted at Adam hospital medical collage

4.3.2. Study subject

Patients older than 17 years of age with a minimum inpatient stay of 48 hours and admitted in selected clinical specialties and patients who visited the emergency departmentwerethe study population.

4.4. Inclusion and exclusion criteria

4.4.1. Inclusion Criteria

- Patients admitted to hospital and stay at least for 48 hours
- Received intravenous therapy at the hospital
- Received wound care or specialized nursing care through a health care agency at the hospital
- Administered intravenous medical therapy in the 30 days before the bloodstream infection
- Attended a hospital or hemodialysis clinic or received intravenous chemotherapy in the 30 days before the bloodstream infection.
- Received urinary catheter during hospital admission and
- Received Respirator ventilator during hospital stay
- Patients having full or partial data(medical record) related to infection, risk factors, mortality, excess length of stay, costs, HCAI etiology in general, and health care-associated UTI, BSI, SSI, and HAP/VAP.

4.4.2. Exclusion Criteria

- PatientsLength of Hospital stays less than 48hrs.
- Patient admitted due to bacterial infection
- Patient age less than 18 years

4.5. Study variables

4.5.1. Dependent variable (Composite variable)

- Infection due to healthcare
  - health care-associated urinary tract infection (UTI),
  - surgical site infection (SSI),
  - hospital-acquired pneumonia (HAP),
  - ventilator-associated infection (VAP), and
  - Healthcare-associated blood-stream infection(BSI).

4.5.2. Independent variable (Confounding variable)

- Patient demographics
  - Age
  - Sex

- Medical risk factors
    - Major Trauma
    - COAD
    - Stroke/paraplegia
    - Diabetes
    - Malnourished
    - Obesity
    - Cancer
    - Smoking
    - Leukocytopenia/Leukocytosis
- Surgical risk factors & other invasive procedures
    - ERCP
    - Percutaneous drainage procedure
    - Other endoscopy(exclude surgery but include gastromy insertion)
    - Other invasive procedure
- Non-surgical break in skin
    - Vascular ulcer
    - Pressure sore
    - Vascular and pressure
    - Diabetic ulcer
    - Other
- Device-related risk factors
    - Urinary catheter
    - Intravascular line
    - Respirator
    - Prostatic device
- Antibiotic and non-antibiotic therapy during admission
    - Steroid
    - Blood
    - Chemotherapy
    - Cytotoxic

- Length of hospital stay

4.6. Measurement and Data collection

4.6.1. Sampling size determination

The sampling size of the study depend on the rate of the patient admission in the hospital, it is 173 patient per weeks. So, about 2076 patients (from HMIS office at Adama Hospital)were asource population, instead all the patient, greater than 17 years of old admitted in the hospital and the patient who fulfill the inclusion and the exclusion criteria,approximately 300 study subject patients were enrolled in the study and they were followed for maximum of three months during hospitalization.

4.6.2. Sampling method

We were using convenient non-probable sampling techniques during our study.

4.6.3. Data collectionprocedure

4.6.3.1. Structured interviews

We wereInterview participants to obtainpatient's demographic data and recent admission information using structured question.See more on annex- III andquestion number 5.1 and 5.2

Follow-up continued for a maximum of 3 months after enrollment. If a patient transferred from another hospital, the duration of inpatient stay calculated from the date of the first hospital admission.

4.6.3.2. Structured Observation

The observation period confined to admission ward and the patients observed over many different times and across several days. During data collection, some medical vital sign were collected using some medical equipment like thermometer, statoscope, Bp apparatus and so on to know the patient's medical condition. Well-trained and oriented medical care practitioner collected all the data.

The patient's admission information, type of health care service provided and Health profession who provide the service recorded on the information on the questioner. See more on Annex III and question number 6.1, 6.2, 6.3 and 6.4

4.6.3.3. Medical records

Mortality data retrieved from medical records. The medical records were the gold standard for assessing mortality. Moreover, Information about patient reason of admission comorbid medical conditions hematological profile during admission, patient therapy information and prescribed antibiotic during infection and patient discharge or expired information were obtained through medical record review. See more on annex III and question number 7.1, 7.2, 7.3, 7.4, 10.1 and 10.2.

4.6.3.4. Clinical evaluation

Using case definition, the alleged patient acquiring infection were confirmed using laboratory test and if the laboratory test result is negative and clinically suspected the patient is put under clinically confirmed and the patient sample were stored for future study, for example antibiotic associated diarrhea are possibly caused by C.difficuli, so the stool sample is kept in the refrigerator for laboratory confirmation for future study.Currently laboratory diagnosis for C. difficuli in our study laboratory is not available.

Some infection my need advanced laboratory test, like mycology culture test, mycoplasma, and some other microorganism that may not grow on routine culture media so,in this case the patient is categorized based on clinical evaluation.Factors predisposing to infection, such as chemotherapy, immunosuppressive therapy, and radiation therapy, is considered to be present if they will be administered within 30 days of the infection.

The development of surgical site infection, pneumonia, septicemia, and urinary tract infection suspected case identified by clinical evaluation and some of the important health care associated infection case definition are listed in the annex VI

- Criteria for clinical evaluation of Surgical site infection (SSI) are more explained in annex-VI, section 1

  Note: In addition, there may also be microbiological evidence of wound infection from cultures obtained aseptically from wound fluid or tissue. However, since skin sites are normally colonized by a variety of organisms, positive wound cultures in the absence of clinical signs are rarely indicative of SSI

  Note: Wound sample collection, transport and storage are detailed explained in annex-IV

- Criteria for clinical evaluation of Ventilator associated pneumonia are more explained in annex-VI, section 2

- Criteria for clinical evaluation of catheter associated urinary tract infection are more explained in annex-VI, section 3
- Criteria for clinical evaluation of Central line associated blood stream infection are more explained in annex-VI, section 4
- Criteria for clinical evaluation of Antibiotic associated diarrhea are more explained in annex-VI, section 5
- Criteria for clinical evaluation of malnourished patient are explained some below, detail explanation see on annex VI, section 6

  Inpatients are at risk for malnutrition if they meet one or more of the following criteria:

  1. unintentional loss of ~10% of usual body weight in the preceding 3 months,
  2. body weight <90% of ideal for height, or With regard to varying levels of severity,
     - body weight <90% of ideal for height represents risk of malnutrition,
     - body weight <85% of ideal constitutes malnutrition,
     - <70% of ideal represents severe malnutrition, and
     - <60% of ideal is usually incompatible with survival
  3. Body mass index [BMI; the weight (kg) divided by the height (m^2)] <18.5.
- Criteria for clinical evaluation of Obesityare listedbelow, for further information see annex VI, section 7 & 8.

  The most widely used method to gauge obesity is the body mass index (BMI), which is equal to weight/height^2 (in kg/m^2).

  √ BMI for both men and women range from 19 to 26 kg/m^2 which is normal(midpoint)
  √ BMIs are ≥ 25, suggesting that the cut-off for obesity.
  √ BMI between 25 and 30 should be viewed as medically significant and worthy of therapeutic intervention.
  √ BMI of 30 is most commonly used as a threshold for obesity in both men and women.

4.6.3.5. Patient laboratory test

Patient sample like blood, sputum, stool, wound swab, urine, and any other sample which is associated with the health care associated infectionwere prepared and processed depending on the type of sample, and gram stain characteristics on appropriate culture media like Blood culture, blood agar, chocolate agar, MacConky agar, to support growth of the desired organism.

If the bacteria grow, we perform identification using enzymatic test like catalase test, oxidase test, indole test, pyr test and some reagent like bile solubility test, string test and some antibiotic disk like optchindisk, bacitracin disk and novobiocine test, if the growth of the bacteria

is gram negative and carbohydrate fermenter we us biochemical test like TSI, LIA, SIM, urea and Citrate.

After the isolate organism is determine, we perform antibiotic susceptibility test using Muller Hinton agar and antibiotic disk. These antibiotic disks were used based on the type of the organism isolated and the type of specimen processed. Then the isolated organism and its antibiotic susceptibility test result recorded on patient request form and captured the result on the appropriate data-capturing format on hard copy and soft copy using Epinfo 7.

Besides some other routine laboratory tests like hematological profiles and other clinically defined disease is considered during sample processing and diagnosis.

All the isolates werecategorized as true positive, or contaminated. The determination was made after review of the patient's clinical history and physical findings,

Sample collection, transportation, storage, possessing procedure and AST condition see on more on annex-IV.

4.7. Data Quality Assurance

For sample processing and identification, quality control passed culture media, reagent, and antibiotic discwere used plusall the sample that are processed in the laboratory based on updated microbiology guideline and SOP. In addition, the laboratory personnelshould also be experienced and certified in microbiology techniques as well as the laboratory should participating in the external quality control program. The laboratory should also have ATTC organism and EQA isolate organism. All this ensure that the laboratories were providing quality service.

The other, pretest of the study checked to ensure the applicability of the study and compatibility of the variable during data collection to avoid measurement error during the main study, the patient's medical condition was visiting every morning until discharge to determine the health condition of the patients and the data completeness.

4.8. Data analysis method interpretation

Statistical analysis done by using EPINFO7, Exile, and SPSS 20software. Distributions of baseline characteristics were analyzed by using graphical tools and different statistical analysis method based on the data type and the study design, mostly, like table, graphs , cross

tabulation(chisquere), and so on and interpreted based on the P value <0.05. Allthese analysis methods were help to determine the risk of infection due to health care service and the incident rate of infection in the hospital.

4.9. Ethical considerations

The study was approved by "Department Research and Ethical Review Committee (DRERC)" of the Department of Medical Laboratory Science, School of Allied Health Sciences, College of Health Sciences, Addis Ababa University. Permission letter obtained from the study site.

The purpose and procedures of the study explained to the study participants, participants' parents or guardians within the study period. Those participants who gave informed consent selected and enrolled as the participants of the study. Patient results communicated to the attending physicians.

4.10. Disseminationof Result

The study result will be presented to Department of Medical Laboratory Sciences, School of Allied Health Science, College of Health Science, AAU as MSc thesis.In addition, the result also submitted to Oromiya regional health office, Adama Hospital medical college, and presented to any concerned body that is interested to know the magnitude of health care associated infection with in the hospital. Based on the finding, the necessary action will take with the concerned body.

5. Results

5.1. Demographic Characteristics and clinical condition

The average age of thestudy subjects who meet our inclusion and exclusion criteria were 37 years old. The minimum and the maximum age were 18 and 85 years old respectively, the average years of variation among this patient were 17 years.

As seen on the **Table 1**, the highest frequency of admissionobserved at obstetric ward 78 (26%) next medical ward (18.33) and then surgical ward (17.6%) and the least rate of admission observed at ICU (6.33%). The gender distribution was 38.3% male and 61.7% female. The highest frequency of the patient admitted were 30 years old and the highest frequency of patients lays between 25 to 34 years, which cover 36% of the study subject. About 98.64% of the Patients admitted in the hospital were from oromya region, only 1% and 0.33% of the patient from Amara and Afar region, respectively. From these greater than 48 hours admitted patient, 56.67% of the patient were due to emergency and 43.33% due to elective. That all patient's clinical reason of admission is varies such as appidecities, delivery, peptic ulcer, varicose vien, cholilitis, diabetics and so on.

Table 1 Demographic data of the study participants at Adama Hospital Medical collage, Adama Ethipia,2017 G.C (n=300)

	Variables	Number of admitted patient >48 hrs.	In percent
Patient address	Oromia	296	98.64%
	Amhara	3	1%
	Afar	1	0.33%
Sex	Male	115	38.3%
	Female	185	61.67%
Age Category	15-24	70	23.33%
	25-34	108	36.00%
	35-44	33	11.00%
	45-54	32	10.67%
	55-64	19	6.33%
	65-74	25	8.33%
	75-85	13	4.33%
Type of admission	Emergency	170	56.67%
	Elective	130	43.33%
Type of admitted ward	Emergency	20	6.67%
	Gynecology	28	9.33%
	ICU	19	6.33%
	Medical	55	18.33%
	Obstetric	78	26.00%
	Orthopedic	47	15.67%
	Surgical	53	17.67%

See on **Table 2**, about 39.67% of the patient under gone minor surgery, 31.67% of patient major surgery, and 28.67% medical care. 42.33% of the patient admitted had a medical risk factor from those, the highest patients admitted with medical risk factors were at medical ward, 42.51% and the least were at obstetric ward, 6.3%. 86% of the admitted patient took any type of tyerapy; from those admitted patient 82% of the patient had had antibiotic and 30.33% NSAID during admission or before any procedure.The highest antibiotic administrations observed at obstetric ward (26%) and medical ward (18.33%) and the least were ICU, 1.63%.(**Table 2**)

Table 2, medical condition of the patient admitted at Adama hospital medical college, Adama Ethiopia, 2017 G.C. (n=300)

Type of health service	Variables	Frequency	Percentage
Medical service provided	Major surgery	99	33%
	Medical care	81	27%
	Minor surgery	120	40%
Therapy	No	42	14%
	Yes	258	86%
Type of therapy	NSAID	91	30.33%
	Antibiotics	246	82%
Antibiotic used among admission ward	Emergency	12	4.88%
	Gynecology	22	8.94%
	ICU	4	1.63%
	Medical	40	16.26%
	Obstetric	77	31.3%
	Orthopedic	43	17.48%
	Surgical	48	19.51%
Medical risk	No	173	57.67%
	Yes	127	42.33%
Medical risk factor among wards	Emergency	12	9.45%
	Gynecology	5	3.94%
	ICU	15	11.81%
	Medical	54	42.51%
	Obstetric	8	6.3%
	Orthopedic	11	8.7%
	Surgical	22	17.32%

The type of antibiotic orderd was varies as the clinical condition of the patient. The highet type of antibiotic ordered were ceftriaxone IV/IM and ampicillin IV, 30% and 21.33% respectively and the least were cloxacillin alone or combination of deoxacillin and metrendazol or other drug,. Eighteen percent of the patients were free from any type of antibiotic during admission. (**Figure 1**)

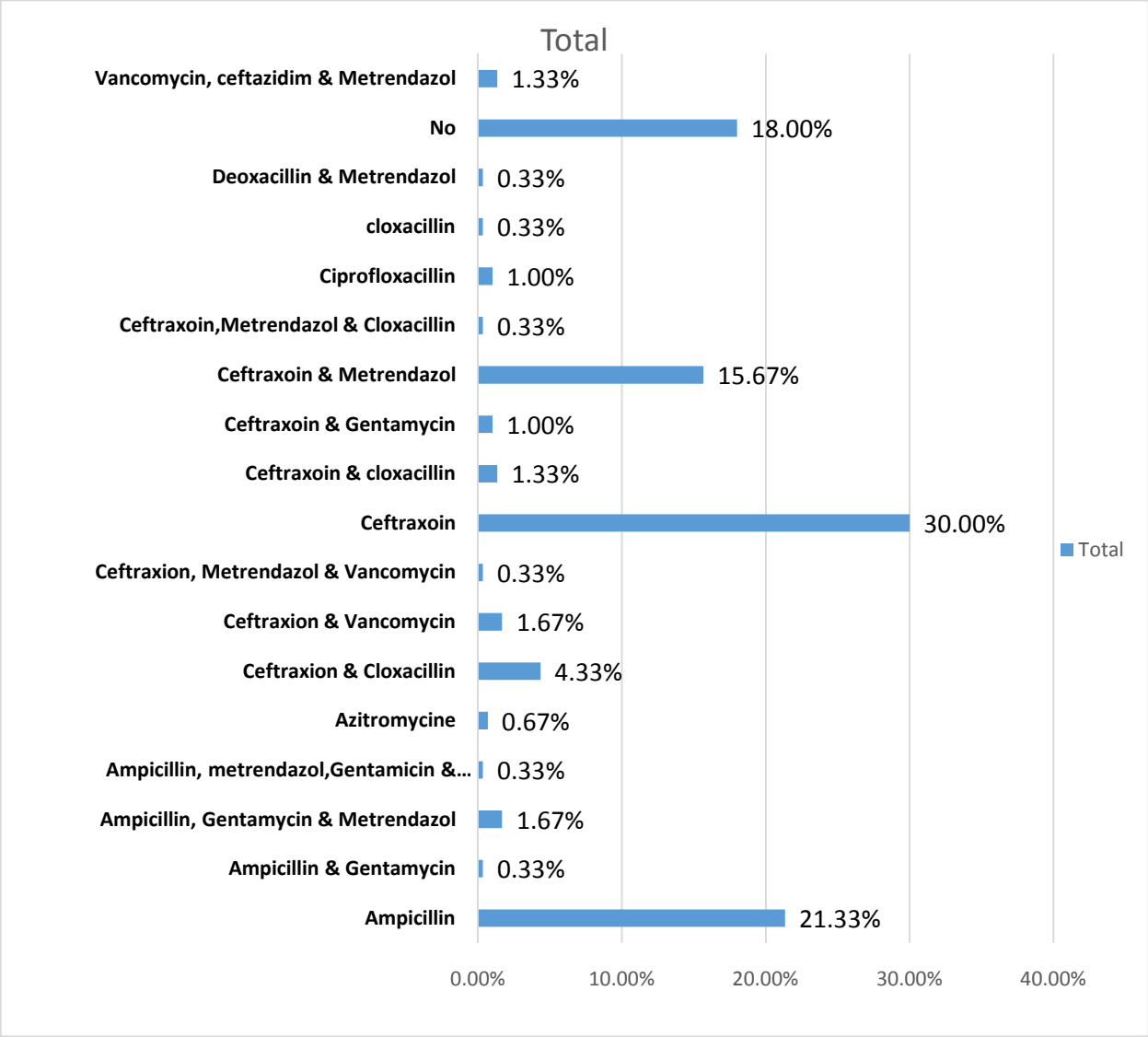

Figure 1, Type of antibiotic used during admission at adama hospital medical collage, Adama Ethiopia 2017 G.C. (n=300)

From these who admitted greater than 48hrs in the hospital ward, the highest frequency of healthcare device used was intravenous cannula 81%, following urinary catheter, 44.67% and the least device used were central cannula, and mask ventilator. As a general, most the patients were using different kind of healthcare device during admission. (**Figure 2**)

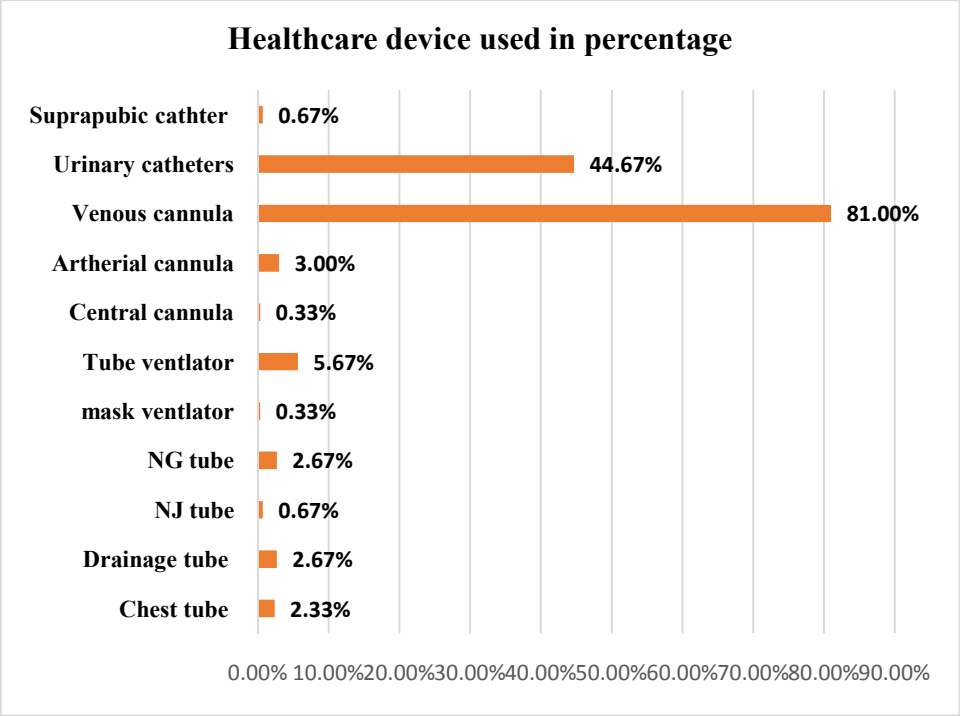

Figure 2, Type and frequency of device used at Adama medical college, Adama, Ethiopia2017 G.C (n=300)

The highest and the least length of deviece used were intravenous cannula, it was 408 and 4 hours, respectively and the average length of hour of this intavenous cannula used was 78.64 hrs. However, the highest average hours of device used observed in chest tube, it was 144 hrs and the least were urinary catheter. (**Figure 3**)

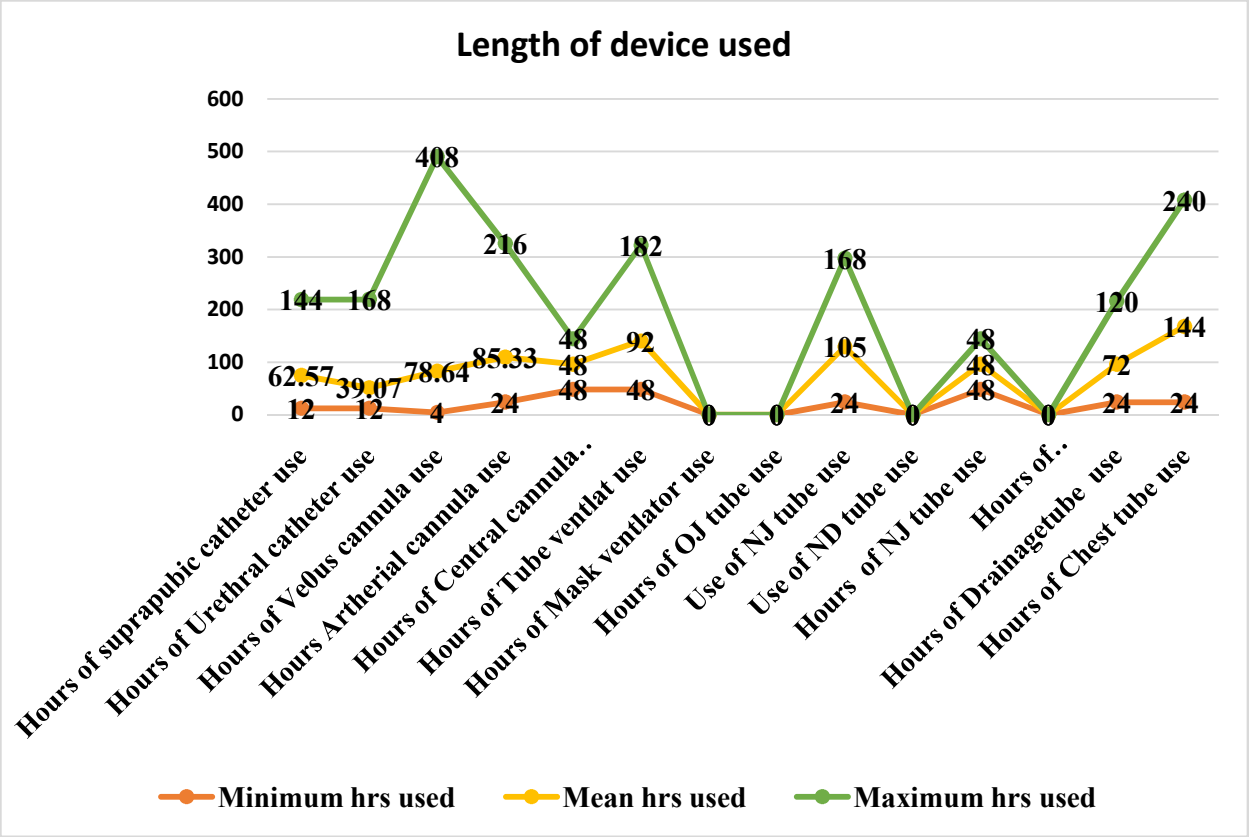

Figure 3, length of hours of healthcare device used during admission at adama Hospital meical collage at Adama Ethiopia, 2017 G.C.

The total patient lengths of stays at adama hospital were 2885(737 + 2148) days andtheir average lengths of stay were 9.61 days. The highest and the least length of stay were 804 and 85 days which observed at the orthopedic wards and emergency ward, respectively (see annex 0, Table 13). The total length of patients with HCAI and non-infected in each ward were737 and 2148 days and its average length of stay with a 95% CI were 17.5(13.9, 20.7) and 8.28(7.44, 9.32) days, respectively.Therefor, the average lengh of stay of patient with HCAI and non-HCAare

strongly statistically significant difference with a p –value of 0.0004. HCAI patients' lengths of stay were greater than 2.12 times than non-infected. (Table 3)

The average cost of patients who have HCAI and non-infection with a 95% CI were 526.95 birrs(609.87,768.59) and 251.8 birrs(207.58,248.12) respectively and the difference between this average healthcare cost were statistically significant with a P-value of 0.0002(P<0.05). Therefore, the cost for HCAI infected patient increased by 2.79 times than non-infected patients.(Table 3)

Table 3, Patient length of stay and health service costat Adama Hospital medical college, Adama Ethiopia, 2017 G.C (n=300)

Variables	SUM	minimum	maximum	SD	Mean	95% CI		P-value
						lower	**upper**	
LOS of HCAI(days)	737	2	49	11.958	17.55	13.9	20.70	0.0004
LOS of non HCAI(days)	2148	2	63	8.128	8.33	7.44	9.32	
Total cost of HCAI(birrs)	28352	300	1328	254.167	675.05	609.87	768.59	0.0002
Total cost of non HCAI(birrs)	58745	40	1288	169.944	227.69	207.58	248.12	

The reasons of discharge were expired, improved, referred to other hospital and self-discharge against medical care. Among 300 studies participants, 1% of the patient discharged due to expired, which seen at medical ward and orthopedic ward and 94% of the patient discharged due to improvement. (**Table 4**)

Table 4, patient reason of discharge at Adama hospital medical college at Adama Ethiopia, 2017 G.C. (n=300)

Type of discharge	**Emergency**	**Gynecology**	**ICU**	**Medical**	**Obstetric**	**Orthopedic**	**Surgical**	**Grand Total**	**percentage**
Expired/dead	0	0	0	2	0	1	0	3	1%
Improved	15	28	19	46	76	45	53	282	94%
Referred to other hospital	5	0	0	3	0	1	0	9	3%
Self-discharge against medical care	0	0	0	4	2	0	0	6	2%
Grand Total	20	28	19	55	78	47	53	300	100%

5.2. Magnitude of HCAI at Adama hospital

The magnitude of HCAI among different health care service unit in the hospital were varies as the type healthcare service provided. The highest to the least frequency of HCAI among different admission ward wereOrthopedic ward, 40.48% (17/47), Medical ward 19.05% (8/55), Emergency ward 16.67%(7/20), ICU ward,14.29%(6/19), surgical ward 9.52%(4/53) and no infection were observed at obstetrics and gynecology ward (see**Table 5**). Among different age category, the highest HCAI observed between 25-34 year old 33.3 %(14/108), and the least were between 75-85 years old 2.38 %(1/13). (**Table 5**)

As a whole, 14 % of the patients (42/300) with a 95% CI (10.38, 18.57%) developed Health care associated infection. From those 214 patient who had had surgery, 9.6% (21/219) patients develop SSI, and the number of urinary tract infection (UTI) episodes found to be 9.56% (13/136), among patients who had indwelling urinary catheter. The number of episodes of blood stream infection was 0.395 %(1/253), among patients having central line and intravenous catheters. The number of VAP was found to be 5.56% (1/18) and 1 patient developed AAD from 246 patient who were taking antibiotic during admission and 62.5% (5/8) patient develop nonsurgical skin break infection from 8 patient who have skin break due to pressure sore and diabetic ulcer.(**Table 5**)

Table 5, Magnitude of HCAI among patient admitted in different ward at Adama hospital medical collages, Adama, Ethiopia., 2017 G.C.(n=300).

	Variables	HCAI					Total
		No, n=258	Yes (%) n=42				
		%(n)	%(n)	95% CI		P-value	
				Lower	Upper		
Name of admission Ward	Emergency	65(13)	35(7)	16.31	59.05	0.1797	20
	Gynecology	100(28)	0(0)	-	-	-	28
	ICU	68.4(13)	31.58(6)	13.56	56.5	0.1083	19
	Medical	85.4(47)	14.55(8)	6.93	27.2	0.000	55
	Obstetric	100(78)	0(0)	0	0	0	78
	Orthopedic	63.8(30)	36.17(17)	23.06	51.52	0.0579	47
	Surgical	92.5(49)	7.55(4)	2.45	19.07	0.000	53
Age category	15-24	88.6(62)	11.43(8)	5.41	21.82	0.000	70
	25-34	87(94)	12.96(14)	7.525	21.12	0.000	108
	35-44	93.9(31)	6.06(2)	1.057	21.62	0.000	33
	45-54	81.8(27)	15.62(5)	5.80	33.55	0.000	32
	55-64	73.7(14)	26.3(5)	10.12	51.42	0.039	19
	65-74	72(18)	28(7)	12.87	49.6	0.0278	25
	75-85	92.3(12)	7.7(1)	0.4	37.91	0.0023	13
Sex	Male	80(92)	20(23)	13.35	28.7	0.000	115
	Female	89.7(166)	10.27(19)	6.46	15.8	0.000	185
Type of healthcare service	SSI(Surgery)	90.4(198)	9.6(21)	6.173	14.48	0.000	219
	CAUTI(Urinary catheter used)	90.4(123)	9.56(13)	5.395	16.1	0.000	136
	CABSI(Intravenous cannula used)	99.6(252)	0.395(1)	0.02064	2.526	0.000	253
	VAP(Ventilator used)	94.4(17)	5.56(1)	0.9876	25.76	0.000	18
	AAD(Antibiotic used)	99.6(245)	0.41(1)	0.02123	2.597	0.000	246
	NSSBI(Non-surgical skin break present)	37.5(3)	62.5(5)	25.9	89.76	0.4795	8
	HCAI(All type of healthcare service provided)	86(258)	14(42)	10.38	18.57	0.000	300

CAUTI: catheter associated urinary tract infection, **CABI**: cathter associated blood stream infection, **VAP**: Ventilator-associated pneumonia, **AAD**: antibiotic associated pneumonia, **NSSBI**: Non-surgical skin break infection, **HCAI**: healthcare associated infection.

The other magnitudes of HCAI were among patients who have medical risk factors, see onTable 15. Patient who enrolled in the studies period have medical risk factors were42.33% (127/300)patients. The highest number of medical risk factor were congestive heart failure 10.33 %(31/300), and next old age (>65 years)8%(25/300), HIV/AIDS 5.33%(16/300), Obesity 5%(15/300) and renal disease 4%(12/300).Among thosepatients (n=127), about18.9% (24/127) developed HCAI, the highest HCAI were CAUTI 7.87% (10/127), next SSI 4.7% (6/127) and NSSBI3.9%(5/127). Patients who sick with diabetics and renal disease have the risk of exposure for HCAI is 80% and 50%, respectively, and 1.243 and 4 time as likely as non-diabetic and non-renal disease to develop HCAI with p-value of 0.01754and 0.0005902, respectively.Generally, the proportions of patient with and without medical risk factor who develop HCAI were 6 % (18/300) and 8% (24/300). The difference was not statistically significant, its risk ratio were1.243 with a p-value of 0.284(P>0.05).(Table 6)

Table 6, Association of HCAI and medical risk factors at adama hospital medical college, Adama,Ethiopia, 2017 G.C.

	Medical risk factors (n=300)		HCAI among medical risk factors						X^2	P-vale
	Yes	No	RRisk ratio	95% CI		Risk in exposed	95%CI			
				Lower	Upper		lower	upper		
HCAI	8%(24)	6%(18)	1.243	0.6962,	2.218[1]	15.29%	10.6	21.52	0.3258	0.2841
Type 2 diabetes with HCAI	0.67%(2)		5.96	0.009,	11.81[1]	80%	24.02,	99.64	4.441	0.018
Renal disease with HCAI	2%(6)		4	2.103,	7.609[1]	50%	25.38,	74.62	10.52	0.001

- Data analyzed using of chi-square

5.3. Incident rate and associated risk factorsof HCAI

The type of healthcare service were, administration of antibiotic, insertion of urethral catheter, surgery, providing of ventilator, dressing of wound, use of intravenous or arterial cannula.Therefore, the incident rate of theHCAI in the hospital was9.666 case /1000 persons-days with a 95% CI (7.056, 12.94). The risk of getting infection of those exposed for health care service were 14.24% with a 95% CI (10.64, 18.77) and the exposed for healthcare serice have 1.708 with 95% CI (0.2561,11.4[1])time risk of getting the infection than the non-exposed. However this healthcare service statistically (p-value=0.4393) has no significant difference between peoples who getHCAI and who have no HCAI.(See,**Table 7**). Amon thos type of HCAI,the incident rate of SSI was10.375per 1000 person-days with a 95% CI (8.74,20.66). The risk of exposed for infection were 9.346 %(6.068%, 14.06%) and surgery patient would be 8.037(1.096,58.95) time as likely as non-surgery to develop SSI withP-value of 0.012 (P<0.05) which indicate that there was a statistically significant relation between surgery and infection.

The second type of HCAI was CAUTI. The incident-rate of CAUTI among catheter indwelling patientswas60.19case per 1000 persons-days with a 95 % CI (33.47, 100.3). The risk of CAUTI were 8.209 %(4.508, 14.24%) and the patient who were using urinary catheter would be 6.813(0.01607, 30.21[1]) times as likely as non-urinary catheter used to develop CAUTI with the P-value of 0.003(<0.05) which show that there is statistically strong association with CAUTI and urinary catheter use.

The third type of HCAI were CABSI which is mostly due to Intravenous and arterial cannula used during administration of antibiotic and fluid. The incident rate of CABSI were 1.35 (0.06752, 6.656) case per 1000 person-days and the risk of getting the infection were 0.4115% (0.0, 2.532) with a P-value of 0.2752(>0.05) which indicate that there is no statistical significant association between using of intravenous cannula and CABSI.

The fourth type of HCAI were VAP, it refers to pneumonia that occurs 48 hours or more after endotracheal intubation. During our study period the incident rate of VAP were 14.08(0.7047, 69.46)case per 1000 persons-days. Moreover, the risk of getting the infection were 6.667% (0.0, 31.84) and using of respirator would be 38.07(1.329, 1090[1]) times as likely as non-ventilator patient to develop VAPwith a p –value of 0.0002533 (P>0.056) which indicate that there is statistical significant association between exposed for respirator and infection.

The fifth type of infection was antibiotic related diarrhea that mostly caused by clostridium *difficuli*. In developing country which was mostly identified by clinically. So based on this, the incident rates of antibiotic associated diarrhea were 0.5807 (0.02906,2.864) case per 1000 persons-days and the risk of exposed for infection were 0.4065% (0.0, 2.502). Antibiotic taking would be 0.4431(0.01506, 13.04[1]) times as likely as non-antibiotic taking to develop AAD. In addition,its p- value was0.2817, which indicate that there is no statistically association between antibiotic use and AAD.This diarrhea wasdue to using of azithromycin antibiotic.

The final type of HCAI was NSSBI, which is mostly occur after a non-surgical skin break present due to different clinical condition. So the incident rate of infection were 73.53case per 1000 persons-days and the risk of getting infection who have skin break during admission was 62.5% (30.38%, 86.51%).Besides patients who have non-surgical skin break would be 135.5 times as likely as non-skin break to develop the infection with a p- value of0.0001, which indicate that there is strong statistical association between non-surgical skin break and infection. (**Table 7**)

Table 7, Calculated Value of HCAI relative risk, risk in exposedand incident rate at Adama hospital, Adama Ethiopia 2017 G.C.

	Risk ratio	95% CI		Risk in exposed	95%CI		Incident rate(/1000p-d)	95%CI		X^2	P-vale
		Lower	Upper		lower	upper		Lower	upper		
HCAI	**1.708**	**0.2561**	**11.4[1]**	**14.24%**	**10.64**	**18.77**	**9.666/1000**	**7.056**	**12.94**	**0.02336**	**0.4393**
SSI	**8.037**	**1.096**	**58.95[1]**	**9.346%**	**6.068**	**14.06**	**13.75/1000**	**08.74**	**20.66**	**5.116**	**0.01186**
CAUTI	**6.813**	**1.537**	**30.21[1]**	**8.209%**	**4.508**	**14.24**	**60.19/1000**	**33.47**	**100.3**	**7.166**	**0.003715**
CABSI	**0.4733**	**0.01607,**	**13.93[1]**	**0.4115%**	**0.0**	**2.532**	**1.35/1000**	**0.06752**	**6.656**	**0.3567**	**0.2752**
VAP	**38.07**	**1.329,**	**1090[1]**	**6.667%**	**0.0**	**31.84**	**14.08/1000**	**0.7047**	**69.46**	**2.553**	**0.0002533**
AAD	**0.4431**	**0.01506**	**13.04[1]**	**0.4065%**	**0.0**	**2.502**	**0.5807/1000**	**0.02906**	**2.864**	**0.334**	**0.2817**
NSSBI	**365.6**	**21.78**	**6139[1]**	**62.5%**	**30.38**	**86.51**	**73.53/1000**	**26.94**	**163**	**135.5**	**<0.0000001**

5.4. The commonly isolated organism in HCAI at Adama Hospital medical collage

The isolated pathogenic organism that were causing HCAI during study period from Adama hospital were C.*albicans*, citrobacter *fruindii*, Enrtobacter *cloacea*, Esherchia *coli,*Enterococcus species, Klebsella *pneumonia,*Pseudomonas *aerogenosa,*Proteus *mirabilis*, Staphylococcus *aureus*, and Serasia *marscence*. The most frequent HCAI causing bacteria were isolated from orthopedic, itwas 40.48%, almost all bacteria were isolated except C.albican and AAD, and no bacteria were isolated at obstetrics and gynecology wards. The mostfrequent isolated bacteria wereEsherchia *coli,* which was isolated from orthopedy, ICU, surgical, medical and emergency ward. (**Table 8**)

Table 8, Distribution of bacterial isolate from various ward at Adama hospital medical college, Adama, Ethiopia, 2017 G.C.

Row Labels	Emergency	ICU	Medical	Orthopedic	Surgical	Gynecology	Obstetric	Total isolate
AAD	0	0	1(2.38)	0	0	0	0	1(2.38)
C.*albicanes*	1(2.38)	0	0	0	0	0	0	1(2.38)
C.*fruindii*	1(2.38)	0	1(2.38)	2(4.76)	2(4.76)	0	0	6(14.29)
E.*cloacae*	0	0	0	1(2.38)	0	0	0	1(2.38)
E.*coli*	1(2.38)	4(9.52)	3(7.14)	4(9.52)	1(2.38)	0	0	13(30.95)
Entrobacter *cloacae*	0	0	0	1(2.38)	0	0	0	1(2.38)
Entrococcus spps	0	2(4.76)	0	0	0	0	0	2(4.76)
K.*pneumonia*	2(4.76)	0	2(4.76)	0	0	0	0	4(9.52)
P.*aerogenosa*	0	0	0	3(7.14)	1(2.38)	0	0	4(9.52)
P.*mirabilis*	2(4.76)	0	0	3(7.14)	0	0	0	5(11.9)
S.*aureus*	0	0	1(2.38)	1(2.38)	0	0	0	2(4.76)
S.*marscence*	0	0	0	2(4.76)	0	0	0	2(4.76
Total isolate in the related ward	7(16.67%)	6(14.29%)	8(19.5%)	17(40.48%)	4(9.52%)	0	0	42(100%)

Among age group, 33.3% of the Bacteria were isolated from patients whose age group was between 25-34 years old who mostly infected by E.*coli* and the least patient age group were between 75-85 years old who infected by k.pneumonia. From each age group, a minimum of one organism were isolated. (**Table 9**)

Table 9, Prevalence of infections and crude mortality by age group and isolated organism at Adama hospital medical collage, Adama Ethiopia 2017 G.C.

Type of organism	15-24 (n=8)	25-34 (n=14)	35-44	45-54	55-64	65-74	75-85	Total isolate
AAD	0	1(2.38)	0	0	0	0	0	1(2.38%)
C.*albicanes*	0	0	0	0	0	1(2.38)	0	1(2.38%)
C.*fruindii*	1(2.38)	2(4.76)	0	1(2.38)	1(2.38)	1(2.38)	0	6(14.29%)
E.*cloacae*	0	1(2.38)	0	0	0	0	0	1(2.38)
E.*coli*	3(7.14)	5(11.9)	1(2.38)	2(4.76)	1(2.38)	1(2.38)	0	13(30.95%)
Entrobacter *cloacae*	0	0	0	0	1(2.38)	0	0	1(2.38%)
Entrococcus *spps*	0	0	0	0	0	2(4.76)	0	2(4.76%)
K.*pneumonia*	0	1(2.38)	0	1(2.38)	1(2.38)	0	(2.38)1	4(9.52%)
P.*aerogenosa*	0	2(4.76)	0	0	1(2.38)	1(2.38)	0	4(9.52%)
P.*mirabilis*	3(7.14)	1(2.38)	0	1(2.38)	0	0	0	5(11.90%)
S.*aureus*	0	1(2.8)	0	0	0	1(2.38)	0	2(4.76)
S.*marscence*	1(2.38)	0	1(2.38)	0	0	0	0	2(4.76)
Total isolate	8(19.05%)	14(33.33%)	2(4.76%)	5(11.9%)	5(11.9%)	7(16.67%)	1(2.38)	42(100%)

The highest frequency of organism that causes HCAI were E.*coli* (30.95%) and the least were Candidia *albicanus* (2.38%) and AAD (2.38%) too, even though it would not be laboratory confirmed. During study period, the clinical sample were blood, urine, sputum, wound ulcer swab and bed sore swab. The least clinical specimen was sputum and stool.

During the study period 50% of the clinical case were surgical site infection from which the isolated organism were Citrobacter *fruindii*, Entrobacter *cloacea*, Escherchia *coli*, Pseudomonas *aeroginosa*, proteus *mirabilis*, staphylococcus *aurous*, and serascia *marscence*.

E.*coli* (23.81%) was the most isolated organism, next Citrobactor *fruindii* (19.05%) and Pseudomonas *aeroginosa* (19.05%). The least organism that isolated from SSI were S.aureus(4.76%).and the organism that isolated from CAUTI were Candidia *albican*, Citrobacter *fruindii,* Escherichia *coli*, Entococcus*species*, Klebsella *pneumonia*, and Proteus *mirabilis*. E.*coli*(38.46%) were the dominant isolate, next Klebsella *pneumonia*(15.38%), Enthrococcus *species*(15.38%),and Proteus *mirabilus*(15.38%) and the least were Candidia *albicanse*(7.69%). The other type of clinical specimen were non-surgical skin break infection like wound ulcer and bed sore swab, it was 7.14% from the whole sample. The isolated organisms were Escherichia *coli* (60%), Citrobacter *fruindi* and Klebsellan *pneumonia*. The other two infection from whichS.*aureus* and k.*pneumonia*, isolated were CABSI and VAP, respectively.(**Table 10**)

Table 10, Type bacteria isolated from different type of HCAI at adama Hospita medical collage adama, Ethiopia, 2017 G.C.

Row Labels	AAD	CABSI	CAUTI	NSSBI	SSI	VAP	Grand Total
AAD	1(2.38)	0	0	0	0	0	1(2.38%)
C.albicanes	0	0	1(2.38)	0	0	0	1(2.38%)
C.fruindii	0	0	1(2.38)	1(2.38)	4(9.52)	0	6(14.28%)
E.cloacae	0	0	0	0	1(2.38)	0	1(2.38%)
E.coli	0	0	5(11.9)	3(7.14)	5(11.9)	0	13(30.95%)
Entrobacter cloacae	0	0	0	0	1(2.38)	0	1(2.38%)
Entrococcus spps	0	0	2(4.76)	0	0	0	2(4.76%)
K.pneumonia	0	0	2(4.76)	1(2.38)	0	1(2.38)	4(9.52%)
P.aerogenosa	0	0	0	0	4(9.52)	0	4(9.52%)
P.mirabilis	0	0	2(4.76)	0	3(7.14)	0	5(11.90%)
S.aureus	0	1(2.38)	0	0	1(2.38)	0	2(4.76)
S.marscence	0	0	0	0	2(4.76)	0	2(4.76)
Grand Total	**1**(2.38%)	**1**(2.38%)	**13(30.95%)**	**5**(11.90%)	**21(50%)**	**1**(2.38%)	**42(100%)**
Gram negative bacteria=			**90.48%**				
Gram positive bacteria=			**9.52%**				

5.5. Antibiotic profile of the commonly isolated organism that cause HCAI

The antibiotic susceptibility test method was a Kirby-power dick diffusion technique. For all isolated organism, antibiotic susceptibility had done. The results of the susceptibility measureinterpreted based on the type of clinical sample and CLSI guideline. Based on the clinical site of infection, the isolated organism susceptibility patter described here.

The antibiotic that used for susceptibility test for entrobacteriaceia isolated from SSI was ceftriaxone, ampicillin,amox/clavlunic acid,cefazolin, chloramphenicol, tetracycline, cephalothin, ciprophloxacillin sulphametoxazole/trimetoprim, cefuroxime and gentamycin.Among this antibiotic, ampicillinwas 100% resistance for all isolated organism however, there were no 100% susceptibleorganism seen. The type of susceptibility pattern were varies as isolated organism and its site of infectionvaries. For example, E.*cloacia* were 100% susceptible for sulfametoxazole/trimethoprim but it was 100% resistance for 1st, 2nd, 3rd generation cephalosporin, amoxa/clavulinic acide, and tetracycline, in the contrary Citrobacter *fruindii* were also 100% resistance for sulfametoxzole/trimethoprim drug. E.*coli* and Proteus *mirabilsi* were 100% susceptible for gentamycin and it was 50% susceptible for Enterobacter *cloace*, Citrobacter *fruindii* and Serascia *marcsence*. Among those antibiotics, the highestsusceptibilitypatters for majority of the drug seen by P.*mirabilis* and the highest resistance pattern for majorityof the selected antibiotic also seen by C. *fruindii*.(**Table 11**)

The other antibiotics that used for treatment of surgical site infection by P.aeroginosa were imipenum, ceftazidim, gentamacine, piprazilin, pipraziline/tazobactem, ciprofloxacillin and tobramycin. These organisms were100% susceptible for imipenem and 50% were susceptible for ceftazidim, ciprofloxacin, pipracillin, and gentamycin.**Table 11**

Gram-positive S.*aureus*were isolated from SSI, its antibiotic profile for oxacillin, clindamycin, 1st and 2nd generation cephalosporin antibiotic were 100% susceptible.Therefore, there is no a best choose of antibiotic for surgical site infection treatment, unless the susceptibility test done for the recommended antibiotic.

The antibiotic that that used for treatment of CAUTI were Ampicillin, nitrofrantoin, amoxa/clavlunic acid, cefazoline, tetracyclin, cephalothin, ciprofloxacillin, sulfametexazole, cefroxamine, and gentamycin.From these antibiotic lists, Cefazolin and cephalotin were 100% resistance by all isolate organism. Citrobacter *fruindii* were 100% resistance for all antibiotic that recommended for treatment of CAUTI, Klebsella *pneumonia*very resistance for most of the antibiotic category except nitrofrantoin. Nitrofrantion was 100% susceptible by E.*coli* and 50% by Klebsellan *pneumonia* and P. *mirabilis*, but P.*mirabilus* were 100% susceptible for majority of the antibiotic that used for treatment of CAUTI like amox/clavlonic acide, gentamycin, cefroxamin, and ciprofloxacillin but it is susceptible 50% to ampicillin, which was resistance for majority of the isolate organism. The other organism that was isolated from CAUTI was Enterococcus *species*. It was 100% susceptible for vancomycine and nitrofrantoin but it was 100% resistance for tetracycline and ciprofloxacillin.

The only organisms that were isolated from blood and sputum were S.*aureus* and K. *pneumonia*, respectively. S.*aureus* was 100% susceptible for oxacillin, cephazolin, cephalothin and clindamycin but it is 100% resistance for penicillin.The antibiotics that used for treatment of VAP were ampicillin, amox/clavulinc acid, cefazolin, chloramphenicol, tetracycline, cephalothin, ciprofloxacillin, sulfametoxazole/trimethoprim, cefuroxime, and gentamycin. Therefore,k. pneumonia was 100% susceptible for chloramphenicol, but resistance for ampicillin, amoxa/clavulonic acid, gentamycin and 1st and 2nd generation cephalosporin drug.Besides, organisms isolated from NSSBI were E.*coli*, C.*fruindii* and k.*pneumonia*. Only k.*pneumonia*was 100% susceptible for ciprofloxacillin and gentamicin. E. *coli* were 66.7% susceptible of ciprofloxacilin. C.*fruindii*was 100% resistance for all selected antibiotic. Here, most of the organisms were 100% resistance for 1st, 2nd and 3rd generation cephalosporin, amoxa/clavlonic acid, chloramphenicol, tetracycline, and sulfametoxazole/ trimethoprim. These organisms were more resistance than other site of isolate.(Table 11)

Table 11, Percent of Antibiotic sensitivity of bacteria isolated from different HCAI at adama Hospital medical collage, Adama Ethiopia 2017 G.C.

Type of HCAI	Organism isolate	Cephamycine	Glycopeptidase		Macrolide	Tetracycline	Folate pathway inhibitors	penicilin		Betalactamase inh.	Fluroquinolones	Phenocols	Extended – spectrum cephalosporine		Non-extended spectrum cephalosporin			Carbapenem		Ureidopenicillin class		Aminoglycoside	
		Fox	V	DA	E	TTC	SXT	P	AMP	AMC	CIP	C	CTX	CAZ	KZ	KF	CXM	IPM	NI	PRL	PTZ	GM	TOB
SSI	E.coli					0	1(20)		0	0	3(60)	3(60)	1(20)		0	0	0					4(100)	
	C.fruindii					1(25)	0		0	1(25)	2(50)	2(50)	1(25)		0	0	0					2(50)	
	E.cloacea					0	2(100)		0	0	2(50)	2(50)	0		0	0	0					2(50)	
	P.mirabilus					0	3(75)		0	4(100)	4(100)	4(100)	4(100)		1(25)	1(25)	1(25)					4(100)	
	S.marscence					2(100)	1(50)		0	1(50)	1(50)	0	1(50)		0	0	0					1(50)	
	P.aeroginosa										2(50)			2(50)				4(100)		2(50)	3(75)	(50)	3(66.7)
	S.aureus	2(100)		2(100)	0			0							2(100)	2(100)							

Continue in next page

Type of HCAI	Organism isolate	Fox	V	DA	E	TTC	SXT	P	AMP	AMC	CIP	C	CTX	CAZ	KZ	KF	CXM	IPM	NI	PRL	PTZ	GM	TOB
		Cephamycine	Glycopeptidase		Macrolide	Tetracycline	Folate pathway inhibitors	penicilin		Betalactamase inh.	Fluroquinolones	Phenocols	Extended – spectrum cephalosporine		Non-extended spectrum cephalosporin			Carbapenem		Ureidopenicillin class		Aminoglycoside	
	E.coli					2(40)	1(20)		0	1(20)	4(80)				0	0	0		5(100)			2(40)	
	C.fruindii					0	0		0	0	0				0	0	0		0			0	
CAUTI	K.pneumonia					0	0		0	0	0				0	0	0		2(50)			0	
	P.mirabilus					1(50)	1(50)		1(50)	2(100)	2(100)				0	0	2(100)		1(50)			1(100)	
	Enterococcus species		2(100)			0					0								2(100)				
CABSI	S.aureus	1(100)		1(100)	0		0	0			0				1(100)	(100)							
VAP	K.pneumonia					0	0		0	0	3(66.7)	1(100)	0		0	0	0					0	
	E.coli					0	0		0	0	0	0	0		0	0	0					0	
NSSBI	C.fruindii					0	0		0	0	0	0	0		0	0	0					0	
	K.pneumonia					0	0		0	0	1(100)	0	0		0	0	0					1(100)	

SSI: Surgical site infection, **CAUTI**: Catheter-associated infection, **CABSI**: catheter associated blood stream infection, **VAP**: ventilator associated blood stream infection, **NSSBI**: non-surgical skin break infection.

So generally, based on their susceptible pattern, organism categorized as MDR, XDR and PDR bacteria. So based on this criteria,the isolated bacteria were classified see more on **Table 12**. Therefore, from the isolated E. *coli*, 53.85% were multidrug resistance (MDR), 23.07% suspeious of extensively drug resistance (XDR), and only 23.07% were susceptible. The other bacteria that show the highest drug resistance patter are C. *fuindii*that was 50% multidrug resistance (MDR) and 50% suspecioun of extensive drug resistance (XDR), no susceptibility identified. All the isolated K.*pneumonia* and Entrobacter *cloacea* were 100% multidrug resistance. Generally, from HCAI isolated bacteria in Adama hospital medical college, the most drug resistance patter seen by C.*fruindii* and E. *coli*.(**Table 12**)

Table 12, classification of the isolate organism based on antimicrobial resistance

Organism isolate	Susceptible	MDR	Suspicion of XDR
Esherchia *coli*	23.7%(3/13)	53.85%(7/13)	23.07%(3/13)
Citrobacter *fruindii*	0	50%(3/6)	50%(3/6)
Klebsella *pneumonia*	0	100%(4/4)	0
Entrobacter *cloacea*	0	100%(2/2)	0
Proteus *mirabilis*	40%(2/5)	60%(3/5)	0
Serasia *marscsence*	50%(1/2)	0	50%(1/2)
Pseudomonas *aerogenosa*	75%(3/4)	25%(1/4)	0
Enterococcus *species*	100%(2/2)	0	0
Staphilococcus *aureus*	50%(1/2)	50%(1/2)	0

Key

- MDR=multi drug resistance
- XDR= Extensive drug resistance
- PDR= pan drug resistance

6. Discussion

In our study, the proportion of HCAI among 300 admitted patient were14% (42) with a 95% CI(10.8,18.57) which is very similar to study conducted at a two teaching hospitals in Ethiopia , there were 135 patients with HAI among a total of 650 patients, with a mean prevalence of 14.9% (95% confidence interval 12.7–17.1)(32). The other finding from 10 papers published in peer-reviewed journals and one dissertation,the prevalence of HCAI ranging from 10 to 33%(33) with in which our finding is in range. But when we compare our result with the finding of a national report of republic of Ireland, the prevalence was very high, and their national crude HCAI prevalence was 5.3% and the most prevalent HCAI types were: respiratory tract infections (RTI), urinary tract infections (UTI) and skin infections; affecting 1.9%, 1.7% and 1.3% of all residents, respectively(34). However, this is completely different from our study finding, our most prevalent finding was SSI, CAUTI, and non-surgical Skin break infections.

There are different type of HCAIdiscovered in the hospital, the prevalence of such infection with a 95% CI in our study hospital were9.59%(6.173, 14.48)SSI, 9.56% (5.35,16.1)CAUTI, 0.395%(0.02,2.53) CABSI,5.56(0.29,29.37)VAP,0.41%(0.021,2.59)AAD and 62.5%(25.9-89.76) NSSBI.All this result is very low from study done in Hospital das Clı´nicas (HC) in the city of Sa˜o Paulo, Brazil, from 195 patients 43 (22%) developed HAI: 16 pneumonia, 12 urinary-tract, 8 bloodstream, 2 surgical site, 2 other respiratory infections and 3 other(35).In Slovenia, the national survey study, the prevalence of HCAI was 6.4%(36), it is lower than our study too.Nevertheless, this variability depends on the demographic characteristics of the study group. The best indicator to compare the magnitude of HCAI among different healthcare facility is the incident rate.

With a 95% CI, the incident rate ofhealth care associated infection in our study hospital were 9.666(7.056, 12.94) case /1000 persons-days. This incident rate is lower than studies described in 10 papers published in peer-reviewed journals and one dissertation,the healthcare-associated infection incidence density ranged from 20.0 to 51.7 per 1,000 patients/days(33).Another systematic literature review and meta-analysis of Southeast Asia was performed on 41 different studies, the pooled incidence density of HCAI was 20 cases per 1000 intensive care unit per days(28). It indicate that incident rate is two time higher than our studies hospital. This indicates that our hospital healthcare services aresafer than the described hospital in peer reviewed journals. In addition, the studies show us that this infection in our study has no association (p-value=0.4393) with any health care service (**Table 7**). However it does not mean

that, the risk of HCAI are suppressed by other proposed associated factors like antibiotics and using of intravenous cannula, both factor have no association with HCAI in our studies. The risks of HCAI in our studies are SSI, CAUTI, VAP and NSSBI.

The proportion of surgical site infection was 9.6 %(6.2, 14.48), 99 major surgery and 120 minor surgery. This result matched with studies done at Felege Hiwot Referral Hospital, Bahirdar, Ethiopia. Nosocomial surgical site infection was 10.2 %(31) and the incident rate of SSI in our study area were 10.375per 1000 person-days with a 95% CI (8.74, 20.66)which is agreed withmost surveyed and most frequent type of infection in low- and middle- income countries. It is incidence rates ranging from 1.2 to 23.6 per 100 surgical procedures and a pooled incidence of 11.8%.The other studies were from a biomedical databases of a published studies from 1995 to 2009 on the epidemiology of HCAI in African countries and also from international infection control conferences from 2004 to 2009, in resource limited country, a Hospital-wide HAI prevalence varied between 2.5 and 14.8 per 100 patients; in surgical wards, the cumulative incidence ranged from 5.7 to 45.8 per 100 patients. Among specific types of infection, the largest number of studies focused on surgical site infection with a cumulative incidence ranging from 2.5 to 30.9 per 100 operated patients(29), here our finding results are agreed. However, our result finding did not agreed with developed countries , SSI rates vary between 1.2% and 5.2% (4)

The incident rates of CAUTI in our study hospital were60.19case per 1000 persons-days with a 95% CI (33.47, 100.3). it is very greater than studies done in Intensive care unit of a tertiary care hospital in India, which reported as9.06/1000 urinary catheter days(37), and another studies in other place of an intensive care unit in Northern Indiaalsoreported,an incident rate of 9.08/1000 catheter days(38). Our result finding even does not agreed withA systematic literature review and meta-analysis of Southeast Asia was performed on 41 different studies, Catheter-associated urinary tract infection were 8.9 per 1000 catheter-days(28). This result variability may due to the type of the urinary catheter mostly used in the hospital and the experience of the nurse who insert the catheter. Nonetheless the proportion of CAUTI 13(9.7%) is almost similar in both studies case, it is prevalence was 73 (10.75%) (37).

The third top most risk of infection for HCAI in Adama hospital was VAP. With a 95% CI, the prevalence of infection were 5.9 %(0.29,29.37)and the incident rate were 14.08(0.7047,

69.46)case per 1000 persons-days which is fully agreed with asystematic literature review and meta-analysis of Southeast Asia,it is pooled incidence density of ventilator-associated pneumonia were 14.7 per 1000 ventilator-days(28).Moreover, the incident rate in Adama hospital was with in the rage of studies described in 10 papers published in peer-reviewed journals and one dissertation, VAP rates were 11.6 and 8.87 per 1,000 days of ventilation(33). Another ,study done in 2005, by the American Thoracic Society (ATS) and Infectious Disease Society of America (IDSA), it state that HAP or VAP occurs at a rate between 5 and 15 cases per 1,000 hospital admissions and accounted for approximately 15% of all hospital-acquired infections(39)(40). But our result finding somewhat higher thanstudies done in ICU of a tertiary care hospital in India, it is incident rate were 5.42/1000 ventilator days(37) and a 23 Scottish Intensive Care Units**,t**he incidence density of ventilator-associated pneumonia was 5.2 per 1000 invasive respiratory device days(41).This variation is due to the type of ward where the study done, in both study they used ICU but in our case, it was in a general ward.

The third most type of risk factor was Non-surgical skin break. It was from eight non-surgical skin break due to diabetes, pressure sore and other, five patient develop infection.

Among intravenous cannula used patient, the proportion of CABSI were 0.041 % (1/243) which is similar to with a 95% CI (0.020, 2.526) studies done at Felege Hiwot Referral Hospital, Bahirdar, Ethiopia, the Nosocomial blood stream infection rate was 2.4% correspondingly(31). The incident rate of infection in our study hospital was 1.35 (0.06752, 7.519) case per 1000 person-days which within the range of studies done in 23 Scottish Intensive Care Units, itsincidence density of BSI (not including CR-BSI) was 2.3 per 1000 patient days, (95% CI: 1.9, 2.7(41).Moreover the finding is very close to studies done in a systematic literature review and meta-analysis of Southeast Asia, it is incident rate of Central line–associated bloodstream infection were 4.7 per 1000 catheter-days (28). However, our result finding is very less than studies done in India, one study was Intensive care unit of a tertiary care hospital, its incident rate were13.35/1000 central venous pressure line days(37) and the other was an intensive care unit of Northern India, the incident rate of CLABI was 13.86/1000 central line days(38). The reason of this low resultand no risk of using of IV catheter in our study is due to, one they practice the procedure aseptically using of antiseptic.The second reason is majority of the patient were using antibiotic during admissionfor propose of prophylaxis or treatment before any

surgery or any procedure is done, the third reason is the type of the blood stream device they used.

The other less or no risk for HCAI in our study were antibiotic that causing AAD. In our studies the proportion of AAD were 0.4 %(1/246) and the incident rate were 0.5807 (0.02906,2.864) case per 1000 persons-days. The relative risk of taking antibiotic were 0.4431(0.01506, 13.04[1]) and its p- value were 0.2817 which indicate that there is no statistically association between antibiotic use and AAD.Even though the there is no similar studies found, one studies done in the US academicmedical centers of the University HealthSystem Consortium(UHC) during the 2009 calendar year, HA-CDI, The odds of acquiring HA-CDI increased with the following medications [OR (95% CI)]: anti-methicillin-resistant Staphylococcus aureus agents [1.38 (1.22–1.56)]; third- or fourth-generation cephalosporin [1.75 (1.62–1.89)]; carbapenems [1.60 (1.44– 1.79)]; b-lactam/b-lactamase inhibitor combinations [1.49 (1.36–1.64)]; vancomycin [1.73 (1.57–1.89)]; and proton pump inhibitors [1.43 (1.30–1.57)]. The odds of acquiring HA-CDI decreased with the following medications: clindamycin [0.74 (0.63–0.87)]; and macrolides [0.88 (0.77–0.99)]. Controlling for patient-level covariates, no hospital-level medication covariates thatanalyzed had statistically significant effects on HA-CDI. The odds of acquiring HA-CDI increased with the hospital proportion of patients aged ≥65 years [1.01 (1.00–1.02)](42).When we compare this result with our finding the age of the patient who developed the AAD were a 27 years old female and the type of the antibiotic were azitromycin, which is a macrolides drug. Therefore, based on the above studies description, macrolide drugs has no relation with AAD as a result the cause of the infection (AAD) in our study may related to other factors.

The top most organism that causes HCAI in Adama hospital were E.*coli* (30.95%), Citrobacter *fruindii* (14.29%), Pseudomonas *aeroginosa* (9.52%) and K.*pneumonia* (9.52%) and the least were Candidia *albicanus* (2.38%), majority of the organism were gram negative rode bacteria. So, our studies result agreed with studies done at Mekelle Hospital, Tigray region, North Ethiopia, Of the 68 (27.6%) developed nosocomial infections (SSI and/or nosocomial UTI),Gram negative bacteria were predominantly isolated with a rate of 18/34 (53%) and 34/41 (83%) from SSI and UTI respectively(30). However, it wasdifferent from studies done in two teaching hospitals in Ethiopia, Culture results showed that Klebsiella *spp*. (22.44%) and

Staphylococcus *aureus* (20.4%) were the most commonly isolated HAI-causing pathogens in these hospitals(32). and it also different from studies done at Felege hiwot hospital at bahirdar,A total of 42 bacterial pathogens identified, S. aurous was the leading isolates accounting 26.2% followed by E. coli and Coagulase negative Staphylococcus species each 21.4%(31).The other, an intensive care unit in Northern India**,t**he organisms most commonly associated with HCAI were Pseudomonas aeruginosa and Acinetobacter species(38).

This variability of the isolated organism from different area may varies with different reason for example,geographical nature, the physiology and the nature of the patient immunity and the type of service that frequently serve for the patient in the hospital. For example, Organism that were isolated from SSI were E.*coli* (23.81%) ,citrobactor f*ruindii*(19.05%), pseudomonas *aeroginosa*(19.05%), proteus *mirabilis* (14.29%), Entrococus *cloace*(9.52%),serasia *marscence*(9.52%) and S.*aureus*(4.76%).In the contrary, organism that isolate from CAUTI by some extent werediffer, which was E.*coli*(38.46%), klebsella *pneumonia*(15.38%), proteus *mirabilus*(15.38%), Enterococcus*species*(15.38%), C.*fruindii*(15.38%)and C.*albicans*,(7.69%). Our result finding in CAUTI is a bit similar to the organism isolated from studies done in ICUof a tertiary care hospital in India.the most common organisms isolated from urine were Pseudomonas *aeruginosa* (34.48%), Enterococcus *species* (13.79%), Klebsiella *pneumonia* (13.79%) and Candida *species* (13.79%)(37).

From VAP and CABSI, the isolated organism were klebsella pneumonia and Staphylococcus *aurous*, respectively. In CABSI, the uses of intra blood stream device have no risk for infectionand no association of using IV cannula and CABSI.Nevertheless, Ventilator has a risk for VAP in our studies. The organism isolated from this infection were similar to one of the organism isolated in Intensive care unit of a tertiary care hospital in india, the organism wereAcinetobacter *species*. (40.0%), Pseudomonas *aeroginosa* (33.33%) and Klebsiella *pneumonia* (13.33%)(37).In our study finding, it is in some extent similar to a 23 Scottish Intensive Care Units studies.The most frequently isolated micro-organisms from pneumonia were Klebsiella spp. (14.5%) and Staphylococcus aurous (14.5%), followed by Haemophilus spp(41).

Different organism isolated from different clinical samples and their antibiotic profile varies as the clinical sample varies. From those different clinical sample, E.*coli* have different

susceptibility pattern.About 80% of E.*coli*isolated from SSI wasresistance for 3rd generation cephalosporinand sulfametoxazole/ trimethoprim.So, E.*coli* isolated in our studies were more resistance than E.*coli* described innational report – march 2014 report of republic of ireland: only29% of E. *coli* were resistant to 3rd generation cephalosporin(34).Here we understood that E.*coli* that isolated from different clinical sample have different susceptibility patter for different antibiotics.The second top most isolate organism wereC.*fruindi*, which is 100% resistance for all antibiotics that isolate from NSSBI, CAUTI, and SSI andthe highest susceptibility patter for majority of the drug seen by p.mirabilis, which was isolated from SSI and CAUTI. See on more on Table 11, and **Error! Reference source not found.Error! Reference source not found.**page**Error! Bookmark not defined.**.

S.*aureus* isolated from SSI and CABSI were 100% susceptible for oxacillin, clindamycin and 1st and 2nd generation cephalosporin but it were 100% and 50% resistance for erythromycin isolated from SSI and CABSI, respectively and isolate from CABSI and CAUTI were 100% resistance for penicillin. But in our study we were not isolated MRSA from any HCAI clinical sample but report described in republic of ireland: national report – march 2014 Report , 44% of S. aureus isolated were meticillin/flucloxacillin resistant (i.e., MRSA) (34). So here, our studies finding by some extent sidetrack from this finding result.

In our study, organism isolated from SSI and NSSBI were more resistance for more commonly used antibiotics than organism isolated from other type of HCAI. But this is completely different from studies done in Mekelle Hospital, Tigray region, North Ethiopia, Most of the isolates from UTI have high rates of resistance (> 80%) to the commonly used antibiotics(30).

In our study, drug resistance organism were more observed in gram negative organism than gram positive organism but at Felege Hiwot Referral Hospital, Bahirdar, Ethiopia Nearly 100% of Gram positive and 95.5% of Gram negative bacterial isolates showed resistance against two or more antimicrobial drugs(31) which is different from our studies.

Generally, in our studies case, 23.07% of E.*coli*, 50% of C.*fruindi* and 50% of S.*marsesence* were extremely drug resistance (XDR) and from gram-positiveorganism, 50% of the isolated s.*aureus*was multidrug resistance. (**Table 12**)

7. Strength and limitation

7.1. Strength

- It is a cohort study since we can caught all the information of the studysubject

7.2. Limitation

- We cannot make free the studies subject from any type of antibiotic treatment during our study period, they were taking the drug for propose ofpreventionor prophylaxis.
- Not all patient were involved during studies, some patient were missing due to the assigned staff shift.
- There is no similar study found in the hospital before that used as a reference.
- There were no laboratory test confirmation for antibiotic associated diarrhea, it was identified clinically

8. Conclusion

The crude incident rate of HCAI in Adama Hospital was 9.666 case /1000 persons-days with a 95% CI (7.056, 12.94). Among different health care delivery, the major risks factors for infection were surgery (major), non-surgical skin break, using of urinary catheter and ventilator , besides this infection might be blown up by a medical risk factors of diabetics and renal disease. On the other hand, no risks of infection observed using of intra venous cannula, and antibiotic administration.

The highest SSI were observed at orthopedic ward in which most of the patient had been operation major surgery, and the highest CAUTI were observed at emergency and ICU ward, where most of the patient came with a critical condition, and the highest NSSBI were observed at medical ward where patients is immunologically depilated and exhausted. All this infection related to medical condition of the patients and the type of the healthcare service provided, not the health care system of the hospital.

Among healthcare associated infection cousing bacteria, E.*coli*, Citrobacter *fruindi,* Proteus *mirabilis*, Klebsella *pneumonia* and Pseudomonas *aeroginosa* were the most frequent isolated organism.The antibiotic profile of those isolated bacteria were varies. For example, E.*col*i that isolated from different clinical sample has different susceptibility patter for different antibiotics.Citrobacter *fruindii* and E.*coli*were the most drug resistance, andp.mirabiles were the most susceptible. From HCAI isolated bacteria,53.85% of E. *coli*, 50% of C. *fuindii and* 100% of K.*pneumonia* and Entrobacter *cloacea* were multidrug resistance (MDR), and about23.07% of E.*coli,* 50% of C.*fruindi* and 50% of S.*marsesence* were suspicion of extremely drug resistance. Therefore, no specific antibiotic that universally treat HCAI, the treatment should depend on the type of bacteria isolated and the site of infection.

Generally, patients with HCAI, the average length of stays and health service cost increased by 2.12 and 2.79 times than non-infected patients, respectively and from 300 studies subjects, 1% of the patient discharged due to expired and 94% of the patient due to improvement. (**Table 4**)

9. Recommendation

- A single organism isolate from different clinical specimen have different antibiotic susceptibility pattern for a single antibiotics, since treatment should be stick on laboratory culture result.
- The incident rate of CAUTI and VAP are high, since there should be prioritization of patients and selection of type urinary catheter to minimize the infection.
- In our study finding, there was isolation of MDR bacteria and suspicion of XDR bacteria. There for, there should be a surveillance system established in the hospital to prevent widespread of the bacteria.

10.Reference

1. Sprague L. Health Care-Associated Infections. In: NATIONAL HEALTH POLICY FORUM [Internet]. Washington, D.C.; 2009. p. 1–14. Available from: www.nhpf.org

2. CDC. National and State Healthcare-Associated Infections Progress report [Internet]. Centers for Disease Control and Prevention. 2016. Available from: www.cdc.gov/hai/progress-report/index.html.

3. WHO. Technical paper Infection prevention and control in health care□: time for collaborative action. Regional Committee for the Eastern Mediterranean. 2010.

4. WHO. Report on the Burden of Endemic Health Care-Associated Infection Worldwide Clean Care is Safer Care [Internet]. World Health Organization. 2011. Available from: www.who.int

5. Kolmos HJ. Health Care Associated Infections□: Sources and Routes of Transmission [Internet]. InTech. 2012. Available from: http://www.intechopen.com/books/infection-control-updates/sources-and-routes-of-infection

6. Goto M, Ohl ME, Schweizer ML, Perencevich EN. Accuracy of Administrative Code Data for the Surveillance of Healthcare-Associated Infections□: A Systematic Review and Meta-Analysis. Clin Infect Dis [Internet]. 2014;58(5):688–96. Available from: http://cid.oxfordjournals.org/, on September 17, 2016

7. Harrison TR. Basic Considerations In Infectious Diseases. In: Principles of Internal Medicine. 16th ed. The McGraw-Hill Companies; 2005. p. 695–725.

8. James J. Champoux P, W. Lawrencedrew, Md P, Frederick C.Neidhardt P, James J. Plorde Mp. Local And Systemic Infections. In: Sherris Medical Microbiology. 4TH EDITIO. 2004. p. 815–915.

9. WHO. WHO Guidelines on Hand Hygiene in Health Care: a Summary [Internet]. 2009. p. 1–52. Available from: www.who.int/patientsafety/en/

10. Ailawadi G, Hohmann SF, Thourani VH, Argenziano M, Alexander JH, Sankovic K, et al. Costs Associated With Health Care – Associated Infections in Cardiac Surgery. Jou Rnal Ame R I Can Coll O F Cardiol [Internet]. 2015;65(1):16–22. Available from: http://content.onlinejacc.org/ on 09/17/2016

11. Tripathi S. Health care quality and hospital acquired infection in Intensive care□: Bundles and. Br J Med Pract. 2014;7(2):7–9.

12. Loveday HP, Wilson JA, Pratt RJ, Golsorkhi M, Tingle A, Bak A, et al. epic3□: National Evidence-Based Guidelines for Preventing Healthcare-Associated Infections in NHS Hospitals in England. ELSEVIER [Internet]. The Healthcare Infection Society; 2014;86(1):S1–70. Available from: http://dx.doi.org/10.1016/S0195-6701(13)60012-2

13. Zingg W, Holmes A, Dettenkofer M, Goetting T, Secci F, Clack L, et al. Hospital organisation , management , and structure for prevention of health-care-associated infection□: a systematic. Lancet Infect Dis [Internet]. Elsevier Ltd; 2014;3099(14):1–13. Available from: http://dx.doi.org/10.1016/S1473-3099(14)70854-0

14. Revelas A. Healthcare – associated infections□: A public health problem. Niger Med Journals. 2012;53(2):59–64.

15. Raka L, Mulliqi-osmani G. Infection Control in Developing World [Internet]. InTech; 2011. p. 66–78. Available from: http://www.intechopen.com/books/infection-control-updates/infection-

control-in-developing-world

16. Finch R. Current challenges in antimicrobial resistance and healthcare- associated infections : role and organization of ARHAI. J Antimicrob Chemother [Internet]. 2012;67(1):i3–10. Available from: http://jac.oxfordjournals.org/ on September 17, 2016

17. Neidell MJ, Cohen B, Furuya Y, Hill J, Jeon CY, Glied S, et al. Costs of Healthcare- and Community- Associated Infections With Antimicrobial- Resistant Versus Antimicrobial-Susceptible Organisms. Clin Infect Dis [Internet]. 2012;55(6):807–15. Available from: http://cid.oxfordjournals.org/, on September 17, 2016

18. Shibabaw A, Abebe T, Mihret A. Nasal carriage rate of methicillin resistant Staphylococcus aureus among Dessie Referral Hospital Health Care Workers ; Dessie , Northeast Ethiopia. Antimicrob Resist Infect Contro. 2013;2(23):1–5.

19. Johnson AP, Mcconnell J. Interventions in healthcare-associated infection : researchers urged to CONSORT with ORION. J Antimicrob Chemother [Internet]. 2007;59:823–4. Available from: http://jac.oxfordjournals.org/, on September 17, 2016

20. Khan HA, Ahmad A, Mehboob R. Asian Paci fi c Journal of Tropical Biomedicine. ELSEVIER [Internet]. Elsevier; 2015;5(7):509–14. Available from: http://dx.doi.org/10.1016/j.apjtb.2015.05.001

21. Barr C, Boyd N, Cleator N, Dyck B, Fecteau AM, Henderson E, et al. Infection Prevention and Control Best Practices. The Canadian Committee on Antibiotic Resistance. 2007. 1-54 p.

22. Admasu T, Edward AS, Lindsay M, Ermias K, Henry MB, Russell RK. Infection Control Knowledge, Attitudes, and Practices among Healthcare Workers in Addis Ababa, Ethiopia. NIH Public Access. 2014;34(12):1289–96.

23. Klevens RM, Edwards JR, Richards CL, Horan TC, Gaynes RP, Pollock DA, et al. Estimating Health Care-Associated Infections and Deaths in. Public Health Rep. 2007;122:160–6.

24. Clarke K, Tong D, Pan YI, Easley KA, Norrick B, Ko C, et al. Reduction in catheter-associated urinary tract infections by bundling interventions. Int J Qual Heal Care. 2013;25(1):43–9.

25. Chen YT, Rabilloud M, Thiolet JM, Coignard B, Metzger MH. Benchmarking French regions according to their prevalence of healthcare-associated infections. Int J Qual Heal Care. 2013;25(5):555–63.

26. Hagel S, Ludewig K, Moeser A, Pausch C, Scherag A, Gastmeier P, et al. Effectiveness of a hospital-wide educational programme for infection control to reduce the rate of healthcare associated infections and related sepsis (ALERTS). Antimicrob Resist Infect Control. 2015;4(Suppl 1):2015.

27. Cheong HS, Kang C, Kwon KT, Heo ST, Wi YM, Kim ES, et al. Clinical significance of healthcare-associated infections in community-onset Escherichia coli bacteraemia. J Antimicrob Chemother [Internet]. 2007;60:1355–60. Available from: http://jac.oxfordjournals.org/,on September 17, 2016

28. Ling ML, Apisarnthanarak A, Madriaga G. The Burden of Healthcare-Associated Infections in Southeast Asia : A Systematic Literature Review and Meta-analysis. Clin Infect Dis [Internet]. 2015;60(11):1690–9. Available from: http://cid.oxfordjournals.org/ on September 17, 2016

29. Nejad SB, Allegranzi B, Syed SB, Ellis B, Pittet D. Health-care associated infection in Africa. BMC Proc [Internet]. 2011;5(Suppl 6):6561. Available from:

http://www.biomedcentral.com/1753-6561/5/S6/O14

30. 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 . Ethiop Med J. 2009;47(2):117–27.

31. Mulu W, Kibru G, Beyene G, Damtie M. Postoperative Infections And Antimicrobial Resistance Pattern Of Bacteria Isolates Among Patients Admitted At Felege Hiwot Referral Hospital , Bahirdar , Ethiopia. Ethiop J Heal Sci. 2012;22(1):7–1.

32. Yallew WW, Yehuala A, Moges F. Point prevalence of hospital-acquired infections in two teaching hospitals of Amhara region in. Drug Healthc Patient Saf [Internet]. 2016;8:71–6. Available from: www.dovepress.com

33. Souza WV De, Correia JB, Carlos M, Britto A De. Risk factors for healthcare-associated infection in pediatric intensive care units□: a systematic review Fatores de risco para infecções associadas aos cuidados de saúde em unidades de terapia intensiva pediátrica□: uma revisão sistemática. Cad Saúde Pública, Rio Janeiro. 2009;25(Sup 3):S373–91.

34. Roche F, Donlon S, Burns K, Hpsc. Health Protection Surveillance Centre, Point Prevalence Survey Of Healthcare□Associated Infections & Antimicrobial Use In Long□Term Care Facilities: May 2013 – Republic Of Ireland National Report: March 2014. Republic of Ireland. 2014.

35. Padilha KG, Inoue EN, Vasconcelos TN, Cunha S, Figueiredo B, Levin AS. Nursing Workload as a Risk Factor for Healthcare Associated Infections in ICU□: A Prospective Study. PLoS One. 2012;7(12):3–8.

36. Klavs I, Kolman J, Zupanc TL, Kevorkijan BK, Korošec A. The Prevalence Of And Risk Factors For Healthcare-Associated Infections In Slovenia□: Results Of The Second National Survey Prevalenca In Dejavniki Tveganja Za Bolnišnične Okužbe V Sloveniji□: Rezultati Druge Nacionalne Presečne Raziskave. Natl Inst Public Heal. 2016;55(4):239–47.

37. Masih SM, Goel S, Singh A, Sanjeev Kumar Khichi V., Tank R. Epidemiology and risk factors of healthcare associated infections from intensive care unit of a tertiary care hospital. Int J Res Med Sci. 2016;4(5).

38. Datta P, Rani H, Chauhan R, Gombar S, Chander J. Health-care-associated infections□: Risk factors and epidemiology from an intensive care unit in Northern India Methods□: Results□: Conclusions□: Indian J Anaesth. 2014;58(1):30–5.

39. Tedja R. Hospital – Acquired , Health Care – Associated , and Ventilator – Associated Pneumonia. Cleveland Clinic [Internet]. 2013; Available from: www.cdc.gov/nhsn/PDFs/vae/CDC_VAE_CommunicationsSummary-for-compliance_20120313.pdf

40. Smith DS. Hospital-Acquired , Health Care-Associated , and Ventilator-Associated Pneumonia Empiric Therapy. Medscape. 2016;8:1323–8.

41. Intensive S, Society C, Group A. Surveillance of Healthcare Associated Infections in Scottish Intensive Care Units. Natl Serv Scotl. 2012;(January 2011).

42. Pakyz AL, Jawahar R, Wang Q, Harpe SE. Medication risk factors associated with healthcare-associated Clostridium difficile infection: a multilevel model case-control study among 64 US academic medical centres. J Antimicrob Chemother [Internet]. 2014 Apr 1;69(4):1127–31. Available from: http://www.jac.oxfordjournals.org/cgi/doi/10.1093/jac/dkt489

43. Magiorakos A, Srinivasan A, Carey RB, Carmeli Y, Falagas ME, Giske CG, et al. bacteria□: an international expert proposal for interim standard definitions for acquired resistance. Eur Soc Clin Microbiol Infect Dis. 2011;(18):268–81.

11.Annex

Annex I

H. Staff Member Consent Form

Project Description

You are being asked to take part in a research study that is looking at ways to improve the way hospitals work and provide care to patients. You are being asked to be in this study because you are a medical staff member at Adama hospital medical college, where this study is taking place. You will be observed for the duration of your shift in the hospital. We will also document the medical care you provide, the patient you communicate with, and other tasks performed. The duration of these events will also be documented.

Up to 2076 local subjects will be enrolled in this research study.

Procedures

If you agree to take part in this study, your duties during your shift will not be changed in any way. We will ask you to read and sign this consent form only. From this point on, we will observe your movements throughout the hospital until the end of your shift. The information collected that could identify you on an individual basis will be kept in our records until April and during this time will be kept confidential. You are being asked to be in this study because you are clinical staff that provides direct patient care in the hospital admission staff Department.

Discomforts and Risks

The study may include risks that are unknown at this time. For example disagreeing with your patient, needle injury during sample collection and acquiring infection from the patient that you are caring.

Benefits

This study is designed for the researcher to learn more about improving hospital care. This study is not designed to treat any illness or to improve your health.

Study Sponsor

The sponsor for this study is the AHRI (Arman Hansen Research Institution)

Cost to Subject

There is no cost to you for participating in this study. You will not be paid for participation in this study.

Voluntary Participation and Study Withdrawal

Taking part in this study is voluntary.You have the right to choose not to take part in this study. If you do not take part in the study, your boss will still take care of you.You will not lose any benefits or medical care to which you are entitled. If you choose to take part, you have the right to stop at any time.If there are any new findings during the study that may affect whether you want to continue to take part, you will be told about them. The study doctor may decide to stop your participation without your permission, if he or she thinks that being in the study may cause you harm, or for any other reason. Also the sponsor may stop the study at any time.

Invitation for Questions

The researcher carrying out this study is Mr Adinew Zewdu. You may ask any questions you have now. If you have questions later, you may call 091136020 or 0924552982at any time. You will be given a copy of this form to keep.

If you have questions regarding your rights as a research subject, please call the Institutional Review Board office at Addis Ababa university School of medical laboratory sciences Department (office): 0112755170 or Kassu Dasta: 0911107099

Confidentiality

We will try to keep your research records confidential, but it cannot be guaranteed. Records that identify you (including your medical records) and the consent form signed by you, may be looked at by the following people:

- Federal agencies that oversee human subject research.

- Institutional Review Board.
- The investigator and research team for this study.
- The sponsor or an agent for the sponsor.
- Regulatory officials from the institution where the research is being conducted, to ensure compliance with policies or monitor the safety of the study.

The results of this research may be presented at meetings or in published articles. However, your name will be kept private. You will also be asked to sign a separate authorization form. This form will explain who will have access to your protected health information.

Injury and Compensation

You should inform your boss or your coworker if you decide to participate in this research study. If you have questions about injury related to the research, you may call _____ at (___) ___-____ and/or your case team leader _____ should be informed about any injury you experience while you take part in this study.

AUTHORIZATION:

I have read this paper about the study or it was read to me. I understand the possible risk and benefits of this study. I know that being in this study is voluntary. I choose to be in this study. I know I can stop being in this study and I will still get the usual medical care. I will get a copy of this consent form. (Initial all the previous pages of the consent form).

Signature: _____

Print Name (subject) _____ Date _____

Consent form explained by: _____

Print Name _____ Date _____

Investigator _____ Date _____

Annex II

I. Patient Consent Form

Project Description

Youare being asked to take part in a research study that is looking at ways to improve the way hospitals work and provide care to patients. You are being asked to be in this study because you are a patient at Adama hospital, where this study is taking place. You will be observed for the duration of your hospitalization. We will write down where you go in the hospital and how long you stay there. We will also write down who gives you medical care and what they do to you.

Up to 2076 local subjects will be enrolled in this research study.

Procedures

If you agree to take part in this study, your care will not be changed in any way. We will ask you to only read and sign this consent form. From this point on, we will observe your movements throughout the hospital until you are discharged and not ask anything else of you. The information collected that could identify you as a patient will be kept in our records until June 2017. Patients have been selected to participate in this study if they are admitted to the hospital or visit the emergency room at Adama hospital from February through May 2017 G.C.

Discomforts and Risks

The study may include risks that are unknown at this time.

Blood sampling can cause bruising or pain but other effects are unlikely and we will provide treatment if needed. Taking sample or physical examination as well as asking below mentioned questions may make you feel uncomfortable. You may refuse any physical examination, taking sample or answering any question or may take a break at any time. You may stop your participation in this study at any time.

Benefits

This study is designed for the researcher to learn more about ways to improve hospital care. This study is not designed to treat any illness or to improve your health.

Study Sponsor

The sponsor for this study is the AHRI (Arman Hansen Research Institution)

Cost to Subject

There is no cost to you for participating in this study. There are no procedures or drugs required by the study. All of the costs associated with your hospital stay will be billed to you or your insurance, just as they would without participation in this study. You will not be paid for participation in this study.

Voluntary Participation and Study Withdrawal

Taking part in this study is voluntary.You have the right to choose not to take part in this study. If you do not take part in the study, your doctor will still take care of you. You will not lose any benefits or medical care to which you are entitled. If you choose to take part, you have the right to stop at any time. If there are any new findings during the study that may affect whether you want to continue to take part, you will be told about them. The study doctor may decide to stop your participation without your permission, if he or she thinks that being in the study may cause you harm, or for any other reason. Also the sponsor may stop the study at any time.

Specimen collection

The physicians or your healthcare provider may take a specimen if it is necessary for diagnosis. The type and volume of specimen collected depend on your health condition and it is also more explained by your health care provider. The type of specimen collected from you might be two or three spoon of sputum with cup, ten or twenty spoon of blood with syringe two or three time, wound, throat, discharge with cotton tipped applicator swab, and five or ten spoon of urine with urine cup and different sample might be taken as needed

Invitation for Questions

The researcher carrying out this study is Mr Adinew Zewdu. You may ask any questions you have now. If you have questions later, you may call 091136020 or 0924552982 at any time. You will be given a copy of this form to keep.

If you have questions regarding your rights as a research subject, please call the Institutional Review Board office at 0112755170 or Kassu Dasta: 0911107099

Confidentiality

We will try to keep your research records confidential, but it cannot be guaranteed. Records that identify you (including your medical records) and the consent form signed by you, may be looked at by the following people:

- Federal agencies that oversee human subject research.
- Institutional Review Board.
- The investigator and research team for this study.
- The sponsor or an agent for the sponsor.
- Regulatory officials from the institution where the research is being conducted, to ensure compliance with policies or monitor the safety of the study.

The results of this research may be presented at meetings or in published articles. However, your name will be kept private. You will also be asked to sign a separate authorization form. This form will explain who will have access to your protected health information.

Injury and Compensation

You should inform your care provider(s) if you decide to participate in this research study. If you have questions about injury related to the research, you may call 0911360320 or 0924552982 and/or your private physician. _____should be informed about any injury you experience while you take part in this study. If you are hurt by this research, we will provide medical care if you want it, but you will have to pay for the care that is needed.

AUTHORIZATION:

I have read this paper about the study or it was read to me. I understand the possible risk and benefits of this study. I know that being in this study is voluntary. I choose to be in this study. I know I can stop being in this study and I will still get the usual medical care. I will get a copy of this consent form. Initial all the previous pages of consent form.

Print Name (subject) _____ Date _____

Signature: _____

Consent form explained by: _____

Investigator _____ Date _____

<u>የህመምተኛው የስምምነት ውል ቅፅ</u>

በሆስፒታል ውስጥ የጤና አገልግሎት ጥራት ለማሻሻል ሲባል በዚህ ጥራት ውስጥ እንድትካተት እንጠይቅሀለን፡፡ የተጠየክበትም ምክንያት ይህ ጥናት በሚደረግበት ሆስፒታል ውስጥ ታካሚ ህመምተኛ ስለሆንክ ነው፡፡

በዚህ ሆስፒተል ውስጥ በቆየህበት ጊዜም ክትትል ይደረግልሃል፡፡ በቆየህበትም ጊዜ ወዴት እንደምትሄድ ለምን ያህል እንደምትቆይ ምን አይነት የህክምና እርዳታ እንደተሰጠህና ማን ምን እንደሰጠህ ይመዘገባል፡፡

በጥናት ውስጥም በግምት ወደ 2,076 የሚሆኑት ህሙማኖች ይሳተፋሉ፡፡

<u>*መመሪያ*</u>

በቆይታህም ጊዜ የሚደረግልህን የህክምና እርዳታ አይቀይረውም፡፡አንብበክ እንድትፈርም በትህትና እጠይቃለን፡፡ ይህንንም ውል ከፈረምክበት ጊዜ ጀምሮ ምንም አይነት ሌላ ጥያቄ ሳንጠይቅህ በሆስፒታሉ እሰክትወጣ ድረስ ክትትል እናደርግልሃለን፡፡

ካንተም የተወሰዱትን ኢንፎርሜሽኖች ከኛ ጋር እስከ ሰኔ 2009 ዓ.ም ድረስ ይቆያል፡፡በዚህም ጥናት የተመረጥክበት ምክንያት በሆስፒታላችን ውስጥ ከየካቲት እስከ ግንቦት ድረስ 2017 ታካሚዎች ዉስጥ አንዱ ስለሆንክ ነው፡፡

<u>አለመመቸትና አዳጋዎች</u>

በጥናት ውስጥ የማይታወቁ አለመመቸትና አዳጋዎች በገጠመህ ጊዜ በጥናት ውስጥ ልናካትታቸው እንችላለን፡፡

<u>ጥቅም</u>

ይህ ጥናት ለአጥንው የሆስፒታል አገልግሎት መንገዶች እንዲት እንደሚሻሻል በደንብ ይማርበታል እንጂ የአንተን የታካሚውን የህክምና አገልግሎት መሻሻል አያዳርግም፡፡

<u>የጥናቱ ደጋፊ</u>

ይህን ጥነት ድጋፍ በመስጠት የሚተባበረው የአርመን አንሰን የጥናት ምርምር(Armen Hansen Research institusion) ተቋም ነው፡፡

የበሽተኛው ክፍያ

በዚህ ጥናት ውስጥ ሰለተሳተፍክ የሚደረግልህ ምንም አይነት ክፍያ የለውም ሁሉም ክፍያ የሚሸፈነው ባንተ ወይም በገባህበት የጤና መድህን ድርጅት ነው።።በጥናት ውስጥም በመሳተፍክ የምትከፍለው ክፍያም የለም።።

ታካሚው በጥናት ውስጥ የመሳተፍና የማቋረጥ መብት

በጥናት ውስጥ የአንተ መሳተፍ በአንተ ሙሉ ፍቃደኝነት ላይ የተመሰረተ ነው።። ያለመሳተፍም መብትና መርጫክ ነው።።

በጥናትውስጥ ባትሳተፍም ሐኪምክ ተገቢውንየህክምና ክትትል ያደርግልሃል።።ባለመሳተፍክም የሚደርግልህ የህክምና መመሪያ ውስጥ የምታጣውና የምታገኘው ጥቅም የለም።። በጥናቱ ውስጥ እያለክ ማቋረጥ ከፈለክ ማቋረጥ ትችላለህ።።

በጥናት ውስጥ አዲስ ነገር አንተን የሚጠቅም ነገር ከተገኘ ይነገርካል እናም ሐኪሙ ጥናቱ በአንተ ላይ ችግር እየፈጠር ነው፡ ብሎ ካሰበ በማንኛውም ወቅት ያላንት ፍቃድ ሊያስቆምህ ይችላል እናም ድጋፍ የሚያደርግልክ አካል እንኳን በፈለከው ጊዜ ሊያስቆምክ ይችላል።።

የምርመራ ነሙና መዉሰድ

ሀኪምክ ወይም ለአንተየጤና እንክብካበቤ የሚያደርግልክ ሰው ምርመራ ባስፈለገክ ጊዜ የምርመራ ናሙና ሊወስድ የችላል።። የምርመራ ናሙና አይነት እና መጠን በአንተ የጤና እመም ሁኔታ የሚወሰን ነዉ።። ስለ ናሙና አወሳሰድ በአንተ የጤና ተንከባካቢ በኩል በደንብ ማብራሪያ የደረግልሃለ።። ካንተላይ የሚወሰደዉ ናሙና ሁለት ወይም ሶስት ማንኪያ አክታ ክዳን ባለዉ ፕላስቲክ ሲኒ፣ አስር ወይም ሀያ ማንኪያ ደም በመርፌ መውጊያ ሁለቴ ወይም ሶስቴ፣ ያመረቀዘ ቁስል እና የመሳሰሉትን ጫፉ ጥጥ ባልዉ ትንሽ እንጨት እና አምስት ወይም አስር ማንኪያ ሽንት ክዳን ባልው ፕላስቲክ ሲኒ ነዉ።። እናም የተለያዩ ናሙናዎች እንደየ አስፈላጊነታቸዉ ሊወሰዱ ይችላሉ።።

ጥያቄ ካለክ

ጥያቄ ካለክ ይህ ጥናትና ምርምር የሚያደርገውን አቶ አድነው ዘውዱ የሆኑትን የፊለከውን ጥያቄ በፊለከው ጊዜ በስልክ ቁጥራቸው 0911360320 ወይም 0924552982 ደውለው ማነገር ይችላለ።።

እና ይህ ወረቀት አንዱ ኮፒ ከእርሶ ጋር ይቆያል።። እንደ ጥናቱ ተሳታፊነትክ መብትህን በተመለከተ ለተቋሙ በዚህ ስልክ 0112755170 ደውለው መጠየቅ ይችላለ።።

<u>ሚስጥራዊነት</u>

በተቻለን መጠን የእርሶን የህክምና ውጤት ሚስጥሮችን እንጠብቃለን ነገር ግን ዋስትና አንገባሎትም ምክንያቱም ከዚህ በታች ባሉት የድርጅት ስም ዝርዝር ስለሚታይ

1- የፌዴራል ድርጅት በሰዎች ላይ የሚደርገውን ጥናት ስለሚያይ
2- የተቋሙ ሪቪው ቦርድ ኮሚቴ ስለሚያየው
3- የጥናቱ ተመራማሪ የሆኑት ሰዎች ስለሚያዩት
4- ለጥናቱ ድጋፍ የሚያደርጉ ሰዎች ስለሚያዩት
5- የተቋሙ ተቆጣጣሪ የሆኑት ሰዎች ስለሚያዩት

ሌላው ይህ ጥናት በስብሰባዎች ላይ ሊቀርቡ ይችላሉ እንደዚህም በህትመት ላይ ነገር ግን የእርሶ ስም ሚስጥራዊ ነው።።

<u>ጉዳቶችና ማካካሻዎች</u>

በጥናቱ ውስጥ መሳተፍ ከፈለክ የህክምና ክትትል ለሚያደርጉልክ ሃኪም ማሳወቅ ትችላለህ በጥናቱ መሰረት ጥያቄዎች ካሉክ በ0911360320 ወይም 0924552982 ወይም ለግል ሃኪምክ የገጠሞትን ችግር ሁሉ ማሳወቅ ይችላሉ በጥናቱ ውስጥ ችግር ከገጠሞት እርዳታ እንናደርግሎታለን።። ነገር ግን ተጨማሪ ክፍያ እናስከፍሎታለን።።

<u>ስምምነት</u>

ይህን ወረቀት ስለጥናቱ የሚለውን አንብበው ከጥናቱ የሚገኙ ጉዳቶችን ጥቅሞችን ተረድቻለሁ እናም የጥናቱ አካል መሆኔበፍቃደኝነቴ ነው እናም በጥናቱ ውስጥ ለመካተት መርጫለው እናም ጥናቱ ውስጥ መሳተፍ ባቋርጥም እንኳን ተገቢውን የህክምና እርዳታ

አገኘለው እናም የስምምነት ወረቅ ቀሪው ከእኔ ጋር ይሆናል እናም ከዚህ በላይ ያሉትን ውሎች ተስማምቼ እዚ ቅፅ ላይ በፊርማዬ አረጋግጣለሁ፡፡

ስም---------- ቀን ---------- ፊርማ ----------

ውሉን ያስፈረመው

ሰው ስም---------- ቀን ---------- ፊርማ ----------

አጥኚው ስም---------- ቀን ----------

Unkaa Waliigaltee Dhukkubsataa

Qulqulina tajaajila fayyaa hospitaalaa foyeessuf jecha qo'anno kana keessatti akka galtan isin gaafana. Sababni itti gaafatamtanis yeroo qo'annoon kun gaggeeffamu dhukubsataa hospitaala keessatti yaalii irra turtan wanta taataniif.

Yeroo turmaataa hospitaala kessaa keessanis hordoffiin isiniif godhama. Yeroo turmaataa kessanis karam akka deemtan yeroo hangamiitiif akka turtan gargaarsi yaalii akkamii akkaisinii taasifamee fi enyu maal akka isinii kenne nigalmaa'a.

Qo'anno keessattis tilmaaman dhukkubsattoota haaga 2,076 ta'an nihirmaatan.

Qajeelfama

Gargaarsi yeroo turmaataa keessanitti isinii godhamu hinjijjiiramu.Dubbistanii akka mallatteesitan kabajaan isin gaafanna.Waliigaltee kana ega mallatteesitanii kaasee haanga hospitaala kessaa baatanitti osoo gaaffii addaa kamiiyyuu isin hingaafatin hordoffii taasifna.

Odeffannoon isin irraa fudhatamaniis haanga Waxabajjii 2009 nubira tura.Sababni qo'annoo kanaa itti filatamtaniif dhukkubsattoota ji'a Gurraandhalaa haanga Ji'a Caamsaa 2009 hospitaala kessatti yaalii argatan kessaa isa tokko wanta taataniif.

Mijaayina dhabuuf balaa

Mijaayina dhabuu fi balaan adda addaa yeroo qo'annoo kessatti yoo isin mudatee qo'annoo keessa galchuu nidandeenya.

Faayidaa

Qo'annoon kun qo'ataadhaa haala tajaajilli yaalaa hospitaala kessaa itti foya'u itti barata malee tajaajila yaalaa isiniif godhamu irratti foyya'insa hingodhu.

Deggaraan qo'anno,

Qo'annoo kana kandeeggarsa kennuun gargaaru Dhaabbata Qorannoo Arman Haansan (Armen Hansen Research Institute) dha.

Kaffaltiin Dhukkubsataa

Qo'annoo kana irratti hirmaachu kessaniin kaffaltiin isiniif raawwatamu homumtuu hinjiru.kaffaltiin hundi kan raawwatamu gama keessaniin yokan waajjira Inshuraansii Fayyaatin. Qo'annaa keessatti hirmaachuu keessaniinis kaffaltiin kaffalamu homaa hinjiru.

Dhukkubsataan qo'annaa keessatti mirga hirmaachuuf jidduun dhaabuu

Hirmaannaan qo'annoo kessan fedhii gutuu keessan irratti kan hundaayeedha.Hirmaachuu dhiisunis mirgaa fi filannoo kessan.

Qo'annoo keessattis hirmaachu baattanhaakiimni keessani hordoffii yaalii barbaachisaa ta'e isiniif godha.Hirmaachuu dhisuu kessaniin qajeelfama tajaajila yaalaa keessatti wanti dhabdanii fi faayidaa argattan homumtuu hinjiru.

Qo'annoo keessatti wanti haarawaa isin fayyadu yoo argame isinitti himama.Haakimni rakkoo isin irratti umaa jira yoo jedheyeroo kamiiyyu haayyama keessan malee dhaabsisuu nidanda'a.Qaamni deeggarsa isiniif godhusi yeroo feetanitti isin dhaabsiisuu nidanda'a.

Saamuda qorannoof fuudhuu

Haakiimni kee yookan ogeessi kunuunsa yaalii fayyaa isiniif laatu qorannoon yeroo sibarbaachisetti saamuda qorannoof fuudhuu nidanda'a.Haalli qorannoo fi baayyinni saamudaa haala dhukkuba isin dhukkubsattan irratti kanmurta'u ta'a. Ibsii saamuda fudhatamu gama ogeessa kunuunsa fayyaa isiniif laatun sirritti isiniif kennama. Saamudni isin irraa fuudhatamu akii fal'aana lama yookan sadii sinii plaastikaa qadaada qabuun, dhiiga fal'aana kudhan yookan diigdama limmoodhaan, Fal'aana lama yokan sadii malaa madaa fi kankana fakkaatan muka xiqqaa jibrii qabun fi fal'aana shan yokan kudhan sinii plaastikaa qadaada qabuunidha.fi saamudni adda addaa akka barbaachisumaa isaanitti fudhatamuu nidanda'an.

Gaafii yoo qabaattan

Gaaffii yoo qabaattan obboo Adinaw Zawidu qo'annaa kana gaggeessaa jiran gaaffii barbaaddan yeroo barbaaddanitti lakkoofsa bilbilaa 0911360320/0924552982bilbiltanii dubbisuu nidandeessani.

Waliigalteen kuni koppiin tokkoisinii wajjin tura. Akka hirmaataa ta'uu keessanitin mirga keessan ilaallatee bilbila 0112755170 bilbiltanii waajjira gaafachuu nidandessan.

Iccitummaa

Hanga dandeenyyetti iccitii bu'aa yaalii keessanii niegna garuu sababa maqaa waajjiroota asii gadittii tarreefamaniin wanta laalamuuf wabii isinii hinseennu.

1. Waajjirri fedaraalaa qo'annoo ilma namaa irratti raawwatamu wanta laaluuf
2. Koreen boordii riiviiwii dhaabbataa wanta laaluf
3. Namootni qo'anoo kessatti hirmaatan wanta laalaniif
4. Namootni qo'annoof deegarsa kennan wanta laalaniif
5. Namootni to'ataa dhaabbataa ta'an wanta laalaniif

Kan biraa qo'annoon kun walgahii irraatti dhihaachufii maxxanfamuu nidanda'a garuu maqaan keessan iccitii dha.

Midhaaf benyaa

Qo'annoo kessatti hirmaachu yoo barbaaddan haakima hordoffii yaalaa isiniif godhutti beksisuu nidandeessani gaaffi qo'annoo irratti hundaa'e yoo qabaattan biilbila 0911360320/0924552982 yokan gana hakiima kessaniitin rakkoolee isin mudatan hunda beksisuu nidandessan.Qo'annoo keessatti rakkoon yoo isin mudate gargaarsa isiniif goona.garuu kaffaltii dabalataa isin kaffalsiisna.

Waliigaltee

Waan qo'annoowaraqaa kana irra jiru dubbisee midhaa fi faayidaa qo'annoo irra argamu hubachun fedhii kotiin qaama qo'annoo ta'uf qo'annoo keessa galuuf filadhee hirmaannaa kiyya jidduun dhaabbileegargaarsa yaalii barbaachisaa ta'e ninargadha haafteen waraqaa waliigalteeanaa wajjin ta'a.Waliigalteewwan unkaa kanaa olitti barreeffaman ofitti fudhachuu kiyya mallattoodhan mirkaneessa.

Maqaa_____ Guyyaa_____ Mallattoo_____

Waliigaltee kanmallatteesisee

Maqaa_____ Guyyaa_____ Mallattoo_____

Maqaa qo'ataa_____ Guyyaa_____

Annex III

HCAI Questioner

1. Who should fill in this question?

This can be filled in by any responsible person.

2. Any queries?

If you are uncertain how to answer any question, or wish to discuss any aspects of the questionnaire, or if you would like longer to complete it, please contact us. You can contact either:

Adinew Zewdu **Email** adinewz@yahoo.com**Telephone:** 0911360320/0924552982, or

Kassu Desta **Email**kassudesta2020@gmail.com**Telephone:** 0911107099

3. Due date

We would be grateful if you could complete the questionnaire as quickly as possible.

Please return it by the end April 30 of 2017 G.C.

4. Details of the person who filled in this questionnaire

Name		
Title/position		
Contact numbers:	Telephone	Fax
Email		

Note:If you have given your contact details on another questionnaire, just give your name

5. Interview Data collection techniques use

5.1. Patient detail information

Date of survey:				
Patient name:		Age:	Sex: M	F
Region:	Zone:	Wereda:	Kebele:	
Phone number of patient:				
Patient Card number:				

5.2. Patient reason of admission information

Type of admission:	◯	Elective	◯	Emergency	◯ Term labor
Other, what is it? _____					
Date of admission: Date:			Time:		
Diagnosis of Admission:					

5.3. Patient recent admission history before admitted in the hospital

Has the patient transferred (Referred)?	◯ **Yes**	◯ **No , if no go to section** 6		
If yes from which facility?	◯ Health center	◯ Government Hospital	◯ Private Hosp	
If yes, How long stay there?				

6. Observational Data collection techniques use

6.1. Patient admission ward Information

Which ward has the Patient admitted?						
◯ Emergency	◯ Gynecology	◯ obstetric	◯ Medical	◯ Surgical	◯ ICU	◯ Orthopedic
Ward number:						
Bed number:						

7. Use medical records to fill the following question

7.1. Medical risk factor(Comorbid) of the patient(Medical records)

What medical risk factor has the patient? Circle one or more of the risk factor that are listed below.

◯	Major trauma	◯	malnourished	◯	smoking
◯	Obesity	◯	Peptic ulcer disease	◯	HIV/AIDS
◯	Renal disease	◯	Mild liver disease	◯	Age >65
◯	COPD	◯	Moderate or severe liver disease	◯	Diabetes without chronic complications
◯	Diabetes with chronic complications	◯	Dementia	◯	

	Vascular disease				
○	Congestive heart failure	○	Peripheral vascular disease	○	Cerebrovascular disease
○	Myocardial infarction	○	Other(state)		
	Immunological and Hematological disease				
○	Hemiplegia or paraplegia/strock	○	Leukocytopnia	○	Other immunosuppression (state)._____
○	Rheumatologic disease	○	Allergic(state type of allergy):-	○	History of beta-lactam allergy (state nature)
	Cancer				
○	Any malignancy, including leukemia and lymphoma	○	Metastatic solid tumor	○	Other(state)

7.2. Patient therapy information

Has the patient taking any therapy?	○ **Yes**	○ **No ,if no, go to section 7.3**

What type of therapy has the patient taking?

○ steroid	What?1, _____	for how long? _____
	What?2, _____	for how long? _____
	What?3, _____	for how long? _____
○ NSAID	What?1, _____	for how long? _____
	What?2, _____	for how long? _____
	What?3, _____	for how long? _____
○ chemotropic(cytotoxic)	What?1, _____	for how long? _____
	What?2, _____	for how long? _____
	What?3, _____	for how long? _____
○ antibiotics	What?1, _____	for how long? _____
	What?2, _____	for how long? _____
	What?3, _____	for how long? _____

7.3. Patient Medical care device use

Has the patient use any medical care device?	◯	Yes	◯	No , if no go to section 6.3

If yes, what type of device used?

		Date of device procedure start:	Time	Date of device procedure termination	Time	Average date
◯	Suprabubic catheter					
◯	urethral catheter					
◯	venous intravascular catheter					
◯	arterial intravascular catheter					
◯	central intravascular catheter					
◯	tube ventilator(Respirator)					
◯	mask ventilator(Respirator)					
	Other, what type is it, write here _____					

7.4. Surgical or non-surgical wound cleaning or dressing information

		Date of cleaning start	Frequency cleaning	Dressing or cleaning termination Date
	Surgical site cleaning or dressing			

Has the patient undergoes any form of surgery? ◯ Yes ◯ No, if no go to section **7.5**

If yes, what type of surgery? Write here the type of surgery served

_____
_____

7.5. Health care device provider (health professional) information

Who provide the health care device service to the patient?			
◯	Senior doctors	◯	Nursing/midwives students
◯	Resident medical staff	◯	Allied health professionals
◯	Medical students	◯	Health care assistants or equivalent
◯	Nurses/midwives		

8. Clinical evaluation data collection technique use

8.1. Patient infection information after 48 hours admission and above.

Has the patient develop infection?	◯ Yes	◯ No , if no go to next section

If yes, what type of infection has the patient developed?

◯	SSI	☐	superficial infections	☐	under the skin, organs, or implanted material	☐	Bone and Joint (including spine)
◯	Pneumonia	☐	Ventilator associated	☐	None VAP	☐	
◯	UTI	☐	With urethral catheter	☐	Without indwelling device	☐	
◯	Septicemia	☐		☐		☐	
◯	Meningitides	☐		☐		☐	
◯	GI. infection	☐		☐		☐	

If other than the list , write here:_____

Has the patient non-surgical break in the skin? ◯ Yes ◯ No

If yes, what type of skin break has?

◯ Vascular ulcer ◯ Diabetic ulcer

◯ Pressure sore ◯ Other

◯ Vascular pressure If other, what: _____

Date and time of infection diagnosed: Date:_____ Time:_____

9. Laboratory result Data collection

9.1. Microbiology laboratory Result

What type of sample collected for Diagnosis?

- ○ Wound swab
- ○ Sputum
- ○ Midstream Urine
- ○ Blood
- ○ CSF
- ○ Stool
- ○ Ear swab
- ○ Pleural fluid
- ○ Suprapubic Urine
- ○ Pericardial fluid
- ○ Ascites fluid
- ○ Eye swab
- ○ Throat swab
- ○ Catheter urine
- ○ Urethral swab
- ○ Vaginal swab

What type of Organism isolated from clinical sample?

- ○ *S.aureus*
- ○ *CNS*
- ○ *S.pyogen*
- ○ *S.agalactae*
- ○ *S.pneumonia*
- ○ *s. viridian group*
- ○ *Entrococcus species*
- ○ *Hemophilus influenza*
- ○ *Hemophilus para influenza*
- ○ *Citrobacter frundi*
- ○ *Citrobacter diversus*
- ○ *Enterobacter aerogenosa*
- ○ *Enterobacter cloacae/amnigenus*
- ○ *Erwinia chrysanthemi*
- ○ *Erwinia carotovora*
- ○ *Erwinia cacticida*
- ○ *E.coli*
- ○ *K.oxytoca*
- ○ *K.pneumoniae*
- ○ *Serratia marcescencens*
- ○ *Serratia liquefaciens*
- ○ *Edwardsella Tarda*
- ○ *Morgenella morganii*
- ○ *Proteus mirabilis*
- ○ *Proteus vulgari*
- ○ *Proteus penneri*
- ○ *Providencia stuartii*
- ○ *Salmonella species(bongori & enterica)*
- ○ *Shigella spps*
- ○ *Shigella sonnei*
- ○ *Yersinia enterocolitica*
- ○ *Yersinia pseudotuberculosis*
- ○ *Yersinia pestis*
- ○ *Pseudomonas aeroginosa*
- ○ *Acinetobacter baumanii*
- ○ *Aeromonas spps*
- ○ *Vibrio spps*
- ○ *Clostridium difficuli(if antibiotic associated*

○	*Serratia fonticola*	*infection of Gastrointestinal*
○	*Serratia rubidaea*	

9.2. Antibiotic profile of isolate organism

Select the antibiotic and circle the status of the antibiotic in front of it

S: sensitive I: intermediate R: resistance

○	**CEFOXITIN**	**S**	**I**	**R**
○	CLINDAMYCIN	S	I	R
○	ERYTHROMYCIN	S	I	R
○	OXACILLIN	S	I	R
○	PENICILLIN G	S	I	R
○	TETRACYCLINE	S	I	R
○	TRIMETH - SULFA	S	I	R
○	VANCOMYCIN	S	I	R
○	AMIKACIN	S	I	R
○	AMPICILLIN	S	I	R
○	AMOXYCILLIN	S	I	R
○	AMOX-CLAV ACID	S	I	R
○	CEPHAZOLIN	S	I	R
○	CEFEPIME	S	I	R
○	CEFOTAXIME	S	I	R
○	CEFTAZIDIME	S	I	R
○	CEFTRIAXONE	S	I	R
○	CEFUROXAME	S	I	R
○	CEPHALOTHIN	S	I	R
○	CHLORAMPHENICOL	S	I	R
○	CIPROFOXACIN	S	I	R
○	GENTAMICIN	S	I	R
○	IMIPENEM	S	I	R
○	NALIDIXIC ACID	S	I	R
○	NITROFURANTOIN	S	I	R
○	PIPERACILLIN	S	I	R
○	PIPERACILLIN/TAZOBACTAM	S	I	R
○	TOBRAMYCIN	S	I	R
○	CARBENICILIN	S	I	R

10. Use Medical records to fill the following information

10.1. Prescribed patient antibiotic

Has the patient been prescribed antibiotic	○ **Yes**	○ **No**

If yes, what type of antibiotic prescribed?	1					
	2					
	3					
Rout of administration	**PO**	IV	IM	ID	Annals	
If no, write the reason						

10.2. Patient discharge or expired information

Date of discharge	**Time of discharge**	
Reasoned of discharge or expired		

Annex IV

General Microbiology Specimen Collection processing and Identification procedure

1. Specimen collectionprinciple &safety

The quality of a result is directly related to the quality of the specimen being cultured. The best results areobtained when the following guidelines are maintained.

- Follow universal precaution guidelines. Treat all specimens as potential biohazards.
- Collect specimen before administering antimicrobial agents when possible.
- Collect specimen with as little contamination from indigenous flora.
- Utilize appropriate collection devices, sterile equipment, and aseptic technique to collect specimens.Various types of transport media are provided depending on the type of culture required.
- All swabs are to be kept moist in a transport medium after the specimen is collected.
- Clearly label the specimen container with:
    - patient's name
    - date
    - Time of collection.
- Collect an adequate amount of specimen. Inadequate amounts of specimen may yield false negativeresults.
- Identify the specimen source and/or specific site correctly so that proper culture media will be selectedduring processing in the Laboratory.
- Transport all specimens to the Laboratory promptly. This ensures the survival and isolation offastidious organisms and prevents overgrowth by more hardy bacteria. It also shortens the duration ofspecimen contact with some local anesthetics used in collection procedures that may have antibacterialactivity

2. Specimen collection

A. BLOOD

1. **Number and timing**: Most cases of bacteremia are detected by using 2 to 3 separately collected blood cultures. More than 3 blood cultures yield little additional information. Conversely, a single blood culture may miss intermittent bacteremia and make it difficult to interpret the clinical significance of certain isolated organisms. The following can be used as general guidelines:

    a) Acute sepsis. Collect 2 from separately prepared sites prior to starting therapy.

b) Acute endocarditis. Obtain 3 blood cultures with 3 separate venipunctures over 1 to 2 hours.

c) Subacute endocarditis. Obtain 3 blood cultures on day 1 (15 minutes or more apart). If all are negative 24 hours later, obtain 3 more.

d) Fever of unknown origin. Obtain 2 separate blood cultures at least 1 hour apart. If these arenegative, then 24 to 36 hours later obtain 2 more blood cultures 1 hour apart.

2. **Volume**: The volume of blood is critical because the concentration of organisms in most cases ofbacteremia is low. In infants and children, the concentration of organisms during bacteremia is higherthan in adults, so less blood is required. In general:

a) Infants: 0.5 to 1.5 ml of blood per venipuncture.

b) Children: 1.0 to 10 ml of blood per venipuncture.

c) Adults: 10 to 25 ml of blood per venipuncture.

3. **Type of blood culture**: Blood cultures may be drawn in a variety containers. Refer to the specific testfor the type of container to use.

a) Routine blood culture

b) Treated blood culture

c) Fungus blood culture

d) Acid fast blood culture

e) CMV blood culture

4. **Blood collection**:

a) Clean venipuncture site with alcohol.

b) Apply iodine solution in concentric circles working from the inside.

c) Allow to dry for 30 seconds before performing the venipuncture.

d) Do not touch the site with fingers or any non-sterile object.

B. CENTRAL NERVOUS SYSTEM SPECIMEN COLLECTION

1. Cerebrospinal Fluid

a) Specimen is collected by a physician.

b) CSF should be collected into sterile leak proof tubes. Three tubes are generally required formicrobiology, hematology and chemistry testing. The second tube drawn will generally go tomicrobiology and the last tube drawn will generally go to hematology.

c) Suggested volumes are 1, 2 and 3 ml for routine, fungal and mycobacterial cultures.

2. Brain abscess

a) Specimen is collected by a physician.
b) Most brain abscesses are caused by anaerobic bacteria. Specimen should be submitted in anaerobictransport or in a capped syringe.

C. GASTROINTESTINAL TRACT SPECIMEN COLLECTION

1. Fecal specimens: Have patient obtain stool specimen by one of the following methods:
   a) Pass stool directly into a sterile, wide-mouth, leak proof container with a tight fitting lid.
   b) Pass stool into a clean, dry bedpan, and transfer into a sterile leak proof container with a tight fitting lid.
   c) Keep stool specimen cool. Do not incubate.
   d) Do not use toilet paper to collect stool. Toilet paper may contain substances, which are inhibitoryfor some fecal pathogens.

D. RESPIRATORY SPECIMEN COLLECTION

LOWER RESPIRATORY

1. Expectorated sputum
   a) Have the patient rinse mouth and gargle with water prior to sputum collection.
   b) Instruct the patient not to expectorate saliva or post nasal discharge into the container.
   c) Collect specimen resulting from deep coughing in a sterile screw cap container.
   d) For routine bacteria a single specimen is sufficient. For acid fast bacilli and fungi three firstmorning specimens on consecutive days is recommended.
   e) Specimens consisting primarily of saliva are rejected.
2. Induced sputum
   a) Using a wet toothbrush, brush the buccal mucosa, tongue, and gums prior to the procedure.
   b) Rinse the patient's mouth thoroughly with water.
   c) Using an ultrasonic nebulizer, have the patient inhale approximately 20 to 30 ml of 3 to 10% 0.85%NaCl.
   d) Collect the induced sputum in a sterile screw cap container.
3. Tracheostomy and endotracheal aspirations
   a) Aspirate the specimen into a sterile sputum trap.
4. Bronchial specimens

a) Bronchoscopy specimens include Broncho alveolar lavage, bronchial washing, bronchial brushing,and Tran's bronchial biopsy specimens.
b) Bronchial wash and Broncho alveolar lavage specimens are generally obtained before brushing orbiopsy specimens to avoid excess blood in the recovered fluid. The bronchial brushes should beplace in the special bronchial brush transport tubes supplied by the Microbiology Laboratory.
c) Quantitative bacteriology cultures can be performed on the bronchial washing and bronchial brushspecimens.

5. Lung aspirations or biopsies
   a) These specimens are obtained by inserting a needle through the chest wall into the pulmonaryinfiltrate.
   b) If the lesion is large or if there are multiple lesions, collect multiple specimens from representativesites.

UPPER RESPIRATORY

1. Throat (pharyngeal specimens)
   a) Do not obtain throat sample if epiglottis is inflamed, as sampling may cause serious respiratoryobstruction.
   b) Depress tongue gently with tongue depressor.
   c) Extend sterile swab between the tonsillar pillars and behind the uvula. Avoid touching the cheeks,tongue, uvula or lips.
   d) To obtain sample, sweep the swab back and forth across the posterior pharynx, tonsillar areas and inparticular any inflamed or ulcerated areas.
2. Nasal
   a) Insert a sterile swab into the nose until resistance is met at the level of the turbinates (approximately1 inch into the nose). Rotate the swab against the nasal mucosa.
   b) Repeat the process on the other side.
3. Nasopharyngeal suction
   a) Suction material from the nasopharynx, and collect it in a sterile container.
4. Nasopharyngeal swabs

a) Carefully insert a flexible-wire calcium alginate-tipped swab through the nose into the posteriornasopharynx and rotate the swab. Keep the swab near the septum and the floor of the nose.

5. Nasopharyngeal washings
   a) Submitted primarily for viral studies.
   b) Instruct the patient not to swallow during the procedure.
   c) With the patient's head hyperextended instill 2 to 5 ml of sterile saline into each nostril.
   d) Aspirate the fluid by inserting a rubber bulb syringe into each nostril.
   e) Place the wash in a sterile container or in viral transport medium if viral culture is desired.
6. Sinus
   a) The only appropriate specimen is material directly aspirated from a sinus cavity.
   b) Using syringe aspiration technique, a specially trained physician will obtain material frommaxillary, frontal or other sinuses.
   c) Send the specimen in a capped syringe.
7. Middle ear
   a) Submitted primarily to diagnose middle ear infections only if previous therapy has failed.
   b) The physician will obtain the fluid from behind the eardrum by a syringe aspiration.
   c) Send the specimen in a sterile container or send it in the syringe.
   d) If eardrum is ruptured, collect exudate by inserting sterile swab through an auditory speculum.

E. **STERILE BODY FLUIDS:** (excluding CSF, urine, blood)

a) Disinfect the needle puncture site.
b) The physician will aseptically perform percutaneous aspiration to obtain pleural, pericardial, peritonealor synovial fluids.
c) Expel any air bubbles from syringe, and immediately inject specimen into a sterile screw capcontainer.
d) Transport to the Laboratory immediately.

F. SUBCUTANEOUS TISSUE AND SKIN SPECIMEN COLLECTION

1. Burn **specimens**: The surfaces of burn wounds will become colonized by the patient's microbial flora or by environmental organisms. When the organism load is large, infection of underlying tissue may occur and bacteremia may result. Cultures of the surface alone are misleading. Therefore, biopsies of deeper tissue are often indicated. Additionally, organisms may not be distributed evenly in the burn wound, so sampling of different areas of the burn is recommended.
   a) Disinfect the surface of the burn. Allow the disinfectant to dry prior to collecting the specimen.
   b) Collect a punch biopsy sample for quantitative culture.
2. **Superficial wound, bacterial**: Syringe aspiration is preferable to swab collection.
   a) Disinfect the surface of the wound and allow the disinfectant to dry prior to collecting the specimen.
   b) Using a sterile needle and syringe, a physician will aspirate the deepest portion of the lesion. If avesicle is present, collect both fluid and cells from the base of the lesion.
   c) If the initial aspiration fails to obtain material, inject sterile, nonbacteriostatic saline subcutaneously.
   d) Repeat the aspiration attempt.
3. Superficial lesions, fungal
   a) Clean the surface with sterile water.
   b) Using a scalpel blade, scrape the periphery of the lesion border. Samples from scalp lesions shouldinclude hair. If there is nail involvement, obtain scrapings of debris or material beneath the nailplate. Transport in a sterile container.
4. Ulcers and nodules
   a) Disinfect ulcer or nodule.
   b) Remove overlying debris.
   c) Curette the base of the nodule or lesion.
   d) If exudate is present, collect it with a syringe or sterile swab.

G. DEEP WOUNDS, ASPIRATES AND TISSUE SPECIMEN COLLECTION

1. Bite wounds
   a) Aspirate pus from the wound, or obtain at the time of incision, drainage, and debridement of infected wound.
   b) Do not culture fresh bite wounds, as infectious agents will likely not be recovered.
2. Bone

a) Obtain bone specimen at surgery.
b) Submit in sterile container without formalin.

3. Deep wounds, abscesses or sinus tracts
   a) Disinfect the surface of the wound or abscess.
   b) Aspirate the deepest portion of the lesion or sinus tract, avoiding contamination by the woundsurface.
   c) c) If collection is done at surgery, a portion of the abscess wall should also be sent for culture.
4. Punch skin biopsies
   a) Disinfect the skin surface.
   b) Collect 3 to 4 mm sample with dermal punch.
   c) Submit in sterile container without formalin.

H. URINE SPECIMEN COLLECTION

General considerations

- Never collect urine from a bedpan or urinal.
- Thoroughly clean the urethral opening (and vaginal vestibule in females) prior to collection proceduresto ensure that the specimen obtained is not contaminated with colonizing microorganisms in this area.
- Use soap rather than disinfectants for cleaning the urethral area. If disinfectants are introduced into theurine during collection, they can inhibit the growth of microorganisms.
- Transport the specimen to the laboratory such that it will be plated within two (2) hours of collection.

Urines from clinics outside the main hospital campus should be place in tubes with preservative. These specimens can be held for eight (8) hours. Alternatively, urines can be refrigerated for 24 hours before plating.

- Use sterile tubes or cups to collect and transport the urine.

1. Clean catch urine specimen collection (female)
   a) The person obtaining the urine specimen should wash hands with soap and water, rinse and dry. If the patient is collecting the specimen, she should be given detailed instructions.
   b) Cleanse the urethral opening and vaginal vestibule area with soapy water or clean gauze padssoaked with liquid soap.
   c) Rinse the area well with water or wet gauze pads.

d) Hold labia apart during voiding.
e) Allow a few milliliters to pass.
f) Collect the midstream portion of urine in a sterile container.

2. Clean catch specimen collection (male)
   a) The person obtaining the specimen should wash their hands with soap and water, rinse and dry. Ifthe patient is collecting the specimen, he should be given detailed instructions.
   b) Cleanse the penis, retract the foreskin (if not circumcised), and wash with soapy water.
   c) Rinse the area well with water.
   d) Keeping foreskin retracted, allow a few milliliters of urine to pass.
   e) Collect the midstream portion of urine in a sterile container.
3. Ileal conduit urine collection
   a) Remove the external urinary appliance and discard the urine within the appliance.
   b) Gently swab and clean the stoma opening with a 70% alcohol pad and then with an iodine solution.Remove excess iodine with an alcohol pad.
   c) Using sterile technique, insert a double catheter into the stoma.
   d) Catheterize the ileal conduit to a depth beyond the fascial level.
   e) Collect the urine drained into a sterile container.
4. Indwelling catheter urine collection
   a) Clean the catheter collection port with a 70% alcohol swab.
   b) Using sterile technique, puncture the collection port with a needle attached to a syringe.
   c) Aspirate the urine and place it into a sterile container.
5. Straight catheter urine collection
   a) Clean the patient's urethral opening (and in females the vaginal vestibule) with soap, and carefullyrinse the area with water.
   b) Using sterile technique, pass a catheter into the bladder.
   c) Collect the initial 15 to 30 ml of urine and discard it.
   d) Collect a sample from the mid- or later flow of urine in a sterile container.

3. Summary Of Collection And Transport Requirement For Specific Specimens

SPECIMEN	COLLECTION	TRANSPORT CONTAINER	TRANSPORT TIME	COMMENTS
Blood	Cleanse venipuncture site with 70% alcohol followed by Iodine. .	Inoculate the blood into the Blood culture bottle immediately.	Immediately on collection. **Do notrefrigerate**	Volume-**Adults** 8-10 ml/bottle 2- 3 cultures per septic episode. **Infants** 1-2 ml
Body Fluid	Cleanse skin as above-collected by physician	Sterile screw cap tube	Immediately on collection **Do notrefrigerate**	Volume-5 ml (minimum-1ml)
CSF	Cleanse skin as above-collected by physician	Sterile screw cap tube	Immediately on collection **Do notrefrigerate**	Volume-5 ml (minimum-1ml)
Conjunctiva/ Eye	Cleanse skin around the eye with a mild antiseptic and swab infected area	Swab in Transport Media	Within 2 hours of collection	Submit a swab from the uninfected eye for comparison
Ear (Otiits Externa)	Remove debris; collect specimen by rotating the swab in the ear canal.	Swab in Transport Media	Refrigerate if >2hour delay in transport	Inner ear specimens are collected by a physician
Genital Females	Cervix and vagina-use a non-lubricated speculum and swab affected site.	Swab in Transport Media	For diagnosis of ***N.gonorrhoeae*** transport immediately Vaginal swabs - refrigerate if >2 hour delay in transport	For diagnosis of ***N.gonorrhoeae*** submit swab in charcoal Transport Media. **Do notrefrigerate**
Genital Males & females	Swab urethra, collect discharge	Swab in charcoal Transport Media	For diagnosis of ***N.gonorrhoeae*** transport immediately	As above
Sputum	Freshly expectorated sputum	Sterile wide-mouthed	Refrigerate if > 2 hour delay	Delay of > 2hours compromises the ability

		container	in transport	to isolate fastidious organisms
Stool	Freshly passed stool	Sterile/ clean container	Refrigerate if > 2 hour delay in transport	Rectal swabs in Transport Media are acceptable
Throat	Swab of pharynx and tonsils	Swab in Transport Media		Avoid touching mouth or gums with the swab
Urine	Mid-stream, clean catch, catheter, cystoscopy	Sterile wide-mouthed container	Refrigerate if > 2 hour delay in transport	24 hour urines and those from catheter bags are unacceptable
Wound	Aspirate, swab of pus, tissue	Swab in Transport Media Aspirate , tissue in sterile container	Aspirates and tissues to be delivered immediately Refrigerate swab if delay in transport media	

4. MICROBIOLOGY SPECIMEN PROCESSING GUIDE

SPECIMEN	MEDIA	GRAM STAIN	INCUBATION	COMMENTS
BLOOD	Blood culture bottles, direct inoculatio	No.	Bottles: 35-37°C for 5 days; examine bottles daily for signs of growth.	Gram stain is perfomed only on bottles showing evidence of growth after incubation.
Cerebrospinal Fluid (CSF)	BA, CHOC	Yes	35-37°C in CO_2, 72 hours	Perform India Ink stain for Cryptococcus Report Gram stain and India ink results within one hour from receipt of specimen.
Ear swab	BA, CHOC, MAC	Yes	35-37°C in CO_2,48 hours	Report Gram stain result within one hour from receipt of specimen
Eye	BA, CHOC, MAC	Yes	35-37°C in CO_2, 48hours	Report Gram stain result on the same day of specimen receipt.
Genital:	CHOC, TM			Report Gram stain result on the same day

a)cervix & urethra b)vagina	BA, CHOC (Add TM for vaginal swab from children)	Yes Yes, report BV, yeast, and PMN only	35-37°C in CO_2, 72 hours 35-37°C in CO_2, 72 hours	of specimen receipt. Perform wet mount for T. vaginalis
Sputum	BA, CHOC, MAC	Yes	35-37°C in CO_2 ,48 hours	Report Gram stain result on the same day of specimen receipt.
Sterile fluid	BA, CHOC, MAC	Yes	35-37°C in CO_2, 72 hours	Report Gram stain result within one hour from receipt of specimen
Stool	MAC, XLD, TCBS, SEL, APW	No	35-37°C for 48 hours	
Throat	BA	No	35-37°C in CO_2, 48 hours	
Urine	BA, MAC	No	35-37°C, 24 hours	
Wound	BA, MAC	Yes	35-37°C in CO_2, 48 hours	Report Gram stain result on the same day of specimen receipt.

5. MICROBIOLOGY CULTURE WORKSHEET

Lab. Number:	**Patient Number:**		**Specimen:**
Specimen receive date:	**Set-up date**	**Set-up Time:**	**Tech Initial:**

GRAM STAIN RESULTS:

PMN:	GPC:	GPR:	GNDC:	Others/Remarks:
EPITH. CELLS:	GNR:	GNCB:	Yeast:	
Date Reported:		Tech Initial:		

CULTURE OBSERVATIONS AND WORK-UP:

Date	**Tech Initial**	**Observations and work-up**

FINAL CULTURE REPORT:

SUSCEPTIBILITY TEST RESULTS: Organism # 1 **Organism # 2**

Drug	Zone size (mm)	Interp. (S, I, R)	Drug	Zone size (mm)	Interp. (S, I, R)
AMPICILLIN			AMPICILLIN		
CEFAZOLIN			CEFAZOLIN		
CIPROFLOXACIN			CIPROFLOXACIN		
ERYTHROMYCIN			ERYTHROMYCIN		
GENTAMICIN			GENTAMICIN		
OXACILLIN			OXACILLIN		
PENICILLIN			PENICILLIN		
NALIDIXIC ACID			NALIDIXIC ACID		
NITROFURANTOIN			NITROFURANTOIN		
SULFA/TRIMETH (SXT)			SULFA/TRIMETH (SXT)		

Final report released by: _____ Date: _____Reviewed by: _____ Date: _____

6. Microbiology Identification short guide

General purpose, enriched, selective, differential and selective are the general categories of media that are used for growth and cultivation of microorganisms. All types of media used in this facility are prepared in-house. At the time of preparation, each batch of medium is tested with selected organisms to confirm the required growth characteristics, selectivity, enrichment, and biochemical response. Stock reference organisms are maintained in this laboratory for this purpose. A means of labeling and recording the identity of the media, lot and batch numbers, preparation date, expiration date, identitity of the preparer, and storage requirmerements is in-place. Since it is onerous to label individual tubes or plates of prepared media, tubes with tightened caps and plated media are stored in bags or boxes that are labeled as described above. All elements of appropriate labeling are recorded and the individual items are traceable to the appropriate data in the record form. Each tube or plate of media are labeled with the identity of the medium and preparation date.

The media and reagent that we use for isolation and identification of microorganism in Microbiology laboratory are the listed below:-

Plate culture media

- Sheep Blood agar
- Chocolate agar
- MacConkey agar
- XLD agar
- TCBS agar

Tube culture media

- TSI
- LIA
- SIM
- Citrate
- Urea
- Bile esculine

Reagent and antibiotic disk

- Oxidase

- Kovacs reagent
- Catalase test
- Supperoxol
- Bile solubility reagent
- String test
- Pyr test
- X,V, XV factors
- Novobiocine disk
- Optochin disk
- Bacitracine disk

N. B:For each culture media and reagent preparation use, laboratory guidline and Standared procedure

7. Antibiotic susceptibility Test

For antibiotic susceptibility testing, we use disk diffusion technique using of Muller Hinton agar

Notes:
All antibiotic susceptibility test guideline copied from CLSI 100 based on that we perform AST for all bacterial isolate as listed bellow.

1) Zone diameter breakpoints are measured in mm.
2) **Bolded** antibiotics are those indicated in CLSI as the first-line to test and report.

S. aureus and other Staphylococcus spp.
Inoculum: Direct colony suspension, equivalent to a 0.5 McFarland standard.
Use Mueller-Hinton Agar. Incubate at 35 ±2^{o}C ambient air for 16 – 18 hours; 24 hours (CNS andcefoxitin).

Drug	Conc. (mcg)	Sensitive	Intermediate	Resistant
Penicillin**	10 units	≥ 29	-	≤ 28
Oxacillin (Cefoxitin)*	30			
Erythromycin	15	≥ 23	14-22	≤ 13
Clindamycin	2	≥ 21	15-20	≤ 14
Trimethoprim-Sulfamethoxazole	1.25/23.75	≥ 16	11-15	≤ 10
Tetracycline	30	≥ 19	15-18	≤ 14
Vancomycin(MIC)				
Ciprofloxacin	5	≥ 21	16-20	≤ 15
Nitrofurantoin	300	≥ 17	15-16	≤ 14

Reporting:
1. Report PEN, OX, ERYTHRO, CLINDA, AND TRIMETH-SULFA.
2. Test and report VANCO for Oxacillin-resistant Staph.
3. Test and report Nitrofurantoin for urine isolates.

*Use CEFOXITIN disk to test for OXACILLIN resistance.
For S. aureus and S. lugdunensis:
Incubate playe at 33-35°C ambient air for 16-18 hours.
≤ 21mm = mec A positive → report as OXACILLIN RESISTANT (do not report Cefoxitin)
≥ 22mm = mecA negative → report as OXACILLIN SENSITIVE (do not report Cefoxitin)
For CNS:
Incubate at 33-35°C ambient air for 24 hours; may be reported after 18 hours if resistant.
≤ 24mm = mec A positive → report as OXACILLIN RESISTANT (do not report Cefoxitin)
≥ 24mm = mecA negative → report as OXACILLIN SENSITIVE (do not report Cefoxitin)

**Penicillin resistant strains of staphylococci produce β-lactamase. Perform an induced β-lactamase test on all Staph isolates for which the zone diameter is ≥ 29mm before reporting the isolate as penicillin susceptible. β -lactamase POSITIVE → report as PENICILLIN RESISTANT.
Induced growth – growth taken from the zone margin surrounding an oxacillin or cefoxitin disk test on either MHA or blood agar plate after 16-18 hours.

Enterococcus spp.
Inoculum: Growth or direct colony suspension, equivalent to a 0.5 McFarland standard.
Use Mueller- Hinton agar. Incubate at 35 ±2°C ambient air for 16 – 18 hours.

Drug	Conc. (mcg)	Sensitive	Intermediate	Resistant
Ampicillin	10	≥ 17	-	≤ 16
Vancomycin (Read at 24 hours)*	30	≥17	15-16	≤14
Erythromycin	15	≥23	14-22	≤13
Chloramphenicol	30	≥18	13-17	≤12
Ciprofloxacin	5	≥ 21	16-20	≤ 15
Tetracycline	30	≥ 19	15-18	≤ 14
Nitrofurantoin				

Reporting:
1. Test and report AMPICILLIN.
2. For serious enterococcal infections (bacteremia, endocarditis):
3. Test and report AMP, VANCO, and GENTAMICIN 120 mcg.

Testing with Gentamicin 120 mcg disk:
6mm = resistant →report GM is not synergistic with Ampicillin, Penicillin, or Vanco
7-9mm = inconclusive → confirm with MIC
≥ 10mm = susceptible → report GM is synergistic with Ampicillin or Vanco that is also susceptible

Combination therapy with ampicillin, penicillin, or vancomycin (for susceptible strains) plus an aminoglycoside (Gentamicin or Streptomycin) is usually indicated for serious enterococcal infections such as bacteremia and endocarditis, unless high level resistance for both gentamicin and

streptomycin is documented; such combinations are predicted to result in synergistic killing of Enterococcus.
*For VANCO, the presence of a haze or any growth within the zone of inhibition indicates resistance.
4. Test and report Nitrofurantoin for urine isolates.

S. pneumoniae

Inoculum: Direct colony suspension, equivalent to 0.5 McFarland standard.
Use Mueller-Hinton agar with 5% sheep blood. Incubate at 35 ±2°C, 5% CO2, for 20-24 hrs.

Drug	Conc. (mcg)	Sensitive	Intermediate	Resistant
Penicillin MIC (meningitis)	-	-	-	-
Penicillin MIC (nonmenigitis)	-	-	-	-
Erythromycin	15	≥21	16-20	≤15
Trimethoprim-Sulfamethoxazole	1.25/23.75	≥19	16-18	≤15
Vancomycin	30	≥17	-	-
Tetracycline	30	≥23	19-22	≤18
Levofloxacin	5	≥17	14-16	≤13
Chloramphenicol	30	≥21	-	≤20
Cefotaxime MIC (meningitis)	-	-	-	-
Cefotaxime (nonmeningitis)	-	-	-	-

Reporting:

1. For isolates from CSF, blood, and other sterile sites, test and report:
   - MIC: PENICILLIN, CEFOTAXIME and MEROPENEM
   - Disks: VANCO
   - Report VANCO if PEN resistant.

2. For isolates from other sites, set-up OXACILLIN (1 mcg) disk screen with OPTOCHIN disk.
   - Prepare a suspension (0.5 McFarland) from a pure culture of alpha-hemolytic colonies

suggestive of S. pneumoniae on TSB. Inoculate on a sheep blood agar plate. Place Oxacillin and Optochin disk on the plates. Incubate overnight at 35°C in 5% CO2.
OPTOCHIN: Zone of ≥ 14 mm, report as S. pneumoniae
Zone of less than 14 mm is questionable; confirm with the bile solubility test.
No zone – Viridans streptococci
OXACILLIN: Zone size IS ≥20 mm → report as PENICILLIN SENSITIVE
Zone size is ≤ 19mm → confirm with MIC

- If PEN is resistant, test and report:
  Disks: ERYTHRO, TRIMETH-SULFA, VANCO
  MIC: PEN, CEFOTAXIME, and MEROPENEM.
- Report VANCO if PEN resistant.

Beta-haemolytic Streptococci (large colony-forming groups A, C, G and S. agalactiae)
Inoculum: Direct colony suspension, equivalent to 0.5 McFarland standard.
Use Mueller-Hinton agar with 5% sheep blood. Incubate at 35 ±2°C, 5% CO2, for 20-24 hrs.

Drug	Conc. (mcg)	Sensitive	Intermediate	Resistant
Penicillin*	10	≥24	-	-
Erythromycin	15	≥21	16-20	≤15
Clindamycin	2	≥19		≤15
Cefotaxime	30	≥24	-	-
Chloramphenicol	30	≥21	18-20	≤17
* Penicillin and ampicillin are drugs of choice for treatment of β-hemolytic Streptococcal infections; **susceptibility testing need not be performed routinely** because non-susceptible isolates are extremely rare in any β-hemolytic streptococcus and have not been reported for S. pyogenes.				

Streptococcus spp. Viridans group
Inoculum: Direct colony suspension, equivalent to 0.5 McFarland standard.
Use Mueller-Hinton agar with 5% sheep blood. Incubate at 35 ±2°C, 5% CO2, for 20-24 hrs.

Drug	Conc. (mcg)	Sensitive	Intermediate	Resistant
Penicillin* MIC				
Cefotaxime	30	≥28	26-27	≤25
Vancomycin	30	≥17	-	-
Chloramphenicol	30	≥21	18-20	≤17
Clindamycin	2	≥19	16-18	≤15
Erythromycin	15	≥21	16-20	≤15
Reporting: 1. Isolates from CSF, blood and other sterile body sites: test and report PENICLLIN (MIC) 2. Report VANCO (disk) if PEN resistant. *Disk testing is not reliable for testing				

ENTERIC PATHOGENS: *Salmonella and Shigella spp.*
Inoculum: Growth or direct colony suspension, equivalent to a 0.5 McFarland standard.
Use Mueller-Hinton agar. Incubate at 35 ±2°C ambient air for 16 – 18 hours.

Drug	Conc. (mcg)	Sensitive	Intermediate	Resistant
Ampicillin	10	≥17	14-16	≤13
Ciprofloxacin	5	≥31	21-30	≤20
Trimethoprim/Sulfa	25	≥16	11-15	≤10
Reporting: 1. For Stool isolates: Report AMP, CIP, and TRIMETH-SULFA. 2. For Salmonella in blood and other extra-intestinal sites: • Report AMP, CIP, and TRIMETH-SULFA • In addition, test and report CEFOTAXIME and CHLORAMPHENICOL. • Test for resistance to NALIDIXIC ACID. For isolates that test susceptible to CIP and resistant to nalidixic acid, the physician should be informed that the isolate may not be eradicated by fluoroquinolone treatment.				

ENTERIC PATHOGENS: *V. cholera*
Inoculum: Growth or direct colony suspension, equivalent to a 0.5 McFarland standard
Use Mueller-Hinton agar. Incubate at 35 ±2°C ambient air for 16 – 18 hours.

Drug	Conc. (mcg)	Sensitive	Intermediate	Resistant
Ampicillin	10	≥17	14-16	≤13
Tetracycline	30	≥19	15-18	≤14
Trimethoprim/Sulfa	25	≥16	11-15	≤10
Chloramphenicol	30	≥18	13-17	≤12
Furazolidone	100	≥ 18	-	< 18
Nalidixic acid	30	≥19	-	≤19
Ciprofloxaciline	5	≥21	16-20	≤15
Reporting: Report all				

***OTHER ENTEROBACTERIACEAE*:**
Inoculum: Growth or direct colony suspension, equivalent to a 0.5 McFarland standard
Use Mueller-Hinton agar. Incubate at 35 ±2°C ambient air for 16 – 18 hours.

Drug	Conc. (mcg)	Sensitive	Intermediate	Resistant
Ampicillin	10	≥17	14-16	≤13
Cefazolin*	30	≥23	20-22	≤19
Gentamicin	10	≥15	13-14	≤12
Amoxicillin/clavulanate	20/10	≥18	14-17	≤13

Piperacillin-Tazobactam	100/10	≥21	18-20	≤17
Cefuroxime	30	≥18	15-17	≤14
Cefotaxime	30	≥26	23-25	≤22
Ciprofloxacin	5	≥31	21-30	≤20
Imipenem	10	≥23	20-22	≤19
Trimethoprim/Sulfa	25	≥16	11-15	≤10
Chloramphenicol	30	≥18	13-17	≤12
Nitrofurantoin	300	≥17	15-16	≤14

Reporting:
1. Report AMPICILLIN, CEFAZOLIN, and GENTAMICIN.
2. If AMP resistant, report AMOX-CLAV; if resistant, report PIPERACILLIN-TAZOBACTAM.
3. If CEFAZOLIN resistant, report CEFUROXIME; if cefuroxime resistant, report CEFOTAXIME.
4. If only one antibiotic is sensitive, report CIP and IMIPENEM.
5. CEFOTAXIME AND CEFTRIAXONE should be reported on isolates from CSF in place of cefazolin
6. Test and report NITROFURANTOIN for urine isolates.

Pseudomonas aeruginosa:

Inoculum: Growth or direct colony suspension, equivalent to a 0.5 McFarland standard
Use Mueller-Hinton agar. Incubate at 35 ±2^{o}C ambient air for 16 – 18 hours.

Drug	Conc. (mcg)	Sensitive	Intermediate	Resistant
Ceftazidime	30	≥18	15-17	≤14
Gentamicin	10	≥15	13-14	≤12
Tobramycin	10	≥15	13-14	≤12
Piperacillin	100	≥21	15-20	≤14
Ciprofloxacin	5	≥21	16-20	≤15
Amikacin	30	≥17	15-16	≤14
Piperacillin-Tazobactam	100/10	≥21	15-20	≤14
Imipenem	10	≥19	16-18	≤15

Reporting:
1. Report CEFTAZ, GENT, TOBRA, and PIP, and CIP.
2. If CEFTAZ resistant, report IMIPENEM.
3. If PIP resistant, report PIP-TAZO.

H.influenzae

Inoculum: Direct colony suspension, equivalent to 0.5 McFarland standard.
Use Haemophilus Test Medium (HTM). Incubate at 35 ±2^{o}C, 5% CO_2, for 16-18 hours.

Drug	Conc. (mcg)	Sensitive	Intermediate	Resistant
Ampicillin*	30	≥22	19-21	≤18

Trimethoprim-Sulfamethoxazole	1.25/23.75	≥16	11-15	≤10
Ampicillin-sulbactam	10/10	≥20	-	≤19
Cefotaxime	30	≥26	-	-
Chloramphenicol	30	≥29	26-28	≤25
Meropenem	10	≥20	-	-

Reporting:
1. Perform direct β-lactamase test
   Negative test → report as AMPICILLIN SENSITIVE
   Positive test → report as AMPICILLIN RESISTANT
2. If AMP resistant, test and report TRIMETH-SULFA, AMP-SULBACTAM and CEFOTAXIME.
3. For CSF isolates: only AMP, CEFOTAXIME, CHLORAMPHENICOL and MEROPENEM should be reported.
4. Rare β-lactamase negative, ampicillin resistant (BLNAR) strains of H. influenza should be reported as resistant to AMP-SULBACTAM despite apparent in-vitro susceptibility of some BLNAR strains to this agent.

N.gonorrhoeae

Inoculum: Direct colony suspension, equivalent to 0.5 McFarland standard

Use GC agar base with 1% growth supplement. Incubate at 36 ±1°C, 5% CO_2 for 20-24 hrs.

Drug	Conc. (mcg)	Sensitive	Intermediate	Resistant
Penicillin*	10	≥47	27-46	≤26
Cefixime	5	≥31	-	-
Cefotaxime	30	≥31	-	-
Ciprofloxacin	41	≥41	28-40	≤27
Spectinomycin	100	≥18	15-17	≤14
Tetracycline	30	≥38	31-37	≤30

Reporting:
1. Perform direct β-lactamase test
   Positive test → report as PENICILLIN RESISTANT
   Negative test → set-up PEN disk diffusion testing.
   *Penicillin-Beta lactamase positive organisms are resistant to Penicillin, but disc-diffusion testing is required to detect strains with chromosomally-mediated resistance.
2. If PEN resistant, test and report all.

N.meningitidis

Inoculum: Direct colony suspension from 20 to 14 hours growth from chocolate agar, equivalent to a 0.5 McFarland standard.

Use Mueller-Hinton agar with 5% sheep blood. Incubate at 35 ±2°C, 5% CO_2, for 20-24 hrs.

Drug	Conc.	Sensitive	Intermediate	Resistant

	(mcg)			
Penicillin MIC				
Cefotaxime	30	≥34	-	-
Meropenem	10	≥30	-	-
Chloramphenicol	30	≥26	20-25	≤19
Test and report all. Caution! Perform all AST of N. meningitidis in a BSC. Manipulating suspensions of N. meningitidis outside a BSC is associated with a high risk for contracting meningococcal disease. Laboratory acquired meningococcal disease is associated with a case-fatality rate of 50%. Exposure to droplets or aerosols of N. meningitidis is the most likely risk for laboratory-acquired infection.				

Annex V

Health care associated infection rate in Adama hospital ward summary form

Hospital beds surveyed)	BSI rate	UTI rate	RTI rate	SSI rate	Total
Medical ward					
Surgical ward					
Gynecology & obstetric ward					
Orthopedic ward					
Other ward					
Total					

Annex VI

1. Criteria for clinical evaluation of surgical site infection

1. SUPERFICIAL INCISIONAL	2 DEEP INCISIONAL/ORGAN SPACE
Definition must meet the following criteria Infection involves only skin and subcutaneous tissue of this incision **and** Occurs within 30 days after the operative procedure and Exhibits **at least one** of the following from the superficial incision: 1. Purulent discharge (NOT stitch abscess). 2. Organisms isolated from an aseptically collected culture of fluid or tissue. **Note**: a positive wound swab (in contrast to wound aspirate) without other significant evidence of infection is not adequate for diagnosis of infection. 3. Displays at the site of incision any of the following signs and symptoms of infection: • Pain or tenderness • Localized swelling • Redness or heat AND the incision is deliberately explored by the Surgeon resulting in a positive wound culture. **Note:*A culture-negative finding does not meet***	Involves deep soft tissues (eg fascial and muscle layers) AND/OR organs/spaces opened or manipulated during an operation**AND** Occurs within 30 days after the operative procedure if implant not present OR within one year if implant in situ **AND** Exhibits either 1 and/or 2: 1. Purulent drainage from deep soft tissue or drain that is placed through a stab wound into the organ/space. 2. Spontaneous dehiscence at the incision site or the wound is deliberately explored by a surgeon withthe patient showing evidence of **one or more** of the following signs or symptoms: • Fever > 38ºC, • localized pain or • Tenderness with culture positive specimen. **Note**: A culture-negative finding does not meet this criterion unless the patient was on antibiotics immediately prior to the wound being explored

this criterion unless the patient was on antibiotics immediately prior to diagnosis. 4. Diagnosis or antimicrobial treatment of superficial incisional infection by the operating Surgeon or Registrar.	and/or the culture being taken; • Organisms isolated from aseptically obtained culture of fluid or tissue obtained from an organ/space; • An abscess or other evidence of infection involving a deep/organ space is found on direct examination, during re-operation, or by histopathologic or radiologic examination; or • Diagnosis of, or antimicrobial treatment of a deep incisional or organ/space SSI by the operating Surgeon or Registrar.

Note: In addition, there may also be microbiological evidence of wound infection from cultures obtained aseptically from wound fluid or tissue. However, since skin sites are normally colonized by a variety of organisms, positive wound cultures in the absence of clinical signs are rarely indicative of SSI

Note: Wound sample collection, transport and storage are detailed explained in annex-IV

2. criteria for clinical evaluation of ventilator associate infection

Ventilator-associated pneumonia (VAP) is defined as pneumonia that occurs 48–72 hours or thereafter following endotracheal intubation, characterized by the presence of a new or progressive infiltrate, signs of systemic infection (fever, altered white blood cell count), changes in sputum characteristics, and detection of a causative agent. Health care–associated pneumonia is pneumonia that occurs in persons in one of the following criteria below:

Parameter	Result	Score
Temperature (°Celsius)	36.5–38.4 °C 0	0
	38.5–38.9 °C 1	1
	≤ 36 or ≥ 39 °C 2	2
Leukocytes in blood (cells/mm3)	4,000–11,000/mm^3	0
	< 4,000 or > 11,000/mm^3	1
	≥ 500 Band cells/mm^3	2
Tracheal secretions (subjective visual scale)	None	0

	Mild/non-purulent	1
	Purulent	2
Radiographic findings (on chest radiography, excluding CHF and ARDS)	No infiltrate	0
	Diff use/patchy infiltrate	1
	Localized infiltrate	2
Culture results (endotracheal aspirate)	No or mild growth	0
	Moderate or florid growth	1
	Moderate or florid growth AND pathogen consistent with Gram stain	2
Oxygenation status (defined by PaO2:FiO2)	> 240 or ARDS	0
	≤ 240 and absence of ARDS	2

Notes: For sputum sample collection, transporting and storage, more detailed explained in the annex IV

3. criteria for catheter associated urinary tract infection

Catheter-associated Urinary Tract Infection (CAUTI)
Patient must meet 1, 2, and 3 criteria below : Patient had an indwelling urinary catheter that had been in place for > 2 days on the date of event (day of device placement = Day 1) AND was either: • Present for any portion of the calendar day on the date of event†, **OR** • Removed the day before the date of event‡ I. Patient has at least ***one*** of the following signs or symptoms: • fever (>38.0°C) • suprapubic tenderness* • cost vertebral angle pain or tenderness* • urinary urgency • urinary frequency • dysuria Patient has a urine culture with no more than two species of organisms identified, at least one

of which is a bacterium of $\geq 10^5$ CFU/ml (See Comments). All elements of the UTI criterion must occur during the Infection Window Period. ^These symptoms cannot be used when catheter is in place. An indwelling urinary catheter in place could cause patient complaints of "frequency" "urgency" or "dysuria".

Note: Fever is a non-specific symptom of infection and cannot be excluded from UTI determination because it is clinically deemed due to another recognized cause.

Note: Urine Sample collection, transportation and storage are more detailed explained in annex-IV

4. criteria for clinical evaluation of central line associated blood stream infection

Central Line Associated Blood Stream Infection (CLABSI)

A Central Line Associated Blood Stream Infection (CLABSI) is a laboratory-confirmed bloodstream infection in a patient where the central line was in place for > 2 calendar days (48 hours)* on the date of the event, with day of device placement being Day 1.

and

The central line was in place on the date of event or the day before. If the central line was in place for > 2 calendar days (48 hours) and then removed, the CLABSI criteria must be fully met on the day of discontinuation or the next day.

The CLABSI must meet one of the following criteria:

Criterion 1

- Patient has a recognized pathogen cultured from one or more blood cultures *and*
- Organism cultured from blood is not related to an infection at another site.

Criterion 2

- Patient has at least one of the following signs or symptoms:
    - fever (> 38°C),
    - chills, or
    - Hypotension.

and

- Organism cultured from blood is not related to an infection at another site.

and

- The same (matching) potential contaminant organism^ is cultured from two or more blood cultures drawn on separate occasions.
- Criterion elements must occur within a time frame that does not exceed a gap of 1 calendar day (24 hours)* between any two elements e.g. positive blood cultures and fever.
- The same (matching) potential contaminant organisms represent a single element. The collection date of the first positive blood culture should be used to determine the date of the event.

Note: Blood Sample collection, transport and storage are explained in detail in annex-IV

5. Criteria for antibiotic associated diarrhea

Antibiotic associated diarrhea(AAD) or Antibiotic-Associated Colitis(Clostridia difficile diarrhea)(AAE)

Antibiotic-associated colitis, also called antibiotic-associated enterocolitis, can occur following antibiotic treatment.

- The bacteria *Clostridia difficile*are normally found in the intestines of 5% of healthy adults, but people can also pick up the bacteria while they are in a hospital or nursing home.
- Although all antibiotics can cause this disease, it is most commonly caused by
    - clindamycin (Cleocin),
    - Ampicillin (Omnipen),
    - Amoxicillin (Amoxil, Augmentin, or Wymox), and any in the cephalosporin class (such as cefazolin or cephalexin).

Risk factors

Antibiotic-associated diarrhea can occur in anyone who takes an antibiotic. But you're more likely to develop antibiotic-associated diarrhea if you:

- Have had antibiotic-associated diarrhea in the past
- Have taken antibiotic medications for an extended time
- Are taking more than one antibiotic medication

Causes and symptoms

Antibiotic-associated colitis is caused by toxins produced by the bacterium *Clostridium difficile* after treatment with antibiotics. When most of the other intestinal bacteria have been killed, *Clostridium difficile* grows rapidly and releases toxins that damage the intestinal wall. The disease and symptoms are caused by these toxins, not by the bacterium itself.

Symptoms of antibiotic-associated colitis usually begin four to ten days after antibiotic treatment has begun.

- The early signs and symptoms of this disease include
    - Lower abdominal cramps,
    - an increased need to pass stool, and
    - Watery diarrhea.
- As the disease progresses, the patient may experience
    - a general ill feeling,
    - fatigue,
    - abdominal pain, and
    - Fever.
- If the disease proceeds to pseudomembranous enterocolitis, the patient may also experience
    - nausea,
    - vomiting,
    - Large amounts of watery diarrhea, and
    - a very high fever (104-105°F/40-40.5°C).
- Complications of antibiotic-associated colitis include
    - severe dehydration,
        - a very dry mouth,
        - intense thirst,
        - little or no urination, and
        - Weakness
    - imbalances in blood minerals,
    - low blood pressure,
    - fluid accumulation in deep skin (edema),

- enlargement of the large intestine (toxic megacolon), and
- The formation of a tear (perforation) in the wall of the large intestine.

The *Clostridium difficile* toxin is found in the stools of persons older than 60 years of age 20-100 times more frequently than in the stools of persons who are 10-20 years old. As a result, the elderly are much more prone to developing antibiotic-associated colitis than younger individuals.

Note: stool sample collection, transportation and storage procedure are explained detailed in the Annex-IV

6. Ideal weight for height to measure malnutrition status

Men				***Women***			
Height	***Weight***	***Height***	***Weight***	***Height***	***Weight***	***Height***	***Weight***
145	51.9	166	64.0	140	44.9	161	56.9
146	52.4	167	64.6	141	45.4	162	57.6
147	52.9	168	65.2	142	45.9	163	58.3
148	53.5	169	65.9	143	46.4	164	58.9
149	54.0	170	66.6	144	47.0	165	59.5
150	54.5	171	67.3	145	47.5	166	60.1
151	55.0	172	68.0	146	48.0	167	60.7
152	55.6	173	68.7	147	48.6	168	61.4
153	56.1	174	69.4	148	49.2	169	62.1
154	56.6	175	70.1	149	49.8		
155	57.2	176	70.8	150	50.4		
156	57.9	177	71.6	151	51.0		
157	58.6	178	72.4	152	51.5		
158	59.3	179	73.3	153	52.0		
159	59.9	180	74.2	154	52.5		
160	60.5	181	75.0	155	53.1		
161	61.1	182	75.8	156	53.7		

162	61.7	183	76.5	157	54.3		
163	62.3	184	77.3	158	54.9		
164	62.9	185	78.1	159	55.5		
165	63.5	186	78.9	160	56.2		

Values are expressed in cm for height and kg for weight. To obtain height in inches, divide by 2.54. To obtain weight in pounds, multiply by 2.2.

Source: Adapted from GL Blackburn et al: J Parenter Enteral Nutr 1:11, 1977; with permission.

7. Body Mass index to measure obesity

Body mass Index(BMI=m/kg^2)					
<19	19-25	26-30	31-35	36-40	>45
Very low	Normal	Over weight	Obese (high)	Obese (very high)	Relative Risk

8. Waist to hip ratio to measure obesity

Waist to hip ratio >0.9 for women	Waist to hip ratio >1.0 in men
abnormal	Abnormal(obese)

Annex VII

Table 13, LOS of patients admitted at AHMC, Adama, Ethiopia, and 2017 G.C.

Type of variables		ICU	Orthopedic	Medical	Surgical	Emergency	Gynecology	Obstetric	Total
Total LOS	**HCAI**	44	352	153	149	39	0	0	737
	Non HCAI	73	452	440	479	46	156	488	2148
TLOS		117	804	607	628	85	156	488	2885
Number	**HCAI**	6	17	8	4	7	0	0	42
	Non HCAI	13	30	47	49	13	28	78	258
Average LOS	**HCAI**	7.33	20.7	19.12	37.25	5.57	0	0	17.54
	Non HCAI	5.6	15.1	9.36	9.78	3.54	5.57	6.28	8.28
Ratio of HCAI over Non HCAI		1.3	1.37	2.04	3.81	1.57	0	0	2.12
Total LOS of all patients		117	804	607	628	85	156	488	2885
Number of patients		19	47	55	53	20	28	78	300
Average LOS all patients		6.16	17.1	10.78	11.85	4.25	5.57	6.28	9.58

Table 14, Total Healthcare service cost at AHMC,Adama,Ethiopia, 2017 G.C.

Type of variables		ICU	Orthopedic	Medical	Surgical	Emergency	Gynecology	Obstetric	Total
Total health service cost	**HCAI**	2676	12640	5480	4432	3124	0	0	28352
	Non HCAI	1752	11412	11854	13628.3	140	4496.9	14192.1	57475.3
Number	**HCAI**	6	17	8	4	7	0	0	42
	Non HCAI	13	30	47	49	13	28	78	258
Average health service cost	**HCAI**	446	743.53	685	1108	446.29	0	0	623.6
	Non HCAI	134.8	380.4	252.2	278.13	10.77	160.6	181.95	222.77
Ratio of HCAI over Non HCAI cost		3.31	1.955	2.72	3.98	41.44	0	0	2.79
Total healthcare cost		4428	24052	17334	18060.3	3264	4496.9	14192.1	85827.3
Number of patients		19	47	55	53	20	28	78	300
Average health cost		233.05	511.745	315.16	340.7	1632	160.60	181.95	286.091

Table 15, Healthcare associated infection among patients with medical risk at Adama hospital medical collage,Adama, Ethiopia, 2017 G.C.

	Number of admitted patient > 48 hrs	Percent(n=300)	HCAI	SSI	CAUTI	VAP	CA BSI	AAD	NSSBI
Major trauma	12	4%	5	5	0	0	0	0	0
Metastatic solid tumor	2	0.67%	0	0	0	0	0	0	0
Any malignancy including leukemia and lymphoma	7	2.33%	2	1	1	0	0	0	0
Leukocytopinia	3	1%	1	0	1	0	0	0	0
Hemiplegia or paraplegia stroke	5	1.7%	1	0	0	1	0	0	0
Myocardial infraction	7	2.33%	2	0	2	0	0	0	0
Peripheral vascular disease	2	0.67%	1	0	1	0	0	0	0
Age>65	25	8.33%	3	2	1	0	0	0	0
Malnourished	2	0.67%	1	0	1	0	0	0	0
Congestive heart failure	31	10.33%	6	0	4	0	1	1	0
Diabetes with chroniccomplication	6	2%	0	0	0	0	0	0	0
HIV/AIDS	16	5.33%	4	1	2	0	0	0	1
Diabetes with mild complication	9	3%	3	0	1	0	0	0	2
Smoking	7	2.33%	2	0	2	0	0	0	0
Moderator severe liver disease	2	0.67%	0	0	0	0	0	0	0
Type2 diabetes	2	0.67%	2	0	0	0	0	0	2
Renal disease	12	4%	6	0	3	0	0	0	3
Mild liver disease	4	1.33%	0	0	0	0	0	0	0

Obesity	15	5%	4	0	4	0	0	0	0
Total medical risk factors	127	42.33%	24(18.9%)	6(4.7%)	10(7.87%)	1(0.79%)	1(0.79%)	1(0.79%)	5(3.9%)

Annex VIII

Table 16, Antibiotic susceptability pattern of bacetria isolated from different clinical sample at adama hospital medical collage, Adama,Ethiopia, 2017 G.C

Table, 16 . 1. Antibiotics susceptibility of E.coli

		Extended spectrum of beta lactamase	penicillin		Beta lactamase inh.	Phenocols	TTC	Fluroquinolones	Folate pathway inhibitors	Non-extended spectrum cephalosporin			Aminoglycoside	Drug resistance classification
Type of specimen cultured	**Organismi solate**	**CTX**	**Amp**	**NI**	**AMC**	**C**	**TTC**	**CIP**	**SXT**	**KZ**	**KF**	**CXM**	**GM**	
surgical site swab	E.*coli*	R	R		R	R	R	R	R	R	R	R		**XDR**
surgical site swab	E.*coli*	S	R		I	I	R	S	S	I			S	**susceptible**
surgical site swab	E.*coli*	R	R		R	S	R	S	R	R	R	R	S	**MDR**
Surgical site swab	E.*coli*	R	R		R	S	R	R	R	R	R	R	S	**MDR**
surgical site swab	E.*coli*	R	R		R	S	R	S	R	R	R	R	S	**MDR**
Catheter urine	E.*coli*	S	R	S	R		R	S	R	R	R	I	S	**MDR**
Catheter urine	E.*coli*	S	R	S	S		S	S	S	R	R	R	S	**Susceptible**
Catheter urine	E.*coli*			S	I		S	S	R	R	R	R	I	**Susceptible**
Catheter urine	E.*coli*		R	S	R	R	R	R	R	R	R	R	R	**XDR**
Catheter urine	E.*coli*		R	S	R		R	S	R	R		R	I	**MDR**
Bed sore	E.*coli*	R	R		R	R	R	S	R	R	R	R	R	**MDR**
Bed sore	E.*coli*	R	R		R		R	R	R	R	R	R	R	**XDR**
Bed sore	E.*coli*	R	R		R	R	R	S	R	R	R	R	R	**MDR**
Percent of	**23.07% susceptable, 53.85% MDR and 23.07%(76.9% resistance)**													

susceptibility

Table 16 .2. Antibiotic susceptibility of C. fruindii

		Extended spectrum of beta lactamase	penicillin	Beta lactamase inh.	Phenocols	Tetracycline	Fluroquinolones	Folate pathway inhibitors	Non-extended spectrum cephalosporin			Aminoglycosid	Drug resistance classification
Type of specimen cultured	**Organism i solate**	**CTX**	**Amp**	**AMC**	**C**	**TTC**	**CIP**	**SXT**	**KZ**	**KF**	**CXM**	**GM**	
Catheter urine	C.*fruindii*	R	R	R	R	R	R	R	R	R	R	R	XDR
wound ulcer	C.*fruindii*	R	R	R	R	R	R	R	R	R	R	R	XDR
surgical site swab	C.*fruindii*	R	R	R	R	R	R	R	R	R	R	R	XDR
surgical site swab	C.*fruindii*	R	R	R	R	R	I	R	R	R	R	R	MDR
surgical site swab	C.*fruindii*	R	R	R	S	R	S	R	R	R	R	S	MDR
Surgical site swab	C.*fruindii*	S	R	S	S	S	S	R	R	R	I	S	MDR
Percent of susceptibility	50%MDR and 50%XDR												

Table.16.3 antibiotic susceptibility of K. pneumonia

		Extended – spectrum cephalosporine	penicillin		Beta lactamase inh.	Phenocols	Tetracycline	Fluroquinolones	Folate pathway inhibitors	Non-extended spectrum cephalosporin			Aminoglycoside	Drug resistance classification
Type of specimen cultured	Organismisolate	CTX	Amp	NI	AMC	C	TTC	CIP	SXT	KZ	KF	CXM	GM	
wound ulcer	K.*pneumonia*	R	R		I	R	R	S	R	R	R	R	S	MDR
Catheter urine	K.*pneumonia*		R	I	R		R	R	R	S	R	R	R	MDR
Catheter urine	K.*pneumonia*	R	R	S	R		R	I	R	R	R	R	R	MDR
Sputum	K.*pneumonia*	R	R		R	S	R	I	I	R		R	R	MDR
Percent of susceptibility		100% MDR												

Table 16. 4. Antibiotic susceptibility of E.cloacae

		Extended – spectrum cephalosporin	penicillin	Beta lactamase inh.	Phenocols	TTC	Fluroquinolones	Folate pathway inhibitors	Non-extended spectrum cephalosporin			Aminoglycoside	Drug resistance classification
Type of specimen cultured	**Organism isolate**	**CTX**	**Amp**	**AMC**	**C**	**TTC**	**CIP**	**SXT**	**KZ**	**KF**	**CXM**	**GM**	
surgical site swab	**E. *cloacae***	**R**	**R**	**R**	**S**	**R**	**S**	**S**	**R**	**R**	**R**	**S**	**MDR**
surgical site swab	**E.*cloacae***	**R**	**R**	**R**	**R**	**R**	**R**	**S**	**R**	**R**	**R**	**R**	**MDR**
Percent of susceptibility		**100% MDR**											

Table 16.5. Antibiotics susceptibility of P. mirabilis

		Extended – spectrum cephalosporine	penicillin		Beta lactamase inh.	Phenocols	TTC	Fluroquinolones	Folate pathway inhibitors	Non-extended spectrum cephalosporin			Aminoglycoside	Drug resistance classification
Type of specimen cultured	**Organismi solate**	**CTX**	**Amp**	**NI**	**AMC**	**C**	**TTC**	**CIP**	**SXT**	**KZ**	**KF**	**CXM**	**GM**	
surgical site swab	P.*mirabilis*	S			S		R	S	R	S	S	S	S	susceptible
surgical site swab	P.*mirabilis*	S	R		S	S	R		S	R	R	I	S	MDR
surgical site swab	P.*mirabilis*	S	R		S	S	R		S	R	R	I	S	MDR
Catheter urine	P.*mirabilis*		S	R	S		S	S	S	I		S	S	susceptible
Catheter urine	P.*mirabilis*		R	S	S		R	S	I	R		S	S	MDR
Percent of susceptibility	60% MDR and 40% susceptible													

Table 16 .6 . Antibiotic susceptibility of s. marscence

		Extended – spectrum cephalosporine	penicillin	Beta lactamase inh.	TTC	Fluroquinolones	Folate pathway inhibitor	Non-extended spectrum cephalosporin			Aminoglycoside	Drug resistance classification
Type of specimen cultured	**Organismi solate**	**CTX**	**Amp**	**AMC**	**TTC**	**CIP**	**SXT**	**KZ**	**KF**	**CXM**	**GM**	
surgical site swab	S. *marscence*	S	R	S	S	S	S	R	R	I	S	**susceptible**
surgical site swab	S. *marscence*	R	R	R	S	R	R	R	R	R	R	**XDR**
Percent of susceptibility	**50% susceptible**											

Table 16.7.Antibiotics susceptibility of p.aeroginosa

		Carbapenem		Extended – spectrum cephalosporine	Ureido penicillin class	Anti-pseudomonas beta lactamase inhibitor	Fluroquinolones	Aminoglycoside	Aminoglycoside	Drug resistance classification
	Organismi solate	IM	AK	CAZ	Pi	PTZ	CIP	TOB	GM	
surgical site swab	P.aerogenosa		S	R	R	I	S	S	S	susceptible
Surgical site swab	P.aerogenosa		S	R	R	S	R	R	I	MDR
surgical site swab	P.aerogenosa	S	S	S	S	S	S	S	S	susceptible
surgical site swab	P.aerogenosa	S	S	S	S	S	I		R	susceptible
Percent of susceptibility						25% MDR, & 75% susceptible				

Table 16.8Antibiotic susceptibility of Entrococcus species

		Glycopeptidase		TTC	Fluroquinolones	Drug resistance classification
Type of specimen cultured	**Organismi solate**	**VA**	**NI**	**TTC**	**CIP**	
Catheter urine	Entrococcus *spps*	S	S	R	R	**Susceptible**
Catheter urine	Entrococcus *spps*	S	S	R	R	**Susceptible**
Percent of susceptibility		**100% susceptible**				

Table 16.9.Antibiotics susceptibility of S.aureus

		Cephamycine	Lincosamide	Macrolide	Cephamycin	penicillin	Non-extended spectrum cephalosporin		Fluroquinolones	Folate pathway inhibitors	Drug resistance classification
Type of specimen cultured	Organismi solate	Fox	DA	E	OX	PG	KZ	KF	CIP	SXT	
surgical site swab	S.*aureus*	S	S	I	S	R	S	S			susceptible
Blood	S.*aureus*	S	S	R	S	R	S	S	R	I	MDR
Percent suceptability	50% MDR, and 50% susceptible										

AnnexIX

Criteria for defining MDR, XDR and PDR in Enterobacteriaceae, Entrococcus species, s.aureus and p.aerogenosaare, If the organism non-susceptible to ≥1 agent in ≥3 antimicrobial categories is MDR. If the organism non-susceptible to ≥1 agent in all but ≤ 2 categories is XDR. If the bacteria non-susceptible to all antimicrobial agents listed we call it PDR. The other Criteria for s.aureus are, MRSA is always considered MDR by virtue of being an MRSA, (43).

Declaration

I, the undersigned, declare that this M.Sc. thesis is my original work, has not been presented for a degree in this or any other university and that all sources of materials used for the thesis have been duly acknowledged.

M.Sc. candidate: **Adinew Zewdu (B.Sc.)**

Signature: _____

Date of submission: _____

This thesis has been submitted with our approval as university based advisors.

Advisor: **Kassu Desta (MSc, PhD candidate)**

Signature: _____

Date: _____

Place: Addis Ababa, Ethiopia.