BACTERIOLOGICAL SPECTRUM OF POST OPERATIVE WOUND INFECTIONS AND THEIR ANTIBIOGRAM IN A TERTIARY HOSPITAL, DAR ES SALAAM, TANZANIA

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By

Joel Manyahi

A dissertation Submitted in Fulfillment of the Requirement for the Degree of Master of Medicine (Microbiology and Immunology) of Muhimbili University of Health and Allied Sciences

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CERTIFICATION

The undersigned certify that they have read and hereby recommend for acceptance by Muhimbili University of Health and Allied Sciences a thesis/dissertation entitled **Bacteriological Spectrum of Post operative wound Infections and their Antibiogram in a tertiary hospital, Dar es Salaam, Tanzania,** fulfillment of the requirements for the degree of the of Master of Medicine (Microbiology/Immunology) degree of Muhimbili University of Health and Allied Sciences.

…….

Prof. E.F. Lyamuya

(Supervisor)

Date…….

DECLARATION

AND

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I, **Joel Manyahi**, declare that this **dissertation** is my own original work and that it has not been presented and will not be presented to any other university for a similar or any other degree award.

Signature…… Date…….

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DEDICATION

This dissertation is dedicated to my best friend; love of my life Mary and to our beloved daughter Karen Madeleine Mpinguih.

ABSTRACT

Background: Surgical site infection (SSI) is among the most common problem for patients who undergo operative procedures. It remains a common and widespread problem contributing to morbidity and mortality; partly attributed to increase in infections due to antimicrobial resistant bacterial pathogens. In Tanzania there has been limited data regarding the magnitude of SSIs due to antimicrobial resistant pathogens as well as the resistant pattern to antibiotics commonly used in the treatment of these infections.

Objective: To determine the spectrum of bacteria isolates from postoperative wound infections and their antimicrobial susceptibility patterns at Muhimbili National Hospital (MNH) and Muhimbili Orthopedic Institute (MOI).

Methodology: This was a descriptive cross sectional study which was conducted among patients with post operative wound infections in the general surgery and obstetrics/gynecology wards at MNH and Orthopedics and Trauma unit at MOI. The study participants were consecutively recruited in general surgery, obstetrics/gynecology wards at MNH and orthopedics and trauma wards at MOI from September 2011 to February, 2012. Structured questionnaires were used to collect social demographic characteristics, clinical history and operative information from patients and their case notes. Culturing for colony characteristics followed by Gram stain was used for provisional identity of pathogenic bacteria. Further identification was done by a set of biochemical tests, API 20E, and VITEK. Antimicrobial susceptibility pattern of isolated bacterial pathogens was determined by Kirby Bauer disc diffusion method.

Results: *Pseudomonas aeruginosa* was the most frequently isolated pathogenic organism from post operative wound infections. Most of the Gram negative bacteria isolated were multiply resistant to antimicrobial agents tested; but all were sensitive to carbapenems. Eighty eight percent (88%) of enteric gram negative rods were multi-drug resistance. ESBLs production

was detected in 92.3% of *Escherichia coli* and 69% of *Klebsiella pneumoniae*. Forty four percent (44%) of the 18 *S. aureus* isolates obtained were MRSA.

Conclusion and recommendation: *Pseudomonas aeruginosa* was the most common isolate from SSI. Most of gram negative isolates were multiply resistant to commonly prescribed antimicrobial agents. Also there was an increase in ESBLs producing Enterobacteriaceae as well as MRSA strains. Routine culture should be performed whenever SSI is suspected and choice of antibiotics for treatment of SSIs should be guided by routine antimicrobial sensitivity (including MRSA and ESBL screening) testing. Ciprofloxacin should replace first line antibiotics for empirical treatment of SSIs; and strict guidelines for antibiotics prescriptions in treatment of SSIs should be established.

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LIST OF ABBREVIATIONS

AMP	Antimicrobial prophylaxis
ASA	American Society of Anesthesiologist
BMI	Body Mass Index
BMC	Bugando Medical Centre
CoNS	Coagulase Negative Staphylococci
CDC	Centres for Disease Control and prevention
CLSI	Clinical Laboratory Standard Institute
ESβLs	Extended Spectrum Beta Lactamases
KCMC	Kilimanjaro Christian Medical Centre
ICR	Induced clindamycin resistance
MNH	Muhimbili National Hospital
MOI	Muhimbili Orthopedics Institute
MUHAS	Muhimbili University of Health and Allied Science
MRSA	Methicillin Resistant *Staphylococcus aureus*
MSSA	Methicillin Susceptible *Staphylococcus aureus*
SSI	Surgical Site Infection
USA	United States of America

CHAPTER 1

1.1 INTRODUCTION AND LITERATURE REVIEW

1.1.1 Background

Surgical site infection (SSI) is defined as an infection occurring within 30 days after a surgical operation (or within 1 year if an implant is left in place after procedure) and affecting either incision or deep tissues at the operation site. These infections may be superficial or deep incisional infection or infections involving organ or body space (1). Postoperative SSI is among the most common problems for patients who undergo operative procedures and the third most frequently reported nosocomial infection in the hospital population (1). Postoperative surgical site infections are associated with increased morbidity, mortality, prolonged hospital stay and increased economic costs for patient care (2).

There has been advance in SSI control practices which include improved operating room ventilation, sterilization methods, use of barriers, surgical technique and availability of antimicrobial prophylaxis. Despite, these SSIs remain common causes of morbidity and mortality due to emergence of antimicrobial resistant pathogenic bacteria (1). This is partly contributed by inappropriate use of surgical antimicrobial prophylaxis (3).

SSIs can be reduced by appropriate use of surgical antimicrobial prophylaxis. In hospital practice 30- 50% of antibiotics are prescribed for surgical prophylaxis and 30-90% of this prophylaxis is inappropriate (4). This inappropriate use increases selection pressure favoring emergence of pathogenic drug resistant bacteria (3) which makes the choice of empirical antimicrobial agents more difficult and hence increasing the risk of post operative wound infections.

1.1.2 Magnitude of surgical site infections

Studies on the magnitude of SSI are complicated by heterogeneous nature of these infections. The prevalence and incidence rates of post operative wound infections vary widely between procedures, hospitals, surgeons, patients and geographical locations (5, 6). One study among 322 children surgical patients in Nigeria reported high SSI rate of 25.8% in emergency procedures in contrast to 20.8% in elective procedures, although the association was not statistically significant (5). Also a similar study documented high rate of SSI in dirty surgery (60%) compared with contaminated (27.3%), clean contaminated (19.3%) and clean surgery (14.3%), the association being statistically significant (5). Studies have shown that introduction of minimal invasive surgery like laparoscopic surgery has resulted in decrease in incidence of SSI. A review by Boni et al reported a decrease in SSI in patients with acute appendicitis to 2% with minimally invasive procedures compared to 8% with open procedures (6). Similarly, in patients undergoing cholecystectomy the incidence of SSI was reported to be low (1.1%) with laparoscopic in comparison with 4% following open surgery (6).

Several literature sources report varying SSI prevalence and incidence rates in different parts of the world, ranging from 5.6% to 26% (7-18). A study at a University Hospital in Brazil among general surgical patients reported high SSI rate of 16.9%, with high rate in clean contaminated (17.8%) as compared to contaminated surgery (12.5%), however majority of intervention involved the digestive tract (7).

A retrospective multicenter study among patients older than 50 years who underwent surgery for femoral neck fracture in France reported low SSI rate of 5.6%, with high rate (6.9%) in patients who had prosthesis compared with those who had osteosynthesis (3.9%) (8). Surgical antibiotic prophylaxis was appropriately provided in 93% of procedures likely contributing to low SSI rate (8). But a study at reference hospital in Vietnam reported high incidence rate of SSI of 15.2% among orthopedic patients, which is higher than that of France with no difference in the SSI rate between patients who received appropriate antimicrobial prophylaxis(AMP) and patients who did not (4.4% vs 6.4%, P=0.4) (9). The high SSI rate in

Vietnam as compared with France may have been contributed by limited resources in Vietnam which is a developing country and most common procedures in Vietnam were internal fixation of fracture and wound debridement.

Few studies conducted in Africa have also reported varying magnitude of SSI depending on procedures and specialties in which it was performed. In one prospective multicenter study done at large hospitals in Lagos, Nigeria, low prevalence rate of SSI 9.6% was reported among women who underwent caesarian section, with only those with Pfannesteil incision included in the study (10). The reason for this low prevalence was inferred to possibly be due to exclusion of cases with sub umbilical midline incision (10).

In a prospective study at a teaching hospital in Ethiopia among patients with abdominal surgical wounds, pathogenic organisms were isolated in 38.7% of patients, however on clinical grounds alone wound infection rate was 21% (11). This finding calls for the need to utilize laboratory techniques to confirm diagnosis of potentially infected wounds. Wound infection was significantly associated with class of wound, with highest rate being 64.1% for contaminated and dirty wound, and no difference in infection rate was observed between emergency and elective operations (11).

A study at a district hospital in Kenya among women delivered by caesarian section reported high incidence rate (19%) of SSI, which was higher than that reported in Nigeria (12). The incidence was higher in single women (32%) as compared to married women (16%), but the difference was not statistically significant (12). Another study in Kampala, Uganda, among surgical patients reported high SSI rate of 9.64% in pre-intervention phase in which no antimicrobial prophylaxis (AMP) was administered, as compared to 2.56% in intervention phase in which AMP was administered preoperatively (13). High rates were observed in orthopedics surgery (34%), large bowel surgery (28%) and caesarian sections (7.2%); the rates were reduced to 0%, 5.55% and 2.5% respectively with implementation of AMP in the intervention phase (13). This shows that appropriate use of AMP can effectively reduce the incidence of SSI.

Limited studies have been done in Tanzania to determine the extent to which SSI occurs. One of those few studies was done at Ifakara district hospital among surgical patients where high prevalence rate (22%) of SSI was reported (14). Although all patients received surgical prophylactic antibiotics, the antibiotics were inappropriately given, possibly contributing to the high SSI rate. Another study done at Kilimanjaro Christian Medical Centre (KCMC) among general surgical patients reported incidence of SSI rate of 19.4%, in which 36.4% of the patients were diagnosed post-discharge (15). Incidence was high in dirty surgery (50%) compared to clean (15.6%), clean contaminated (17.7%) and contaminated (37%). Inappropriate use of antibiotics in this study could have contributed to high rate of SSI. A recent study done in Bugando Medical Centre (BMC), Mwanza among general surgical patients found high rate of SSIs at (26%), of whom (86.2%) and (13.8%) had superficial and deep SSIs respectively (16). This rate was higher than that reported before, indicating increasing rate of SSIs among patients undergoing operations in this country.

The incidence of SSI in clean contaminated surgery has been reported to be higher than in clean surgery. At Muhimbili National Hospital (MNH) few studies have reported the magnitude of SSI in general. One of the studies among clean elective general surgical patients reported low SSI incidence rate of 12.3% (17), which was in contrast to an observation made by Ussiri et al who documented SSI rate of 15.6% in a study among surgical patients who underwent clean contaminated and dirty surgery at the same hospital (18). The differences in SSI rates between these two studies could be attributed to the type of patients investigated, since Ussiri et al studied clean contaminated and dirty surgery while the previous study included only patients with clean surgery.

1.1.3 Microbiology

In most post operative SSIs the causative pathogens originate from endogenous flora of the patient's skin, mucous membranes or hollow viscera (1). The most commonly isolated bacterial pathogens are *S. aureus,* Enterobacteriaceae, Coagulase Negative Staphylococci

(CoNS), Enterococci and *Pseudomonas aeruginosa* (19, 20). Although the pathogens isolated depend on the surgical procedure involved, recent reports have documented an increasing proportion of Gram positive organisms and decrease in number of Gram negative organisms associated with SSIs (1). Furthermore, there is an increase in incidence of SSIs attributed to antimicrobial resistant pathogenic bacteria like methillin resistant *Staphylococcus aureus* (MRSA) (2, 21) and Vancomycin resistant *Staphylococcus aureus*.

In the United States of America a study conducted from small community hospital among all patients who underwent surgery reported *S. aureus* as the commonest isolate (25.8%), followed by Enterobacteriaceae (12.4%), streptococci species (11.2%), CoNS (10.1%), Enterococci species (7.9%) and *Pseudomonas aeruginosa* (6.7%), but MRSA was isolated from only 4.5% of SSIs (20). Another recent study in USA among patients who underwent operation for hollow viscus injury documented *Escherichia coli* as the most commonly isolated microorganism (64.7%) followed by Enterococci species (41.2%) and Bacteroides (29.4%) (22). Findings from these two studies suggest that the aetiologic agents of SSIs depend on where the procedures are performed and whether skin was incised or gastrointestinal tract was opened. When incisions are made near the perineum or groin, organisms usually include aerobic gram positive cocci and fecal flora (anaerobic bacteria and gram negative aerobes).

A recent study at a University hospital in Iran, reported *S. aureus* to be the commonest bacteria pathogen (43%), followed by *Escherichia coli* (21%), Klebsiella spp (13%), Pseudomonas (10%) and CoNS (5%) among a surgical patients (23). In that study MRSA accounted for a high rate of 78.9% of all *S. aureus* isolates (23). Another study in the same region among patients who underwent orthopedic and neurosurgery reported that the three most frequently isolated pathogens were *Pseudomonas aeruginosa* (29.5%), *S. aureus* (11.5%) and *Escherichia coli* (10.3%) (9). Although 90% of *S. aureus* isolates were MRSA (9), gram negative organisms were the most common causative pathogens in contrast to what has been reported in other studies in which gram positive organisms predominate.

Findings from a study carried out at a University hospital in Nigeria showed that the commonly isolated bacteria were *S aureus* (25%), *Pseudomonas aeruginosa* (20%), *Escherichia coli* (15%), *Klebsiella oxytoca* (10%) and *Proteus mirabilis* (10%) (24). Similarly, in a prospective survey done in Central African Republic among orthopedic surgical patients it was found that methicilin-susceptible *S. aureus* was the most frequent species isolated followed by Enterobacteriaceae and *P. aeruginosa.* A strain of *E. cloacae* harbouring extended spectrum beta lactamase (ESBLs) was also isolated (25). Frequent isolation of *S. aureus* (28.8%) and *Escherichia coli* (27.1%) have also been reported among patients with abdominal surgical wounds in Ethiopia (11).

Of studies conducted in East Africa, one cross-sectional survey among 63 surgical patients at University teaching hospital in Kenya, reported that *S. aureus* was the most frequently isolated pathogens (54.7%) while Proteus, Pseudomonas and *Escherichia coli* were 15.5%, 11.9% and 2.3%, respectively (26). This study investigated patients of all age groups and no attempt was made to characterize the bacteria isolated from SSIs. Similar finding was reported in a study at referral hospital in Uganda, which documented the *S. aureus* as being the commonest isolate (45.1%) followed by coliforms (16.9%) and *Proteus mirabilis* (11.3%) (27). MRSA accounted for 25% of all *S.aures* and the majority of surgical patients underwent caesarian and herniorraphy procedures (27).

In the study done at MNH in Tanzania among patients who underwent elective clean surgery, it was reported that *S. aureus* was the commonest isolate accounting for 36.1% followed by Klebsiella spp (31.2%) and *Escherichia coli* (14.8%) (17). Almost similar findings have been reported among general surgical patients at KCMC, which is in the northern part of Tanzania, where *S. aureus* was reported to be the most commonly isolated micro-organism (27%) followed by *Escherichia coli* (14.8%) and Klebsiella spp (14.8%) (15). Fehr et al in a study conducted at St Francis Hospital in Ifakara reported *S aureus* (36%), *Escherichia coli* (5%) and Enterococci (4%) as the pathogens most commonly isolated from SSIs, (14). This prospective cohort survey was conducted between November 2003 and March 2004 among all

adult surgical patients with caesarian sections being the most frequently performed procedure (14). Similar observation have been found in a recent study among general surgical patients in BMC, Mwanza, where *S. aureus* was reported to be the predominant isolate accounting for 28.6% followed by enteric gram negative bacilli. This study, however did not investigate the common pathogens of SSI from other surgical units in that tertiary hospital (16). These studies conducted in Tanzania have demonstrated that the spectrum of microorganisms isolated in SSIs at district and referral hospitals is almost comparable to that reported in studies conducted in tertiary hospitals and elsewhere. However, from these few studies conducted in Tanzania there is paucity of information regarding the extent of emerging antimicrobial drug resistant pathogenic bacteria as significant pathogens in SSIs.

Studies have shown an increase in the trend of SSIs attributable to antimicrobial resistant pathogens such as MRSA. Weigelt et al in the data collected between 2003 and 2007 reported that the proportion of MRSA significantly increased (from 16.1% to 20.6%) among culture positive SSIs patients readmitted in 97 US hospitals (2). Another study reported that MRSA was the most frequent pathogen recovered and the prevalence rate of MRSA SSI almost doubled during the study period increasing from 0.12 infections per 100 procedures to 0.23 infections per 100 procedures (21).

Confusion has existed since the 1970s concerning the aetiology of the 15-25% of SSIs, which yield no bacterial growth upon routine culture. Gram staining of the exudates from these infections often reveals pleomorphic gram negative or positive bacilli with irregular staining in addition to other morphological types. These infections usually present with foul smelling discharge (28) which raises the suspicion of possible role of anaerobic bacteria. Thus, the failure to isolate the infecting causative organisms has often led to inappropriate use of antibiotics and hence many clinical failures to treatment. Improvement in anaerobic cultures has made it possible to make accurate diagnosis of this kind of SSIs. The few studies done in Tanzania on SSI, however have not reported isolation of anaerobes (17, 18).

The anaerobic pathogens isolated from SSIs, as is the case for aerobic pathogens vary primarily with the type of surgical procedure. In one study in USA among children with gastrostomy site wound infection, the most prevalent anaerobes were *Peptostreptococcus* species and members of *Bacteroides fragilis* group (29). Polymicrobial flora were the most common isolates (29).

1.1.4 Pathogenesis

Bacterial contamination of the surgical site is a prerequisite for SSIs. Following contamination the risk of development of SSIs will depend on several factors, the most important ones being the dose and virulence of the pathogens, and host defense mechanisms (1). The risk of SSIs increases if the surgical site is contaminated with more than 10^5 organism per gram of tissue (30). The dose required for infection can even be lower if a foreign body such as suture is present at the site, (e.g only 10^2 staphylococci can cause infection in the presence of silk suture) (1).

Virulence of bacteria depends on the ability to produce toxins and other substances that increase their ability to invade the host, produce tissue damage or survive within the host cells. For example Gram negative bacteria contain endotoxin or Lipopolysaccharide (LPS) which is the most potent microbial mediator implicated in the pathogenesis of sepsis and septic shock. LPS triggers the release of procoagulant factors and inflammatory mediators such as cytokine which may initiate systemic inflammatory response syndrome and cause multiple systemic organ failure (31). Some bacteria produce polysaccharide capsule, which inhibit phagocytosis which is a critical host immune response following bacterial contamination (1). When incision is made invariably it impairs first line of defenses between the environmental microbes and internal host environment, therefore the exposed tissues are at risk of contamination with endogenous patient's flora (1). Exogenous contamination may also occur from operating room environments, surgical teams and instruments.

1.1.5 Risk factors for surgical site infections

A number of preoperative, perioperative and postoperative predisposing factors have been studied and found to be associated with risk for development of post operative SSIs. Preoperatively a number of patients-related factors have been associated with the increased risk of SSIs. Prospective investigation of the risk factors for SSIs among patients in medical wards in Iran revealed age older than 60 years, diabetes mellitus, smoking and obesity as significantly associated with risk of SSIs (32). Kaya et al reported similar findings in addition to malnutrition, prolonged preoperative hospital stay and coexisting infections being risk factors but smoking was not associated with risk of SSIs (33). . Kalmeijer et al reported high nasal carriage of *S. aureus* as the most important and significant independent risk factor for development of SSI with *S. aureus* (34).

Many studies have reported a number of procedure related factors as contributory risk factors for the development of SSIs. Kaya et al in one year surveillance program in a tertiary care centre in Turkey reported abdominal incision, whole blood transfusion, early preoperative hair removal, inappropriate antimicrobial prophylaxis, famotidine treatment and repair with mesh as independent risk factors for SSI (33). Eriksen et al in Northern Tanzania reported prolonged operation time, sepsis of the wound, type of operation, type of incision, inappropriate antimicrobial prophylaxis and increased time lapse between shaving and operation as significantly associated with increased risk of SSI among patients who had undergone abdominal surgery (15).

Length of preoperative hospital stay, early preoperative hair removal and poor nutrition status were significant risk factors for SSIs in Uganda (13). A prospective incidence study at a district hospital in Tanzania reported American society of Anasthesiologist (ASA) score of 2-4 and long duration of operation as risk factors significantly associated with SSI (35). Inadequacy and inappropriate use of preoperative AMP is known to be a major risk factor associated with increased incidence of SSI. However, when applied properly it can significantly prevent occurrence of SSI. For a example, a study at a rural hospital in Tanzania

showed dramatically decreased rate of SSI from 21.6% to 4% after implementation of appropriate use of preoperative AMP (36).

1.1.6 Antimicrobial susceptibility pattern

The sensitivity pattern of SSI isolates is changing due to increasing emergence of antimicrobial resistant pathogenic bacteria strains like MRSA (21), making the choice of empirical treatment more difficult and expensive. The magnitude of antimicrobial resistance among bacteria globally is unknown and more so in developing countries where few data are available (37).

It has been reported from Nigeria that among the bacterial pathogens from SSI, Gram-positive isolates were highly resistant to penicillin, cloxacillin, chloramphenicol and ampicillin but all except *S. aureus* were highly sensitive (70-90%) to streptomycin, gentamycin and erythromycin (24). Gram-negative bacterial isolates showed high level of resistance to clotrimoxazole, ampicillin, streptomycin and tetracycline and moderate susceptibility to nitrofurantoin, nalidixic acid but were highly sensitive to gentamycin and colistin except *Klebsiella oxytoca* and *Pseudomonas aeruginosa* (24). These results showed that 70% of the bacterial isolates were multi drug resistant.

Andhoga et al in a study conducted at a University hospital in Kenya among the bacteria isolated from SSI, *S. aureus* showed high resistance to ampicillin (78.3%), chloramphenicol (84.8%), methicillin (79.4%) and contrimoxazole (84.8%) (26). All Pseudomonas and *Escherichia coli* strains were completely resistant to ampicillin and cotrimoxazole (26). Similar observation was also reported in the same region, in Uganda, it was shown that most of the gram negative bacteria isolated from SSI were highly resistant to first line antibiotics namely Ampicillin (90.6%), Amoxycillin (96.9%) and Chloramphenicol (100%). *S.aureus* isolates were highly resistant to Ampicillin (97%) and erythromycin (56.2%), but sensitive to

gentamicin (87.5%), ciprofloxacin (68.7%) and methicillin (75%). Pseudomonas was sensitive to gentamicin (87.5%) and ceftazidine but resistant to ciprofloxacin (57.2%) (27).

Studies conducted in Tanzania have reported variable antimicrobial susceptibility pattern of bacteria pathogens isolated from SSIs. For example work done 11 years ago among surgical patients at MNH demonstrated that, *S. aureus* was 100% resistant to commonly used Penicillin G but was 100% sensitive to methicillin. Klebsiella spp showed susceptibility to ceftriaxone (93.3%) and gentamycin (64.7%) but were resistant to ampicillin (77.8%) (17). But another data from the same study setting revealed that microorganisms isolated from SSIs were frequently resistant to Ampicillin, Chloramphenicol, tetracycline, cotrimoxazole and gentamycin. CoNS were resistant to all antibiotics used in this study (15).

Of all bacterial pathogens isolated from SSI at Ifakara hospital, Tanzania, 60% were resistant to antimicrobial agents commonly administered (14). In the same study, 33% and 95% of *S. aureus* strains isolated from SSI were resistant to chloramphenicol and penicillin, respectively. Interestingly MRSA was rather uncommon comprising only one of 114 isolates.

1.1.7 Risk factors associated with antimicrobial resistance

Resistant organisms pose a great challenge in the treatment of bacterial infections often leading to treatment failure, prolonged duration of illness and great risk of death. Bacteria have ability of undergoing mutation or acquiring a resistance gene when antimicrobial agents are inappropriately used (38). There has been an increase in the number of multidrug resistant organisms isolated from patients in hospitals world wide. Infection with antibiotic resistant bacteria also increases the likelihood that the patients will receive inadequate therapy.

Development of antimicrobial drug resistant pathogens occurs as a result of complex interactions, which favour the emergence, persistence and increased transmission of these

resistant bacterial strains (38, 39). Widespread and inappropriate use of antibiotics has been shown to increase the development of antimicrobial resistant pathogens (39).

Several literature sources have documented different risk factors associated with isolation of antimicrobial resistant pathogens from patients. In a case control study conducted in Denmark identifying possible risk factors for MRSA and methicillin susceptible *Staphylococcus aureus* (MSSA), prior hospitalization for more than 7 days within the previous six months tended to be associated with MRSA (40). Furthermore a study done in USA, antimicrobial use 1-6 months to culture, history of boil and having a household member who was a smoker were associated with MRSA compared to MSSA (41).

Another case control study in Australia, reported hospitalization within the preceding six months and residence in long care facility as being associated with higher risk of MRSA bacteremia (42). In a retrospective study at a university hospital in Malaysia, duration of hospitalization, previous antibiotic use, and bedside invasive procedures were significantly associated with MRSA than MSSA (43).

Prior exposure to antibiotics as a risk factor for emergence of drug resistant bacterial strains has also been reported in studies done in Asian countries (44, 45). In the study done in Thailand, patients with prior ESBL colonization and recent antibiotics exposures (<90 days), especially to third generation cephalosporins and fluoroquinolones were statistically significantly associated with risk of ESBL-producing compared with Non ESBL-producing *Escherichia coli* (44) . Interestingly diabetes was not a risk factor with either type of infection. Use of ventilator, use of catheter and days of stay in hospital wards have also been significantly associated with acquisition of antibiotic resistant isolates (45). Multivariate analysis of data from a study done in Madagascar showed that diabetes and use of an invasive procedure were independent risk factors for resistance to third-generation cephalosporins among ESBL-producing Enterobactraceae isolated from surgical wards and intensive care unit (46).

1.2 PROBLEM STATEMENT

Post operative wound infection remains a common and widespread problem contributing to significant morbidity and mortality. It is widely accepted that it prolongs hospital stay and increases the cost of hospitalization (1, 2). It is also the third most frequently reported type of nosocomial infection (1). Morbidity and mortality is partly attributed to increase in infections due to antimicrobial resistant bacterial pathogens (2, 21), which make the choice of empirical therapy more difficult.

Limited studies have been conducted in Tanzania on post operative wound infection as well as the extent to which such infections are caused by bacterial pathogens that are resistant to commonly used antimicrobial agents. Those studies have reported rates of SSI ranging from 12.3-22% (14-18) and antimicrobial resistance rate of 60% among all pathogens isolates from SSI (14). These studies have only been limited to general surgical patients but the magnitude of the problem to other surgical specialities is unknown. These previous studies have also not investigated the extent to which anaerobes are involved in the aetiology of SSIs. The paucity of comprehensive data regarding the extent of SSI due to antimicrobial resistant pathogens in Tanzania poses a challenge in developing evidence-based interventions for treatment, control and prevention of SSIs.

1.3 RATIONALE OF THE STUDY

Post operative wound infections are among the most common nosocomial infections, accounting for 14-20% of all hospital acquired infections (1, 47). SSIs have been associated with increased morbidity, mortality, prolonged hospital stay and increased economic costs for patients care. Also there has been an increase in SSIs contributed by resistant pathogenic bacteria which make treatment of these infections more difficult especially in developing countries. The magnitude of these antimicrobial resistant bacterial strains globally is unknown and more so in developing countries where few data are available (37). In Tanzania there has been limited data regarding the magnitude of SSIs due to antimicrobial resistant pathogens as well as resistance pattern to commonly prescribed antibiotics used in treatment of these infections. This gap makes the choice of empirical therapy more difficult to the clinician. Advance in the treatment of diseases has led to a significant increase in diverse surgical interventions. In parallel with these advances, the magnitude of SSIs, use of AMP and emergence of antibiotic resistant bacterial strains are likely to increase. Therefore a better understanding of the spectrum of pathogens causing SSI as well as their susceptibility pattern is important for prompt management of patients, as antimicrobial therapy significantly influences the outcome of the patients with SSI.

This study was therefore undertaken in an attempt to establish local data on the magnitude of SSI due to antimicrobial resistant pathogenic bacteria as well as their susceptibility pattern in various surgical specialities at MNH and Muhimbili Orthopedic Institute (MOI). Having such data would help to establish guidelines for the management of SSIs and contribute to planning of surveillance, prevention and control of this group of infections. The data also can be adopted by the policy makers to lay a basic foundation for further extensive surveillance studies within the country.

1.4.0 RESEARCH QUESTIONS

4.1.1 To what extent do antimicrobial resistant bacterial pathogens cause SSIs in MNH and MOI?

4.1.2 What contributes to the occurrence of SSIs despite administration of surgical antimicrobial prophylaxis?

1.4.1 hypothesis of the study

4.2.1 There is no increase in SSIs due to antimicrobial resistant pathogens in MNH and MOI.

4.2.2 There is no difference in the patient characteristics of those acquiring SSI with non antimicrobial drug resistant strains compared to those who acquire drug resistant microbial SSI.

CHAPTER 2

2.0 OBJECTIVES

2.1 Broad objective

To determine the spectrum of bacterial isolates from postoperative wound infections and their antimicrobial susceptibility patterns at MNH and MOI.

2.2 Specific objectives

5.2.1 To determine the bacteriological aetiology of post operative SSI among post operative patient at MNH and MOI

5.2.2 To determine the antimicrobial susceptibility pattern of the isolates from SSI at MNH and MOI

5.2.3 To describe patients' characteristics associated with harboring of antimicrobial resistant pathogens from SSI at MNH and MOI

5.2.4 To establish the pattern of surgical antimicrobial prophylaxis used among patients with post operative wound infections.

CHAPTER 3

3.0 METHODOLOGY

3.1 Study design

This was a descriptive cross sectional study.

3.2 Study duration

The study was conducted in a period of six months, from September, 2011 to February, 2012

3.3 Study area

The study was carried out in general surgery and obstetrics/gynecology wards at MNH and in the orthopedic/trauma ward and clinic at MOI.

3.4 Study population

This included all patients with post operative wound infections in the general surgery, and obstetrics/gynecology wards at MNH and in orthopedic/trauma ward and clinic at MOI.

3.5 Inclusion criteria

a. Patients of all age groups except neonates
b. Presence of post operative SSIs
c. Giving informed consent to participate.

3.6 Exclusion criteria

a. Neonates
b. Infection occurring 30 days after operation if no implant is in place
c. Infection on episiotomy
d. Burn injuries and donor sites of split skin grafts
e. Procedures in which healthy skin was not incised such as opening abscess
f. Refusal to give consent for participating in the study

3.7 Case definition

Post operative surgical site infection was defined according to CDC criteria (1, 48). Timing and classification of SSI was used; SSI was classified as superficial, deep incisional or organ/space infection (1, 48), with:

a. Purulent drainage with or without laboratory confirmation from the superficial or deep incision
b. Organism isolated from an aseptically obtained culture of fluid or tissue from superficial or deep incision or organ/space.
c. Sign or symptoms of infection: Pain and tenderness, localized swelling, or heat
d. Purulent drainage from the drain that is placed into the organ/space.
e. Diagnosis of SSI by surgeon or attending physician.

3.8 Sample size

Sample size for this study was calculated using the following formula,

$$N = \frac{Z^2 P(1-P)}{E^2}$$

Where;

Z is standard deviation corresponding to two specified confidence interval is 1.96 (At confidence interval 95%).

P is the proportion of antimicrobial resistant pathogens isolated from SSI at Ifakara district hospital, Tanzania which was 60% (14).

E corresponds to margin of error (precision), is 10%.

The minimum sample size **N** is 92; therefore 100 participants were recruited into the study.

3.9 Sampling technique

Convenient sampling was employed and all patients with clinical evidence of sepsis were included during the study period. Samples were only taken from the patients during the period of surgical wound dressing before the wound was cleaned with antiseptic solution. Every day new patients were enrolled until all sample size was attained.

3.10 Patient data collection

Structured questionnaires were used to extract data from the patients case notes; the information included were; demographic data, existing chronic disease (such as diabetes mellitus), past medical history, current drug use such as steroid, smoking, length of preoperative hospital stay, duration of operation and antimicrobial prophylaxis. Physical examination was done to determine location of the wounds

3.11 Specimen collection

The specimens were collected aseptically on the first day when patients presented with clinical evidence of infection (purulent drainage from incision or drain) before the wound was cleaned with antiseptic. Using sterile cotton wool, swabs were obtained from surgical site without contaminating with skin commensals and transported to the laboratory immediately on Amies transport media.

3.12 Laboratory procedures

Swab specimens were processed and tested in the Central Pathology Laboratory, MNH. Specimens were immediately cultured upon arrival in the laboratory. Culturing for colony characteristics followed by Gram stain and biochemical tests were used to identify pathogenic bacteria. Culture media used were blood agar, MacConkey agar, nutrient agar and fresh blood agar. Culture media were made by reconstituting the commercial powder in distilled water and sterilizing at 127°C for 15 minutes in an autoclave as per manufacturer's instructions.

3.12.1 Microscopic examination and Culture

Smears were air dried; heat fixed and stained by gram's stain, in order to group pathogens into Gram positive and Gram negative depending on ability of bacterial cell to retain primary stain. The stained slides were examined microscopically under oil immersion lens for pus cells, and bacterial cells and then quantified as No. of cells/High power field. Specimens were inoculated on both differential and enriched media (MacConkey agar and blood agar) and incubated aerobically at 37°C for 24-48hrs. After 24 hrs, another Gram stain from discrete

colonies growing on media was made. Isolated colonies were subcultured in nutrient agar for biochemical testing.

Specimens for anaerobic culture were inoculated onto fresh blood agar on which 5μg metranidazole disc was placed for presumptive recognition of anaerobes (49). Plates were placed in anaeropack system and incubated at 37°C for 2 to 5 days. Anaerobic plate was re-examined for a total of five days' incubation (50).

3.12.2 Identification of bacterial pathogens

Preliminary identification of bacteria was based on the colony characteristics of the organism i.e colonial morphology, haemolysis on blood agar, changes in the physical appearance of the differential media and enzyme activities of the organisms and Gram staining. Biochemical tests were performed on colonies from the nutrient agar. It was planned to identify anaerobes by morphology, biochemical tests and antibiogram pattern (51). All isolates exhibiting ambiguous taxonomic classification were retested with API 20E (BioMerieux, France) and VITEX (BioMerieux, France) following the manufacturer's instructions.

3.12.3 Antimicrobial susceptibility testing

Antimicrobial susceptibility pattern of isolated bacterial pathogens was performed by Kirby Bauer disc diffusion method according to the guidelines of the Clinical and Laboratory Standards Institute (52). Inoculum was prepared by picking parts of two or three identical colonies with a sterile wire loop. This was suspended in sterile peptone water (broth) and incubated up to two hours to allow organisms to reach their log phase of growth. The density of suspension to be inoculated was determined by comparison with the opacity standard on McFarland 0.5 Barium sulphate. Sterile swab was dipped into the suspension of the isolate in the peptone water, squeezed free from excess fluid against the side of bottle and spread over the Mueller –Hinton agar plate. The test organism and the standard control from the broth were spread evenly over the surface of the Mueller –Hinton agar using sterile cotton wool swabs. Sensitivity discs for appropriate drugs were placed onto the media and incubated at 37°C for 24hrs. After 24 hours each plate was examined and growth zones were measured to the nearest millimeter, using sliding caliper which was held at the back of the inverted media

plate. The Petri dish was held a few inches above a black, non- reflecting background and illuminated with reflected light. The inhibition zone margins were taken as the area showing no obvious, visible growth that could be detected with the unaided eye. Faint growth of tiny colonies, which could be detected only with a magnifying lens at the edge of the zone of inhibited growth, was ignored. However, discrete colonies growing within a clear zone of inhibition were sub cultured, re-identified, and retested. The results were reported as sensitive or resistant to the agents that had been tested. Methicillin resistance *Staphylococcus aureus* was determined by Disc diffusion test using cefoxitin (30µg) disc on Mueller –Hinton Agar (52). Plates were incubated and maintained at 33-35°C for 24 hours. Results were interpreted according to CLSI guidelines (52). Induced clindamycin resistance among *Staphylococcus aureus* was detected by disc diffusion method on Mueller-Hinton Agar, 15µg of erythromycin disc and 2µg of clindamycin disc were spaced 15mm apart, incubated at 35$\pm$ 2ºC for 16-18 hours. Flattening of the zone of inhibition adjacent to erythromycin (D-zone) was interpreted as inducible clindamycin resistance (52) (Figure 1). ESBLs production was screened by disc diffusion on Mueller-Hinton Agar with ceftazidime (30µg) or ceftaxime (30µg) according to the CLSI guidelines and confirmed by double disc approximation method (Figure 2) (52, 53). Discs containing ceftazidime (30µg) and cefotaxime (30µg) were placed 20mm center to center to the amoxicillin/clavulanate (20/10µg) disc. The plate was incubated at 37ºC for 18-20hours. An enhanced zone of inhibition toward the amoxicillin/clavulanate (20/10µg) disc indicated positive ESBL production. For gram positive organisms susceptibility was tested against penicillin (10 unit), ampicillin (10µg), amoxicillin/clavulanate (20/10µg), ceftriaxone (30µg), vancomycin (30µg), gentamycin (10µg), erythromycin (15µg), tetracycline (30µg), ciprofloxacin (5µg), clindamycin (2µg), triomethoprim/sulfamethaxazole (1.25/23.75µg) and chloramphenicol (30µg). Gram negative organisms were tested against ampicillin (10µg), amoxicillin/clavulanate (20/10µg), ceftriaxone (30µg), ceftazidime (30µg), cefotaxime (30µg) gentamycin (10µg), tetracycline (30µg), ciprofloxacin (5µg), triomethoprim/sulfamethaxazole (1.25/23.75µg), chloramphenicol (30µg) and imipenem (10µg).

Quality of media, antibiotic disc as well as performance of a person carrying the tests were

controlled by reference strains: *Escherichia coli* ATCC 25922, *Klebsiella pneumoniae* ATCC 700603 for ESBL, *S.aureus* ATCC 25923, and *S.aureus* ATCC 29213 for MRSA.

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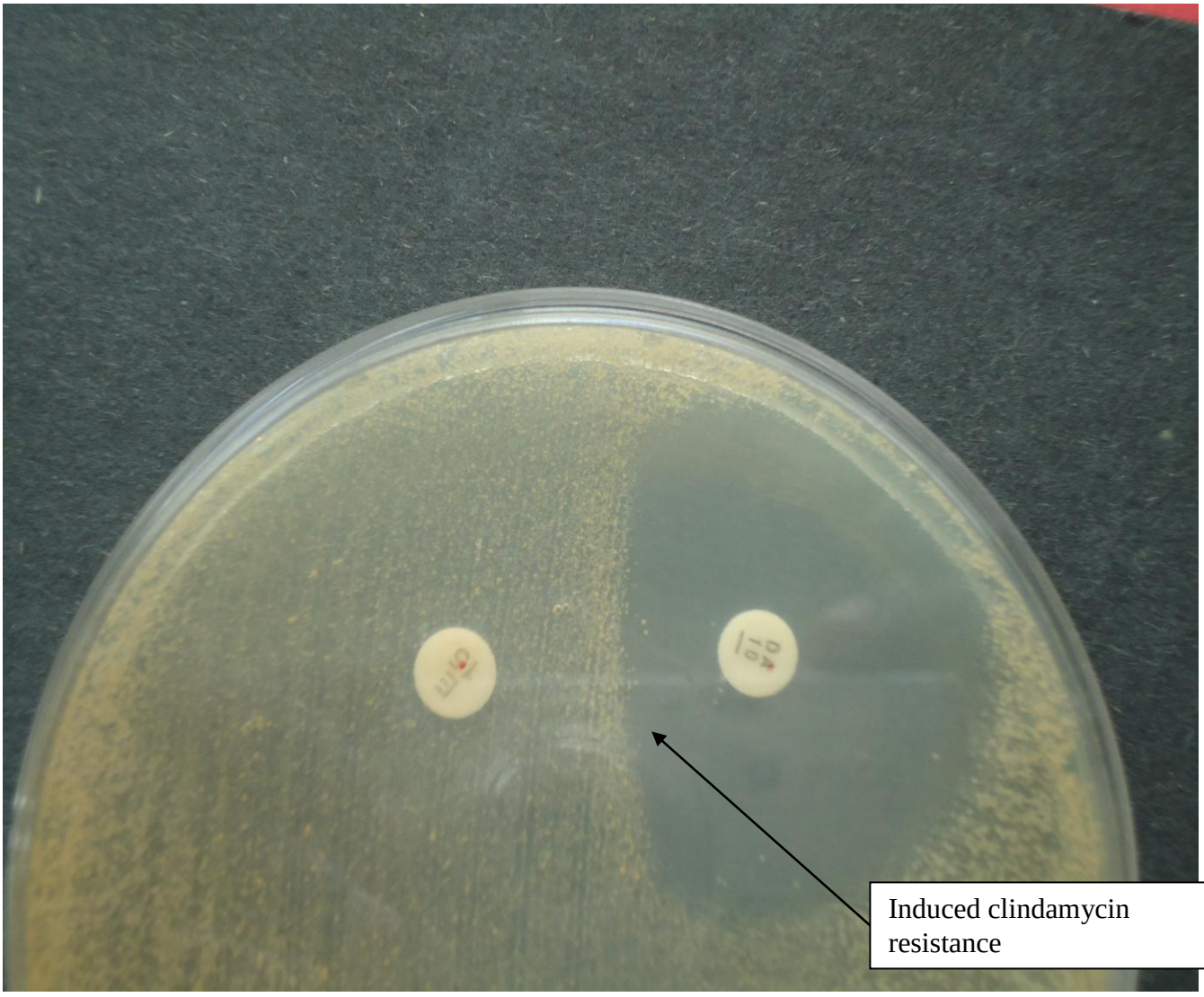

Figure 1: D zone of inhibition positive for induced clindamycin resistance

Figure 2: Double disc approximation method for ESBL detection

3.12.4 Quality control

Aseptic techniques were observed in all the steps of specimen collection and inoculation onto culture media to minimize contamination. All culture media were prepared according to the directions of the manufacturers. Three plates of each batch were incubated at 37°C for 48 hours to check for sterility. The ability to support growth of the common organisms causing surgical site infection was determined by inoculating the media with a typical stock culture. Negative and positive controls were included to validate the biochemical reagents/test kits. Standard quality control strains were used to monitor accuracy and precision of susceptibility

testing procedures, antibiotic discs as well as performance of the person carrying out a test and read the results.

3.13 Plans for data processing and analysis

All filled questionnaires were coded before entering into the computer using Epidata Entry version 3.1. Data cleaning was done by using consistence checks. Data was analysed on STATA version 11.2. Frequency distribution and two way tables were used to summarize the data and Chi-square test or Fishers Exact Test were used to determine the association between independent and dependent variables, p values of < 0.05 were considered significant.

3.14 Ethical consideration

Specific ethical issues like pain during taking swabs were addressed with assurance that pain was self limited and in case of persistence, analgesics would be offered. The study was conducted in accordance to existing ethical guidelines. Ethical clearance was sought from MUHAS ethical committee. Permission to conduct the study in MNH and MOI was sought from the MNH Director of Clinical Services and MOI Executive Director, respectively. Written informed consent was requested from the patients, parents/guardians for participation into the study. Information about the study was given to the participants to ensure that they have the information needed to make an informed consent. A complete description of the aims of the study and assurance of confidentiality for any information was given to all patients' and parents/guardians (in case of children) who were potential study participants. Appropriate counseling and assurance of confidentiality was given to participants with worries and anxiety about the study.

Laboratory results of study participants were communicated to the attending clinician, for use in guiding patients' management. Patients who did not consent to participate in the study were assured of being given the same quality of care.

3.15 Limitations of the study

a. Inappropriate use of antibiotics prior to specimen collection may have affected the rate of the isolations
b. Due to small number of the isolates in some instances statistical test were not done.
c. Due to financial constraints it was not possible to do the following:
   To use kanamycin blood agar culture media for isolation of anaerobes
   Genotypic tests for confirmation of ESBLs and MRSA
   Using antipseudomonal penicillins
d. Due to short time of study and financial constraints sample size was very small and was not proportionally distributed between surgical specialties.

CHAPTER 4

4.1 RESULTS

This study was conducted for a period of 6 months between September 2011 and February 2012. A total of 100 patients with clinically suspected post-operative wound infections were enrolled in the study. Table 1 shows demographic and clinical characteristics of the patients. Majority of the study population were males 53(53%) with age distribution ranging from 18-80 years. The majority of the patients (46%) were from orthopedic and trauma unit. Emergency surgery contributed majority of patients accounting for 80%. Most (37%) of the surgeries performed were contaminated surgery while a small proportion (5%) was clean surgery. More than one fourth (27%) of the patients had surgical debridement and external fixation performed. The majority of the patients (71.4%) had operation performed on the day of admission or on the second day of admission. From the patients case notes most patients (95%) had documentation of antimicrobial exposure within one month. About seventy five percent of the patients reported history of previous hospitalization within 6 months.

Table 1: Demographic and clinical characteristics of patients with post operative wound infections

Variables	No (%)
Age (years)	
Mean (SD)	36.5 (16.6)
Median	32
Range	13-81
Sex	
Male	53(53)
Female	47(47)
Surgical department	
General surgery	29 (29)
Obstetrics/Gynecology	25 (25)
Muhimbili Orthopedic Institute	46 (46)
Type of surgery	
Emergency	80 (80)
Elective	20 (20)
Type of incision	
Clean	30 (30)
Clean contaminated	5 (5)
Contaminated	37 (37)
Dirty	28 (28)
Type of operation	
Surgical Debridement + External Fixation	27 (27)
Caesarian section	15 (15)
Laparotomy	25 (25)
Open reduction + Internal fixation	9 (9)
Amputation	8 (8)
Surgical debridement	6 (6)
Others	10 (10)
Previous antibiotics exposure within 1 month	
Yes	95(95)
No	5(5)
Previous hospitalization within 6 months	
Yes	75 (75)
No	25 (25)

Table 2 shows Gram stain morphology in relation to culture results. Majority (88%) of the Gram-stained smears revealed presence of pus cells. Among these, 89.7% had bacterial growth while 10.3% had no bacterial growth. Of the 12 smears with no pus cell, 91.6% showed bacterial growth suggesting that absence of pus cell on Gram stain does not exclude the possible presence of bacteria. Nine (9.4%) smears with obvious bacterial cell morphology on Gram stain had no bacterial growth on culture suggesting the possibility of presence of anaerobic organisms from wound infections or dead bacterial cells.

Table 2: Gram stain morphology in relation to culture results

Gram stain morphology	**Culture results**		
	Bacterial growth	No bacterial growth	Total
Pus cell			
Seen	79(89.7%)	9(10.3%)	88
Not seen	11(91.6%)	1(8.4%)	12
Bacterial cell morphology			
Present	87(90.6%)	9(9.4%)	96
Absent	3(75%)	1(25%)	4

Figure 3 shows the number of bacterial isolates from culture. A total of 100 wound swabs were collected from patients with post operative wound infections. Among these, 90% had bacterial growth within 24hours of incubation. More than half (52.2%) had pure bacterial growth (mono isolate) while the rest had mixed growth. Most specimens (83%) from clean procedure grew bacterial colonies, of which 72% were mono microbial isolates. In contrast more than half (51.5%) of the specimens from contaminated wound had mixed infections.

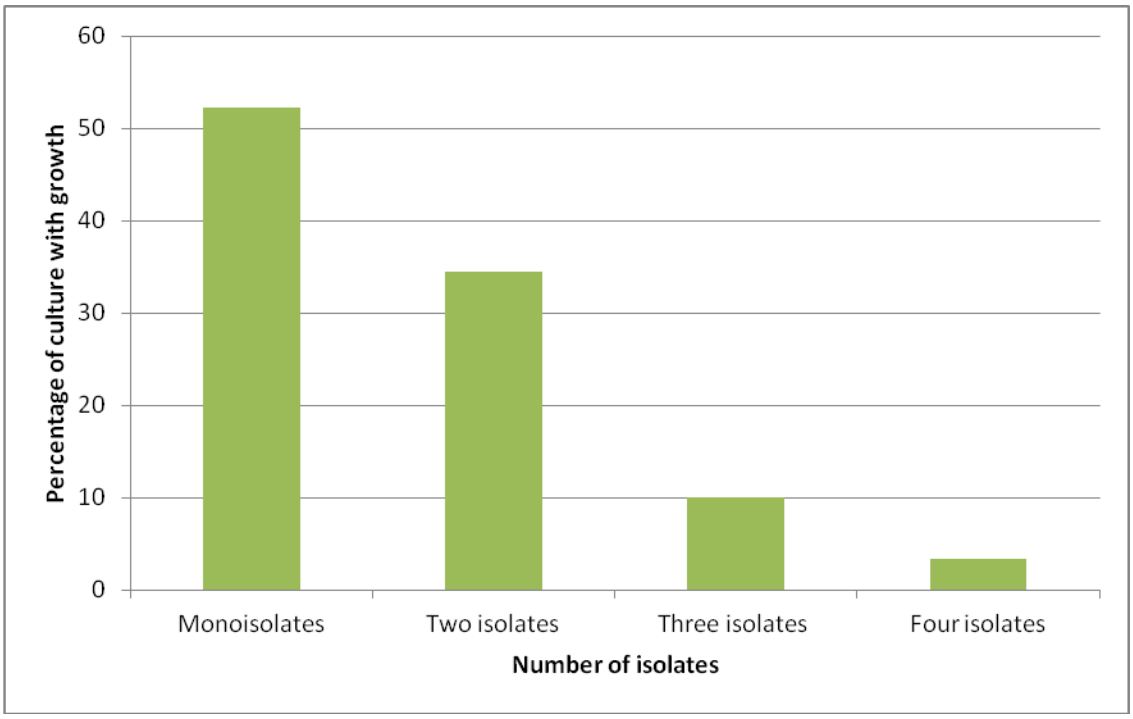

Figure 3: Number of bacteria isolates from culture

The 90 cultures that were positive yielded a total of 147 aerobic bacteria and none of anaerobic isolates. Gram negative organisms were more prevalent than gram positive bacteria accounting for 77.5% and 22.5% of isolates respectively. The three most commonly isolated bacterial species were *Pseudomonas aeruginosa* 24(16.3%), *S. aureus* 18(12.2%) and *Klebsiella pneumoniae* 16(10.8%) (Figure 4)

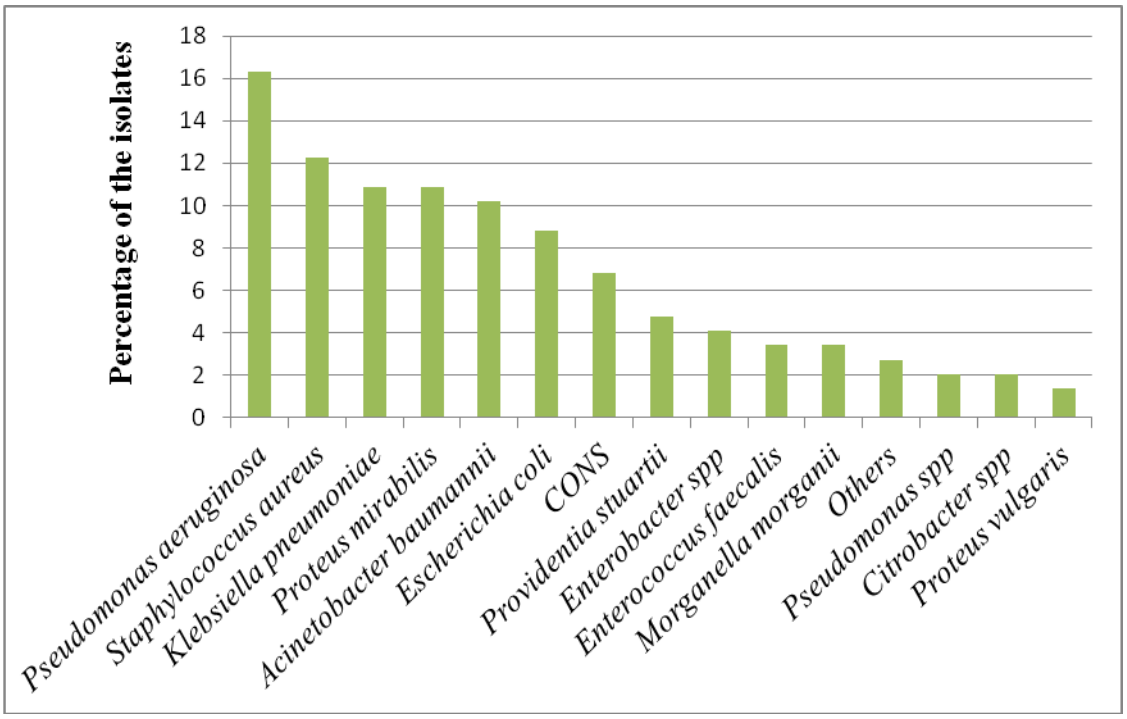

Figure 4: Frequency of pathogenic bacterial isolates from post operative wound infections

Bacterial isolation rate was higher in orthopedic surgery (47.6%) compared to obstetric-gynecology (22.4%) and this difference was statistically significant ($p<0.05$). Comparing to general surgery, the bacterial isolation rate was higher in orthopedic unit than that of general surgery (30%), however the difference was not statistically significant ($p>0.05$).

As summarized in Table 3, *S. aureus* was the most common organism isolated from the orthopedic unit accounting for 16/70(23%) followed by *P. aeruginosa* 10/70(14%) and *Proteus mirabilis* 8/70(11%). *Escherichia coli, Klebsiella pneumoniae* and *P. aeruginosa* were the three most common pathogens isolated from general surgery. Isolates from obstetrics-gynecology surgery were *Pseudomonas aeruginosa* 7/33(21%), *Acinetobacter baumannii* 5/33(15%) and *Klebsiella pneumoniae* 4/33(12%).

The most common procedures performed in orthopedic unit were surgical debridement - external fixation 27/46(58.6%), open reduction-internal fixation 9/46(19.5%) and surgical debridement 6/46(13%). Laparotomy was the commonest procedure performed in general surgery accounting for 16/29(55.1%) followed by amputation 8/29(27.6%) while Caesarian section was the most common procedure in obstetrics-gynecology at 15/25(60%).

Table 3: Frequency of pathogenic bacterial isolates from post operative wound infections in various surgical specialties

Organisms	**General surgery n(%)**	**Obs-Gynacology n(%)**	**MOI (%)**
Staphylococcus aureus	1(2)	1(3)	16(23)
Escherichia coli	7(16)	3(9)	3(4)
Klebsiella peumoniae	7(16)	4(12)	5(7)
Proteus mirabilis	6(14)	2(6)	8(12)
P. aureginosa	7(16)	7(21)	10(14)
Acinetobacter spp	5(11)	5(15)	5(7)
GPC	5(11)	4(12)	6(9)
GNR	6(14)	7(21)	17(24)
Total	**44 (100)**	**33 (100)**	**70 (100)**

(GPC (Gram positive cocci) = CONS, *E.faecalis*) GNR (Gram negative rods) = *Citrobacter spp, Enterobacter spp, P.stuartii, M.morganii, P.vulgaris, Pseudomonas spp*

Table 4 shows the frequency of pathogenic bacterial isolates in relation to type of operation. The majority of the isolates were from surgical debridement and external fixation procedures accounting for 44/147(30%). Among these *S. aureus* was the most prevalent organism at 9/44(20%) isolates. Of note is the observation that *Pseudomonas aeruginosa* was the most common organism isolated from post caesarian section wounds at 4/17(24%). *Escherichia coli* and *Pseudomonas aeruginosa* were the most common isolates from post laparotomy wounds.

Table 4: Frequency of pathogenic bacterial isolates in relation to the type of operation

Organisms	C.section n n(%)	SD + EF n(%)	ORIF n(%)	Laparotomy n(%)	Amputation n n(%)	SD n(%)	Others n(%)
S. aureus	1(6)	9(20)	3(19)	1(3)	0	2(29)	2(20)
Escherichia coli	0	2(5)	0	8(23)	1 (6)	0	2(20)
Klebsiella peumoniae	2(12)	3(7)	1(6)	4(11)	2 (11)	2(29)	2(20)
Proteus mirabilis	1(6)	5(11)	1(6)	2(6)	4 (22)	2(29)	1(10)
P. aureginosa	4(24)	6(14)	3(19)	7(20)	3 (17)	0	1(10)
Acinetobacter spp	4(24)	4(9)	1(6)	3(9)	1 (6)	0	2(20)
GPC	2(12)	2(5)	3(19)	4(12)	3(17)	1(13)	0(0)
GNR	4(18)	13(30)	4(26)	4(18)	4(24)	0	0
Total	17(100)	44(100)	16(100)	35 (100)	18 (100)	7(100)	10(100)

Key: C. Section = Caesarean section; EF = External Fixation; SD = Surgical debridement; ORIF = Open reduction and internal fixation

Of the 18 *S. aureus* isolates from various wards, 8 (44.4%) were MRSA strains. Three (17%) isolates were carrying both MRSA and induced clindamycin resistance (ICR); while 37.5% of MRSA strains were carrying ICR. ESBL producing Enterobacteriaceae accounted for 79.3% of the isolates which were tested. Most (92.3%) of the 13 *Escherichia coli* isolates and 11/16 (69%) of the *Klebsiella pneumoniae* isolates were ESBLs producing strains (Figure 5).

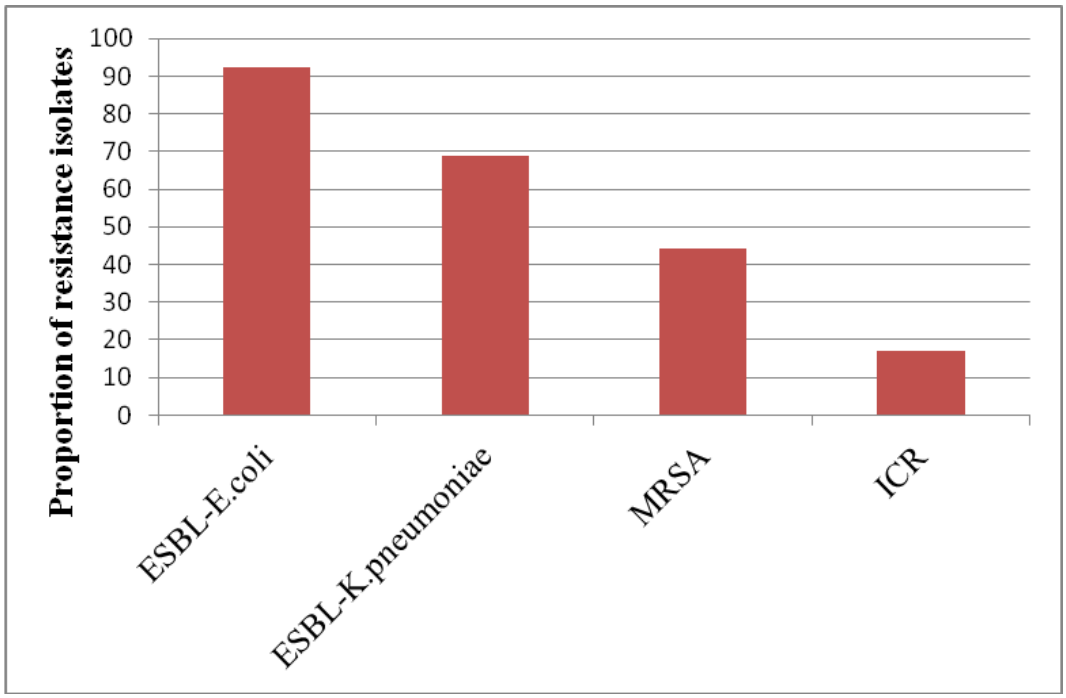

Figure 5: Characterization of bacterial isolates

Table 5 summarizes antimicrobial resistance patterns of gram positive bacterial isolates. Among the *S. aureus* isolates, majority were highly resistant to both Ampicillin (92%) and penicillin (83%); some had low to moderate resistance to gentamycin, ciprofloxacin, sulphamethoxazole/trimethoprim, oxacillin and erythromycin. All MRSA isolates were resistance to ceftriaxone, seventy five percent of these isolates were resistant to gentamycin, sulphamethaxazole/Trimethoprim and tetracycline while 87.5% were sensitive to clindamycin. CoNS isolates showed moderate resistance to a number of antibiotics tested including penicillin (67%), gentamycin (63%), erythromycin (57%), ampicillin (40%) and tetracycline (33%) but all were sensitive to vancomycin. Among *Enterococcus faecalis* isolates, majority were found to be highly resistant to erythromycin and ciprofloxacin respectively while 60% were resistant to gentamycin, tetracycline and vancomycin.

Table 5: Antimicrobial resistance patterns of gram positive bacterial isolates

Antibiotics	*S.aureus* (%)	MRSA (%)	CONS (%)
Gentamycin	33	75	63
Ceftriaxone	47*	100	50
Ciprofloxacin	29	57	50
Ampicillin	92		40*
Amoxy/clav	73		67*
Cotrimoxazole	35*	75	50
Chloramphenicol	20*	50	50*
Tetracycline	39	75	33
Penicillin	83		67
Cefoxitin	44		
Clindamycin	6	12.5	25
Oxacillin	44		33
Erythromycin	17	37.5	57

*Not all isolates were tested with respective antibiotics.

As summarized in Table 6 all Enterobacteriaceae isolates showed high resistance to multiple antimicrobial agents tested but all were highly sensitive to imipenem. Eighty eight percent of enteric gram negative rods were multi-drug resistance. All Gram negative organisms tested showed low to moderate resistance (20-56%) to ciprofloxacin. Most common Gram negative isolates from SSIs were found to be highly resistant to third generation cephalosporin's frequently used for surgical prophylaxis. Most (92%) of 24 *Pseudomonas aeruginosa* isolates were sensitive to both gentamycin and ciprofloxacin. Emerging *Acinetobacter baumannii* isolates were highly resistant to most antimicrobial agents tested in the study; however 60% of them appeared to be moderately sensitive to imipenem.

Table 6: Antimicrobial resistance patterns of gram negative bacterial isolates

Antibiotic	*E.coli* (%)	*K.pneumoniae* (%)	*P.mirabilis* (%)	GNR(%)	*P. aureginosa* (%)	*A. baumannii* (%)
Gn	92	67*	63	38	8	86
Ctr	92	81	69	83	88	100
Cip	58	56	56	47	8	71
Amp	100	94	73	90		100
A/Cl	92	94	87	83		100
Sxt	85	94	69	77		77
C	42	54*	69*	73		100
Tet	85	56	94	65		73
Ctx	92	88	100	76		100
Caz	92	88	67	57	21	86
Imp	0	0	0	0	0	40

*Not all isolates were tested with respective antibiotics. Gn-Gentamycin, Ctr-Ceftriaxone, Cip-ciprofloxacin, Amp-ampicillin, A/Cl-Amoxycillin/Clavulanic acid, Sxt-sulphamethoxazole/trimethoprim, C-chloramphenical, Tet- Tetracycline, Ctx-Cefotaxime, Caz- Ceftazidime, Imp-Impenem

Table 7 shows overall antimicrobial resistance pattern of SSI isolates. Both gram positive and gram negative bacteria showed high resistance rate to ampicillin and amoxicillin/clavulanic acid. All gram negative bacteria showed high level of resistance to majority of antibiotic tested in our study but were all sensitive to imipenem. Gram positive organism displayed moderate level of resistance to most antimicrobial agents tested.

Table 7: Resistance pattern of gram positive and gram negative bacteria isolates from SSI.

Antibiotics	Gram positive organisms (%)	Gram negative organisms (%)
Gentamycin	45	52
Ceftriaxone	48	87
Ciprofloxacin	45	45
Ampicillin	73	87
Penicillin	83	-
Amoxy/clav	73	87
Cotrimoxazole	39	80
Chloramphenicol	29	69
Tetracycline	41	72
Cefotaxime	48	89
Ceftazidime	-	61
Imipenem	-	0

As shown in Table 8 the majority of ESBLs-producing strains were found to be highly resistant to multiple antibiotics tested in the study. All ESBLs producing Enterobacteriaceae were found to be highly resistant to third generation cephalosporins (ceftriaxone, cefotaxime, ceftazidime), ampicillin and amoxicillin/clavulanic acid. Imipenem(carbapenems) was the only antimicrobial agent for ESBLs- producing strains infection with 100% sensitive.

Table 8: Antimicrobial resistance pattern of ESBLs-Enterobacteriaceae

Antibiotics	**ESBLs-*E.coli* (N=12) (%)**	**ESBLs-*K.pneumoniae* (N=11) (%)**
Gentamycin	92	82
Ceftriaxone	100	100
Ciprofloxacin	50	73
Ampicillin	100	100
Amoxy/clavul	92	100
Sulph/Trimethoprim	83	91
Chloramphenical	42	78
Tetracycline	83	64
Cefotaxime	100	100
Ceftazidime	100	100
Imipenem	0	0

Table 9 summarizes patient characteristics associated with harboring antimicrobial drug resistant pathogens. MRSA was more likely to be isolated from patients with antimicrobial exposure within one month and those with hospitalization history within six months than those with no such history. However, this difference was not statistically significant ($p>0.05$). Patients with previous exposure to third generation cepharosporin within one month were found to have high number of ESBLs bacteria isolates than those with no exposure and the difference was statistically significant ($p<0.05$). Exposure to fluoroquinolones, and hospitalization within 6 months were found to have increased isolation of ESBLs bacteria ($p>0.05$).

Table 9: Patient characteristics associated with harboring of antibiotic resistant pathogens

Patients characteristics	**MRSA N=8**	**OR (95%CI) P-value**
Previous antimicrobial exposure within 1 month	7	0.7 (0.0-69.6) 1
Previous Hospitalization within 6 months	6	0.3 (0.0-8.2) 0.5
	ESBLs bacteria N=23	
Previous exposure to cepharosporins	21	21 (1.5-327.2) 0.00
Previous exposure to fluoroquinolones	22	11 (0.4-677) 0.09
Diabetes mellitus	3	1.3 (0.0-21.2) 1
Previous hospitalization within 6 months	19	2.38 (0.1-24.4) 0.5

Figure 6 below depicts the pattern of surgical antimicrobial prophylaxis used at MNH and MOI. Surgical antimicrobial prophylaxis was administered to 91(91%) operations. Post operative, preoperative and intra operative prophylaxis was given to 49(53.8%), 37(40.7%) and 5(5.5%) patients respectively. Most commonly used antibiotics were ceftriaxone, metronidazole, gentamycin and ampicillin. The most commonly used regimen was either one third generation cephalosporin alone or combination with other antibiotics.

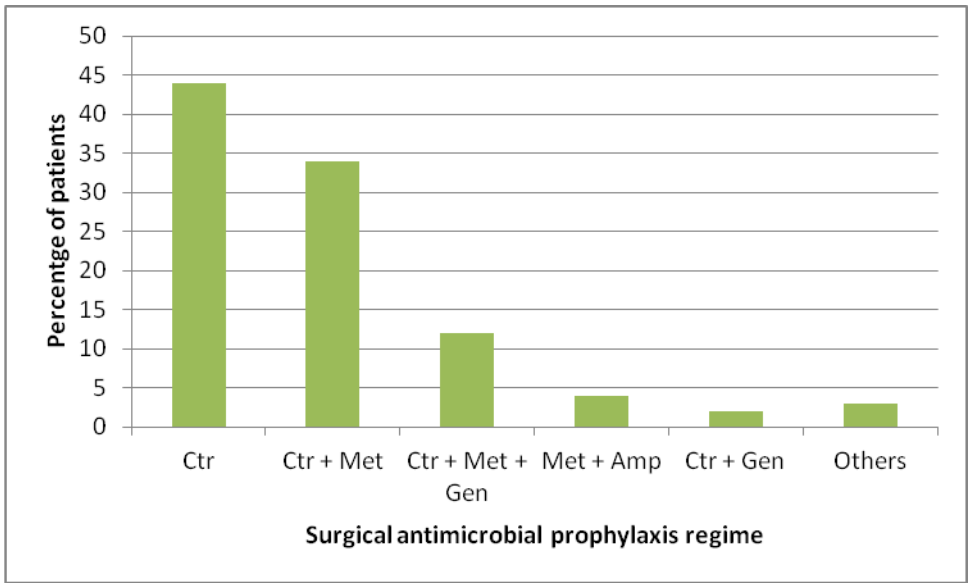

Figure 6: Pattern of surgical antimicrobial prophylaxis used

Ctr = Ceftriaxone, Met=Metronidazole, Gen=Gentamycin, Amp=Ampicillin

4.2 DISCUSSION

In the current study 147 bacterial isolates were investigated to determine their types and antimicrobial susceptibility pattern. Our finding demonstrates the predominance of gram negative bacterial isolates in SSIs, *Pseudomonas aeruginosa* being the commonest isolated organism followed by *S. aureus*, *Klebsiella pneumoniae*, *Proteus mirabilis* and *Acinetobacter baumannii*. This pattern of organisms causing SSIs in the current study is in contrast with previous studies from the same study setting and elsewhere within the region which reported *S.aureus* as the most common SSI bacterial pathogen (16, 18, 26). The possible reason for variation in these studies could be attributed to differences in the populations investigated; diversity of surgical procedures performed on the study participants, as well as timing of specimen collections. In the present study the majority of the isolates were obtained from patients who were already on antimicrobial treatment, and this could have led to the low recovery of antimicrobial susceptible Gram positive pathogens. This finding may demonstrates relative shift in aetiological agents causing SSIs, since recent studies from western Africa and Asia countries have reported increasing trend of *Pseudomonas aeruginosa* and other enteric Gram negative rods as the common organisms causing SSIs (9, 54) There are multiple factors that could have contributed to the high proportion of infections due to Gram negative pathogens in this study. A recent review has reported that hands of health care workers and patients can play a role in transfer of Gram negative bacteria during cross infection (55). During the present study (by observation) one nurse was responsible for dressing more than 15 surgical wounds per session, a situation that raises the risk of cross infection if aseptic procedures are not strictly adhered to.

Regarding the frequency of isolation of organisms in different surgical units in the present study, *S. aureus* was the most common isolates from orthopedic surgery while *Klebsiella pneumoniae* and *Escherichia coli* were among the most common isolates from general surgical wards. This observation is similar to findings from East central Africa by Bercion et al (25) who reported *S. aureus* as the most frequent species isolated in orthopedics unit followed by Enterobacteriaceae and *P. aureginosa*, while Anvikar et al from developing country (56)

documented that *Klebsiella pneumoniae* was the commonest bacteria isolated from general surgical wounds. These findings suggest that the aetiologic agents of SSIs depend on where the procedures are performed and whether skin was incised or gastrointestinal tract was opened. When gastrointestinal tract is opened, organisms usually include aerobic Gram negative rods. In the present study the majority of general surgery procedures involved colon operation, likely explaining the increased isolation of Enterobacteriaceae in surgical wards.

In this study, *Pseudomonas aeruginosa* was the commonest isolates from obstetrics-gynecology wards followed by *Acinetobacter baumannii*. This finding is in contrast to that from a the recent study in Bulgaria (57) which reported aerobic Gram positive including *S.aureus*, Enterococci and CoNS as the commonest organisms causing SSIs in obstetrics-gynecology wards. This difference could be attributed by differences in geographical locations and standards of hygiene, since these isolates from obstetrics-gynaecology ward are hospital environment normal flora probably explaining the nosocomial spread due to poor adhering of aseptic procedures.

In the present study anaerobic organisms were not isolated from culture, despite measures taken to recover such organisms from surgical wounds. The probable reasons could be delay in inoculation of the swabs into the fresh blood agar media; some patients received prophylactic metronidazole which kills anaerobes and the use of dry cotton wool swabs for specimen collection. A previous study has documented that use of dry swabs for collection of specimens could hinder the isolation of the anaerobes (58). Challenges in isolation of anaerobic bacteria were also reported in a study done for 5 years in the same hospital where the present study was carried out, whereby among 13,833 blood culture samples processed, 1,855 bacterial pathogens were isolated, none of which were anaerobes (59).

Our investigations found that majority of *S. aureus* isolates were highly resistant to ampicillin and penicillin. These findings concur with previous studies done in Tanzania and elsewhere in developing countries which also reported high resistance rates of *S. aureus* to ampicillin and

penicillin (14, 15, 17, 26, 27). These findings may be as result of injudicious use of these drugs in the study population leading to high selection pressure of resistant bacteria. Therefore the use of these drugs in our settings is questionable as they are still commonly prescribed, widely used since they are more affordable than other antibiotics. In contrast to previous data from the same study area (60), *S. aureus* displayed high rate of resistance to amoxicillin-clavulanic acid, a finding that discourage the current use of this antibiotic for the treatment of staphylococcal infections at the hospital. Resistance to erythromycin was observed in only 11% of *S. aureus* isolates, the observation which was lower than previous data from the same hospital (61). While the result should be interpreted with some caution since the number of isolates tested was small, erythromycin can still be used in non severe staphylococcal infections. Gentamycin resistance in *S. aureus* varies worldwide; moderate resistance was noted in our study, which was higher than that reported by Blomberg et al at Muhimbili National hospital (60). Increased use of gentamycin for surgical antimicrobial prophylaxis at this tertiary hospital could probably explain higher rate compared to previous data from the same hospital.

The current investigation documented high rate of methicillin resistance among *S. aureus*; 44.4% of *S. aureus* from SSI were MRSA. The findings that was relatively higher than that reported 13 years ago at the same hospital (2%) (61), and less higher than recently reported in Mwanza, Tanzania (18.8%) and elsewhere in the same region (31.5%) (16, 62). Even though, the results should be interpreted with great caution since confirmatory genotypic testing was not available, but the data support increasing trend of MRSA infection in the country and elsewhere within the region. Furthermore, most of these strains were found to be multiply resistant to commonly prescribed antibiotics but highly sensitive to clindamycin. These findings demonstrate the need of susceptibility testing in guiding the treatment of staphylococcal infections at this tertiary hospital. In addition, the current use of isoxazolyl penicillins, such as cloxacillin (by observation) in these infections should be discouraged. Clindamycin which has been considered as an alternative drug for the treatment of MRSA infections should also be used with some caution in our setting due to possibility of

clindamycin induced resistance. Since, we found an increasing trend of induced clindamycin resistance among MRSA strains as in contrast to previous data from same study setting (63). Even though, the finding should be interpreted with caution due to small number of strains isolated; but this underscore the need for active screening of these strains for prevention clindamycin treatment failure in patients with erythromycin exposure.

In this study gram negative bacteria displayed high rates of resistance to common prescribed inexpensive antibiotics such as ampicillin, sulphamethaxazole/Trimethoprim, Tetracycline and amoxicillin/clavulanic acid, this findings are in consistent with previous studies from the same hospital (59, 61) and elsewhere within the region (26). This high rate of resistance could be attributed due to the fact that, this least priced antibiotics are easy to administer, relatively cheap and widely prescribed in empirical treatment of various bacterial infections in the study setting. Therefore use of these drugs in treatment of surgical site infections should be closely monitored for clinical response and be guided by microbiological testing. The high level of resistance to amoxicillin/clavulanic acid in this study is relatively higher than previous data from the same study area (64, 65). Injudicious use of this antibiotic at this tertiary facility probably can explain the increasing trend of resistance, as unpublished data suggest it's among most prescribed antibiotic at the hospital. This data suggest that beta-lactam/beta-lactamase inhibitor combination may not be useful for empirical treatment of gram negative bacteria SSI in our setting. Resistance rate to sulphamethaxazole/Trimethoprim (cotrimoxazole) in gram negative bacteria was 82%, which was relatively higher than that reported 3 years (25%) and 2 years (50%) ago at the same hospital (59, 64). These findings demonstrate an increasing trend of resistance to cotrimoxazole at MNH. Wide use of this drug in our setting and in this era of Human Immunodeficiency Virus-Aids may probably explain for the increasing rate of resistance to this antibiotic.

Moderate resistance to ciprofloxacin in Enterobacteriaceae was observed in this study, findings which was higher than those of previous data from the same study area and elsewhere (19, 59, 60). This may be due to increased prescription of this type antibiotic in our settings.

It's well recognized that increased use of ciprofloxacin over the last decade has led to progressive loss of susceptibility, particularly to gram negative bacteria (66). Resistance to ciprofloxacin is an early warning sign since fluoroquinolones are effective agents for treatment gram negative bacterial infections especially in sulphamethaxazole/Trimethoprim resistance.

Resistance to third generation cephalosporins in gram negative bacteria in the current study was very high. This observation was in contrast to a number of previous studies from the same hospital and other countries (27, 61, 64). It is alarming to note that the resistance to third generation cephalosporins appears to have highly increased compared to the previous study from the same hospital (59, 61). A possible explanation for the high resistance could be due to presence of ESBLs production in these strains and increased inappropriate prescription of ceftriaxone for surgical antimicrobial prophylaxis at this tertiary hospital. As unpublished data from MNH pharmacy documented ceftriaxone as the most common prescribed injectable antibiotics, with more than 470 prescriptions per month in general surgical ward alone. Furthermore in this study majority of patients received ceftriaxone prophylaxis for prevention of surgical site infections probably may have hampered detection of ceftriaxone susceptible gram negative bacteria.

ESBLs phenotype was found in 92.3% and 69% of *Escherichia coli* and *Klebsiella pneumoniae* isolates respectively. These findings are much higher than that reported 10 years ago at the same hospital with 25% and 17% of *Escherichia coli* and *Klebsiella pneumoniae* respectively producing ESBL (67). But relatively higher than that reported 2 years ago at the same setting with *Escherichia coli* 39.1% and *Klebsiella pneumoniae* 51.5% of isolates from urinary tract infections carrying the ESBL (65). This finding demonstrates increasing of these strains in Tanzania as documented with recent study at Bugando hospital in Mwanza which also found high rate of this strains (16). The possible explanation for the increase of this strain could be attributed to rampant injudicious use of antibiotics in developing countries including Tanzania, leading to emergence of drug resistant strains as a consequence of drug pressure. These findings imply the increasing trend of ESBL producing strains at this tertiary hospital and underscore the need for routine screening ESBL production in clinical isolates. Since the

spread of this strains has grave implication and its treatment remains difficult challenge in our settings.

Consistent with observation from previous studies at MNH (65, 67), ESBL producing strains displayed high rates of resistance to most antibiotics tested in this study. Mechanism of co-resistance in gram negative bacteria harboring ESBLs are not clear but one possible mechanism is the co-transmission of the ESBLs and resistance to other antimicrobials within the same conjugate plasmids (68). The association probably explaining ESBLs producing gram negative bacilli are resistant to multiple other antibiotics classes in addition to oxyimino-β lactams antibiotic.

Most of the *Pseudomonas aeruginosa* strains isolated were highly sensitive to gentamycin, ciprofloxacin and ceftazidime. These findings are in agreement with those from the same hospital (60) and elsewhere (19). This data demonstrate that these groups of drugs can still be recommended for the treatment of Pseudomonas in SSIs. All *Pseudomonas aeruginosa* in this study were sensitive to carbapenems. This finding is in line with previous report from MNH (60). But, recent report from the same hospital has indicated higher carbapenems resistance by metallo beta lactamase production (69), therefore finding from this study should be interpreted with caution since no molecular testing was done for further characterization of *Pseudomonas aeruginosa*.

All *Acinetobacter baumannii* isolates in our study were highly resistant to majority of antimicrobial agents tested, a finding that concur with previous data from the same study setting (70) which documented that *Acinetobacter baumannii* isolates displayed high rates of resistance to common inexpensive antibiotics. *Acinetobacter baumannii* showed significant high resistance to ceftazime, ciprofloxacin and gentamycin. These findings were relatively higher that reported 10 years ago at same hospital by Blomberg et al (60). This implies an increase in spreading of multi drug resistant *Acinetobacter baumannii* strains in our setting. Underscoring the need of microbiological testing to identify this strain and prevent further

spread. Our finding documented that 40% of *Acinetobacter baumannii* were resistance to carbapenems, showing 40% increasing in rate of resistance from previous data from the same setting (60). This demonstrates the threat we face particularly with problematic multiply drug resistant pathogens like *Acinetobacter baumannii* strains.

This study attempted to describe patient's characteristics associated with harboring antimicrobial resistant pathogens such as previous antimicrobial exposure, previous hospitalization and diabetes mellitus. In the present study previous antimicrobial exposure within one month and hospitalizations within six months were not associated with harboring of MRSA. These findings differ from those of a previous study which reported association between previous antimicrobial exposure and hospitalization with isolation of MRSA (40, 41). Lack of association in the present study could partly be attributed to the small number (8) of MRSA isolates in the study and difference in the study design. The present study found previous cephalosporin exposure as being associated with harboring ESBLs producing *Escherichia coli* and *Klebsiella pneumoniae* $P<0.05$ an observation which is similar to that reported in an earlier study in a developing country (46). The frequent inappropriate exposure to antibiotics which is common in Tanzania may possibly explain this observation.

In the present study we found that majority of patients received surgical antimicrobial prophylaxis postoperatively and antibiotics were continued for more than five days. Current guidelines for surgical antimicrobial prophylaxis to prevent SSIs recommend that the antimicrobial agent be administered immediately prior to surgery and discontinued soon after surgery (1). Inappropriate administration of antimicrobial agents to patients who do not need them will promote the emergence of resistant pathogens. In this study we found high rate of antimicrobial drug resistance, raising concern that the antimicrobials commonly used in surgical patients may possibly be ineffective in preventing SSIs. Most of the patients received third generation cephalosporin alone or in combination with gentamycin or metronidazole. This combination could not be effective against multi-resistant Gram negative organisms. Ceftriaxone was the most commonly used agent for surgical antimicrobial prophylaxis at

Muhimbili but was found to be ineffective against common wound pathogens like *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Escherichia coli*, MRSA and other Gram negative rods. This emphasizes the need of using antibiogram pattern to guide choice of antibiotics.

CHAPTER 5

5.0 CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

There was predominance of Gram negative bacilli from SSIs, with *Pseudomonas aeruginosa* being the most common isolates. We found most of the Gram negative isolates were multiply resistant to commonly prescribed antimicrobial agents. The present study also found an increase in SSIs due to ESBLs producing *Esherichia coli* and *Klebsiella pneumoniae* strains as well as MRSA. Ceftriaxone, a third generation cephalosporins commonly used for antimicrobial prophylaxis to prevent SSIs was found to be ineffective against most of gram negative organisms and MRSA isolates.

5.2 RECOMMENDATIONS

From the study findings it is recommended to:

a. Perform routine culture whenever SSIs is suspected; use antimicrobial sensitivity (including MRSA and ESBL screening) test results to guide choice of antibiotics.
b. Ciprofloxacin should replace first line antibiotics for empirical treatment of SSIs.
c. Establish strict guidelines for antibiotics prescriptions in treatment of SSIs.
d. Conduct large study to to isolate large number of isolates including anaerobic bacteria, establish the magnitude of SSIs due to antimicrobial resistant pathogens and identifying relevant gene responsible for antibiotics resistance.
e. Conduct further study on characterization of *Pseudomonas aeruginosa* isolates, including determining mechanism of resistance like metallo beta lactamase (MDL) production.
f. Limit the use of ceftriaxone a third generation cephalosporin in surgical prophylaxis.
g. Review guidelines for surgical antimicrobial prophylaxis at MOI and MNH.
h. Establish continuous surveillance to monitor antimicrobial susceptibility pattern of the common isolates found in SSI.

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APPENDIX NO 1

Informed consent Form

ID No……

Consent to participate in the study on Bacteriological spectrum of post operative wound infections and their antibiogram at Muhimbili National Hospital and Muhimbili Orthopedics institute

Greetings! My name is Dr Joel Manyahi, I am a postgraduate students at MUHAS, investigating on Bacteriological spectrum of post operative wound infections and their antibiogram at Muhimbili National Hospital and Muhimbili Orthopedics institute.

Purpose of the study: To determine the spectrum of bacterial isolates from postoperative wound infections and their antimicrobial susceptibility patterns at MNH and MOI

What Participation Involves:

If you agree to join the study, you will be interviewed using questionnaire, detailed information on social demographic characteristics, past medical history and physical examination will be requested. A pus swab will be taken from the site of surgical incision.

Confidentiality:

All information collected on questionnaires will be entered into computer with identification number. The questionnaires will be handled with greater secrecy in order to maintain confidentiality

Risks:

We do not expect that any harm will happen to you because of joining this study. Sometimes, a minimal pain may occur during swabs taking.

Purpose of the study:

Taking part in this study is completely your choice. If you choose not to participate in the study or if you decide to stop participating in the study you will continue to receive all services that you would normally get from this hospital. You can stop participating in this study at any time, even if you have already given your consent. Refusal to participate or withdrawal from the study will not involve penalty or loss of any benefits to which you are otherwise entitled.

Benefits:

If you agree to take part in this study, will benefit by knowing the result of culture and sensitivity pattern of a collected specimen, and whenever there are culture positive results appropriate medications will be prescribed and you will be advised accordingly

Cost:

No payment will be requested from you as a fee to participate in the study

In Case of Injury:

We do not anticipate that any harm will occur to you or your child as a result of participation in this study. However, if any physical injury resulting from participation in this research should occur, we will provide you or your child with medical treatment according to the current standard of care in Tanzania

Who to Contact:

If you ever have questions about this study, you should contact the study Principal Investigator Dr Joel Manyahi, Muhimbili University of Health and Allied Sciences, P.O.Box 65001, Dar es Salaam). If you ever have questions about your rights as a participant, you may call Prof. M. Aboud, Chairman of the Senate Research and Publications Committee, P.O. Box 65001, Dar es Salaam. Tel: 2150302-6.

Signature:

Do you agree?

Participant agrees …… Participant does NOT agree ……..

I, _____ have read the contents in this form. My questions have been answered. I agree to participate in this study with my child.

Signature of participant _____

Signature of witness (if mother/caretaker cannot read) _____

Signature of research assistant _____

Date of signed consent _____

KIAMBATISHO NO 1

Fomu ya ridhaa

ID No ... ...

Ridhaa ya kushiriki katika utafiti juu ya maambukizi ya vimelea katika vidonda vya operesheni katika Hospitali ya Taifa ya Muhimbili na taasisi ya mifupa ya Muhimbili.

Salamu! Jina langu ni Dk Joel Manyahi, mwanafunzi wa Uzamili katika Chuo kikuu cha sayansi za afya Muhimbili (MUHAS. Nafanya uchunguzi juu ya maambukizi ya vimelea katika vidonda vya operesheni katika Hospitali ya Taifa ya Muhimbili na taasisi ya mifupa Muhimbili.

Madhumuni ya utafiti: Kujua aina ya bakteria wanaosababisha maambukizo katika vidonda vya operesheni

Jinsi ya kushiriki:
Kama utakubali kushiriki, nitakuoji maswali machache kuhusu matatizo haya na nitaomba kutoa sampuli ya usaha kwa ajili ya uchunguzi zaidi.

Utunzaji siri:
Taarifa zote zitakazokusanywa zitatuzwa kwa siri kwa kutumia herufi na nanbari badala ya jina la mgonjwa.

Madhara/athari:
Hatutarajii kutakuwa na madhara yoyote yanayotegemewa kutokana na utafiti huu. Wakati mwingine maumivu kidogo yanaweza kutokea wakati wa kuchukua sampuli.
Uhuru wa kushiriki:

Kushiriki katika utafiti huu ni hiari yako. Kama utachagua kutokushiriki katika utafiti utaendelea kupokea huduma zote kama kawaida kutoka hospitali hii. Unaweza kuacha kushiriki katika utafiti huu wakati wowote, hata kama baada ya kutoa idhini yako.

Faida za utafiti:

Kama utashiriki katika utafiti huu mahambukizo ya vidonda vya operesheni yatachunguzwa na kama kutakuwa na mahambukizi matibabu stahili utapatiwa, na utapatiwa ushauri itakapotakiwa kufanya hivyo.

Gharama:

Hakuna malipo kutoka kwenu kama ada ya kushiriki katika utafiti huu.

Taarifa/Mawasiliano:

Endapo utahitaji kupata maelezo zaidi au taarifa yeyote kuhusu utafiti huu,wasiliana na Dk Joel Manyahi, Chuo Kikuu cha Afya na Sayansi za tiba, SLP 65,001, Dar es Salaam. Kama utakuwa na maswali kuhusu haki yako kama mshiriki, unaweza wasiliana na Prof M. Aboud, Mwenyekiti wa Utafiti , SLP 65,001, Dar es Salaam. Tel: 2,150,302-6.

Sahihi:

Je, unakubali kushiriki kwenye utafiti?

Ndiyo... ... ... Hapana ... ...

Mimi _____ nimeelezwa na nimesoma yaliyomo katika fomu hii. maswali yangu yamejibwa .

Nimekubali kushiriki katika utafiti huu.

Sahihi ya mshiriki/mlezi _____

Sahihi ya ushahidi (kama mama / mlezi hajui kusoma) _____

Sahihi ya mtafiti _____

Tarehe ya ridhaa _____

APPENDIX NO 2

QUESTIONAIRE

TITLE: BACTERIOLOGICAL SPECTRUM OF POST OPERATIVE WOUND INFECTIONS AND THEIR ANTIBIOGRAM AT MUHIMBILI NATIONAL HOSPITAL AND MUHIMBILI ORTHOPEDICS INSTITUTE

Most of the information's were extracted from patients clinical case notes (patients' files)

*Indicates information's gathered directly from the patients

Serial number……..

Date of interview …….Registration number ……

1. Surgical department in which patient admitted or attending (a) General & pediatrics surgery (b) gynecology/obstetrics (c) orthopedics /trauma

2. Age…….. 3. Sex……...

4. Address……

5. Date of Admission……....

6. Date of surgery…….7.Date of discharge……

8. Preoperative hospital stay: 1) <= 3 days 2) 4-7 days 3) More than 7 days

11. Presenting complains: (1) Pain or swelling at the operation site (2) Gaping at the operation

Site (3) Discharge from surgical site *

12. Past medical history (1) DM (2) Prolonged Streroid usage (3) Hypertension (4) boils

13. Past medical history of hospital admission (1) Yes (2) No *

14. If yes, how many times (1) Once (2) Twice (3) Thrice (4) More than three *

15. Last admission was (1) Within 6 months (2) Within a year (3) More than one year ago.

16. History of previous use of antibiotics within one month (1) Yes (2) No

17. If yes, what type of antibiotics (1) Gentamycin (2) Ceftriaxone (3) Ciprofloxacin (4) Metronidazole (5) Others

18. For how long have been in such antibiotics (1) <=7 days (2) 8-15 days (3)

20. Family social history (1) H/o Smoking (2) H/o Alcoholic *

21. Preoperative diagnosis (1) Open fracture (2) Closed fracture (3) Obstructed labor (4) Peritonitis (5) Diabetic foot (6) Others

22. Surgical procedure performed (1) Caesarian section (2) Surgical debridement and External fixation (3) ORIF (4) Laparatomy (5) TAH (6) Amputation (7) Surgical debridement (8) Others

23. Type of surgery: (1) Clean surgery (2) Clean contaminated surgery (3) Contaminated surgery (4) Dirty surgery

24. Nature of surgery (1) Emergency surgery (2) Elective surgery

25. Preoperative hair removal (1) Previous night before surgery (2) Morning of surgery

26. Timing of surgical antimicrobial prophylaxis (1) Before the operation (2) During operation (3) After operation (4) Not initiated at all.

27. Type of surgical antibiotic prophylaxis given (1) Ceftriaxone (2) Gentamycin (3) Metronidazole (4) Others

28. Duration of operation in minutes (1) 0-60 (2) 61-120 (3) >120

Laboratory results

29. WBC/pus cell seen from G/stain ……..

30. Organisms isolated (1) ……..

2) ……..

3) ……

31. Sensitivity pattern of isolated organisms

1…….

Drugs														
Diameter														
Interpretation														

2…….....

Drugs													
Diameter													
Interpretation													

3…….

Drugs												
Diameter												
Interpretation												

4……

Drugs												
Diameter												
Interpretation												