Hospital acquired Infections among patients admitted to Felege Hiwot Referral Hospital, Bahir dar, North West Ethiopia

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DECLARATION

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

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Table of contents **Page**

Lists of Tables **Page**

List of Abbreviations

ALOS	Average length of hospital stay
BSI	Blood Stream infection
CBC	Complete blood count
CDC	Center for disease control & Prevention
CLD	Chronic liver disease
CONS	Coagulase Negative staphylococcus
COPD	Chronic Obstructive Pulmonary Disease
CRBSI	Catheter related Blood stream infection
CVC	Cut down venous Catheter
ESBLs	Extended Spectrum beta lactamase
HAI	Hospital acquired infection
HIV	Human Immunodeficiency Virus
ICU	intensive care unit
IPP	Infection prevention program
IV	Intravenous
MRSA	Methicillin Resistant Staphylococcus aureus
MV	Mechanical Ventilation
NBSI	Neonatal blood stream infection
NICU	Neonatal intensive care unit
NIs	Nosocomial infections
NUTI	Neonatal Urinary tract infection
QAP	Quality assurance project
SSI	Surgical site infection
UCRI	Urinary catheter related infection
UTI	Urinary Tract infection

Abstract

Back ground: Despite advances in the control and prevention of nosocomial infections, it continues to remain a major affectation in hospital treatment and contribute significantly to the high rate of morbidity, mortality and the health care of hospitalized patients in different parts of the world.

Methods : A prospective observational study with the aim of the study to determine the prevalence of hospital acquired bacterial infection and their antimicrobial susceptibility was conducted from April to August, 2009 at Felege Hiwot Referral Hospital, Bahir Dar. One thousand three hundred-eighty three patients, who had been admitted to surgical, Gyaenacology and Obstetrics wards were included in this study were subjected to follow up the diagnosis for HAI. Routine conventional microbiological diagnosis (Culture, biochemical tests, gram staining and antibacterial sensitivity) were done for isolation of pathogens from HAI patients. The questionnaire ---- were used for socio demographic data and to assess associated risk factors. Antibiotic susceptibility tests were done by using the standard Kirby Bauer disc diffusion method.

Results: Among the total 1383 observed patients, 246 developed HAI with a prevalence of 17.8 %. The types of hospital acquired infections were UTI, 118 (48 %), SSI, 112(45.6%), BSI, 9(3.7%), pneumonia, 4(1.6%), and 3 (0.3%) developed mixed infections. Among the types of HAI UTI was the predominant followed by SSI and then BSI and pneumonia were the least type of HAI. Certain primary data collected from the HAI patients who were predispose to conditions like operation procedures, use of catheter, underlying diseases, antibiotics prophylaxis and length of hospital stay contributed as high risk factors based on statistical significance (P= 0.0001). among the patients population. Gram negative bacteria were the predominant organisms with 52.6% compared to gram positive bacteria 47.4%. The predominant 49(37.1%) bacteria observed was *E. coli* when compared to other organisms such as *K pneumoniae* 36 (27.3%), *P.aeruginosae* 26 (19.7*% ,P. mirabilis* 10(7.6%), *Enterobacter specie*s 4 (3%) *P. vulugaris* 3 (2.3%) and both *Acinetobacter baumannii* and *S.marcescens* each accounted 2(1.5%) whereas among gram positive bacteria, *S. aureus* 91(76.5%) was the commonest isolate followed by *CoNS* 18 (15.1%), and *Enteroccocus*

species 10 (8.4%). Most of the isolates were resistant to commonly prescribed antibiotics. Methicillin resistance *S. aureus* was for 94.5% and ampicillin resistance was 98.4%.

Conclusion: UTI, 118(48%) was the commonest Hospital acquired infection. SSI, (87.5%) was the commonest hospital acquired infection in surgical ward where as UTI, 58 (49.2) was the commonest HAI in obstetrics ward. Gram negative bacterial isolates were the predominant etiologies with intermediate to high resistance to commonly prescribed antibiotics

Recommendation: Further studies are needed involving all wards including medical and pediatrics ward, as well as other causative agents anaerobic bacteria, fungal agents etc Organizing an effective infection prevention program in the hospital and continous monitoring and evaluation are essential.

Key words: Hospital acquired infections, surgical site infections, urinary tract infections, blood steam infections , antibiotic susceptibility and Bahir Dar, Ethiopia.

CHAPTER I: INTRODUCTION

1.1 General introduction

The quality of health care provision at any level of health facilities is affected by many factors among which nosocomial infection stands forefront. Nosocomial or hospital-acquired infection is a new infection that develops in a patient who is admitted for a reason other than that infection during hospitalization. It is usually defined as an infection that is identified the first between 48 hours and four days or at least 48-72 hours after a patient is admitted to a hospital or other health-care facility (Toni and Culvert, 2003). With recent changes in health care delivery, the concept of nosocomial infection has sometimes been expanded to include other health care–associated infections, including infections acquired in institutions other than acute-care facilities (e.g. nursing homes), infections acquired during hospitalization but not identified until after discharge; and infections acquired through out patient care such as day surgery, dialysis, or home parenteral therapy (Toni and Culvert, 2003). Early studies reported at least 5 percent of patients became infected during hospitalization. With the increased use of invasive procedures, at least 8 percent of patients acquire nosocomial infections (Toni and Culvert, 2003; Nguyem, 2004).

Hospital acquired infections (HAI) increase the cost of medical care, extended hospital stay and reflect on the morbidity and mortality of the admitted patients. The health care providers are also at risk and add the functional disability and emotional stress of the patient that ultimately reduce the quality of life (Schaffer *et al.*, 1996; Rahman and Anson, 2004). According to the Centers for Disease Control and Prevention (CDC), 2.7% of surgical procedures are complicated by nosocomial surgical-site infections (SSIs), resulting in an increase of the post-operative length of hospital stay by 7 to 10 days, increase hospital charges by US dollar 2,000-4,500 in patients with SSI. Death is directly related to SSI in over 75 percent of patients with SSI who died in the post-operative period (Whitehouse *et al.*, 2002). In obstetric and gynecological wards Urinary tract infection (UTI) is the most

common nosocomial infection with catheterization constituting 14.2 infections per 100 operations (Tran *et al.*, 1998).

In general, there is no sufficient information about prevalence of HAI and pattern of antibiotic susceptibility in most regions of Ethiopia as scarce studies were done in Tikur Anbesa Hospital reported as 16.4% (Habte-Gabr et al.,1988), 17% with wound infection at 47% followed by UTI 16% (Gedebou et al., 1988). In Mekele Hospital HAI was 27.6% (Tesfahunegn et al., 2009) A study result reported from Gondor also showed that the prevalence of SSI was 38.7% (Kotisso and Aseffa, 1998) and 14.8% for SSI was also reported from Addis Ababa (Taye, 2005). Therefore, the present study was designed to asses study on the prevalence and antibiotic susceptibility pattern of HAI in Felege Hiwot Referral Hospital Bahir Dar, North West Ethiopia. The reason why this study conducted was as base line information for the hospital since there was no previous study in this hospital and provides sufficient data that helps as an important guide for organizing infection prevention program to control hospital acquired infections in the study area and the region at large.

1.2 Literature review

1.2.1 Site of Hospital acquired infections

The most frequent types of hospital acquired infections are urinary-tract, surgical-wound, pneumonia, and bloodstream infections which all account for more than 80% of hospital acquired infections (Burke, 2003). Urinary tract infection can be symptomatic or asymptomatic . Symptomatic urinary tract infection (UTI**):** patient has at least one of the following signs or symptoms with no other recognized cause: fever (>38° C)),urgency, frequency, dysuria, or suprapubic tenderness and patient has a positive urine culture, that is, 10^5 microorganisms per cm^3 or urine with no more than two species of microorganisms.

Asymptomatic urinary tract infection(UTI -ASB)**:** patient has had or not had an indwelling urinary catheter within 7 days before the culture *and* a positive urine culture, that is, 10^5 microorganisms per cm3 of urine with no more than two species of microorganisms *and* patient has *no* fever (>38^oC), urgency, frequency,dysuria, or suprapubic tenderness.

Surgical site infection (SSI) is an infection associated with insition during operation. SSI can be classified as follows: Superficial Surgical site infection (SSI): infection occurs within 30 days after operative procedure *and* involves only skin and subcutaneous tissue of the incision with signs or symptoms of infection: pain or tenderness, localized swelling, redness, or heat, and superficial incision is deliberately opened by surgeon, purulent drainage from the superficial incision or organisms isolated from an aseptically obtained culture of fluid or tissue from the superficial incision. Deep incision Surgical site infection (SSI)**:** infection occurs within 30 days after the operative procedure if no implant is left in place or within 1 year if implant is in place and the infection appears to be related to the operative procedure which involves deep soft tissues (e.g., fascial and muscle layers) of the incision and prulent drainage from the deep incision but not from the organ/space component of the surgical site. the patient has at least one of the following signs or symptoms: fever (>38° C), or localized pain or tenderness unless incision is culture-negative. Organ/Space Surgical site infection (SSI): infection occurs within 30 days after the procedure if no implantb is left in place or within 1 year if implant is in place and the infection appears to be related to the operative procedure and infection involves any part of the body, excluding the skin incision,fascia, or muscle layers, that is opened or manipulated during the operative procedure and prurulent drainage from a drain that is placed through a stab wound into the organ/space or organisms isolated from an aseptically obtained culture of fluid or diagnosis of an organ/space SSI by a surgeon or attending physician.

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Blood stream infection (BSI) can be clinical sebsis and laboratory-confirmed bloodstream infection.Clinical sepsis**:** Patient has at least one of the following clinical signs or symptoms with no other recognized cause: fever (>38° C), hypotension (systolic pressure (≤ 90 mm), or oliguria (<20 cm^3 /hr) and blood culture not done or no organisms and physician institutes treatment for sepsis. Laboratory-confirmed bloodstream infection**:** Patient has at least one of the following signs or symptoms: fever (>38° C), chills, or hypotension and at least one of the following: common skin contaminant (e.g. *diphtheroids*, *Bacillus sp*., *Propionibacterium sp., coagulase-negative staphylococci*, or *micrococci*) is cultured from two or more blood cultures drawn on separate occasions.

Pneumonia: patient with two or more serial chest radiographs with at least *one* of the following: Fever (>38°C or >100.4°F) with no other recognized cause, leukopenia (< 4,000 WBC/mm3) *or* leukocytosis (≥12,000 WBC/mm3), for adults ≥70 years old, altered mental status. Patietus with no other recognized cause and at least *two* of the following:new onset of purulent sputum, or change in character of sputum, or increased respiratory secretions, or increased suctioning requirements,new onset or worsening cough, or dyspnea, or tachypnea.

Other infections include gastro intestinal tract (GI), skin and sinus infections. These infections follow interventions necessary for patient care. Hospital procedures that may put patients at risk for nosocomial infection are gastrointestinal procedures, obstetric procedures, and kidney dialysis (Nguyen, 2004; Toni and Culvert, 2003). At least 80 percent of nosocomial urinary tract infections are attributable to the use of an indwelling urethral catheter (Adukauskiene *et al.*, 2006). Bacteria from the intestinal tract are the most common cause. Surgical-wound infection follows interference with the skin barrier, and is associated with the intensity of bacterial contamination of the wound at surgery. Nosocomial pneumonia occurs most frequently in intensive-care-unit patients with endotracheal intubations and mechanical ventilation (Gupta, 2008). The endotracheal tube by passes normal defenses of the upper airway. Patients with chronic obstructive lung disease, for example, are especially susceptible to infection because of frequent and prolonged antibiotic therapy and long-term mechanical ventilation used in their treatment. Primary nosocomial bloodstream infection occurs virtually only with the use of indwelling central vascular catheters, and correlates directly (Nguyem, 2004; Küçükates *et al.*, 2007*).* Local infection may develop in the skin around the catheter. The bacteria can also enter the blood through the vein and cause a generalized infection. The longer a catheter is in place, the greater the risk of infection will be.

1.2.2 Epidemiology of Hospital acquired infections

In developing countries, the unsafe use of injection materials, other medical devices, and blood products, inadequate surgical procedures and deficient biomedical waste management result in thousands of infections acquired not only from patients, but also from healthcare workers in which most of them are unreported. The World Health Organization (WHO)

estimates that the proportion of injections given with syringes or needles that are reused without sterilization is between 1.5% and 69.4% in transitional and developing countries and, the percentage of facilities not using proper waste disposal methods ranged from 18% to 64% (Raka *et al,* 2004). As a consequence, unsafe blood transfusions and injections result in an astounding number of new infections due to hepatitis B virus, hepatitis C virus, and human immunodeficiency virus every year (WHO, 2005).In industrialized countries, healthcare-associated infection is a complication for between 5% and 10% of patients admitted to acute care hospitals (Emmerson, 1996; Ayliffe, 200) whereas in developing countries, the risk of infection is 2-20 times higher, and the proportion of patients infected can exceed 25% (Young *et al.,* 1995).

After open cardiac surgery, 5.0% of patients developed microbiologically documented nosocomial infection and the majority of nosocomial infections were respiratory tract infections (45.7%) and central venous catheter-related infections (25.2%) and all cases of hospital mortality was 16.8% in patients with nosocomial infection (Michalopoulos *et al.,* 2006). In developed countries, between 2% and 5% of patients who undergo surgery develop a surgical site infection where as in developing countries much higher rates are reported, ranging from 12% to 39% (Zaidi *et al*., 2005; Kotisso *et al*., 1998).

A study conducted in England showed that infection of superficial incision was more common than deep incision and organ/space SSI accounted for more than half of all SSI for all categories of surgery assessed during the study (Coello *et al*., 2005). Similarly infection of limb amputation was the highest incidence (14.3%) of SSI. The post-operative length of stay was also assessed and it was longer for patients with SSI than those patients without SSI in which the length of hospital stay was from 3 to 21 days with an additional cost ranging from 259 up to 6,103 pounds (Coello *et al.,* 2005).

In other studies conducted in general surgery showed that hospital acquired infections accounted for 2.11% in which surgical site infections were the most common of nosocomial infections (37.1%) followed by skin and soft tissue infections (20.1%), and respiratory tract infections (17.6%). The most frequent etiological pathogens of nosocomial infections were *Escherichia coli* and *Staphylococcus aureus* (Skarzynska *et al*.,2000). This prevalence of SSI is comparable to the overall prevalence in developing countries but higher than that of

developed countries (Zaidi *et al.*, 2005). According to the study conducted in Brazil among obstetrics patients, only 32 cases (1.6%) of SSI were detected in which the prevalence rate was considerably below the rate of US Centers for Disease Control and Prevention's National Nosocomial Infection Surveillance System benchmark accounted for 3.6% (Couto *et al.*, 1998). Imipenem (IPM)-resistant strains of *Pseudomonas aeruginosa* 27/282 (9.6%) were isolated from urine, exudate from surgical wounds, and ascites of obstetrics and gynecological patients (Yin *et al*., 2003).

About 5–10% of patients admitted to acute care hospitals and long-term care facilities in the United States develop hospital-acquired infections, with an annual total of more than one million people and estimated annual cost related to nosocomial infection ranges from US dollar 4.5-11 billion and up. Nosocomial infections contributed to 88,000 deaths in the U.S. in 1995 (Klevens *et al.,* 2002*).*The Centers for Disease Control and prevention (CDC) of the U.S. has shown that about 36 % of these infections are preventable through the adherence to strict guidelines by health care workers when caring for patients. What can make these infections so troublesome is that they occur in people whose health is already compromised by the condition for which they were first hospitalized. They have considerable impact both in terms of public health (contributing to an increase in morbidity and mortality) and in economic terms. For instance, hospital acquired infection (HAI) diagnosed in intensive care wards alone account for 15 to 20% of hospital expenditure. Bacteria that are acquired during a hospital stay and have developed resistance to multiple antibiotics may remain with a patient for many years (Nguyem, 2004; Toni and Culvert, 2003). The report of the study conducted at Sudanese University Hospital, Khartoum, from 1996-1997 indicated that 13.8 % of the patients developed SSI, and the most prevalent isolate during the study was *S. aureus*. This study indicated that the rate was slightly less than some reports from different developing countries (Ahmed *et al*., 1998).

A surveillance study in two Latvian hospitals showed an overall nosocomial infection rate of 5.6% as compared to 12% for Community acquired infection. Among the nosocomial infections, surgical site infection (SSI) (62%) was predominant followed urinary tract infection being third (6.4%) (Dumpis *et al*., 2003). Another study of nosocomial infection

among 168 post operative patients following intervention for intra-abdominal infections showed an overall infection rate of 39.3%. Among those who had undergone routine/elective brain surgery , post-operative nosocomial infection was found to be 7.0 % in which the overall infection rate was highest in emergency cases (12.2%) compared to routine (clean) cases of 7.8%. *Acinetobacter* was the common organism for meningitis and chest infection, Methicillin resistance *Staphilococus aureus* (*MRSA)* in wound infection; *Pseudomonas aeruginosa* in UTI (Agarwal *et al*., 2003). In another study, the nosocomial infection rate was 10.68% in which the main sites of infection were postoperative cuts, in lower respiratory tract and urinary tract (Zhang and Wang, 1995).

Further studies showed that among 295 patients, 89% of whom underwent resection operations, 90 episodes of nosocomial infection were diagnosed in 76 patients, including 10 pneumonia, 47 lower respiratory tract infection, 16 wound infection. one third were detected after hospital discharge, 9 urinary tract infection, and 8 bacteremia in which three fourths were catheter-related bacteremia and twenty patients had severe infections (pneumonia or empyema), with a mortality rate of 60% (Daniel *et al*, 2005).

A study from Kosovo, the prevalence of hospital acquired infections were reported as bloodstream infection of 62.1%, pneumonia 10.3%, urinary-tract infection 7.0%, surgical-site infection 10.3% and meningitis 10.3%. Regarding etiology Gram-positive bacteria accounted for 33.3% of infections with the most commonly isolated microorganisms being *Enterococcus* species (25.1%), *Staphylococcus aureus* (8.3%), and *Coagulase- negative staphylococci* (8.3%) (Raka *et al*., 2006). In France, the prevalence of hospital acquired infections in 2001 and in 2006 was 6.87% and 7.5%, respectively and the prevalence of each type of infections were UTI (40%), skin and mucous membrane infection (10.8%), SSI (10.3%) and pneumonia (10%) and the over all infection rate of hospitalized patients is estimated about 5% to 19% (Moataz, 2005). In Italy in public hospitals in Lombardy, the overall prevalence of HAI was 4.9% of which the prevalence for each HAI was bloodstream infections (0.6%), pneumonia (1.1%), urinary tract infections (1.6%), gastrointestinal infections (0.4%) and surgical site infections (2.7%). The most frequently isolated pathogen from all sites of infections was *Escherichia coli (*16.8%), followed by *Staphylococcus aureus* (15.0%), *Pseudomonas aeruginosa* (13.2%) and *Candida spp.* (8.7%). Methicillin-

resistant *S. aureus* accounted for 23% of all isolated *S. aureus* (Lizioli *et al.,* 2003). According to the Norwegian Institute of Public Health initiated a surveillance system, the total prevalence of the four recorded nosocomial infections varied between 6.6 and 7.3% and in the surveys nosocomial infections occurred most frequently in the urinary tract (50%), followed by infections of the skin (25%), of the lower respiratory tract (19%) and of surgical sites (5%) (Eriksen *et al.,* 2004).

A study conducted in west India showed that 2.1% nosocomial infections were determined and of these infections, 28.8% were UTI. The most frequently isolated micro-organisms were *Escherichia coli* (31.4%) followed by *Candida spp* (21.3%), *Klebsiella spp* (10.6%) and *Enterococcus spp* (6.9%). The most effective antibiotics against Gram-negative bacteria were found to be Imipenem and Meropenem (Savas *et al.,* 2006).

In Saudi Arabia community hospital, 8.5% of patients developed hospital acquired infections and the rates among gynecological and surgical patients were 16.2% and 11.7% respectively. Urinary tract (31.3%), wound (27.1%) and blood (14.9%) infections accounted for more than 70% of the infections. *Staphylococcus aureus* (23%) and *Pseudomonas aeruginosa* (11%) caused more than 90% of the infections. (Al-Ghamdi., 2003). The majority of the bacterial pathogens (79%) were multi-drug resistant. Over 80% of patients were administered prophylactic and/or therapeutic antibiotics, with 53% receiving multiple antibiotics; 72% of the antibiotics were judged to be misused. Both prophylaxis and treatment were mostly misguided and clinically unwarranted (Al-Ghamdi, 2003).

According to a study conducted in eight African hospitals and Malta, Methicillin resistance was detected in 213 (15%) of 1440 isolates tested. in which the rate of methicillin resistant *Staphylococcus aureus* (*MRSA*) was relatively high in Nigeria, Kenya, and Cameroon (21-30%), and below 10% in Tunisia, Malta, and Algeria. All MRSA isolates were sensitive to Vancomycin, with minimum inhibitory concentrations (MICs) < 4 mg/L. The isolates were also highly sensitive to ciprofloxacin, except in Kenya, Morocco, and Tunisia, where relative resistance to this drug was noted. Susceptibility to Rifampin and Fusidic acid seems to be correlated with the clinical use of these compounds. Only 46% of 59 MRSA strains analyzed were susceptible to Rifampin, Fusidic acid, and Ciprofloxacin. The majority

(>60%) of MRSA strains are resistance (Kesah *et al.*, 2003).

Further more, profile in five European countries showed that most frequently isolated organisms were *Enterobacteriacea* (59%) followed by *Pseudomonas aeruginosa* (24%). The main sources were respiratory tract (4%), urine (26%), blood (14 %), abdomen (11 %), and skin and soft tissue (7%). Among the cultured organisms from sputum (54%), tracheal aspirate (25%), and bronchial lavage fluid (21%) the most common organisms were *Klebsiella spp* (35%), *Acinetobacter baumannii* (27%), and *Escherichia coli* (15%). Imipenem was the most active agent, inhibiting 90% of *Enterobacteriaceae* and *A. baumannii* organisms. It was considered that approximately 12% of *Klebsiella pneumoniae* and 21% of *E. coli* isolates to be possible producers of extended-spectrum beta-lactamase. *K. pneumoniae* isolates of the extended-spectrum beta-lactamase phenotype were more resistant to Imipenem, ciprofloxacin, and tetracycline in this than they are in other regions of the world (Gonlugur *et al*., 2004).

A multi centric study of hospital acquired infections among HIV infected patients showed a rate of 6.3% with 36.6% bloodstream infection, 30.5% urinary tract infection, 18.4% pneumonia, 5.2% skin and soft tissue infection and 2% surgical site infection (Petrosillo *et al.*, 1999). Likewise, most of gram-positive isolates from urinary tract (100%), respiratory tract (89.7%), and bloodstream infections (65.5%) were obtained from leukemic patients in which gram-positive bacteria causing nosocomial BSI were mainly coagulase negative staphylococcus (CoNS) and *S. aureus,* whereas gram-positive bacteria causing nosocomial respiratory tract infection (RTI) were mainly alpha-hemolytic streptococci and CoNS. *S. aureus*, CoNS, and alpha-hemolytic *streptococci* demonstrated methicillin resistance (81.5%, 92.3%, and 90% resistance, respectively). *S. aureus* and CoNS were susceptible to linezolid (15.4% and 0% resistance, respectively), and vancomycin (15.5% and 11% resistance, respectively) (Ashour *et al*., 2007).

Device associated hospital acquired infections in intensive care units in Argentina revealed 30.3 per 1000 device – days for blood stream infections, 18.5 per 1000 device – days on ventilator for pneumonia (Rosenthal *et al*., 2004). Instrumentation poses a major challenge for the susceptible patients causing nosocomial organisms of catheter related blood stream

infection (CRBSI). The predominant organisms of CRBSI were coagulase negative *enterococci* and *Staphylococcus aureus* (Heard *et al*., 2001). Intravascular catheters and urinary catheters are the most frequently used catheters in medical practice in the USA and they are likewise the most common causes of nosocomially acquired blood stream infection. Biofilm formation on the surfaces of indwelling catheters is central to the pathogenesis of infection of both types of catheters. Antibiotic impregnated intravenous catheters are thought to be solutions to prevent infection. However, the usage of potential antibiotics for urinary tract infections could not be effective in preventing infection as the peri-urethral bacteria is diverse (Trautner *et al.,* 2004). Similarly colonization of the endotracheal tube, urinary catheter related infection (UCRI) and colonization of the central venous catheter CVC was studied in which *E. coli* was the commonest organism colonizing the endotracheal tube tip with maximum susceptibility to Cefotaxime and amikacin and it was also the commonest organism causing UCRI with maximum susceptibility to nitrofurantoin and amikacin. *Acinetobacter* was the commonest organism colonizing the CVC with maximum susceptibility to ciprofloxacin (Tullu *et al.,* 1998).

In Tanzania the overall HAI prevalence was 14.8%. The prevalence of HAI were particularly high in the medical intensive-care unit (40%), the surgical (orthopedic and general surgery) wards (36.7%), and one of the general medical wards (22.2%). The most commonly identified HAI in the hospital were urinary-tract infections (14 cases), followed by surgical-wound infections (10 cases) and then lower respiratory-tract infections (6 cases) (Gosling *et al.*, 2003).

In a study conducted in Ethiopia on 1006 surgical patients admitted over 10 months to a hospital in Addis Ababa, nosocomial infections were detected in 165 (16.4%) patients in which wound (59%), urinary tract (26%), and respiratory tract (6%) infections accounted for more than 90% of the infections (Habte-gabr *et al.*, 1984). In this study, fourteen of 18 deaths were attributed to nosocomial infections. With regard to etiology, 90% of the isolates were gram-negative bacteria, of which 84% were *Enterobacteriacea*. More over, most of the isolates were resistant to the commonly used antibiotics (Habte-gabr *et al*., 1988). Another study conducted among gynecology and obstetrics patients in Tikur Anbessa Hospital Addis Ababa indicated that the over all prevalence was 17% with wound infection at 47%

followed by UTI 16% (Gedebou et al., 1988). In Mekele Hospital HAI was 27.6% (Tesfahunegn et al., 2009) A study result reported from Gondor also showed that the prevalence of SSI was 38.7% (Kotisso and Aseffa, 1998) and 14.8% for SSI was also reported from Addis Ababa (Taye, 2005).

Another study in Ethiopia (Seid and Asrat, 2005) showed that extended spectrum β-Lactamases (ESBLs) producer and multi-drug resistant *Klebsiella spp.* are becoming major nosocomial pathogen. In this study, a total of 384 clinical specimens (202 sputum, 164 urine and 18 pus) collected from patients admitted in different wards, showed 57 (15%) *Klebsiella spp.* Among the 57 Klebsiella spp. 54(94.7%) were identified as *K. pneumoniae* and 3(5.3%) as *K. oxytoca*. Resistance was found against cephalosporins [Cefotaxime (39.0%), Cefoxitin (39.0%), Ceftazidime (40.0%), Ceftriaxone (40.0%), Cephalothin (42.0%)], Chloramphenicol (70.0%), Gentamicin (61.0%) and Trimethoprim–Sulphamethoxazole (65.0%). Analyzed *Klebsiella i*solates were characterized also by a high degree of multi-drug resistance (67.0%). In 19/57 (33.3%) of the *Klebsiella* isolates, ESBL production was detected. Multi-drug resistant isolates were more prevalent among the ESBLs producers (95.0%) than non-producers (53.0%). It was stated that in the absence of infection control measures, ESBL producing organisms readily pass horizontally from patient to patient. These strains also transiently colonize the hands of hospital staff members, thereby facilitating patient-to-patient transmission of the organism (Seid and Asrat, 2005)

1.2.3 Modes of transmission of hospital acquired infections

Microorganisms are transmitted in hospitals by several routes and the same microorganism may be transmitted by more than one route which can be exogenous or cross infection and endogenous or autoinfection of patients owen normal flora. The main ways of cross infection include: contact, droplet, airborne, and common vehicle, (Leung, *2006;* Schaffe, 1996; Toni and Culvert, 2003). In contact transmission, the most important and frequent mode of transmission can be cross infection from patient to patient or health personnel to patient during health care delivery. Direct-contact transmission involves a direct body

surface-to body surface contact and physical transfer of microorganisms between a susceptible host and an infected or colonized person. Indirect-contact transmission involves contact of a susceptible host with a contaminated intermediate object or enviroment, usually inanimate, such as contaminated instruments, needles, or dressings, or contaminated gloves that are not changed between patients (Nguyem, 2004; Schaffe, 1996). Droplet transmission occurs when droplets are generated from the source person mainly during coughing, sneezing, and talking from the near by hospitalized patient or carrier of health attendants, and during the performance of certain procedures such as bronchoscope during hospitalization (Jarvis and Williams, 1991). Airborne transmission occurs by dissemination of either airborne droplet nuclei (small-particle residue 5 µm or smaller in size of evaporated droplets containing microorganisms that remain suspended in the air for long periods of time) or dust particles containing the infectious agent. (Jarvis and Martone, 1992). Common vehicle transmission applies to microorganisms transmitted to the host by hands of health personnel and contaminated items such as food, water, medications, devices, and equipment. (Wu *et al*.,2006). Endogenous or auto infection of HAI occurred when patient's normal flora spreads via blood from one site to the other site usually when patient's immune system is decreased.

1.2.4 Risk factors of hospital acquired infections

Among many factors which play a role in the causation of nosocomial infection the hospital environment, patient population with increased susceptibility to infection, extensive patient care giver interaction, intensive care unit exposure, the presence of antibiotic resistant microbes and failure to use pre operative antibiotics are important risk factors (Dulworth and Peyenson, 2004). In addition, invasive device intervention such as urinary bladder catheterization, respiratory procedures such as intubations or mechanical ventilation, surgery and the dressing or drainage of surgical wounds, gastric drainage tubes into the stomach through the nose or mouth and intravenous (IV) procedures for delivery of medication, transfusion, or nutrition are an important factors and the failure of hospital personnel to follow established infection prevention standards such as the easiest hand washing in between patients are important risks (Girou *et al.,* 1998; Toni and Culvert, 2003; Dulworth and Peyenson, 2004)

Case sensitive study on average length of hospital stay (ALOS) gives reason to hypothesize the existence of a positive correlation with development of nosocomial infection. Any reason, be it medical or otherwise, which increase hospital stay is hypothesized as a potential cause of nosocomial infections. Furthermore, the presence of immune suppression (drugs, HIV) concomitant chronic illnesses like diabetes mellitus, obesity, malignancies, malnutrition, chronic liver disease (CLD), previous use of antibiotics, etc along with extended hospital stay and instrumentation are some of the causes. Generally, the influence of time on development of nosocomial infection has previously been approached only through the duration of exposure to risk, defined as the stay in the intensive care unit (ICU) and other wards and/or the duration of use of invasive procedures such as mechanical ventilation or catheterization, which reflects therapeutic activity. Underlying disease, severity of illness, therapeutic activity attribute to nosocomial infections (Dulworth and Peyenson, 2004; Lee *et al.;* 2003; Girou *et al.,* 1998).

1.2.5 Etiologic agents of hospital acquired infections

Hospital-acquired infections can be caused by bacteria, viruses, fungi, or parasites (Schaffer, et al., 1996, Toni and Culvert, 2003). Depending on the causal agents involved, an infection may start in any part of the body. A study conducted in Ethiopia showed that the majority (88%) of the etiologic agents isolated were gram negative bacteria and of these 85% were members of *Enterobactersiae* (Habtegaber *et al.,*1998). Other studies in Ethiopia also showed that 89% of infection were due to *Enterobactersiae* and of these isolates, *Klebsiella species* 28%, *E.coli* 27%, *proteus species* 12%, *Staphilococcous aureus* 11% ,*Pseudomonas* and *enterobacter species* each 5%, *Acinetobacter spp* 4%, *citrobacter spp* 2% were common (Gedebu *et al,* 1988). Furthermore etiological investigations in different studies revealed that the commonest pathogens reported by site included: (1). bloodstream: Hepatitis B, C, D and HIV; coagulase-negative staphylococci, *S. aureus, enterococci, E. coli,* and *Candida spp*. (2). Lower respiratory tract infection: *S. aureus, P. aeruginosa and Enterobacter spp;* (3). surgical wound infection: *S. aureus, enterococci* and coagulase-negative staphylococci; (4). urinary tract infection: *E. coli, enterococci*, and *P. aeruginosa, Proteus species, Klebsiela species, Citrobacter, Morganella species, Seratia. Marsescense* (Jarvis and Martone, 1992; Hadadi *et al.,* 2008).

In the intensive care units (ICUs), the commonest pathogens found in the bloodstream are coagulase-negative staphylococci, *S. aureus*, and *enterococci*. In lower respiratory tract infections *P. aeruginosa, S. aureus*, and *enterococci* are common. In surgical wound infections enterococci, *coagulase-negative staphylococci, Enterobacter spp*. and respiratory viruses like common cold virus and in urinary tract infections *Candida spp., E. coli, enterococci, P. aeruginosa,* and *Enterobacter spp* in which *S. aureus, E. coli* and *P. aeruginosa* remain important nosocomial pathogens. Coagulase-negative *staphylococci, enterococci* and *C. albicans* are pathogens of increasing importance, and the distribution of pathogens differs by site and hospital location (Jarvis and Martone, 1992).

1.2.6 Diagnosis for Hospital acquired infections

An infection is suspected any time a hospitalized patient develops fever that cannot be explained by the underlying illness. Some patients, especially the elderly, may not develop fever. In these patients, the first signs of infection may be rapid breathing or mental confusion. In general, diagnosis of a hospital-acquired infection is determined by: (1). Clinically by evaluation of symptoms and signs of infection , examination of wounds and catheter entry sites for redness, swelling, or the presence of pus or abscess, a complete physical examination and review of underlying illness. (2). By laboratory tests, including hematological tests like complete blood count (CBC) especially to look for increase in infection fighting white cells; urinalysis, looking for white cells or evidence of blood in the urinary tract; microbiological investigations such as cultures and biochemical test of blood, sputum, urine, or other body fluids or tissue to find the causative organism and serological tests using polyvalent and monovalent antisera for species identification. Chest x ray may be done when pneumonia is suspected for consolidation and review of all procedures performed that might have led to infection (Andreoli *et al.*, 1997).

1.2.7 Management of Hospital acquired infections

Treatment

Once the organism has been identified, it will be tested again for sensitivity to a range of antibiotics so that the patient can be treated quickly and effectively with an appropriate

medicine to which the causative organism responds. While waiting for these test results, treatment may begin with common broad-spectrum antibiotics such as penicillin, cephalosporins, tetracyclines, or erythromycin. During a time of increasing resistance, it is crucial that early recognition along with appropriate treatment and dosing strategies are employed to achieve successful outcomes. Fungal infections are treated with antifungal medications like Amphotericin B, Nystatin, Ketoconazole, Itraconazole, and Fluconazole. Viruses do not respond to antibiotics but a number of antiviral drugs have been developed that slow the growth or reproduction of viruses, such as Acyclovir, Ganciclovir, Foscarnet, and Amantadine (Toni and Culvert. 2003; Gupta, 2008).

The emergence and rapid spread of multidrug-resistant isolates causing nosocomial infections are of great concern worldwide and such multidrug-resistant isolates causing nosocomial infection include: methicillin-resistant *Staphylococcus aureus* (MRSA), glycopeptide-resistant *Enterococcus spp*., *enterobacteria* producing extended-spectrum beta -lactamases (ESBLs), multi resistant *Acinetobacter baumannii* and carbapenem-resistant *Pseudomonas aeruginosa* (Biedenbach *et al*., 2004). Infections caused by multidrug-resistant gram-positive organisms continue to occur at an alarming rate worldwide and the most threatening nosocomial "super-bugs" are methicillin-resistant *S. aureus* (MRSA), vancomycin-intermediate resistant *S. aureus* (VISA), and vancomycin-resistant *enterococcus* (VRE) (Capriotti., 2001). A 12% increase in vancomycin-resistant *Enterococcus* (VRE) hospital-acquired infections in the ICU was reported in 2004, with a rate of about 28% (Biedenbach *et al.,* 2004). Extended-spectrum beta-lactamase (ESBL) production was determined in 27% of *E. coli* and in 25% of *K. pneumoniae* isolates, and cases with ESBL producing strains had significantly higher antibiotic consumption rate (Arjona *et al.,* 1996). The susceptibility of ESBL positive *E. coli* isolates to piperacillin+tazobactam was 76% and 65% to cefepime, 63% to ceftazidime, 56% to tobramycin, 24% to ciprofloxacin (Zarakolu *et al*., 2006). In Assiut University Hospitals (Egypt) the prevalence of ESBL enzyme producer isolates was 64.7% (Ahmed *et al*., 2008). The SENTRY Antimicrobial Surveillance Program, performed between 1997-2002 to assess blood stream infections (BSIs) in the United States, Europe, and Latin America, documented that the incidence of oxacillin-resistant *S aureus* (39.1%) and VRE (17.7%) were highest in

the United States and the incidence of nosocomial infections in ICU was 4-5 times greater than in general ward and hence critically ill patients are always at higher risk of developing nosocomial infections with resistant strains (Biedenbach *et al*., 2004; Renato *et al*., 2006).

The gram negative enteric bacilli were uniformly resistant to betalactam antibiotics as well as betalactamase inhibitors in which resistance to ciprofloxacin and ceftriaxone ranged from 50-100% and 25-83.3%, respectively (Adukauskiene *et al.*, 2006). *Staphylococci* were 100% resistant to penicillin and tetracycline, 80% to cotrimoxazole, 60% to erythromycin and gentamicin and 40% to amikacin. *Acinetobacter spp*. were highly resistant to most of the antibacterial agents except gentamicin while *Pseudomonas spp*. showed 75% resistance to it (Adukauskiene *et al*., 2006). IUCs significantly increased the antimicrobial resistance of *E. coli* other species of *Enterobacteriaceae* and rare gram-negative bacilli to nearly all antibiotics tested, such as trimethoprim/sulfamethoxazole (Ko *et al*., 2008) and also increased the prevalence of urinary tract infections caused by some highly resistant pathogens and increased risk of concurrent resistance of *Enterobacteriaceae.* The greatest challenge facing the effective management of *P. aeruginosa* infection is multiple drug resistance (Amadi., 2009).

Prevention

Infection prevention program have dual benefits of ensuring quality of health care as well as un necessary cost by both the health facilities and patients, hence the continuous surveillance of nosocomial infection is an integral part of infection prevention program and quality assurance projects (QAP) have in their objective standardization of management of health problems and the basic issues are consideration of infection prevention.

Prevention measure includes adoption of an infection control program as recommended by the U.S. Centers for Disease Control (CDC), which includes quality control of procedures known to lead to infection and a monitoring program to track infection rates to see if they go up or down, identify high-risk procedures and other possible sources of infection, strict adherence to hand-washing rules by health care workers and visitors to avoid passing infectious microorganisms to or between hospitalized patients (NNIS, 2002). More over

strict attention to aseptic (sterile) technique in the performance of procedures including use of sterile gowns, gloves, masks, and barriers, sterilization of all reusable equipment such as ventilators, humidifiers, and any devices that come in contact with the respiratory tract are important preventive measures (Gupta, 2008; NNIS, 2002; Segers, 2006). Frequent changing of dressings for wounds and use of antibacterial ointments under dressings, remove nasogastric (nose to stomach) and endotracheal (mouth to stomach) tubes as soon as possible, use of an antibacterial-coated venous catheter that destroys bacteria before they can get into the blood stream, prevent contact between respiratory secretions and health care providers by using barriers and masks as needed are methods to prevent hospital acquired infections (Gupta, 2008; WHO, 2002). Similarly use of silver alloy-coated urinary catheters that destroy bacteria before they can migrate up into the bladder; limitations on the use and duration of high-risk procedures such as urinary catheterization, isolation of patients with known infections, sterilization of medical instruments and equipment to prevent contamination, reductions in the general use of antibiotics to encourage better immune response in patients and reduce the cultivation of resistant bacteria are also preventive methods (Toni and Culvert; 2003; Gupta , 2008; Schaffer , 1996; WHO, 2002).

Hand washing is one of the most important means of reducing the transmission of infection. How ever, the habit of hand rubs and or hand washing is way down than expected of health care providers. Encouraging and teaching staff about the importance of hand hygiene should be a great effort in the prevention of nosocomial infections. From observation, the rate of hand washing was only 46% of the expected (Wendt *et al.*, 2004).

1.3 Significance of the study.

HAI is a global problem with the multi face out comes such as devastating effect on patients and their families in terms of increasing cost of treatment , level of morbidity , mortality , pain , distress and consumes scarce hospital resources (Girou *et al*., 1998) .More over these infection adds the functional disability and emotional stress of the patient that ultimately reduce the quality of life. In industrialized countries, HAI is a complication for between 5% and 10% of patients admitted to acute care hospitals whereas in developing countries, the risk of infection is 2-20 times higher, and the proportion of patients infected

can exceed 25%.

The report from the Study on the Efficacy of Nosocomial Infection Control (SENIC) project estimated that at least 2.1 million nosocomial infections occurred annually among 37.7 million admissions in United States hospital, and considered 77,000 deaths to be associated with nosocomial infections. Similarly the highest rates of nosocomial infections are observed in ICUs, which are also the units in which the most severely ill patients are Arabia community hospital 8.5% developed nosocomial infection, the rates were highest for nursery (35.8%), intensive care (19.8%), gynecological (16.2%) and surgical (11.7%) patients. Urinary tract (31.3%), wound (27.1%) and blood (14.9%) infections accounted for treated and in which the highest mortality rates are observed (Kleven *et al*., 2007) In Saudi more than 70% of the infections(Al-Ghamdi, 2003) Further more the antibiotic susceptibility profile in five European countries showed that most frequently isolated organisms were *Enterobacteriacea* (59 %) followed by *Pseudomonas aeruginosa* (24%). The main sources were respiratory tract (4 %), urine (26%), blood (14 %), abdomen (11 %), and skin and soft tissue (7%). And in similar studies decreased antibiotic susceptibility across all species and drugs was highest in Portuguese ICUs followed by French, Spanish, Belgian, and Swedish ICUs(Gonlugur *et al*., 2004). In Ethiopia scarce studies were done in the area like Tikur Anbesa Hospital reported 16.4% (Habte-Gabr et al.,1988), 17% with wound infection at 47% followed by UTI 16% (Gedebou et al., 1988). In Mekele Hospital HAI was 27.6% (Tesfahunegn et al., 2009) A study result reported from Gondor also showed that the prevalence of SSI was 38.7% (Kotisso and Aseffa, 1998) and 14.8% for SSI was also reported from Addis Ababa (Taye, 2005).

There is a need for interventions to reduce the burden of HAI in the tropics and to set up effective surveillance program to determine their impact. Like wise for prudent use of antibiotics and control of nosocomial infections, it is necessary to regularly survey the antibiotic resistance of common pathogen bacteria. There fore the possible reasons to conduct this study could be: the increasing trends of antibiotic resistance and antibiotic susceptibility pattern differ from country to country, region to region and even from hospital to hospital and the out come of the our study was supposed to fill such gaps accordingly. In the same way the importance of quality assurance and infection prevention

program are not given due attention by our health instituitions all over the country and no base line studies in Felege Hiwot Referral Hospital. Further more our study assessed the major trend of hospital acquired infections in the study area and risk factors ultimately to evaluate subsequent improvements as a result of the infection prevention and control measures introduced and help to assess the impact of quality assurance program (QAP) in the hospital.

1.4 Objectives.

1.4.1 General Objective

To determine the prevalence of hospital acquired bacterial infections and assess the associated risk factors among hospital admitted patients in Felege Hiwot Referral Hospital, Bahir Dar

1.4.2 Specific Objectives

- To determine the prevalence of hospital acquired bacterial infections among patients admitted to Surgical, Gynecology and Obstetrics wards in Felege Hiwot Referral Hospital, Bahir Dar.
- To identify the risk factors associated with hospital acquired bacterial infections among patients admitted to Surgical, Gynecology and Obstetrics wards in Felege Hiwot Referral Hospital.
- To isolate the bacterial pathogens responsible for hospital acquired infection among patients admitted to Surgical, Gynecology and Obstetrics wards in Felege Hiwot Referral Hospital.
- To determine the antibiotic susceptibility pattern of bacterial isolates among patients admitted to Surgical, Gynecology and Obstetrics wards in Felege Hiwot Referral Hospital.

Chapter II Materials and Methods

2.1 Study design and period

A prospective observational study was conducted to determine hospital acquired infection in Felege Hiwot Referral Hospital from April to August, 2009.

2.2. Study area

The study was conducted in Felege Hiwot Referral Hospital in Bahir Dar town, Amhara National Regional state North West Ethiopia. Bahir Dar is the capital city of Amhara National Regional State. It is situated at the bank of Lake Tana 565 km from Addis Ababa. The total population of Bahir Dar city is 204,277 of which 98,783 are males and 105,494 females (Amhara National Regional State, 2002). There is one hospital in the city. The hospital has total beds of 208 consisting of Pediatric ward, Gynecology ward, Obstetrics ward , Medical and Surgical ward with number of beds of 42,24, 20, 64 and 58 respectively. The hospital provides services for patients coming from all parts of the Amhara National Regional State and other neighboring regions of hospitals and health center.

2.3 Source population

All hospital admitted patients in Felege Hiwot Referral Hospital, served as source population.

2.4. Study Subjects

All adult patients 18 years and above who were admitted to surgical, gynecology & Obstetrics wards during the study period were included in the study.

2.5. Sampling technique and sample size determination

Patients who had been admitted to surgery, genecology and obstetrics wards included in this study were subjected to follow up the diagnosis for HAI. The sample size was

calculated using the formula for estimating a single population proportion. A minimum of 1383 patients were included in the study based on a single population proportion using the following formula

Total study subjects: $n = \frac{z^2 p(1-p)}{d^2}$

= 1317 in which further adjusting needed + Contingency (5%) = 1383

Where n = total sample size

P=prevalence of nosocomial infection (16.4 %) (Habte-Gaber et al., 1988).

d=degree of accuracy desired (0.02)

$Z^2_{1-} \alpha_{/2}$=the standard normal deviation (1.96)

2.6. **Measurement variables**

2.6.1 Dependent variables: UTI, pneumonia, surgical wound infection, septicemia, bacterial isolates and susceptibility pattern for antibiotics which involve laboratory procedures and their results could be influenced by different independent variables.

2.6.2 Independent variables: age, sex, occupational status, urinary catheter insertion, surgical procedure,antibiotic usage ,duration of admission, clinical diagnosis during operation other than surgical intervention, presence of chronic underline diseases, nature of wound and type of disinfectant or sterilization method used were considered independent variables

2.7. Eligibility criteria

2.7.1 Inclusion criteria: Patients who develop pneumonia, urinary tract infection (UTI), primary bacteremia, surgical wound infection /Caesarian section wound infection as well as other infections with in at least 48 h to 72 h or after operation admitted to surgical,

Gynecology & Obstetrics ward were included.

2.7.2 Exclusion criteria: was include: Patients who developed community acquired infections: pneumonia, urinary tract infection (UTI), primary bacteremia, surgical wound infection /Caesarian sections wound infection before 48 hrs of admission and patients who were discharged and difficulty to follow up were excluded

2.8 Data Collection

The questionnaire collected were used for socio demographic data, to asses the associated risk factors and clinical status on admission of each patient. Patients were followed during their admission/ post operative period for the development of any infection which is noted until the day of their discharge. Clinically suggestive nosocomial infections were identified based on CDC criteria

2. 8.1 Operational Definitions

CDC definitions of hospital acquired infections (Horan and Gayne, 2004) which is applied for selection of clinically suspected patients developing the following nosocomial or hospital acquired infections among admitted patients in the three wards during the study period were applied.

Symptomatic urinary tract infection (UTI): Patient has at least one of the following signs or symptoms with no other recognized cause: fever (>38° C)),urgency, frequency, dysuria, or suprapubic tenderness and patient has a positive urine culture, that is, 10^5 microorganisms per cm^3 or urine with no more than two species of microorganisms.

ASymptomatic urinary tract infection(UTI -ASB) Patient has had or not had an indwelling urinary catheter within 7 days before the culture *and* a positive urine culture, that is, 10^5 microorganisms per cm3 of urine with no more than two species of microorganisms *and* patient has *no* fever (>38^oC), urgency, frequency,dysuria, or suprapubic tenderness.

A superficial Surgical site infection (SSI): Infection occurs within 30 days after operative procedure *and* involves only skin and subcutaneous tissue of the incision with signs or

symptoms of infection: pain or tenderness, localized swelling, redness, or heat, and superficial incision is deliberately opened by surgeon, purulent drainage from the superficial incision or organisms isolated from an aseptically obtained culture of fluid or tissue from the superficial incision.

Deep incision Surgical site infection (SSI): Infection occurs within 30 days after the operative procedure If no implant is left in place or within 1 year if implant is in place and the infection appears to be related to the operative procedure which involves deep soft tissues (e.g., fascial and muscle layers) of the incision and prulent drainage from the deep incision but not from the organ/space component of the surgical site. the patient has at least one of the following signs or symptoms: fever (>38° C), or localized pain or tenderness

Organ/Space Surgical site infection (SSI Infection occurs within 30 days after the procedure if no implant is left in place or within 1 year if implant is in place and the infection appears to be related to the operative procedure and infection involves any part of the body, excluding the skin incision, fascia, or muscle layers, that is opened or manipulated during the operative procedure *and* purulent drainage from a drain that is placed through a stab wound into the organ/space or organisms isolated from an aseptically obtained culture of fluid or Diagnosis of an organ/space SSI by a surgeon or attending physician

Blood stream infection (BSI).

Clinical sepsis: Patient has at least one of the following clinical signs or symptoms with no other recognized cause: fever (>38° C), hypotension (systolic pressure (≤ 90 mm), or oliguria (<20 cm^3 /hr) and blood culture not done or no organisms and physician institutes treatment for sepsis.

Laboratory-confirmed bloodstream infection: Patient has at least one of the following signs or symptoms: fever (>38° C), chills, or hypotension and at least one of the following: common skin contaminant (e.g., *diphtheroids*, *Bacillus sp*., *Propionibacterium sp.*, *coagulase-negative staphylococci,* or *micrococci*) is cultured from two or more blood cultures drawn on separate occasions.

Pneumonia: Patients with two or more serial chest radiographs with at least *one* of the following: Fever (>38°C or >100.4°F) with no other recognized cause, leukopenia (< 4,000 WBC/mm3) *or* leukocytosis (≥12,000 WBC/mm3), for adults ≥70 years old, altered mental staPatietus with no other recognized cause *and* at least *two* of the following:new onset of purulent sputum, or change in character of sputum, or increased respiratory secretions, or increased suctioning requirements, new onset or worsening cough, or dyspnea, or tachypnea.

2.8.2. Laboratory procedures (Isolation of pathogens).

Specimen collection and handling. The following specimens were collected by well trained nurses and most of the samples were collected by principal investigator.

Blood sampling and processing: About 5ml of venous blood was collected aseptically and transfer aseptically to bottle containing 45ml of brain heart infusion and cultured according to standard operational procedure (SOP) for blood collection and culturing procedure. (Chees brough, 2004).

Sputum sample collection and processing: Patients were instructed to deep breath in first and produce real and sufficient amount of sputum, collect in dry, transparent and well caped container and laboratory procedures, like culture and gram stain was done according to standard operational procedure (Chees brough, 2004).

Urine specimens: About 10ml mid stream urine sample was collected aseptically before and after catheterization by using sterilized container for bacteriological examination after the patient was well instructed to clean the genital area .For the patients with indwelling catheter urine was aseptically aspirated using sterile needle and syringe after disinfecting the punctured site of the catheter and cultured according to standard operational procedure (Chees brough,2004).

Swab from wound infection: The purulent discharged pus was collected aseptically using sterile cotton swab and for the patients with no purulent discharge needle aspiration was done aseptically and processed by culture and gram stain procedures. (Chees brough,2004). In general all the above specimens was sent to Bahir Dar Regional Health Research Laboratory which is found with in the compound of the hospital, so transport media was not used.

Laboratory procedures to isolate the pathogen includes: Culture, biochemical test (API 20E (biomerieux France) catalase and coagulase tests) gram stain and antimicrobial sensitivity tests . *Entrobacteriacea* species identifications was made using API 20E. API 20E is miniaturized tubes coated with biochemicals such as amino acids and carbohydrates in which bacteria utilizes producing certain characteristics color at different PH in the prescience of certain color indicators. Catalase and both tube and slide coagulase test was done to identify gram positive bacteria particularly *S. aurous*. Using a calibrated inoculating loop, urine specimens were directly inoculated on blood agar, Chromo agar orientation (biomerieux France) and Cystine-Lactose-Electrolyte Deficient media (CLED)(Oxoid). Significant bacteruria (SB) was defined as urine culture which grew$\geq 10^5$ colony forming unit (CFU)/ml. Wound specimens were inoculated directly on blood agar, Manitol Salt agar and MacConkey agar (Oxoid). Aseptically collected blood was inoculated on Brain Heart infusion broth (oxoid) and observed for growth of bacteria indicating hemolysis, clotting, and turbidity every day for7- 14 days. For those inoculated broth showing an evidence of growth of bacteria were subculture on Blood agar, Chocolat blood agar, Manitol salt agar and MacConkey agar (Oxoid) Sputum was inoculated on Blood agar, Manitol Salt agar and MacConkey agar (Oxoid) Cultures were incubated in aerobic atmosphere at 37^0c for 24-48 hours. First positive cultures were identified based on their colony characteristics on their respective media and followed by the pattern of biochemical profiles on the bases of specific biochemical utilization of bacteria producing distinct features. Gram stain was done to confirm their gram reaction of the colony.

2.8.3 Antimicrobial susceptibility testing

Antibiotic susceptibly pattern of isolated organisms wewre done by using the standard Kirby-Bauer and NCCLS methods (Bauer et al., 1966; NCCLS, 2006). From a pure culture 3-5 selected colonies of the bacteria was taken and transferred to a tube containing 5ml of Nutrient broth and mixed and homogenous suspension was formed and the turbidity was adjusted to a McFarland standard with 0.5.The swab was then used to distribute the bacteria evenly over the entire surface of Mueller Hinton agar (Oxoid). The inoculated plates were left at room temperature to dry for 5-10 minutes and a set of antibiotic discs (Oxoid) were dispense on the surface of Mueller Hinton plate and incubated at 37^0c for 24 hours.

Diameters of the zone of inhibition around the discs were measured to the nearest millimeter using a metal caliper and the isolates were classified as sensitive, intermediate and resistant (Baue *et al*., 1966; NCCL, 2006).

Antibiotics tested:

For Gram Positives bacteria: Ampicillin (AMP)(10µg) **,** Sulphamethoxazole (SXM) (25µg) , Amoxicillin (AML) (30µg) , Augmentin (Amoxa-Clavulinic acid) (AC) (30µg), Ceftriaxone (CRO) (30 µg), Ciprofloxacin (CIP) (5µg) , Chloramphenicol (C) (30µg), Methicillin (MET) (5µg), Cloxacillin (OB) (1µg) , Tetracycline (TE) (30µg), Gentamycin (CN) (10µg) Vancomycin (VA) (30µg) Norfloxacillin (NOR) (10 µg) and Nalidixic acid (NA) (30 µg).

For Gram negatives:, Sulphamethoxazole (SXM) (25µg), Ampicillin (AMP)(10µg) , Chloramphenicol (C) (30µg), Tetracycline (TE) (30µg), Gentamycin (CN) (10µg) ,Ciprofloxacin (CIP) (5 µg) , Ceftriaxone (CRO) (30 µg) , Amoxicillin (AML) (30µg) Augmentin (Amoxa-Clavulinic acid) (AC) (30µg), Norfloxacillin (NOR) (10 µg) and Nalidixic acid (NA) (30 µg).

2.9. Data quality assurance

The quality of data regarding to assessment of risk factors was maintained by using questionnaire and similarly the quality of laboratory result was maintained using control strains or reference Strains such as *S. aureus* ATCC 25923, *E.coli* ATCC 25922, and *P. aeruginosa* ATCC 27853(BBL) during culture, biochemical and antimicrobial sensitivity tests. These strains were obtained from Ethiopian Health and Nutrition Research Institution.

2.10. Data Entry and Analysis

Data was entered in to a PC and analyzed using software packages SPSS- Version-15.2 to assess differences between variables. Prevalence was calculated for the sum of the numbers of positive cases of examined subjects. X^2 test was done along with P-value to see the presence of associations. Multivariant | bivariant logestic regression model analysis were applied to assess the risk factors. P-values<0.05 was considered statistically significant.

2.11. Ethical Consideration

The Department of Microbiology, Immunology and Parasitology (DMIP) approved the M.Sc research project and ethically cleared by the institutional review board (IRB) of the medical faculty and endorsed by the Faculty Academic commission. A letter informing the Amhara National Regional State Health Bureau about the objective of the study was written from the university prior to actual data collection period and finally the consent from medical director and manager was obtained to conduct the study.

CHAPTER III Results

3.1 Study Population

A total of 1383 consecutively admitted adult patients to Surgical , Gynecology and Obstetrics wards were carefully clinically observed by the surgeons and gynecologists in the respective wards during study periods for developing hospital acquired infections during their hospital stay. Socio demographic and risk factor of the patients were assessed by practicing nurses. Among the 1383 observed patients 707(51.1%) were male and 676(48.9%) females ($p<0.02$). Among the total of 1383 patients, 565 (40.9%) were farmers, 442(31.8%) were house wives, 212(15.3%) were government employee, 100(7.2%) were students and 64(4.6%) were others (Table 3.1).The rural and urban patients accounted 1005(72.7%) and 378(27.3%) respectively. Regarding their educational status the illiterate, read and write, elementary, high school and above accounted 943 (68.2%), 108(7.8%), 134 (9.7%) and 198 (14.3%) , respectively (Table 3 .1).

Table 3.1 Socio demographic factors distribution of patients admitted to surgical, gynecological and obstetrics wards in Felege Hiwot Referral Hospital, April-August 2009

Socio demographic factors		No	Percentage
Sex			
	Male	707	51.1
	Female	676	48.9
Age	18-29	660	47.7
	30-39	329	23.5
	40-49	180	13.0
	50-59	91	6.6

	60-69	79	5.7
	≥ 70	44	3.2
Residence	Rural	1005	72.7
	Urban	378	27.3
Educational status	Illiterate	943	68.2
	Read and write	108	7.8
	Elementary	134	9.7
	High school and above	198	14.3
Occupation	Farmer	565	40.9
	House wife	442	31.8
	Government employee	212	15.3
	Student	100	7.2
	Others	64	4.6

Regarding their admission in wards, 961 (69.5%) were admitted to surgical wards of which 707((51.1%) were males and 254(18.4%) were females whereas in obstetrics and gynecology ward admitted patients accounted 333 (24 %) and 89 (6.4%) respectively (Table 3. 2). The mean age of the patients was 33.8 years with the range of 18 to 87 years. Most of the patients 660 (47.7%) admitted to surgical , obstetrics and gynecological wards were within the age range of 18-29 and all of older ages 70 and above years were admitted in surgical wards (Table 3. 2)

Table 3.2 Sex and age distribution of patients admitted to surgical, gynecology and obstetrics wards in Felege Hiwot Referral Hospital, April-August 2009

Age group (years)	Surgical ward No (%)			Gyneccological ward No (%)	Obstetrics ward No (%)	Total
	M	F	Total	Total	Total	
18-29	292(44.2.)	122(18.5)	414	57(8.6)	189(28.6)	660
30-39	136 (41.3)	51(15.5)	187	24(7.6)	118 (35.9)	329
40-49	116 (64.4)	35(19.4)	151	3(3.4)	26 (14.4)	180
50-59	64(70.3)	25 (27.5)	89	2(2.2)	0	91
60-69	64(81)	12 (15.2)	76	3(3.4)	0	79
≥70	35(79.5)	9(20.5)	44	0	0	44
Total	707	254	961	89	333	1383

3. 2 Pattern of primary diagnosis during admission

The commonest primary diagnosis in surgical, obstetrics and gynecology wards were intestinal obstruction 158/961(16.4%), cephalopelvic disproportion 108/333 (32.4%) and abortion 38/89 (42.7%) respectively. Among 87 underlying diseases the majority were malignancy 30 (34.5%) followed by chronic obstructive pulmonary diseases 15(17.2%) chronic liver disease 14(16.1%) and anemia 12(13.9%).

Table 3.3 Pattern of primary diagnosis among patients admitted to surgical ward in Felege Hiwot Referral Hospital, April- August 2009.

Type of diagnosis (n=961)	No	Percentage
Intestinal obstruction	158	16.4
Appencitis	138	14.4
Bone fracture	114	11.9
Head injury	112	11.7
*Other injuries	112	11.7
Cholilithiasis	48	5
Peritonitis	26	2.7

Soft tissue infections	25	2.6
Cancers	24	2.5
Abdominal mass	23	2.4
Abscess	20	2.1
Haemo-pneumo thorax	20	2.1
Benign Prostatic hemorrhage	17	1.8
Goiter	13	1.4
Oestomyelitis	11	1.1
Hernia	10	1.1
Perforated peptic ulcer disease	10	1.1
Cystitis	8	0.8
Kidney stone	8	0.8
Gangrene	8	0.8
Burn	7	0.7
Hydrocell	7	0.7
Septic arthritis	6	0.6
Hemorrhoid	5	0.5
Urinary retention	4	0.4
Renal mass	3	0.3
Mastitis	3	0.3
Diabetics foot ulcer	3	0.3
** Other surgical cases	18	1.8

*****Others injuries include: Abdominal injury, stab injury, polytrauuma, spinal injury, chest injury, soft tissue injury, Traumatic hyperplagia, testicular injury, cervical vertebral injury

** Others surgical cases include: Disk prolapse, ,Fascial paralysis secondary to trauma, Necrotizing fascities, traumatic amputation.

Table 3.4 Pattern of primary diagnosis among patients admitted to obstetrics ward in Felege Hiwot Referral Hospital, April- August 2009.

Type of diagnosis (n= 333)	No	Percentage
Cephalo pelvic disproportion	108	32.4
Rupture uterus	70	21
Obstructed labor	19	5.7
Anti partium hemorrhage	18	5.4
Fetal distress	16	4.8
Post partium hemorrhage	14	4.2
Eclampsia	12	3.6
Intra uterin fetal death	10	0.3
Utro- vaginal prolapse	10	0.3
Preclampsia	9	2.7
Retain placenta	9	2.7
Caesarean section reinfection	6	1.8
Cord prolapse	4	1.2
Hand prolapse	4	1.2
Mal presentation	4	1.2
*Other obstetric cases	20	6

*Other obstetric cases include: Active first stage of labor, Fistula after labor, late first stage of labor and post term pregnancy.

Table 3.5 Pattern of primary diagnosis among patients admitted to gynecology ward in Felege Hiwot Referral Hospital, April- August 2009.

Type of diagnosis (n= 89)	No	Percentage
Abortion	38	42.7
Ectopic pregnancy	15	16.9
Purporial sepsis	10	1.2
Ovarian cyst	6	6.7
Pelvic mass	6	6.7
*Other gynecological cases	14	15.7

* hyperemesis gravidarm, molar pregnancy, Pelvic inflammatory diseases, twin pregnancy. Utrine myoma and Vaginal tears.

3 .3 Prevalence of hospital acquired infections

Among 961 surgical patients, 164(17.1%) developed hospital acquired infections where as in gynecology/ obstetrics patients accounted 422/82(19.4%). A total of 246 pts developed 249 episode infections. Among the total of 1383 observed patients 246 patients developed HAI with a prevalence of 17. 8 %) of which 164/961(17.1%) were from surgical wards and 82/422 (19.4%) were from obstetrics and gynecology wards. About 89% of 276 culture processed specimens, 246 specimens were positive for bacterial isolates. HAI UTI was the The frequency of HAI were UTI,118 (48%) followed by SSI, 112(45.6%) . BSI, 9 (3.7%) d) and pneumonia,4 (1.6%). Three patients had a mixed type of infection UTI+SSI, UTI +BSI, SSI+BSI which accounted each 1(0.4%) and UTI was commonly observed among all types of HAI (Table 3.6). Regarding the site of occurrence SSI 98 (87.5%) was the commonest HAI in surgical ward where as in obstetrics ward UTI 58 (49.2 %) was the commonest HAI (Table 3.6).

Table 3.6. Prevalence of hospital acquired infections by wards among surgical, gynecological and obstetrics wards admitted patients in Felege Hiwot Referral Hospital, April-August 2009

Hospital acquired infections	Surgical ward No (%)	Gynecological ward No %)	Obstetrics ward No (%)	Total No (%)
SSI	98 (87.5))	4 (3.6)	10(8.9)	112(45.6)
UTI	52(44.1)	8(6.8)	58(49.2)	118(48)
BSI	9(100)	-	-	9(3.7)
Pneumonia	4(100)	-	-	4(1.6)
SSI+BSI			1(100)	1(0.4)
UTI+SSI	1(100)			1(0.4)
UTI+ BSI			1(100)	1(0.4)
Total	164 (66.7)	12(4.9)	70 (28.4)	246

3.4 Risk factors of hospital acquired infections

Certain primary data collected from the HAI patients who were predisposed to condition like operation procedure use of catheter, antibiotic prophylactic abuse, the presence of underlying diseases, length of hospital stay contributed as high risk factors for HAI were statistically analyzed using regression and binary logistic methods (Table 3.7). Regarding the operation procedures 1139/1383(82.4%) of undergone surgical operation mainly laparatomy 243/1139 (21.3%), cesarean section 238/1139 (20.9%), appendectomy 138/1139(12.1%) , reduction and plaster of paris (POP) 107/1139 (9.4%) and the rest type of operation procedures accounted for 413 (36.3%). Concerning the risk of infection, there was statistically significant difference in hospital acquired infection among operated and none operated individuals. (OR: 12. 82 ; 95% CI :5.231-31.458; P= 0.0001) (Table 3.7). Among patients under gone surgery 919(80.7%) and 220(19.3%) were major and minor operations respectively. The risk of developing hospital acquired infections among patients undergone major surgery was twice greater than those under gone minor surgery. There was statistically significant difference in type of surgery and hospital acquired infections (OR:

2.221; 95% CI: 1.435-3.440; P=0.0001). Regarding operation schedule, 1021(89.6%) were emergency and 118(10.4%) were elective surgery and hence there was no statistically significant difference in operation schedule and hospital acquired infections (P=0.990). Among a total of 1139 operated cases 1131 patients were given anesthesia of which general and local anesthesia accounted for 922(69.3%) and 209 (30.7%) respectively. There was no statistically significant difference in anesthesia and HAI (p=0.999). Regarding American society of Anesthesiology (ASA) score, among 1139 operated cases, 1109 (97.4%) were Class I and 30 (2.6%) were Class II and the risk of developing hospital acquired infection among ASA class II was about 6 time greater than ASA class I patients. There was statistically significant difference in ASA score and hospital acquired infections (OR: 6.585; 95% CI: 3.172-13.671; P=0.0001).

The types of delivery were cesarean section 238/333 (71.5%), total abdominal hysterectomy 76/333 (22.8%), spontaneous vaginal delivery 12/333 (3.6%) and others accounted for 7/333 (2.1%). There was no statistically significant difference in delivery type and HAI (p=0.98). The mean duration of operation was 48.11 minute ranging from 20 minute to 3 hours. The risk of developing hospital acquired infection among patients taking between one and two hour or above was twice the duration of operation less than one hour (Table 3.7). There was statistically significant difference in duration of operation and hospital acquired infections (OR: 2.016, 1.722; 95% CI: 1.511-2.690, 343-8.643 for 1-2 minute and greater than 2 minute operation duration respectively (P= 0.0001) (Table 3.7). Among 707 male patients 585 (82.7%) developed hospital acquired infections where as hospital acquired infections among females accounted for 552/676(39.9%). There was no statistically significant difference in sex and hospital acquired infections (P=0.615).

A total of 254/1383(18.4%) patients had catheter inserted and of these,118/254 (46.5%) developed infection compared to those who developed infection without catheterization which accounted 128/1129 (11.3%). The risk of developing hospital acquired infection among catheterized patients is about 6.8 times greater than those who do not had catheter insertion hence there was statistically significance difference of catheterization and developing hospital acquired infections (OR: 6.785, 95% CI. 4.988-9.230, P=0.0001). Three hundred and sixteen patients among the total observed patients 316/1383 (22.8%) had

received antibiotic prophylaxis and of these 79/316 (25%) developed infection in contrast to 167/1067 (15.7%) developing the infection without prophylaxis. The risk of developing hospital acquired infection among patients who received prophylaxis was about twice greater than those who did not received prophylaxis. There was statistically significant difference of prophylaxis and hospital acquired infection (OR: 1.796, 95% CI: 1.326-2.433, P=0.0001). Eight seven patients (6.3%) had previous underlying diseases of whom 39/87(44.8%) developed hospital acquired infections compared to only 207/ 1256(16.0%) who develop infection without underlying diseases. Patients with previous underlying diseases had about 4 times more risk to develop hospital acquired infection than those patients who had not underlying diseases and hence there was statistically significance difference of underlying diseases and hospital acquired infections.(OR: 4.274, 95% CI: 2.731-6.690 ,P=0.0001). The average length of the hospital stay was 9.10 day with the minimum and the maximum duration of 2 and 120 days respectively. The risk of developing infection increased as the number of hospital stay of the patients was prolonged (Table 3.7). There was statistically significant difference of prolonging of hospital stay and developing hospital acquired infection (OR: 2.866, 3.253, 5.053; 95% CI: 2.086-3.937, 2.008-5.271, 3.028-8.431 for <7,7-14, and 15-21 and > 21 duration of admission, respectively (P=0.0001).

T**able 3.7** Bivariate analysis of risk factors among surgical, gynecology and obstetrics admitted patients in Felege Hiwot Referral Hospital, April-August 2009

Risk factors	**Hospital acquired infections**					
Operation done(n=1383)	With No(%)	With out No(%)	Total	OR	95% CI	P-value
Yes	241 (21.2)	898 (78.8)	1139	12.828	5.231-31.458	0.0001
No	5 (2.0)	239 (98.0)	244			
Type of operation (n=1139)						
Major	215 (23.4)	704 (76.6)	919	2.221	1.436-3.440	0.0001
Minor	26 (11.8)	194 (88.2)	220			
Operation type (n=1139)						
Emergency	216 (21.2)	805 (78.8)	1021	0.997	0.625-1.589	0.999
Elective	25 (21.2)	93 (78.8)	118	1		
Duration of operation (hr) (n=1139)						
<1	109 (16.3)	561 (83.7)	670	1		
1-2	130 (28.2)	331 (71.8)	461	2.016	1.511-2.690	0.0001
>2	2 (25)	6 (75)	8	1.722	0.343-8.643	0.509
Admission duration/days(n=1383)						
<7	90 (10.9)	737 (89.1)	827	1		
7-14	98 (25.9)	280 (74.1)	378	2.866	2.086-3.937	0.0001

15-21	29 (28.4)	73 (71.6)	102	3.253	2.008-5.271	0.0001
>21	29 (38.2)	47 (61.8)	76	5.053	3.028-8.431	0.0001
Catheterization(n=1383)						
Yes	118 (46.5)	136 (53.5)	254	6.785	4.988-	0.0001
No	128 (11.3)	1001(88.7)	1129	1	9.230	
Antibiotic prophylaxis(n=1383)						
Yes	79 (25)	237 (75)	316	1.796	1.326-2.433	0.0001
No	167 (15.7)	900 (84.3)	1067	1		
Underlying disease(n=1383)						
Yes	39 (44.8)	48 (52.2)	87	3.482	2.080-5.827	0.0001
No	207 (16.0)	1089(84.0)	1296	1		
Age(n=1383)18-29	104 (15.8)	556 (84.2)	660	1		
30-39	68 (20.7)	261 (79.3)	329	1.393	0.992-1.956	0.056
40-49	37 (20.6)	143 (79.4)	180	1.382	0.911-2.101	0.128
50-59	17 (18.7)	74 (81.3)	91	1.228	0.697-2.166	0.478
60-69	9(11.4)	70 (88.6)	79	0.687	0.333-1.419	0.311
70	11 (25)	33 (75)	44	1.782	0.873-3.635	0.113

S ex(n=1383)	Male	122 (17.3)	585(82.7)	707	1		
	Female	124 (60.1)	552(39.9)	676	1.075	0.815-1.414	0.615
ASA score(n=1139)	*I*	224 (20.2)	884(79.8)	1108	1		
	II	17 (61.3)	14 (38.7)	31	6.585	3.172-13.678	0.0001
Wards(n=1383)	Gynecology	12 (13.7)	77 (86.3)	89	1		
	Surgical	164 (17.1)	797 (82.9)	961	1.32	0.702-2.482	0.388
	Obstetrics	70 (21)	263 (79)	333	1.708	0.880-3.314	0.114

On Multivariate analysis the risk factors like ASA score, type of operation and operation duration which showed statistical significant difference by bivariate logestic regression model method did not show statistical significant difference by multivariate analysis , because of controlling the confounding variables (Table 3.8).The risk of prophylaxis showed statistical significant deference at marginal figure ($p<0.051$) and the risk of operation procedure was minimum compared to bivariate analysis which suggested confounding variables were controlled.

Table 3.8 Multivariate analysis of risk factors among surgical, gynecology and obstetrics patients admitted to Felege Hiwot Referral Hospital, April- August 2009

Risk factors	**Hospital acquired infections**					
Operation(n=1383)	with No(%)	With out No(%)	Total	OR	95% CI	P-Value
Yes	241(21.2)	898 (78.8)	1139	5.069	2.010-	0.001
No	5(2.0)	239(98.0)	244	1	12.785	
OperationType(n=1139) Major	215(23.4)	704 (76.6)	919	0.943	0.565-	0.823
Minor	26 (11.8)	194 (88.2)	220	1	1.57	
Emergency	216 (21.2)	805 (78.8)	1021	0.997	0.625-	0.999
					1.589	
Elective	25 (21.2)	898	1139	1		
Duration of operation /hr(n=1139)						
<1	109(16.3)	561(83.7)	670	1		
1-2	130(28.2)	331 (71.8)	461	0.55	0.101-	0.489
					2.993	
>2	2 (25)	6 (75)	8	0.914	0.565-	0.917
					1.570	
Catheterization(n=1383) Yes	118 (46.5)	136 (53.5)	254	6.999	4.950-	0.0001
No	128(11.3)	1001(88.7)	1129	1	9.895	
Antibiotic Prophylaxis(n=1383)						
Yes	79 (25)	237(75)	316	1.43	0.999-	0.051
					2.049	
No	167 (15.7)	900(84.3)	1067	1		
Underlying diseases (n=1383)						
Yes	39 (44.8)	48(55.2%)	87	3.482	2.080-	0.0001
					5.827	
No	207(16.0)	1089(84.0)	1296	1		

Admissionduration/days(n=1383)						
<7	90 (10.9)	737 (89.1)	827	1		
7-14	98 (25.9)	280 (74.1)	378	2.548	1.776-3.655	0.0001
15-21	29 (29.4)	73 (71.6)	102	4.069	2.353--7.036	0.0001
>21	29 (38.2)	47 (61.8)	76	8.02	4.540-14.167	0.0001
Age(n=1383) 18-29	104(15.8)	556 (84.2)	660	1		
30-39	68 (20.7)	261 (79.3)	329	1.393	0.992-1.956	0.056
40-49	37 (20.6)	143 (79.4)	180	1.382	0.911-2.101	0.128
50-59	17 (18.7)	74 (81.3)	91	1.228	0.697-2.166	0.478
60-69	9 (11.4)	70 (88.6)	79	0.687	0.333-1.419	0.311
≥70	11 (25)	33 (75)	44	1.782	0.873-3.635	0.113
Sex(n=1383) Male	122 (17.3)	585 (82.7)	707	1		
Female	124 (60.1)	552 (39.9)	676	1.075	0.815-1.414	0.615
ASA score(n=1139) *I*	224 (20.2)	884(79.8)	1108	1		
II	17(54.8)	14 (45.2))	31	0	3.172-13.678	1
Wards(n=1383) Gynecology	12(13.5)	77 (86.5)	89	1		
Surgical	164 (17.1)	797 (82.9)	961	1.32	0.702-2.482	0.388
Obstetrics	70 (21)	263 (79)	333	1.708	0.880-3.314	0.114

3.5 Bacterial etiologic agents of hospital acquired infections.

A tgotal of 251 bacterial species were isolated from 246 patients developing hospital acquired infections and among these, 5/ 246 infected patients had more than one isolates (mixed) infection. Of the isolates gram negative comprised of 132/251 (52.6%) and 119/251 (47.4%) gram positive ($p<0.05$). *E. coli* was the commonest 49 (37.1%) etiology among gram negative bacteria followed by *K pneumoniae* 36 (27.3%), *P.aeruginosa* 26 (19.7%), *P. mirabilis* 10(7.6%), *Enterobacter* species 4 (3%) *P. vulgaris* 3(2.3%), and both *Acinetobacter baumannii* and *S.marcescens* each account 2(1.5%) whereas among gram positive bacteria, *S. aureus* 91(76.5%) was the commonest isolate followed by *CoNS*, 18 (15.1%), and *Entroccocus* species, 10(8.4%). The frequency of each isolate causing different types of hospital acquired infection was quiet different. Etiologies for each infection types (Table 3.9) were for UTI: *E. coli* was the commonest 36 /123 (29.9%) and the second cause was *K .pneumonia*e 25/123 (20.3%) and for SSI the commonest cause was *S.aureus* 58/115(50.4%) while the second cause was P. *aeruginosa* 22/115 (19.1) (Table 3. 9).

Table 3.9 Prevalence of bacterial isolates by hospital acquired infection types among surgical, gynecology and obstetrics patients admitted to Felege Hiwot Referral Hospital, April-August 2009

	Hospital acquired infections				
Name of isolate bacteria	SSI No (%)	UTI No (%)	BSI No (%)	Pneumonia No (%)	Total No (%)
Gram positive					
S.aureus	58(50.4)	30(24.4)	3 (33.3)	-	91(36.3)
CoNS	11(9.6)	6(4.9)	1(11.1)		18 (7.2)
Enterococcus species	2 (1.7)	8(6.5)	-	-	10 (4)
Gram negative					
E .coli	11 (9.6%)	36 (29.3)	1(11.1)	1(25)	49 (19.5)
K.pneumoniae	8(7.0)	25(20.7)		3(75)	36 (14.3)
P.aeruginosa	22(19.1)	2(1.6)	2(22.2)	-	26 (10.4)

P.mirabilis	1(0.9)	7(6.7))	2(22.2)		10 (3.9)
Enterobacter species	1(0.9)	3 (2.4)	-	-	4 (1.6)
P.vulgaris	1(0.9)	2(1.6)	-	-	3 (1.2)
A. baumannii	-	2(1.6)	-	-	2 (0.8)
S.marcescens		2(1.6)	-	-	2(0.8)
Total	115 (45.8)	123 (49)	9 (3.6)	4(1.6)	251

3.6 Antibiotic susceptibility A single or combined antibiotics were given for pre operative prophylaxis and post operative therapy among the admitted patients. Such commonly, ampicillin, cloxacillin ceftriaxon and metrindazole. Combined therapy was more predominantly prescribed antibiotics for surgical, gynecology and obstetrics admitted patients were amoxacillin, chloramphinicol, gentamycine prescribed than monotherapy in which ampcillin+ gentamicin + chloramphnicol therapy was the coomonest type of combined therapy particularly as preoperative prophylaxis. Antibiotic susceptibility test against fourteen antimicrobial agents for commonly prescribed antibiotics in the study area including others was done (Table 3. 10). In this study, results indicated that most isolates in general had high rate of resistance (>80%) to the commonly used antibiotics in the study area like ampicillin, amoxacillin, chloramphinicol, cloxacillin and for rarely used Augmentin. Intermediate level of resistance (60—80%) was observed for trimethoprisulphamethoxazole, ceftriaxon, gentamycin, naldixic acid and tetracycline where as low level of resistance (<60%) was observed against ciprofloxacillin and norfloxacillin. Gram positive bacterial isolates showed high level of resistance to ampicillin (97.4%), cloxacilline (92.4), chloramphinicol (85.6) and amoxacillin (84.8%) where as low level of resistance to vancomycine. Methcillin resistanc *Staphylococcus aureus* accounted 94.5% (Table 3. 10). Gram negative bacteria were highly resistance to betalactam antibiotics such as ampicillin (99.2) and amoxacillin (90.9%). *E. coli* showed high level of resistance against ampicillin, 49(100%), amoxicillin, 42(85.7), chloramphinicol, 41(83.7%) and tetracycline 40(81.6%) (Table 3.11). Vancomycin resistance *S. aureus* and *Entrococcus species* accounted for 46(50.5%) and 6(60%) respectively.

Table 3.10 Antibiotic susceptibility pattern of gram positive bacterial isolates from patient admitted to surgical , gynecology and obstetrics ward in Felge Hiwot Referral Hospital, April-August 2009.

Organisms	Antibiotic agents No (%)														
		AML	C	AC	NOR	SXM	CRO	CF	CN	METH	Ob	TE	NA	VA	AMP
S.aureus (n=91)	R	79 (86.8)	79 (86.8)	76 (83.5)	59 (64.8)	68 (74.7)	63 (69.2)	33 (36.3)	68 (74.7)	86 (94.5)	85 (93.4)	70(76.9)	75(82.4)	46(50.5)	89(97. 8)
	S	12(13.2)	12 (13.2)	15 (16.5)	32 (35.2)	20 (22.0)	28 (30.8)	58 (63.7)	21(23.1)	5 (5.5)	4 (4.4)	21 (23.1)	16(17.6)	43(47.3)	2(2.2)
	I	-	-	-		3(3.3)	-	-	2(2.2)	-	2(2.2)	-	-	2(2.2)	
CoNS(n=18)	R	16(88.9)	16(88.9)	16(88.9)	11(61.1)	13(72.2)	16(88.9)	8 (44.4)	10(55.6)	Nd	16(88.9)	11(61.1)	5(27.8)	10(55.6)	17(94. 4)
	S	2(11.1)	2(11.1)	2(11.1)	5(27.8)	5(27.8)	2(11.1)	10 (55.6)	8 (44.4)	Nd	2(11.1)	6(33.3)	13(72.2)	8(44.4)	1(5.6)
	I	-	-	-	2(11.1)	-	-	-	-	-	-	1(5.6)	-	-	-
Enterococcus spp(n=10)	R	6 (60.0)	8(80.0)	8(80.0)	6(60.0)	9(90.0)	8(80.0)	4 (40.0)	6(60.0)	Nd	9(90.0)	5(50.0)	3(30.0)	6 (60.0)	10(100)
	S	4(40.0)	2(20.0)	2(20.0)	4(40.0)	1(10.0)	1(10.0)	6 (60.0)	4(40.0)	Nd	-	3(30.0)	7(70.0)	4(40.0)	-
	I	-	-	-	-	-	1(10)	-	-	Nd	1(10)	2(20)	-		-
Total (119)	R	101(84.8)	103(85.6)	100(84)	76(63.9)	90(75.6)	87(73.1)	45 (37.8)	84(70.6)	86	110(92.4)	87(73.1)	83(69.7	62(52.1)	116 (97.4)
	S	18((5.1)	16(14.4)	19(16.0)	41(34.4)	26 (21.8)	31 (26.1)	74 (62.2)	33(27,7)	5	6(5.0)	30(25.2)	36(30.3)	55(46.2)	3(2.6)
	I	-	-	-	2(1.7)	3 (2.6)	1(0.8)	-	2(1.7)	-	3(2.6)	2(1.7)	-	2(1.7)	-

Table 3.11 Antibiotic susceptibility pattern of gram negative bacterial isolates from patient admitted to surgical , gynecology and obstetrics ward in Felge Hiwot Referral Hospital, April-August 2009.

Organisms	**Antibiotic Agents**											
		AML	C	AC	NOR	SXM	CRO	CIP	CN	TE	NA	AMP
E. coli (n=49)	R	42 (85.7)	41 (83.7)	41(83.7)	28 (57.1	37 (75.5)	32(65.3)	14(28.6)	37 (75.55)	40(81.6	20(40.8)	49(100)
	S	4(8.2)	8(16.3)	8(12.2)	21(42.9)	12 (24.5)	17(34.7)	35(71.4)	12 (24.5)	9(18.4)	29(59.2)	-
	I	3(6.1)	-	----	---	---	----	--		-	(14.3)	--
K.pneumoniae (n=36)	R	34 (94.4)	32(88.9)	34(94.4)	14(38.9)	27(75.0)	26(72.2)	8(22.2)	28(77.8)	24 (66.7)	16(44.4)	36(100)
	S	2(5.6)	4(11.1)	2(5.6)	20(55.6)	9(25.0)	10(27.8)	28(77.8)	8(22.2)	12(33.3)	20(55.6)	-
	I	--	-	---	2(5.6)	--	--	---	---	--	-	-
P.aeruginosa (n=26)	R	26(100)	26(100)	21(80.8)	16(61.5)	24(92.3)	16(61.1)	6(23.1)	19(73.1)	24 (92.3)	18(69.2)	26(100
	S	-	-	5(19.2)	10(38.5)	2(7.7)	10(38.3)	20(76.9)	7(26.9)	2(7.7)	8(30.8	-
	I	-	-	-	-	-	-	-	-	-	-	-
P.mirabilis (n=10)	R	8(80.0)	9(90.0)	7(70.0)	4(40.0)	9(90.0)	7(70.0)	3(30.0)	7(70.0)	8(80.0)	8(80.0	9 (90.0)
	S	1(10.0)	1(10.0)	3(30.0)	6(60.0)	1(10.0)	3(30.0)	7(70.0).	3(30.0)	2(20.0)	2(20.0)	-
	I	1(10.0)	-	-	-	-	-	-	-	-	-	1(10.0)
Enterobacter spp (n=4)	R	4(100)	3(75	4(100)	4(100)	4(100)	4(100)	3(75)	3(75)	4(100)	3(75	4(100)
	S	-	1(25)	-	-	-	-	1(25)	1(25)	-	1(25)	-
	I	-	-	-	-	-	-	-	-	-	-	-
P.vulgaris (n=3)	R	2(66.7)	3(100)	2(66.7)	2(66.7)	2(66.7)	2(66.7)	2(66.7)	3(100)	2(66.7)	2(66.7	3(100)

											)	
	S	1(33.3)	-	1(33.3)	1(33.3)	1(33.3)	1(33.3)	1(33.3)	-	1(33.3)	1(33.3	-
	I	-	-	-	-	-	-	-	-	-	-	-
A. bauma nni (n=2)	R	2(100	2(100)	1(50)	-	1(50)	2(100)	-	2(100)	2(100)	1(50)	2(100)
	S	-	-	1(50)	2(100)	1(50)	-	2(100)	-	-	1(50)	-
	I	-	-	-	-	-	-	-	-	-	-	-
S. marcescens (n=2)	R	2(100)	2(100)	2(100)	1(50)	2(100)	2(100)	1(50	2(100)	2(100)	1(50)	2(100)
	S	-	-	-	1(50)	-	-	1(50)	-	-	1(50)	-
	I	--	-	-		--	----	--	--		-	-
Total (n=132)	R	120 (90.9)	118(89.3)	112(84.8)	69(52.2)	106(80.3)	91(68.9)	38(29.8)	101(76.5)	106(80.3)	69(52. 3)	131(99. 2)
	S	8(6.1)	14(10.7)	20(15.2)	61(46.2)	26(19.7)	41(31.1)	94(71.2)	31(23.5)	26(19.7)	63(47. 7)	1(0.8)
	I	4(3)	-	-	2 (1.5)	-	-	-	-	-	-	-

AML= Amoxacilline **C**= chloramphinicol **AC**= Amoxa-clavulnic acid **NOR**= Norfloxacilline = **SXM**= trimetho primsulfonxazol **CRO**= ceftriaxone **CIP**= ciprofloxacilline **CN**= Gentamicine **TE=** Tetracycline **NA=** Naldixic acid **OB**= Cloxacilline **VA**= Vancomycine **METH**= Methicilline **AMP**= Ampicilline Nd= Not determine

CHAPTER IV Discussion

Knowledge of the recent situation and major changes in distribution of hospital acquired infections helps to prioritize resource allocation and establishing effective infection prevention program in hospitals and health care systems. Most of the patients 104 (45.8%) developed hospital acquired infections were between the age group of 18-29 years. There was no statistically significant difference among older age and HAI in our study and this was not agree with other reports (Tesfahunegne *et al.,* 2009; Kampf *et al*., 1997; Rossello *et al.,* 1999; Matthieu *et al.,* 2001). Considering sex there was no statistically significance difference in our study and this was not agree with other report (Kampf *et al.,* 1997; Omran et al., 2007). Among total of 246 patients developed hospital acquired infections, 12(4.87%), 164(66.6%), 70(29.1%) developed hospital acquired infections in gynecology, surgical and obstetrics wards respectively. There was no statistically significant difference in type of wards and HAI in our study and this was not comparable with other report (Vatopoulos *et al.,* 1996).

In this study the major hospital acquired infections including SSI, UTI, BSI and pneumonia showed an overall prevalence of 17.8%. Although inter hospital comparisons may not be valid since the type of hospitals, study set ups as well as the duration of the studies are often different, the prevalence of this study is comparable to rates reported from previous studies done in Ethiopia (16.4% to17%) (Habte-Gaber *et al.,* 1988; Gedebou *et al*., 1988; Gedebou *et al.* 1987). Reports from other countries such as Tunisia showed 17.9% (Kallel *et al.,* 2005) Albania 19.1%, (Faria *et al.,* 2007) , Tanzania 14.8% (Gosling *et al*., 2003) and Malaysia 13.9% (Hughes *et al.,* 2005) prevalence. This prevalence was lower than other studies in Goa 33.93 % (Kamat *et al*., 2008) Burkina Faso 22.4% (Sanou *et al*., 1999) , but higher than report from Saudi Arabia, 8% (Balkhy *et al*., 2006) and North-Eastern Italy 7.5% (Safdar *et al*., 2002), two Latvian hospitals, 5.6% (Dumpis *et al.,* 2003), India 2.1% , (Savas *et al.,* 2006). The possible reason for low prevalence in this study could be this study did not included infection that may have developed in the hospital but become clinically apparent after the patients discharge as other studies indicated that one third of wound infections were detected after hospital discharge and there was no follow up after discharge in this study.

UTI (48%) and SSI (45.6%) were the major hospital acquired infections in this study. The trends of prevalence hospital acquired infections in other studies also shows similar pattern. In Italy, UTI (24.4%) was the commonest infection followed by SSI (20.3%) blood stream (19.3%) (Safdar *et al*., 2002). In Ibadan, Nigeria, BSI (47 %) was the commonest infection followed by UTI (28%). (El- Nawawy *et al*., 2005), In Goa, India (Kamat *et al*.., 2008) Urinary tract infection was the most common hospital acquired infection (26.63 %), followed by surgical site infection (23.7%), wound infection (23%) and nosocomial pneumonia (18.3%) (Kaumat *et al*, 2008). In Saudi Arabian hospital the prevalence of hospital acquired infections were UTI, 172 (25.7%), BSI, 124 (18.6%) and SSI, 86 (12.9%) (Moataz *et al.*,2005). The result of our study was not agree with other studies done in Ethiopia which accounted for 15-26% for UTI in which SSI was the commonest infection (Habte –gaber *et al.,* 1988, Gedebou *et al.,* 1987). The prevalence of each infection in our study was also different from the study in Kosovo which were reported as bloodstream infection 18 (62.1%), pneumonia 3(10.3%). urinary-tract infection 2 (7.0%); and Surgical-site infection 3 (10.3%) (Raka *et al*., 2006).

The occurrence of pneumonia and blood stream infection in this study was much lower than the above mentioned studies and this could be due to difference in study set up which our study was conducted in surgical, gynecology and obstetrics wards where there was no facility for use of intensive procedures like use of central venous catheter and mechanical ventilation which attribute for BSI and pneumonia infections respectively. In this study, SSI was observed in 45.6% among the patient who develop hospital acquired infections which was comparable with previous studies done in Ethiopia which accounted 47% to 59% ((Gedebou *et al*.; 1988; Habte-Gabr *et al*.; 1988; Kotisso and Aseffa, 1998) and 44.1% (Tesfahunegne et al., 2007) but much higher than studies reported from Addis Ababa 14.8% (Taye, 2005), Tanzania 19.4 % to 24.2 % (Eriksen *et al*., 2003; Gosling *et al*., 2003), Hong Kong 5.6% (Lee *et al*., 2007), Albania 24.3 % (Faria *et al*. 2007), in Tunisia 28% (Kallel *et a.,* 2005) and Norway 28% (Ericksen *et al*., 2005).

As to the associations of risk factor and hospital acquired infections, the result of the bivariate analysis of operation procedure, catheterization , length of hospital stay in this study was comparable with other studies (Rebollo *et al.* 1996). The risk of surgical operation

according to multivariate stepwise logestic regression model identified in our study was similar to other reports (Luiz *et al., 1998;* Olsen *et al*., 2008*;*). In this study the association of duration of operation and pre-operative antibiotic prophylaxis with postoperative nosocomial infection was agreed with other reports (Ganguly *et al.,* 2000). Further more the statistically significant difference of urinary catheter to hospital acquired infection in this study was similar to the study conducted in Taipei, Taiwan (Adukauskiene *et al.,* 2006). The risk of pre existing diseases and catheterization in this study was also comparable to other studies (Adukauskiene *et al*., 2006hm; Hossam *et al*., 2009).

Regarding bacteriological etiologies, in this study, gram negative 132 (52,6%) bacteria were the dominant causes compared to gram positive 119 (47.4%) and among gram negative bacteria *E. coli* was the predominant 49 (19.5 %) followed by *K pneumoniae* 32 (13.9%), *P. aeruginosa* 26 (10.4%), *P. mirabilis* 12(4.8%), *Enterobacter species* 4 (1.6%) *P. vulugaris* 3 (1.2%), and *S.marcescens* accounted 2 (0.8%). This result was relatively comparable with pervious result reported from Ethiopia in which the majority (88%) of the etiologic agents isolated were gram negative bacteria and of these 85% were members of *Enterobactersiae* (Habtegaber *et al.,*1998). Other studies in Ethiopia also showed that 89% of infection were due to *Enterobacteriacea* and of these isolates, *Klebsiella species* 28%, *E.coli* 27%, *proteus species* 12%, *Staphilococcous aureus* 11% ,*Pseudomonas* and *entrobacter species* each 5%, *Acinetobacter spp* 4%, *citrobacter spp* 2% were common (Gedebu *et al,* 1988). Other reports in Ethiopia, gram-negative bacteria comprised 88% of all isolated *Enterobacteriaceae* group including *Proteus* 25%, *Escherichia coli* 20% and *Klebsiella* 19% (Gedebu *et al.,* 1987). Moreover the bacterial etiology of hospital acquired infections report of this study was also comparable with other countries reported like in India (Kamat *et al*., 2008) where more than 80% of the hospital acquired infections were caused by Gram-negative bacteria predominantly *P. aeruginosa and Escherichia coli*. In Saudi Arabian (Al-Ghamid, 2003), gram-positive organisms were reported in 31.8% where MRSA (Methicillin-resistant *S. aureus*) was the commonest (10.2%), followed by *Coagulase negative staphylococci* (8.5%) and MSSA (Methicillin-susceptible S. aureus, 7.4%) where as Gram-negative organisms accounted 66.2% in which *E. coli* was the commonest (22.3%), followed by *Pseudomonas aeruginosa* (17.6%) and *Klebsiella*

pneumoniae (9.9%) (Moataz *et al.,* 2005). The etiologies of UTI in our study was also similar to other study in Saudi Arabian in which health care associated urinary tract infection (HCA-UTI) episodes were caused by *E. coli* (37.8%), *K. pneumoniae* (14.4%) and *Pseudomonas aeruginosa* (6.4%) (Jaffa *et al.,* 2009).

According to the distribution of etiologies for each hospital acquired infections in this study, the etiologies, *E. coli, 36(29.8)* was the commonest cause of UTI. This was similar to the report from UK in which E. coli accounted for 26% of UTI (Farrell *et al.,* 2003). The frequency of bacterial etiologies of this study differ from the other reports in which the most frequently isolated causative agents in catheter infections were *Pseudomonas spp.* (17%), *Klebsiella spp.* (16%), *E. coli* (13%), *Acinetobacter spp*. (12%), *Coagulase Negative Staphylococci* (11%) and *Methicillin-Resistant S. aureus* (MRSA*)* (9%) (Cetin *et al.,* 2005). In addition the predominant prevalence of *E. coli, 36(29.8)* in this study was also comparable with another studies which showed that *E. coli* was the commonest 38(27.8) followed by *Enterococcus spp*. (11.%), *P.aeruginosa* (7.6%), *K. pneumoniae* (6.8%) and *Acinetobacter spp*. (4.2%) (Das *et al.,* 2006; Hsueh, 2002). In Banja Luka the commonest etiology was *Escherichia coli* (33.6%) followed by *P.aeruginosa* (14.1%), *P.mirabilis* (13.3%), and *Enterobacter* (10.5%) (Verhaz *et al.,* 2003). In our study most of pneumonia cases (75%) were caused by *K. pneumoniae* that was not agree with reports from Brazil hospitals in which *P. aeruginosa* (30.3%) was the most frequently isolate, followed by *E. coli* (18.6%), *K. pneumoniae* (16.9%), *A. baumannii* (8.8%), and *Enterobacter cloacae* (7.1%) (Kiffer *et al.,* 2005). Another study reported most frequently isolated microorganisms were *P. aeruginosa* (22.3%), *Acinetobacter* spp. (19.4%), *K. pneumoniae* (12.6%), and *S. aureus* (10.7%) (Ronald, 2003).

The rate of antibiotic resistance reported in this study for ampcillin, chloramphinicol, gentamycin, trimethoprim-sulphomethoxazol was higher than previous report done in Ethiopia (Habte-gaber *et al.,* 1988, Gedebu *et al*., 1988). The factors attributing for the higher resistance in our study could be misuse of antibiotics as common use pre operated prophylaxis and antibiotic abuse in the community at large as most of people in Ethiopia practice self chemotherapy without prescribed by the nurses, physicians and other concerned health professionals and even they did not use proper dose and duration of

treatment. Other possible factors could be poor drug quality due to lack of proper shelf life, poor hospital hygienic condition and antibiotic susceptibility test surveillance.

In this study, the gram negative enteric bacilli were highly resistant to beta lactam antibiotics ampicillin and amoxacillin. Staphylococci in our study was 76.9% resistant to tetracycline, 74.8% resistance to cotrimoxazole and 74.8% resistance to gentamicine where as in other reports it was 100% resistant to tetracycline, 80% to cotrimoxazole, 60% to gentamicin (Singh *et al*., 2002). In this study Pseudomonas spp. showed 73.1% resistant to gentamycin which was comparable to other report accounted for75% resistance (Singh *et al*., 2002). Vancomycin resistance rate of *staphilococus* (50.5%) in this study had no agreement with other reports accounted for 98.5%. (Moataz *et al*., 2005; Das *et al.,* 2006). The pattern of gram positive antimicrobial resistance in our study agreed to the concept mentioning that the most threatening nosocomial "super-bugs" are methicillin-resistant S. aureus (MRSA), vancomycin-intermediate resistant S. aureus (VISA), and vancomycin-resistant enterococcus (VRE) (Capriotti., 2001). Antibiotic resistance pattern of *E.coli* (100%) to ampicillin in our study was higher than other report which accounted for 73.4% of ampicilline resistance (Moataz *et al*., 2005). The rate of sensitivity of *P. aeruginosa*`(76.9%) to Ciprofloxacin in our study was comparable to other studies accounted for 80.4% (Ariffin *et al.,* 2004; Brown and Izundu, 2004). The greatest challenge facing the effective management of *P. aeruginosa* infection is multiple drug resistance (Amadi.; 2009). The resistance pattern of *P.aeroginosa* in in our study was also relatively comparable to other reports such as Enugu and Abakaliki in Nigeria for ciprophloxacillin 23%, chloramphenicol (58.8%), amoxycillin (88.2%) and co-trimoxazole (76.5%) and for ciprophloxacillin only Jamaica(19.6%) (Brown and Izundu, 2004), Latin America (28.6%), (Jonas 2001), llorin Nigeria (24.7%) (Fadeyi, 2005) and in Kuala Lumpur, Malaysia (11.3%) (Raja., 2007). The rate of methicillin resistant *Staphylococcus aureus* (MRSA) in our study (92.5%) was higher than the report from Nigeria, Kenya, and Cameroon (21-30%), and which was below 10% in Tunisia, Malta, and Algeria and another report in Tunisia, Malta, and Algeria showed that all MRSA isolates were sensitive to Vancomycin in contrast to our study (Kesah *et al.,* 2003). High level of MRSA comparable to our study was

observed in a multicenter study of nosocomial infection among leukemic patients (>80%) of MRSA (Ashour *et al.,* 2007). **of the s**

4.1 LIMITATIONS OF THE STUDY

1. This study deals with only the selected wards (Surgical, gynecology and obstetrics wards) but did not include medical and pediatrics wards because of logistics and material constraints.
2. It was not possible to deal about anaerobic bacteria and fungal agents because of lack of well organized laboratory facilities.
3. This study did not include patients who had hospital acquired infections during hospital stay but clinically manifest after hospital discharge. There for our study may not provide the actual prevalence of HAI in the hospital, most probably gives low prevalence.

4.2 CONCLUSION

In this study the over all prevalence of HAI is relatively similar to previous studies in Ethiopia however high compared to reports from developed countries. SSI (87.5%) was the commonest HAI in surgical ward where as UTI (49.2%) was the commonest infection in obstetrics ward. UTI (48%) was the predominant of HAI infections detected in this study. The major risk factors associated with hospital acquired infections were operation procedure, catheterization and underline diseases. Gram negative bacteria were the commonest etiologies with intermediate to high level resistance for commonly prescribed antibiotics. Ampicillin resistance was 98.4% and MRSA accounted for 94.5%. A. baumannii showed high level of resistance (>80%) for most antibiotics.

4.3 RECOMMENDATIONS

Based on the findings the following are recommended:

1. Organizing an effective infection prevention program in the hospital and continous monitoring and evaluation are essential.
2. Identification of common organisms involving in nosocomial infections (especially bacteremia) and to investigate their sensitivity and resistance to the commonly used antibiotics could be a matter of concern.
3. Further studies are needed involving all wards including medical and pediatrics ward, as well as other causative agents anaerobic bacteria, fungal agents etc.
4. To reduce HAI in the hospital strategically implement quality assurance/ quality controls on infection prevention program and training about infection prevention should be given to the hospital health staff as well as health education.
5. Further studies that include patients after discharge are recommended.

References

Adukauskiene D, Cicinskaite I, Vitkauskiene A, Macas A, Tamosiūnas R, Kinderyte A (2006). Hospital-acquired urinary tract infections. *Medicina (Kaunas)*. **42** (12):957-64.

Agarwal, Meena, Thomas, Punnamma (2003). Prevalence of post-operative nosocomial infection in neuro-surgical patients and associated risk factors - a prospective study of 2441 patients *Nursing Journal of India*. **94**(9):197-8.

Ahmed AO, Belkum AV, Fahal AH, Elnor AE, Abougroun ES, VandenBergh MF (1998). Nasal carriage of *Staphylococcus aureus* and epidemiology of surgical-site infections in a Sudanese university hospital. *J Clin Microbiol*.. **36:**3614-8.

Ahmed, SH, Dae EA, Badary MS, Mahmoud MA, Abd-Elsayed AA (2009).Nosocomial blood stream infection in intensive care units at Assiut University Hospitals (Upper Egypt) with special reference to extended spectrum β-lactamase producing organisms. *BMC Research Notes*. **2:**76.

Akkoyun S, Kuloğlu F, Tokuç B **(**2008**).** Etiologic agents and risk factors in nosocomial urinary tract infections. *Mikrobiol Bul.* **42**(2):245-54.

Al-Ghamdi S (2003). Nosocomial infections and misuse of antibiotics in a provincial community hospital, Saudi Arabia. *J. Hosp Infect*. **50** (2): 115 - 121.

Amadi E.S (2009)**.** Antibiotic Resistance In: Clinical Isolates of *Pseudomonas aeruginosa* in Enugu And Abakaliki, Nigeria. *The Internet Journal of Infectious Diseases.* **7**(1)

Amhara National Regional State (2002). Amhara National Regional State Finance and Development office (Population projection from 2002-2010).

Andreoli TE, Bennet JC, Carpente CC, Plum F (1997). *Cecil Essentials of Medicine.* 2nd ed Philadelphia: W.B. Saunders Co. 84. www.surgeryencyclopedia.com/.../Hospital-*Acquired-Infections.html*.

Andrew JH, Norliza A, Huattl, Molokha, Salbiah *H*, Juliana S, *et al* (2005). Prevalence

of nosocomial infection and antibiotic use at a university medical center in Malaysia. *Infect. Control Hosp Epidemiol.* **26**(1):100-104

Ariffin H, Navaratnam P, TanKah K, Balan G (2004). Antibiotic resistance patterns in nosocomial gram-negative bacterial infections in units with heavy antibiotic usage. *Trop. Pediatr*. **50**(1):26-31

Arjona MF, Cabrera RH, Gomez-Sancha F, Nieto S, Calero JR (1996). Economical saving due to prophylaxis in the prevention of surgical wound infection. *Euro. Epidemiol*.**12**(5):455-9.

Ashour HM, Sharif A (2007). Microbial spectrum and antibiotic susceptibility profile of gram-positive aerobic bacteria isolated from cancer patients. *J Clin Oncol*. **25**(36):5763-9.

Ayliffe GAJ, Fraise AP, Geddes AM, Mitchell K (200). The importance of hospital infection in: Control of hospital infection: a practical handbook. 4th ed. London:Arnold. 2-3.

Balkhy HH, Cunningham G, Chew FK, Francis C, Al Nakhli DJ, Almuneef MA (2006). Hospital and community-acquired infections: a point prevalence and risk factors survey in a tertiary care center in Saudi Arabia. *Int J Infect Dis*. **10**:326-333.

Bauer AW, Kirby WMM, Sherris JC, Turck M (1966). Antibiotic susceptibility testing by a standardized single disk method. *Am. J. Clin. Pathol***. 36**: 493-6.

Biedenbach DJ, Moet GJ, Jones RN (2004). Occurrence and antimicrobial resistance pattern comparisons among bloodstream infection isolates from the SENTRY Antimicrobial Surveillance Program (1997-2002). *Diagn Microbiol Infect Dis*. **50**(1):59-69.

Brown P D, Izundu A (2004). Antibiotic resistance in clinical isolates of *Pseudomonas*

aeruginosa in Jamaica. *Rev. Panam. Salud. Publica* .**16**(2): 125-130.

Bryde ES, Bradley LC, Whitby M, McElwain DL (2004). An investigation of contact transmission of *methicillin-resistant Staphylococcus aureus*. *J. Hosp Infect.* **58** (2): 104-108.

Burke JP (2003). Infection control- problem for patient safety. *N Engl J Med*. **348**:651-656.

Capriotti T (2001). Multi-Drug Resistant Bacteria Create Continual Need for New Antibiotics *Med Surg Nursing*. **15 (**4):123-26

Center for Disease Control and Prevention (CDC) (2002). Hospital acquired infection.

Centers for Disease Control and Prevention (CDC) (2003). Fact Sheet Respiratory Hygiene/Cough Etiquette in Health care Settings. Atlanta, GA.

Cetin BD, Hasman H, Ozcan N, Gündüz A, Harmankaya O, Seber E (2005). Epidemiology and etiology of catheter-related nosocomial infections in a Turkish hospital**.** *Infez Med*. **13**(3):152-9

Cheesbrough M. (2004). Medical laboratory manual for tropical countries. **2**:146-180.

Coello R, Charlett A, Wilson J, Ward V, Pearson A, Borriello P (2005). Adverse impact of surgical site infections in English hospitals. *J Hosp Infect*. **60**:93-103.

Couto RC, Pedrosa TM, Nogueira JM, Gomes DL, Neto MF, Rezende NA (1998) Post-dis charg surveillance and infection rates in obstetric patients. *Intern. Gyneco Obstetr*. **61**(3):227-31

Daniel N, Fernández-Ayala M, Fariñas-Álvarez C, Mons R , Francisco JO González-Macías J., *et al* (2005). Nosocomial Infection after Lung Surgery. *Chest.* **128**:2647-2652.

Das RN, Chandrashekhar TS, Joshi HS, Gurung M, Shrestha N, Shivananda PG (2006). Frequency and susceptibility profile of pathogens causing urinary tract infections at a

tertiary care hospital in western Nepal. *Singapore Med J.* **47**(4):281-5.

Dulworth S, Peyenson B (2004). Health care associated infection and length of hospital stay in the Medicare population. *Am J Qual.* **19**(3): 121-127.

Dumpis U, Balode A, Vigante D (2003). Prevalence of nosocomial infection in two Lativian hospitals. *Eurosurvillance Monthly Archievesa.* **8**(30) :73-78

El-Nawawy AA, El-Fattah MM, El-Raou HA (2005). One Year Study of Bacterial and Fungal Nosocomial Infections among Patients in Pediatric Intensive Care Unit (PICU) in Alexandria**.** *Trop. Pediatr.* **52**(3):185-191

Emmerson AM, Enstone JE, Griffin M, Kelsey MC, Smyth ET (1996). The Second National Prevalence Survey of infection in hospitals--overview of the results. *J Hosp Infect*. **2**(3):175-90.

Eriksen HM, Chugulu S, Kondo S, Lingaas E (2003). Surgical-site infections at Kilimanjaro Christian Medical Center. *J Hosp Infect*. **55**:14-20.

Eriksen HM, Iversen BG, Aavitsland P (2004). Prevalence of nosocomial infections and use of antibiotics in long-term care facilities in Norway, 2002 and 2003. *J Hosp Infect*. **57**(4):316-20 3.

Fadeyi, A., Akanbi, A.A., Nwabuisi, C., *et al* (2005). Antibiotic disc sensitivity pattern of Pseudomonas aeruginosa isolates obtained from clinical specimen in Ilorin, Nigeria. *Afr. J. Med. Sci*. **34**(3): 303-306.

Faria S, Sodano L, Gjata A, Dauri M, Sabato AF, Bilaj A (2007). Prevalence Study Group. The first prevalence survey of nosocomial infections in the University Hospital Centre 'Mother Teresa' of Tirana, Albania. *J Hosp Infect*. **65:**244-250.

Farrell DJ, Morrissey I, De Rubeis D, Robbins M, Felmingham D (2003). A UK multicentre study of the antimicrobial susceptibility of bacterial pathogens causing urinary tract infection. *J Infect.* **46**(2):94-100

Ganguly PS, Khan Y, Malik A (2000). Nosocomial infection and hospital procedures. Indian Journal of community medicine. **25** (1). www.CookMedical.com/Spectrum

Garner JS, Jarvis WR, Emori TG, Horan TC, Hughes JM (1996) CDC definitions for nosocomial infections. In: Olmsted RN, ed.: APIC Infection Control and Applied Epidemiology: Principles and Practice. St. Louis: Mosby. A1-A20.

Gedebou M, Habte-Gabr E, Kronvall G, Yoseph S (1988). Hospital-acquired infections among obstetric and gynecological patients at Tikur Anbessa Hospital, Addis Ababa. *J Hosp Infect.* **11**:50-59.

Gedebou M, Kronvall G, Habte-Gabr E, Ringertz S (1987). The bacteriology of nosocomial infections at Tikur Anbessa Teaching Hospital, Addis Ababa. *Acta Patho Microbiol Immunol Scand* (B). **95**:331-336.

Girou E, Stephan F,Novara A, Safar M, Fagon J (1998). Risk Factors and Outcome of Nosocomial Infections: Results of a Matched Case-control Study of ICU Patients. *Am. J. Respir. Crit. Care Med.* **157** (4): 1151-1158

Gonlugur U, Bakici MZ, Akkurt I, Efeoglu T (2004). Antibiotic susceptibility patterns among respiratory isolates of Gram-negative bacilli in a Turkish university hospital. *BMC Microbiol*.**4:**32.

Gosling R., Mbatia R., Savage A., Mulligan JA., Reyburn H.(2003) Prevalence of hospital-acquired infections in a tertiary referral hospital in northern Tanzania *Ann Trop Med Parasitol*. **97**(*1)*: 69-75

Gupta R (2008). An Update on the Management of Nosocomial Pneumonia. *J Pharmacy Practice*. **21** (5**)**: 380-389.

Habte-gabr E, Gedebou M, Kronvall G (1984). Nosocomial infection in Addis Ababa hospital, clinical and epidemiological studies. *Ethiop. Med. J.* **22**(2):206.

Habte-Gabr E, Gedebou M, Kronvall G (1988). Hospital-acquired infections among surgical patients in Tikur Anbessa Hospital, Addis Ababa, Ethiopia. *Am J Infect Control*. **16**:7-13.

Hadadi A, Rasoulinejad M, Maleki Z, Yonesian M, Shirani A, Kourorian Z (2008).

Antimicrobial resistance pattern of Gram-negative bacilli of nosocomial origin at 2 university hospitals in Iran. *Diagn Microbiol Infect Dis*. **60**(3):301-5

Hanberger H, Garcia-Rodriguez J, Goossens H G M , Lennart E. Marc J. Struelens M (1999) Antibiotic susceptibility among aerobic gram-negative bacilli in intensive care units in 5 European countries. *JAMA.* **281** (1):67-71.

Heard S (2001). Catheter related infection: Diagnosis, prevention and infection. *Ann Acad Med Singapore.* **30**(4): 419-29

Hossam M, Ashour, El-Sharif A (2009). Species distribution and antimicrobial susceptibility of gram-negative aerobic bacteria in hospitalized cancer patients. *J Transl Med*. **7**: 14

Horan TC, Gaynes RP (2004). Surveillance of nosocomial infections. In:Hospital Epidemiology and Infection Control, 3rd ed., Mayhall CG, editor. Philadelphia:Lippincott Williams & Wilkin.1659-1702.

Hsueh PR, Teng LJ, Chen CY, Chen WH, Yu C-J, Ho SW (2002). Pan drug-resistant *Acinetobacter baumannii* causing nosocomial infections in a university hospital, Taiwan. *Emerg Infect Dis* URL: http://www.cdc.gov/ncidod/EID/vol8no8/02-0014.htm

Hughes AJ, Ariffin N, Huat TL, Abdul Molok H, Hashim S, Sarijo J (2005). Prevalence of nosocomial infection and antibiotic use at a university medical center in Malaysia. *Infect Control Hosp Epidemiol*. **26**:100-4.

Jaffar A. Al-Tawfiq, Adnan A., Anani (2009) Antimicrobial Susceptibility Pattern of Bacterial Pathogens Causing Urinary Tract Infections in a Saudi Arabian Hospital**.** *Chemotherapy*.**55**: 127-131

Jain SK (2005). Nosocomial malaria and saline flush. *Emerg Infect Dis* .**11** (7): 1097-1099.

Jarvis WR, Martone WJ (1992). Predominant pathogens in hospital infections. *J Antimicrob Chemother.* **Suppl A:** 19-24.

Jarvis, William R (1991)**.** Nosocomial outbreaks: the Centers for Disease Control's hospital infections program experience, 1980-1990. *Am J Med***. 91**(3B):116S-120S. 1991.

Jodra, VM, Garcia, ML (1993).Nosocomial infection in surgery wards: A controlled study of increased duration of hospital stays and direct cost of hospitalization. *Eur J Epidemiol*. **9**(5):504.

Jonas, R.N (2001). Resistance pattern among nosocomial pathogens: trends over the past few years. *Chest*. **119**: 397s-404s

Kallel H, Bahoul M, Ksibi H, Dammak H, Chelly H, Hamida CB, *et al* (2005). Prevalence of hospital-acquired infection in a Tunisian hospital. *J Hosp Infect*. **59**:343-347.

Kamat US, Ferreira AMM, Savio R, Motghare DD.(2008) . Antimicrobial resistance among nosocomial isolates in a teaching hospital in Goa. *Indian Journal of Community Medicine*. **33**(2); 89-92

Kampf G , Gastmeier G, Wischnewski N, Schlingmann J , Schumache M, Daschne F(1997). Analysis of risk factors for nosocomial infections results from the first national prevalence survey in Germany. *Hosp Infect.* **37(**2 **):** 103-112

Kesah C, Benredjeb S, Odugbemi TO, Boye CS, Dosso M., Ndinya B (2003). Prevalence methicillin-resistant *Staphylococcus aureus* in eight African hospitals and Malta. *Clin Microbiol infect*. **9**(2) :153-156

Kiffer C, Hsiung A, Oplustil C, Sampaio J , Sakagami E, Turner P (2005). Antimicrobial susceptibility of Gram-negative bacteria in Brazilian hospitals: the Program Brazil 2003 **.***Braz J Infect Dis.* **9**(3): 128-130.

Klevens RM, Edwards JR, Richards CL (2007). Estimating health care-associated infections and deaths in U.S. hospitals. *Public Health Rep* **122** (2): 160–6.

Ko MC, Liu CK, Woung LC, Lee WK, Jeng HS, Lu SH, Chiang HS, Li CY (2008) Species an antimicrobial resistance of uropathogens isolated from patients with urinary catheter. *Tohoku J Exp Med*. **214**(4):311-9.

Kotisso B, Aseffa A (1998). Surgical wound infection in a teaching hospital in Ethiopia. *East Afr Med J*. **75**: 402-405.

Küçükateş E, Kansız E, Gültekin N *(2007).* The incidence of nosocomial bloodstream

infections in our cardiac surgical intensive care unit during a three-year period. *Türk Kardiyol Dern Arş.* **35***:406-411*.

Lee MK, Chiu CS, Chow VC, Lam RK, Lai RW (2007). Prevalence of hospital infection and antibiotic use at a University Medical Center in Hong Kong. *J Hosp Infect.* **65:** 341-347.

Lee S, Choi M, Kim Y, Lee J, Shin C. Nosocomial infection of malnourished patients in an intensive care unit. *Yonsei Med J.* 2003: **44**(2): 203-9.

Leung M, Chan AH (2006). Control and management of hospital indoor air quality. *Med. Sci. Monit*. **12** (3): SR17–23.

Lizioli G, Privitera E, Alliata E, Antonietta Banfi L, Boselli M, Panceri M. (2003) Prevalence of nosocomial infections in Italy: result from the Lombardy survey in 2000. *J Hosp Infect.* **54** (2): 141-148.

Luiz T, Santos C, Martins, DS, Alberto SC, Dias DC, Maria L, Georg M (1998). Risk index for prediction of surgical site infection after oncology operations. *AJIC.* **26**(3):217-223,

Matthieu E, Jean-Luc Q, Pierre R, Alain M., Francis F(2001).Association between hospital-acquired infections and patients' transfers. *Infect Control Hosp Epidemiol*. **22** (11): 693-696

Michalopoulos A, Geroulanos S, Rosmarakis ES, Falagas M (2006). Frequency, characteristics, and predictors of microbiologically documented nosocomial infections after cardiac surgery. *Eur J Cardiothorac Surg*. **29:**456-460

Moataz M, Abdel-Fattah (2005) Surveillance of nosocomial infections at a Saudi Arabian military hospital for a one-year period GMS **3**(6) (http://creativecommons.org/licenses/by-nc-nd/3.0/deed.de.

National Nosocomial Infections Surveillance (NNIS) (2002). Surveillance of surgical site infection in England hospital 1997-2001.

NCCL (2006). Clinical and Laboratory Standards Institute. Performance standards for antimicrobial disk susceptibility tests; approved standard M2-A9, 9th ed. Wayne, PA.

Nguyen V (2004). Hospital-acquired infections. eMedicine. http://www.emedicine.com/

Olsen MA, Nepple JJ, Riew KD, Lenke LG, Bridwell KH, Mayfield J, Johns F (2008). Risk factors for surgical site infection following orthopaedic spinal operations. *J Bone Joint Surg Am.* **90**(1):62-9

Omran, AS, Karim A, Ahmadi SH, Davoodi S, Marzban M, Movahed N,.Ahmed A (2007).Superficial and deep sternal wound infection after more than 9000 coronary artery By pass graft (CABG): incidence, risk factors and mortality. *BMC Infect Dis*. **7**: 112.

Petrosillo N, Pugliese G, Gizardi E, Pallivaciini F, Crosi G, Moro ML, Anderson J (1999). Nosocomial infection in HIV infected patients. *AIDS.* **13**(5): 599-605.

Rahman MH. And Anson J (2004). Pre operative anti-bacterial prophylaxis. *Pharm J*. **272** :743-745.

Raja, N.S and Singh, N.N (2007). Antimicrobial susceptibility pattern of clinical isolates of *Pseudomonas aeruginosa* in tertiary care hospital. *J. Microbiol. Immunol. Infect.* **40**(1):45-49.

Raka L, Zoutman D, Mulliqi G, Krasniqi S, Dedushaj I, Raka N, Rahman G (2006) Prevalence of Nosocomial Infections in High-Risk Units in the University Clinical Center of Kosovo. *Infect. Control Hosp Epidemiol.* **27** (4):125-127.

Raka MW, Kazi BM, Mustafa M, Gould FK (2004). Developing countries have their own characteristic problem with infection control. *J Hosp Infect.* **57**:294-299.

Rebollo M H, Bernal J M , Llorca, J, Rabasa, J M , Revuelta, J M (1996) Nosocomial infections in patients having cardiovascular operations: a multivariate analysis of risk factor.. *J Thorac Cardiovasc Surg*. **112** (4) : 908-1

Renato CC , Pedrosa GMT, Tofani, CDP , Pedroso PRE (2006). Risk Factors for Nosocomial Infection in a Neonatal Intensive Care Unit. *Infect Control Hosp Epidemiol* **27**:571-575.

Ronald A (2003). The etiology of urinary tract infection: traditional and emerging pathogens. *Dis. Mon*. **49**(2): 71-82

Rosenthal VD, Guzman S, Crinch C(2004). Device associated nosocomial infection rates in intensive care units of Argentina. Infection controls. *Hosp. Epidemiol.* **25**(3): 251-5

Rossello J, Fernandez M, Planas M, Bosch J, Morlans M, Linan LI(1999) Trends in prevalence and risk factors of nosocomial infections. 1990-1998. *Int Soc Technol Assess Health Care Meet.* **15**:111.

Safdar N, Dannis G, Maki (2002). The communality of risk factors for nosocomial colonization and infection with antimicrobial resistant staphilococcos aureus, Entrococcus, gram negative bacilli, clostridium difficile, and candida. *Ann Intern Med*. **136**(11): 834-844

Sanou J, Traore SS, Lankoande J, Ouedraogo RM, Sanou A(1999). Survey of nosocomial infection prevalence in the surgery department of the Central national Hospital of Ouagadougou. *Dakar Med.* **44:**105-108.

Savas L , Guvel S, Onlen Y, Savas N, Duran N(2006). Nosocomial urinary tract infections: micro-organisms, antibiotic sensitivities and risk factors. *West Indian Med. J*.**55** (3):45-48.

Schaberg DR, Culver DH, Gaynes RP(1991).Major trends in the microbial etiology of nosocomial infection. *Am J Med.* **91**(3B):72S-75S.

Schaffer SD (1996) Infection Prevention and Safe Practice. New York: Mosby-Year Book. www.healthline.com/.../hospital-acquired-infections

Segers P, Speekenbrink RGH, Ubbink DT, Ogtrop MLV, Mol BAD (2006). Prevention of Nosocomial Infection in Cardiac Surgery by Decontamination of the Nasopharynx and Oropharynx With Chlorhexidine Gluconate. A Randomized Controlled Trial**.** *JAMA.* **296**:2460-2466.

Seid J, Asrat D (.2005). Occurrence of extended spectrum β-lactamase enzymes in clinical isolates of *Klebsiella* species from Harar region, eastern Ethiopia. J *Atca Tropica*. **95**(2):143-148

Singh AK., Sen MR, Anupurba SB ,Hattacharya P (2002). Antibiotic sensitivity pattern of the bacteria isolated from nosocomial infections in ICU. *J. Comm Dis.* **34**(4):257-263

Skarzynska J, Cienciala A, Madry R , Barucha P, Kwasniak M, Wojewoda T (2000). Hospital infections in general surgery wards. *Przegl Epidemiol*. **54** (3-4) : 299-304

Taye M (2005). Wound infection in Tikur Anbessa hospital, surgical department. *Ethiop Med J*. **43**:167-74

Tesfahunegn Z, Asrat D, Woldeamanuel Y, Estifanos K (2009). Bacteriology of surgical site and catheter related urinary tract infections among patients admitted in Mekele Hospital,Mekele, Tigray, Ethiopia. .*Ethiop .Med. J*. **47**(2):117-12.

Toni RL, Culvert LL.(2003).Safer Hospital Stay and Reducing Hospital-Born Infections. *Health Scout News*. <http://www.healthscout.com>.

Tran TS, Jamulitrat S, Chongsuvivatvong V, Geater A (1998). Postoperative hospital-acquired infection in Hungvuong Obstetric and Gynaecological Hospital. *J Hosp Infect.* **40**(2):141-7

Trautner BW, Darouchi RO (*2004).* Catheter associated infection: pathogenesis affects prevention. *Arch Internal Med*. **164** (8): 842-50.

Tullu MS, Deshmukh CT, Baveja SM (1998). Bacterial profile and antimicrobial susceptibility pattern in catheter related nosocomial infections. *J Postgrad Med* .**44** (1): 7-13

Vatopoulos AC , Kalapothaki V, Legaki NJ (1996). Risk factors for nosocomial infections caused by Gram-negative bacilli**.** *Hosp Infec*t. **34**(1):11-12

Verhaz A, Skrbić R, Rakić-Musić M, Sabo A (2003). Catheter-related urinary infections at the Clinical Center in Banja Luka. *Med Pregl.* **56**(9-10):460-4.

Wendt C, Knauth D Von Baum H. (2004). Difference in hand washing behavior related to the contamination risk of health care activities in different group of health care workers. *Infect Control Hosp Epidemiol*. **25** (3): 203-6.

Whitehouse JD, Friedman ND, Kirkland KB, Richardson WJ, Sexton DJ (2002). The impact of surgical-site infections following orthopedic surgery at a community hospital and a university hospital: adverse quality of life, excess length of stay, and extra cost. *Infect*

Control Hosp Epidemiol. 23(4):174-6.

WHO (2002). Prevention of hospital-acquired infections a practical guide, 2nd ed. http://www,who,int/emc.

WHO (2005). The Global Patient Safety Challenge 2005-2006: clean care is safer care. Geneva.

Wu CJ, Lee HC, Lee NY, Shih HI, Ko NY, Wang LR, Ko WC (2006). Predominance of Gram-negative bacilli and increasing antimicrobial resistance in nosocomial bloodstream infections at a university hospital in southern Taiwan, 1996-2003. *J Microbiol Immunol Infect*. **39**(2):135-438.

Yin XH, Mikamo H, Tamaya T (2003). Nosocomial infectious potency of imipenem-resistant *Pseudomonas aeruginosa* isolated from obstetric and gynecologic infections. *Infect Chemother.* **9**(1): 97-100

Young LS, Mandell GL, Bennett JE, Dolin R, Douglas M (1995). Bennett's principles and practice of infectious diseases.. Sepsis syndrome. New York: Churchill Livingstone. 690-705.

Zaidi KM, Huskins WC, Thaver D, Bhutta ZA, Abbas Z, Goldmann M (2005) Hospital-acquired neonatal infections in developing countries. *Lancet.* **365**:1175-1188.

Zarakolu P, Hasçelik G, Unal S (2006). Antimicrobial susceptibility pattern of nosocomial gram negative pathogens: results from MYSTIC study in Hacettepe University Adult Hospital (2000-2004). *Mikrobiyol Bul*. **40**(3):147-54.

Zavascki AP, Barth AL, Gaspareto PB, Fernandes F, Zubaran L(2006) Risk factors for nosocomial infections due to Pseudomonas aeruginosa producing metallo-b-lactamase in two tertiary-care teaching hospitals. *Antimicrob Chemother*. **58**:882–885

Zhang YY, Wang YH (1995). Investigation of nosocomial infection among 2126 operative patients. J *Thorac Cardiovasc Surg*. **16**(3):157-9.

Appendix I Questionnaire

Date---------

I Demographic factors

Patient code number --------

Card NO----------

Sex------

Age ----

Date of admission (day\ month\ year -------- Ward-------- Bed No------

Educational status Illiterate-------- read and write ------ Elementary ------ High school and above---

Occupation Farmer----- Government Employee ----- Student ---other mention ---

Residence urban ----- Rural -----

II Related to present history of illness of patient

A. Admission diagnosis (primary diagnosis) ----------

B Use of antibiotics at time of admission Yes---- No-----

If yes name of antibiotics ------

C presence of any chronic illness like

Diabetes----- Malignancy------ Anemia------ Renal failure Malnutrition -------- HIV\AIDS ----- CLD------COPD-----

Any previous operation (during last month) specify type of operation--------- others (specify)--------

D Nosocomial infection YES------ NO ------- If yes which?

	Yes	**No**	**date of infection**
Urinary tract infection	------	--------	------
Surgical site infection	------	--------	-------
Blood stream infection	------	--------	-------
Pneumonia	------	---------	-------

If there is surgical site infection

Superficial incision ----------

Deep incision ----------

Organ/ space ----------

III procedure related risk factor assessment

A Operation done Yes---- No------

If yes date of operation. ----------

Type of operation: **Major. (Specify)**---------- **Minor (specify)** -------

Duration of operation (minute) ---- Urgent ------ Elective ----

Prosthesis \ implant Yes----- No----------

B. **Type of delivery**

Spontaneous vaginal delivery----- C/ S-------- Instrumental------ (vacuum/ forceps) -------- destructive delivery-------- Episiotomy------- Laparatomy---------

C Type of anesthesia General anesthesia ------ I Intubated------ II No intubations--

Local Anesthesia --------

D. ASA physical status classification

Normal healthily patient ----------

Mild systemic disease ----------

Severe systemic disease ----------

Incapacitating systemic disease ----------

Moribund patient ----------

E. Prophylactic antibiotics used Yes------ No----- If yes Name----

Duration-------- (days)

F. Post operative antibiotics prescribed Yes----- No------

Duration in days-------

G Invasive devices

I Catheterization: Yes--- No ------ if yes a. IV catheter----- duration in days--

b. Urinary catheter-------- duration in days-----

X—ray result----------

Consolidation (suggestion of pneumonia) Present-------- absent------

Date of discharge---------- **Discharge status** Alive----- Death----- Total

duration of admission (hospital stay) in days -------

General Remark if any----------

Date of completion of data -------- **completed by** ------- **SIG**----------

Appendix II Laboratory reporting format

Patient code number-----

Sample lab code------

Ward -----Bed NO-------

Type of specimen collected:

Blood------ urine-------- wound pus------ sputum ----

Procedures:

Gram stain--- Urinanalysis: Sediment (microscopic)------

Culture Isolated species -------- Antibitic sensitivity

Isolated bacteria	Amoxacillin	chloamphinicol	Norfloxacillin	Augmetin	Cotri moxa zole	Ceftriaxone	Ciprofloxac in ,	Gen tami cin	Methicill in ,	Clo xaci llin ,	Tetr acyc line	Nalidxi c acid	• Cloxac illin	Vancom ycin

R =Resistant S=sensitive I = intermediate

Date of report ---------- Reported by -------- SiG ----------

Appendix III

General information for the study participants

Date----- Patient code-----

My name is----------, I am currently a student in the microbiology, immunology and parasitology. Now I am going to conduct a cross sectonal study on hospital admitted patients .The objective of the study is to determine the prevalence of hospital acquired bacterial infection and their antimicrobial susceptibility patterns and to assess associated risk factors among hospital admitted patients. There fore , we kindly request you your participation in this study which requires your willingness to give urine, blood, sputum and surgical wound pus for laboratory examination, responding to an interview and to allow physical examination. Your cooperation and willingness is help full in identifying the problems related to the research work I assured you that all ethical issues like strict confidentiality of all in formations that you give and your laboratory results, your participation is entirely volunteer that is the right not answer any question if you are not willing and withdraw of the study any time if it is not your willing, no risk except little pain of blood drawing , no financial benefits or incentives during the procedure will be fully guaranteed to you. Your kindly and honesty responses to questions will help me to the efficient work of my research therefore, thank you for your cooperation. If you want to contact with me for any problems happened call me on Tel. 0918700222\ 0918012539 Mr. Silabat Melaku.

IRB contact address: Tele. 0115 53 87 34 E. mail. aaumf.@ yahoo. com

አጠቃላይ መረጃ

ቀን ----------

የደንበኛው መለያ ቁጥር ----------

ስሜ ---------- እባላለሁ፡፡ በአሁኑ ወቅት በአዲስ አበባ ዩኒቨርስቲ ሕክምና ፋክልቲ የማይክሮባይሎጂ ትምህርት ክፍል የመጨረሻ ዓመት የሁለተኛ ድግሪ ተማሪ ነኝ፡፡ የመመረቂያ የምርምር ጽሁፌን ለመፃፍ ጥናት በማድረግ ላይ ነኝ፡፡ የምርምራም ርዕሰ ጉዳይ በባህርዳር ከተማ በሚገኘው በፈለገ ሕይወት ሆስፒል ተኝተው የሚ ከሙትን በሽተኞች በሆስፒ ሉ ቆይ ቸው ወቅት በተለያዩ የሕክምና ጥንቃቄ ጉድለቶች አማካኝነት በሽተኞች ሌላ ተጓዳኝ በሽታዎች የሚያመጡ ትሕዋሳትን ለይቶ ማውጣት እና ትሕዋስያኑ በየትኛው መድሃኒት ሊጠፉ እንደሚችሉ ማወቅ፣ በተጨማሪም በሽተኞች ለትሕዋሳኑ መጋለጥ ተዛማች ያላቸው ምክንያቶችን ማወቅ ነው፡፡

በመሆኑም ለዚህ ምርምር ይጠቅመኝ ዘንድ የሕክምና ምርመራ የሽንት፣የደም፣የቁስል ላይ ፈሳሽ፣ አክ ምርመራ እና የቀረቡትን መጠይቆች ለመመለስ ንዲተባበሩኝ በአክብሮት እጠይቃለሁ፡፡ የ ርስዎ ቅን ትብብር የምርምሬን ተግባር ለማሳካት ጠቀሜ ያለው ነው፡፡ በምርመራው ወቅት ለሚደረጉ በቃለ መጠየቅ የሚሰጡንኝ መረጃዎችን እና የላብራቶሪ ውጤትዎን በሚስጥር መያዝ፣ጥናቱን የመሳተፍ ወይም ያለመሳተፍ፣ በጥናቱ ወቅት ጥናቱን የማቋረጥ መብት፣ ለጥናቱ ዋጋ ምንም ዓይነት የገንዘብ ድጐማ የማይሰጥ መሆኑን፣ በጥናቱ ክንውን ወቅትም ደም ሲወሰድ ትንሽ የህመም ስሜት ውጭ ሌላ ጉዳት እንደማይደርስብዎት ሙሉ ዋስትና አደርግልዎታለሁ፡፡ ለጥናቱ የሚያደርጉት መልካም ትብብር ለጥናቱ መሳካት ወሳኝ በመሆናቸው ለትብብርዎ በጣም ከልብ አያመሰገንኩ ለማንኛውም ማብራሪያ እና ችግር ቢያጋጥሞት በስልክ ቁጥር 0918 70 02 22 /0918 01 25 39 ደውለው ይጠይቁኝ፡፡ የህክምና ፋኩሊትው የኢንስቲትዮሽናል ሪቪው ቦርድ (IRB) አድራሻም

ስልክ 0115 53 87 34 E. mail. Aaumf.@Yahoo. Com.

Appendix IV

Patient verbal consent form

The investigator explained to me about the purpose of this study which is to determine the prevalence of hospital acquired bacterial infection, antimicrobial susceptibility and assess the associated risk factors and as this study is expected to reduce the incidence of hospital acquired infection by improving the management of the health care system in the study area by recommending to establish infection prevention program and quality assurance project in the study area. Therefore , I am kindly requested my participation in this study which requires my willingness to give urine, blood, sputum and surgical wound pus for laboratory examination; responding to an interview and to allow physical examination.. It is explained to me that my cooperation and willingness is help full in identifying the problems related to the research work and then I am kindly requested to give my response honestly. Detailed information about ethical issues like my right either to participate or not, withdrawal in this study and this will not affect getting appropriate treatment, all information which I give during interview and my laboratory results will be confidential not to disclose to other than the physician who request and results will be reported to the physician for appropriate treatment and management are explained to me. Also the investigator explained to me about as there is no risk except little discomfort of blood drawing, no incentives or money given and description of the process and procedures to be done. There fore I agree to participate in this study.

For adult patients who are able to respond

I---------- ,after being fully informed about the purpose of this study and ethical issues, here by give my consents on the patients participation in this study as the investigators find best for me.

Name of the study subject---------- signature---------- Date----------

Name of witness---------- Signature---------- Date----------

Name of principal investigator.---------- Signature----------Date----------

contact address of the principal investigator. Tele. 0918700222/ 0918012539.

For families or attendants of patients who are unable to respond.

I----------,parent/guardian/ attendants. After being fully informed about the the purpose of this study and ethical issues, here by give my consents on the patients participation in this study as the investigators find best for the patient.

Name of the study subject---------- signature---------- Date----------

Name of witness---------- Signature---------- Date----------

Name of principal investigator.---------- Signature----------Date----------

Contact address of the principal investigator. Tele. 0918700222/ 09180125

የጥናቱ ስምምነት መጠየቂያ ቅጽ

በሽተኞቹ በሆስፒታሉ ውስጥ ተኝተው በሚከሙበት ወቅት በተጓደኝ የተለያዩ በሽ ዎች ሊያጠቋቸው ይችላሉ፡፡ የዚህ ጥናት ዋና ዓላማ በሽተኞቹ በሆስፒ ል ውስጥ ተኝተው ሲ ከሙ ለተጨማሪ በሽ ዎች በተለያዩ ጥንቃቄ ጉድለቶች ምክንያት ለበሽ የሚዳርጓቸውን ትሕዋስያን ለይቶ ማውጣት እና ትሕዋሲያኑ በየትኛው መድሃኒት ሊጠፉ እንደሚችሉ ለይቶ ማወቅ፡፡ በተጨማሪም በሽተኞቹ ለትህዋስያን መጋለጥ ተዛማች ያላቸው ምክንያቶችን ማወቅ መሆኑ በአጠቃላይ መረጃ ቅጽ ገጽ 35 ተገልጾልኛል፡፡ ጥናቱም የሆስፒታሉን የሕክምና አሰራር በማሻሻል ችግሩን ይቀንሰዋል ተብሎ ተገልጾልኛል

በመሆኑም ለዚህ ምርምር ይጠቅም ዘንድ ለሕክምና ምርመራ፣ የሽንት፣ደም፣አክታ፣ ከቁስል ላይ ፈሳሽ እና የቀረቡትን መጠይቆች በመመለስ እንድተባበራቸው በአክብሮት ተጠይቃለሁ፡፡ በጥናቱ የመሳተፍ ወይም ያለመሳተፍ፣ጥናቱን ከጀመሩኩ በኋላ የማቋረጥ መብቴ የተጠበቀ መሆኑንና ይህም የማገኘውን የሕክምና አገልግሎት እንዳማያቋርጥ፣ በቃለ መጠየቁም የምሰጣቸው መረጃዎችን እና የላቦራቶሪ ውጤቴን በሚስጢር በመያዝ ለመረመርዎ ሐኪም በመስጠት ሕክምና እንዳገኝ መደረጉተገልጾልኛል፡፡ በተጨማሪም ስለ ምርምሩ ቃለ መጠይቅና የላብራቶሪ ምርምራ ናሙና አወሳሰድ ሰዓት፣ ምንም ዓይነት የገንዘብ ድጉማ የሌለዉ ፣ በምርምሩ ሂደት ደም ሲወሰድ ከሚሰማኝ ህመም ውጭ ምንም ዓይነት ጉዳት እንደማይደርስብኝ ተገልጾልኛል፡፡ስለዚህ በጥናቱ እስማማለሁ፡፡

በዚህ ጥናት ለሚዳሰሱ ጥናቶች ሀሳባቸውን መግልጽ ለሚችሉ

እኔ ---------- የዚህን ጥናት ዓላማ እና ለሚደረጉልኝ የሕክምና ስነ ምግባር አጠባበቅ ዋስትና በውል በመገንዘብ በጥናቱ ለመሳተፍ እና ጥናቱን የሚያካሄደው ሰው ያመነበትን አካሄድ ለመከተል መስማማቴን በፊርማዬ አረጋግጣለሁ፡፡

ሐሳባቸውን መግለጽ ለማይችሉ

እኔ ---------- የበሽተኛው ዘመድ / አስታማሚ ስሆን የዚህን ጥናት ዓላማ ና ለመሸተኛው ለሚደረጉለት የሕክምና ሥነ-ምግባር አጠባበቅ ዋስትና በውል በመገንዘብ በሽተኛው ቢሳተፍበት እና ጥናቱን የሚያካሂደው ሰው አካዜድ ብከተል የምስማማ መሆኔን በፊርማዬ አረጋግጣለሁ፡፡

የበሽተኛው ስም _____ ፊርማ _____ቀን _____

የምስክሩ ስም _____ ፊርማ _____ቀን _____

ምርምሩን የሚያካሂደው ስም _____ ፊርማ _____ቀን _____

ምርምሩን የሚያካሂደው አድራሻ ስልክ ቁጥር 0918 70 02 22/0918 01 25 39

Antimicrobial susceptibility testing	S (mm)	I (mm)	R (mm)
• Ampicillin	--------	--------	---------
• Cotrimoxazole	-------	-------	---------
• Amoxycillin	-------	--------	---------
• Augmentin	--------	--------	--------
• Ceftriaxone	---------	--------	----------
• Ciprofloxacin	---------	---------	---------
• Chloramphenicol	---------	--------	------
• Gentamicin	---------	-------	-------
• Methicillin	---------	--------	--------
• Cloxacillin	---------	--------	--------
• Tetracycline	--------	--------	-------
• Vancomycin	---------	--------	-------
• Norfloxacilin	---------	---------	----------
• Naldixic acid	---------	--------	---------

Name of principal investigator _____

Signature _____ Date _____

Interpretation of results

Report the reaction of the test organism to each antibiotic as ‘sensitivity’, ‘intermediate’, or ‘resistant’, as follows:

Sensitivity (S): Zone of radius is wider than, equal to, or not more than 3mm smaller than the control.

A pathogen reported as sensitivity suggests that the infection it has caused is likely to respond to treatment of the drug to which it is susceptible is used in normal recommended dose.

Intermediate (I): Zone radius is more than 3mm smaller than the control but not less than 3mm.

A pathogen reported as being intermediately sensitive suggests that the infection it has caused is likely to respond to treatment if the drug to which it is susceptible is used in larger doses than normal.

Resistant (R): No zone of inhibition or zone radius measure 2mm or less.

A pathogen reported as resistant implies that the infection it has caused will not respond to treatment with the drug to which it is resistant irrespective of dose or site (Cheesbrough, 2004).