



St. Paul Hospital Millennium Medical College Graduate Study Program

Patterns of Microbial Sensitivity in Patient with Open Fracture Admitted to Trauma Center in Central Ethiopia

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Addis Ababa, Ethiopia

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Patterns of Microbial Sensitivity in Patient with Open Fracture with Sign of Infection Admitted to Trauma Center in Central Ethiopia from September 1/2019 to August 31/2021GC

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Abstract

Introduction: An open fracture, also called a compound fracture, is a fracture in which there is an open wound or break in the skin near the site of the broken bone. Fractures that are exposed to environmental contamination through disruption of the soft tissue envelope have been shown to have increased risks of infection, delayed union, nonunion, and even limb amputation. For this reason, early treatment for an open fracture focuses on preventing infection at the site of the injury.

Objectives: To assess pattern of microbial sensitivity in patient with open fracture admitted to AaBET hospital.

Methods: Descriptive cross sectional study was conducted by retrospective medical record review of the patients with open fracture as well as chart documents of the patients with open fracture admitted in AaBET hospital for the last two years (From September 1/2019 to August 2021). All data of patients with open fracture was retrieved and patients who had culture and sensitivity test were assessed for microbial sensitivity pattern. The necessary clinical data were collected mainly from ward logbook and from the charts of the patients with open fracture. Data entry and analysis was done using SPSS. Descriptive method of data analysis like mean, median and frequency distribution was utilized to discuss the results.

Result: A total of thirty-eight open fracture patients who have culture and sensitivity were enrolled in the present study between September 1/2019 to August 31/2021GC. RTA was the major cause of open fractures. Most of the fractures (34.2%) occurred in tibia. Majority of the fractures (63.2%) were grade I&II according to modified G-A classification of open fractures. Poly-microbial was the dominant isolate (39.5%) followed by S.aures(28.9). Ceftriaxon, metronidazole and gentamycine were the commonly prescribed drug and ceftriaxone in combination with metronidazole was frequently used(36.8%). Of the total 38 cases, only 18.4% of the patient were sensitive for three or more commonly used antibiotics and 100% of the case were resistant for three or more commonly used antibiotics.

Conclusion and recommendation: Efforts must be done to decrease occurrence of infection in a patient with open fracture and implementation of the institutional protocol for antibiotics for open fracture that will constantly updated based on trend of bacterial isolate profile and their suscepibility patterns. The government to put in place policies aimed at curtailing injudicious acquisition and use of antibiotics in the country. Larger prospective studies will have paramount importance to formulate national guideline for antibiotics use in open fracture.

Keywords: Open fracture, microbial isolate, antibiotics susceptibility

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Acronyms and Abbreviations

AaBET: Addis Ababa Burn Emergency and Trauma

AIDS: Acquired Immuno Deficiency Syndrome

DM: Diabetes Meletus

ED: Emergency Department

ER: Emergency Room

ESOT: Ethiopian Society of Orthopaedics and Traumatology

FDA: Falling down accident

GA: Gustillo Anderson

G.C: Gregorian calendar

HIV: Human Immunodeficiency Virus

ICU: Intensive Care Unit

IMN: Intra Medullary Nail

IRB: Institutional Review Board

MRN: Medical Record Number

MSK: Musculoskeletal

MVA: Motor Vehicle Accident

OPD: Outpatient Department

OR: Operation Room

ORIF: Open Reduction and Internal Fixation

PACU: Post Anesthesia Care Unit

PI: Principal Investigator

RTA: Road Traffic Accident

RTI: Road Traffic Injury

SPHMMC: St Paul`s Hospital Millennium Medical College

SPSS: Statistical Package for Social Sciences

WHO: World Health Organization

1.Introduction

1.1 Background

The global burden of injury is staggering, and injuries are predicted to be a leading cause of death and disability over the next few decades. In 2001, injuries in developing countries accounted for 11% of the world's disease burden, and ranked 11th in all causes for both mortality and morbidity. It also is estimated that in the developing countries 6 million will die and 60 million will be injured or disabled in the next 10 years. With fractures accounting for the majority of trauma in developing nations, novel therapies are desperately needed to optimize patient outcomes.(1,2)

Road traffic injuries (RTIs) are responsible for a substantial proportion of deaths and injuries and are responsible for more years of life lost than most human diseases. Although the numbers of lives lost in road crashes in high-income countries indicate a downward trend in recent decades, for most of the world's population, the burden of road-traffic injury in terms of societal and economic costs is rising substantially.(3,4)

Open fractures, also known as compound fractures, are one of the consequences of trauma. In such cases, the fracture segments communicate with the contaminated environment through skin and adjacent soft tissues, no matter how small the soft tissue lesion. The open fracture may be an isolated injury or can occur together with a series of multiple wounds and is usually associated with a large number of comorbidities. It is estimated that the incidence of open fractures of long bones is 11.5 cases per 100,000 people per annum. Open fractures are more common in men and have a bimodal age distribution, with the tibia being the most affected bone. The presence of an open fracture results in a range of clinical situations, among which the most common and most serious complication is infection. The prevalence of infection is closely related to the severity of the patient's fracture, that is, according to the classification by Gustilo and Anderson, the higher the lesion type, the greater the likelihood of infection.(4,5)

About 60-70% of contamination of the compound fractures occur at the time of injury. Bacteria originate both from the skin and outside environment. In some cases, the organism

is not present at the time of injury and the wound becomes infected later. The dynamics of bacterial population in soft tissue wounds and bone differ greatly over time. The primary goal in the management of compound fracture is the prevention of infection of the bone and soft tissue. To achieve this goal the most widely accepted treatment protocols include early surgical debridement, irrigation of open wounds, administration of broad spectrum antibiotics and stabilization of fractures.(6) The prevalence of infection is closely related to the severity of the patient's fracture, that is, according to the classification by Gustilo and Anderson, the higher the lesion type, the greater the likelihood of infection.(7,8)

Antibiotics are adjuncts in the management of open fractures, and microbial characteristic of open fractures will guide the use of antibiotics. With changing pattern in microbial colonization of wounds, the need to review antibiotic usage in hospitals becomes imperative. The choice of antibiotics in the treatment of open fractures as an adjunct to debridement and wound care is determined by established microbial characteristics of open fractures in the locality or empirically using combination therapy to cover most of the available organisms such as Gram-positive and Gram-negative aerobes as well as the anaerobes. The choice of antibiotics in the treatment of infections is determined by the type of potential bacterial contaminants.(9–11) Many guidelines have been developed with the aim of reducing these infections.(12,13)

It is important that in the setting of compound fracture, antibiotics should not be considered as prophylactic. As infection commonly occurs in compound fractures not treated with antibiotics, their administration should better be viewed as therapeutic and post-debridement cultures are important in formulating an antibiotic policy to be started in patients of compound fractures as soon as possible.(6)

1.2 Statement of the Problem

Traumatic pathologies have an increasing incidence both in diagnoses and hospital admissions, due to the increase in violence and car accidents. As a consequence, there is an increase in emergency expenses, which is usually more onerous than most conventional procedures.(4) Open fractures, also known as compound fractures, are one of the consequences of trauma. The presence of an open fracture results in a range of clinical situations, among which the most common and most serious complication is infection. Sixty to seventy percent contaminations is believed to occur at the time of injury.(14) Antibiotics are an important adjunct to the management of open fractures and should be initiated as soon as possible. Gram positive coverage is recommended for type I and type II fractures. Broader antimicrobial coverage is recommended for type III fractures.(4,12)

The constantly changing local wound ecology and sampling variations led to the proposition of different ideas by different authors in the orthopedic literature. Based on the types of organisms causing infection compared with those seen on early wound cultures, several authors have proposed that many infections of open fracture wounds are nosocomial. Wound infecting pathogens differ from country to country and from one hospital to another within the same country due to the difference in bacterial prevalence in different environments. Therefore, bacteria that infect open fracture wounds and antimicrobial therapy used vary from hospital to hospital (14).

In Ethiopia, there are only few studies about bacteriology of open fracture and its sensitivity pattern which are inadequate to develop national guideline for antibiotics choice to treat open fracture. Therefore, this research is undertaken to determine the bacterial etiology and their antimicrobial sensitivity pattern in a patient who were admitted at AaBET hospital with a diagnosis of open fracture and who undergoes culture and sensitivity test and this research is expected to be a bench mark for nation wide study and to design local and/or national guideline for antimicrobial choice for open fracture.

1.3 Rationale of the Study

In open fracture sixty to seventy percent contaminations is believed to occur at the time of injury. (14) The rate is two to three times higher in developing countries than the developed ones. (16) In Ethiopia, a high incidence of open fracture wound infection is suspected though the magnitude of the problem is not known. (17) To help physician's choice of appropriate antimicrobials, up-to-date information on local prevailing strains (pathogens) and their drug sensitivity pattern is very crucial to treat patients. (18) In Ethiopia there is no documented report on bacterial isolates from open fracture wounds and their drug resistance pattern. Therefore, this study will be undertaken to determine the bacterial etiologies of open fracture wound infection and their antimicrobial susceptibility pattern in AaBET hospital, which is one of trauma and teaching hospital giving service for patients referred from different parts of the country. Among these trauma patients, open fractures constitute about 56.5% and department of orthopedics and traumatology needs to know pattern of microbial sensitivity in a patient with open fracture to device local as well as national guideline on antibiotic selection. This information will be particularly useful in our environment where availability of resources to do culture and sensitivity for each individual patient.

2. Literature Review

The administration of antibiotics is now generally accepted as a prophylactic treatment of infection in compound fractures. Nevertheless the question is not completely resolved and many problems are still to be discussed. The efficacy of antibiotic therapy in this field has just been recently demonstrated ; with the animals by Worlock et al. in 1988GC using an experimental rabbit model, and clinically by Braul et al. in 1987GC which randomized 87 patients with open fractures to receive either cloxacillin or placebo. The rate of infection was significantly lower in the antibiotic group. No reports comparing various antimicrobial drugs draw effective conclusions regarding the choice of antibiotics. In the same way it seems that the time of interval from injury to antibiotic administration was not associated with a significantly different incidence of infection. The study of duration of the treatment was perfectly conducted by Dellinger. In his prospective trial 248 patients received different doses of the same antibiotic, from a single dose to four doses daily during 5 days. In conclusion he found no relation between the duration of the treatment and the risk of infection. A semantic but very important question concerns the reality of a preventive action of antibiotics against infection in open fractures. In order to answer, it is necessary to assess the incidence of contamination, its nature and its density. (10)

According to papers reporting the results of early cultures of the fracture wound, bacterial contamination was present in 30-70% of the cases. But the bacteria most commonly isolated were members of the normal skin flora (*Staphylococcus epidermidis*, *Propionibacterium acnes*, *Corynebacterium* sp. *Micrococcus*) or environmental contaminants which infrequently were the cause of infection. The specimens taken from patients who have an infection show mostly hospital acquired bacteria as *Staphylococcus aureus* or *Pseudomonas aeruginosa*. These findings emphasize the risk of colonization of the wound by nosocomial bacteria. In addition, it seems that the density of contamination may also be a determinant of subsequent clinical infection. Quantitative bacterial counts suggest a greater risk of infection when microorganisms were present in high number more than 10⁵ colony forming unit per g. of tissue. In conclusion, the prophylactic action of antibiotics against infection in open fractures is well established, but many points are still subject to discussion and need further study. Furthermore antibiotics prophylaxis is only a complement to surgical treatment, debridement and immobilization,

which remains of paramount importance.(10)

Shankara et al. did study in 2017 to know the pattern of bacterial isolates in compound fractures. Forty patients were taken into study of all ages, both sexes with compound fractures of upper and lower extremity were admitted and treated over a period of 2 years and the fracture were classified according to Gustilo Anderson classification. Primarily wound was examined and classified with 1st culture swab taken at that time followed by 2nd culture swab on 1st dressing and 3rd culture swab if infection continues further. Culture and sensitivity reports were collected for studying pattern of bacterial isolate and their sensitivity. They found that presence of growth of organism was found in 20 patients (50%) for whom predebridement culture was done. Out of the positive 20 patients, 13 (65%) were found to have Gram-positive bacterial growth. Coagulase negative *Staphylococcus aureus* was the most common Gram-positive bacteria isolated. Gram-negative bacteria were found in 7 (35%), which showed different isolates occurring in same number. Post debridement cultures showed growth in 14 (35%), patients with no growth in 26 patients. Out of the 14 patients, Gram-positive bacteria were isolated in 7 (50%) patients and Gram-negative in rest 7 (50%). Coagulase-negative *S. aureus* was the most common Gram-positive bacteria isolated with *Acinetobacter calcoaceticus baumannii* complex as the most common Gram-negative bacteria. Finally, they concluded that pre-debridement cultures are of no importance and post-debridement cultures are important in formulating an antibiotic regime.(6)

A retrospective study done by Jackson Lee on two hundred forty five patients with open fracture to assess efficacy of cultures in the management of open fractures. predebridement cultures were available for 225 patients. The study showed that one hundred six of these cultures were negative, and 119 were positive, of which 60 grew a single organism and 59 grew several species of bacteria. Only 8% of the organisms grown on predebridement cultures eventually caused infection. A negative predebridement culture did not preclude infection, because 7% of these fracture wounds became infected. Of those open fracture wounds that did become infected, a pre-debridement culture grew the eventual infecting organism only 22% of the time.(19)

A meta analysis done by Juergen et al in 2017 on duration of administration of antibiotic agents

for open fractures showed that estimate of infection rate favored less than a 72-hour duration of antibiotic treatment, because prolongation of antibiotic treatment more than 72 hours did not seem to offer any protective effect against septic complications of open fractures (odds ratio: 0.85, 95% confidence interval [CI]: 0.60–1.21). In Gustilo I and II open fractures, the calculated pooled estimate of infection rate did not differ significantly when antibiotic treatment exceeded 72 hours (6%, 95% CI: 3.3%–9%) compared with shorter (up to 72 h) antibiotic protocols (4%, 95% CI: 1.8%–7%) ($p=0.52$). In Gustilo III open fractures also, the calculated pooled estimate of infection rate (21.3%, 95% CI: 13%–31%) when duration of antibiotic treatment was more than 72 hours did not differ significantly compared with a shorter (less than 72 h) antibiotic treatment (17.7%, 95% CI: 12.5%–23.5%) ($p=0.39$). A further subgroup analysis indicated that even shorter antibiotic regimes (24–48 h) were also equivalent to prolonged regimes of more than 72 hours in terms of infection rates.(9)

Aamal Ghaz et al from Iraq determined to assess the prevalence of the gram positive and gram negative bacteria in open fractures and their resistance profiles to antimicrobial agents. A total of 150 superficial swabs were collected from patients who clinically diagnosed to have open fractures in private fractures clinics in Al-Diwaniya city/ Iraq in a period from January to December 2016. From this study a total of 119 bacterial isolates were gotten from culture positive fracture wounds. The predominant species was *Staphylococcus aureus* (23.52%) followed by *Acinetobacter* species (19.32%). The other identified bacterial species were: *E.coli* (14.28%), *Pseudomonas* spp (11.76%), *Enterobacter* spp (9.24%), *Klebsiella* spp (6.72%), Coagulase Negative *Staphylococci* (5.04%), *Citrobacter* spp (4.20%), *Proteus* spp (2.52%), *Diphtheroids* (0.84%), *Streptococcus pyogenes* (0.84%), *Viridans streptococci* (0.84%), *Micrococcus* spp (0.84%).(20)

In this particular study, the antibiotics resistant profiles of the identified gram positive species tested for 10 types of commonly used antimicrobial agents showed that (92.8 %) of *S. aureus* isolates were resistant to ampicillin, (58.2%) to amoxicillin, (46.5%) to ciprofloxacin and tetracycline, (28.5%) to each of amoxicillin clavulanic acid, chloramphenicol, gentamycin, and norfloxacin, (14.3%) to ceftriaxone, and (10.8%) to trimethoprim-sulphamethoxazol. The average resistance rate of *S. aureus* was (38.31%) to most of antibiotics tested. *Diphtheroids* isolates revealed (100%) resistance to amoxicillin clavulanic acid, gentamycin,

amoxicillin, tetracycline, trimethoprim sulphamethoxazol, ceftriaxone, and norfloxacin, while no resistance to ampicillin, chloramphenicol, and ciprofloxacin. *Streptococcus pyogenes* isolates were (100%) resistant to ampicillin, trimethoprim-sulphamethoxazol, ceftriaxone, and norfloxacin, while they were (100%) sensitive to amoxicillin clavulanic acid, chloramphenicol, gentamycin, amoxicillin, and tetracycline. Viridans streptococci isolates were (100%) resistant to ampicillin and norfloxacin, and (100%) sensitive to the other types of antibiotics. In addition, *Micrococcus* spp isolate was only resistant (100%) to ampicillin and sensitive to the other antimicrobial agent.(20)

T. O. Alonge et al from Nigeria conducted prospective study on microbial isolates in open fractures seen in the accident and emergency unit of a teaching hospital on 52 patients admitted to university college hospital of Ibadan, Nigeria. Of 52 cases, the same organisms were isolated in both cultures taken from superficial and deep swab in 37(71%) cases, with majority cases was due to *E.coli*(40.9%), followed by *S.aures*(31.8%) and *Klebsiella* species(18.1%).(21)

Thuita Macharia conducted descriptive cross-sectional study on determination of bacterial isolate profiles, their antimicrobial susceptibility patterns and trends of antibiotic use in patients with open fractures from Kenyatta national hospital, Kenya on 66 patients over the period of October 2019 to January 2020. There was a 79% (n = 52) culture growth rate out of the 66 pus swab specimen. 81% (n = 42) had single bacterial isolates while 21% (n = 10) had 2 isolates each, thus the total number of isolates were 62. The overall proportion of gram negative bacterial isolates (73%) was higher than that of gram positive isolates (27%). The most predominant bacterial isolate was *Pseudomonas aeruginosa*(34%), followed by *Staph.aureus*(27%), *E.Coli* (20%), *Proteus mirabilis* (16%) and *Klebsiella pneumoniae*(3%). There was high resistance against commonly used antibiotics. Overall, there was high resistance against Benzyl penicillin (100%), Cefuroxime (86%), Erythromycin (86%), Amoxycillin Clavulanate (85%) and Clindamycin (85%). Four isolates had Oxacillin resistance which was classified as MRSA and treated with Vancomycin to which they were sensitive. More than 80% of the isolates had resistance to at least 3 commonly used antibiotics.(22)

A prospective study done by Taye M of surgical wound infection has been conducted on 1754

surgical patients operated from January 1, 1999 to Dec 31, 1999 in Tikur Anbessa hospital to assess wound infection showed that, the overall wound infection rate in any surgical patient was 14.8% and this percentage has been significantly low in a patient who took prophylactic antibiotics. The study concluded that the infection rate are much higher than the acceptable standard and this underscores the need for establishing hospital infection control system.(16)

Yishak A. et al conducted study on 200 patients with open fracture during the period from November, 2007 – May 2008 to assess microbial susceptibility of bacteria isolated from open fracture wounds presenting to the err of black-lion hospital, Addis Ababa University, Ethiopia. Out of the 200 open fracture wounds, 55 (27.5%) were with overt signs of clinically important infection (erythema, pain, drainage, fever $>38.5^{\circ}\text{C}$ and foul odor). Foul odor was typical feature of older wounds. Only 26 (13%) of the wounds were irrigated and surgically debrided. 61 (30.5%) were positive for the presence of bacteria and different bacterial morphologies were observed. Most gram-positive isolates, 29/55 (52.7%) showed multiple drug resistance (to three or more drugs). A total of 162 bacteria were isolated from the culture-positive wounds and *S. aureus* accounted for 14.8% of the total isolates followed by *Acinetobacter* spp. (*A. calcoaceticus*-*baumanni* complex) (11.4%), *E. coli* (10.5%), *Pseudomonas* spp. (9.9%). Anaerobic bacteria, *Clostridium* spp. (*C. perfringens* and *C. tetani*) were also isolated. The gram-positive and -negative bacteria account-ted for 55/162 (34.0%) and 107/162 (66.0%), respectively ($p < 0.05$). Of the 191 patients, 56 (29.3%) had been treated with cloxacillin alone or in combination with other antimicrobials (mainly ceftriaxone) before collection of samples. Of the patients who received antimicrobial/s, 40/56 (71.4%) had positive culture results, while those who did not receive any antimicrobial had 42/135 (31.1%) positive culture results ($p > 0.05$). (17)

3. Objectives

3.1 General Objective:

- To assess pattern of microbial sensitivity in patient with open fracture admitted to AaBET hospital.

3.2 Specific objectives:

- To assess the bacterial etiologic agents responsible for open fracture wound infection in AaBET hospital.
- To determine the antimicrobial sensitivity pattern of the bacterial isolates to the commonly used antimicrobial agents in AaBET hospital.

4. Methods

4.1 Study Setting:

Ethiopia is an east African country which is among the most populous countries. It has land, air and water transportation services. Addis Ababa is the capital city of Ethiopia where AaBET hospital (an affiliate of SPHMMC) is located. The hospital was inaugurated as a public hospital under SPHMMC in 2015 G.C, and it is one of the first health sectors with an entire trauma and burn unit.

This study will be conducted in AaBET hospital, SPHMMC, Addis Ababa. The hospital is organized and equipped with ER, Ward, and ICU. The ER has 37 Emergency room beds and recliner chairs while the two ICUs have 11 beds together with 3 more beds for the semi- ICU. The Orthopaedic, Neurosurgery, General Surgery, Pediatrics(≤ 14 years), Burn and Private wing wards having 49, 17, 10, 21, 19, 12 beds respectively. It also has operative theater equipped with 4 operation tables and ORs along with PACU that has 5 beds for Emergency service and 4 beds for elective service. The hospital receives patients from all over the country. The Orthopedic department of the hospital is involved in giving service at ER, Orthopedic ward, and orthopedic outpatient services. The ward service is given using 49 beds for adult and 14 beds for pediatrics. The department uses 2 OR tables for scheduled surgeries though one OR table is reserved for emergency surgery sometimes. The manpower of the department comprises of 14 Consultants and 41 orthopedic surgery residents of different year of study. The department is one of the few government facilities giving operative services for trauma patients referred from all over the country.

4.2 Study Period: The study was conducted from December 2021 -March, 2022 G.C.

4.3 Study Design: Descriptive cross sectional study was conducted by reviewing medical record and logbook comprising open fracture cases at AaBET hospital.

4.4 Study Population:

4.4.1. Source population

All patients who were admitted to orthopaedics ward with a diagnosis of open fracture at AaBET hospital.

4.4.2. Study population

All patients who were admitted to orthopaedics ward with a diagnosis of open fracture that have culture and sensitivity test at AaBET hospital during September 1/2019 to August 31/2021 GC.

4.4.3 Inclusion Criteria:

- Folders of patients who were admitted to orthopaedics ward with a diagnosis of open fracture that have culture and sensitivity test.

4.4.4 Exclusion Criteria:

- Patients on chemotherapy or long-term corticosteroids
- Patient with known DM, HIV/AIDS, Chronic Renal Failure.
- Patients who died before discharge.

4.5 Sample Size and sampling: All patients admitted to orthopedic ward with a diagnosis of open fracture for whom surgery was done from September 1/2019GC to August 31/2021GC. The study aims to include all eligible patients that fulfills the inclusion criteria during the period.

4.6 Measurement

1.1.1. Study Variables:

- ☐ Sociodemographic factors
 - Age
 - Gender
 - Time from injury to admission
 - Date and time of initial debridement
 - Hours or days after initial debridement
- ☐ Trauma related factors
 - Mechanism of injury (Pedestrian, Automobile, Motorcycle, Bicycle, Fall from height, Industrial injury, Assault, Fallen on by weight, Sport injury)
- ☐ Site of the open fracture (humerus, radioulnar, hand, pelvic, femur, tibiofibular, ankle and foot)
- ☐ Fracture pattern (Simple transverse, Oblique, Spiral, Wedge, Segmental, Comminute)
- ☐ Gustilo Anderson grade (grade I, II, IIIA, IIIB, IIIC)
- ☐ Method of fracture stabilization (Long back-slab, External fixation, Intramedullary nailing, Plating)
- ☐ culture results (growth, sensitivity pattern, resistance pattern, list of prescribed antibiotics, duration of prophylactic antibiotics)

- 1.1.2. **Instruments:** The data was filled on a data collection form adopted from published researches done on similar topics with additional components developed by reviewing relevant literatures on the problem under the study to include variables that address the objective of the study.

4.7 Data Collection and Procedures:

All patients who were admitted to orthopedic ward in the study time frame are recorded on ward patient logbook. The MRNs of these cases was collected from the data base for retrieval of the charts from chart storeroom for further data collection. For patients whose MRN was not available on logbook, the date of admission is taken from the logbook and the MRN of the patient was obtained from the chartroom by using computer-based registry system.

Data was collected from logbook and the chart record of all eligible patients admitted for open fractures during the mentioned time frame. The data was filled on a data collection form adopted from published researches done on similar topics with additional components developed by reviewing relevant literatures on the problem under the study to include variables that address the objective of the study. The data collection format was designed in English language; and it has information including socio-demographic profile (age, and sex), time from injury to admission, date and time of initial debridement, hours or days after initial debridement, trauma related factors (mechanism of injury, site of the fracture, fracture pattern), Gustilo Anderson grade, method of fracture stabilization, culture results (growth, sensitivity pattern, resistance pattern, list of prescribed antibiotics, duration of prophylactic antibiotics).

The data from the patient chart was collected by the principal investigator. To collect the required data from the patient folders, the hospitals record room workers retrieved the charts according to the MRN. Data was collected by two data collectors at AaBET hospital. The chart of the patients retrieved for the study was returned to its place after the data obtained is checked for completeness.

4.8 Operational Definitions:

Open fracture – is an injury where the fractured bone and/or fracture hematoma are exposed to the external environment via a traumatic violation of the soft tissue and skin.

Microbial sensitivity – is a test done to help choose the antibiotic that will be most effective against the specific types of bacteria or fungus infecting an individual person.

Microbial resistance pattern - is the capacity of bacteria to withstand the effects of antibiotics or biocides that are intended to kill or control them.

Pattern – is series of actions showing how things normally happen

4.9 Data Quality Control and Management:

Data quality was controlled by training the data collectors (three nurses trained on the topic for data collection for half a day) on the contents of the checklist and by supervision during data collection process. Prior to the actual data collection, the PI revised the chart records of all patients.

4.10 Data Analysis Plan and Procedures:

To assess results of, all data of eligible cases during the study time frame was be ready for the data analysis. The data collected was cleared, categorized and analyzed by the investigator; the collected data was entered into a computer using Statistical Package for Social Science. The data was summarized and described using tables, charts and figures. Descriptive statistics was used to put results of the study in the form of findings and percentages.

4.11 Ethical Consideration:

Ethical clearance was obtained from the Institutional review board (IRB) of SPHMMC and research committee of orthopedic and traumatology department of SPHMMC and permission was obtained from the head of record and registration office of AaBET hospital. Patient's data confidentiality was kept strongly.

4.13 Dissemination of Results:

The study results will be submitted to department of Orthopedics and Trauma surgery for partial fulfillment of postgraduate study in Orthopedic and Trauma surgery specialty. Every possible effort will be made for publication on reputable journals.

5. Result

A total of 38 open fractures treated was included in this study. All were managed with I&D, fracture stabilization and antibiotics during the period under review and all cases were getting empiric antibiotics for different duration. Ceftriaxone, metronidazole and gentamycin were the commonly used antibiotics with different mode of combinations. Of 38 cases, all were culture positive with different microbial isolation and sensitivity patterns.

The age range was from 16 to 70 years with an average age of 37.05 years (with SD of 15.77). Most patients lie in the age category of 20-50 years (65.5%)(Figure 1)

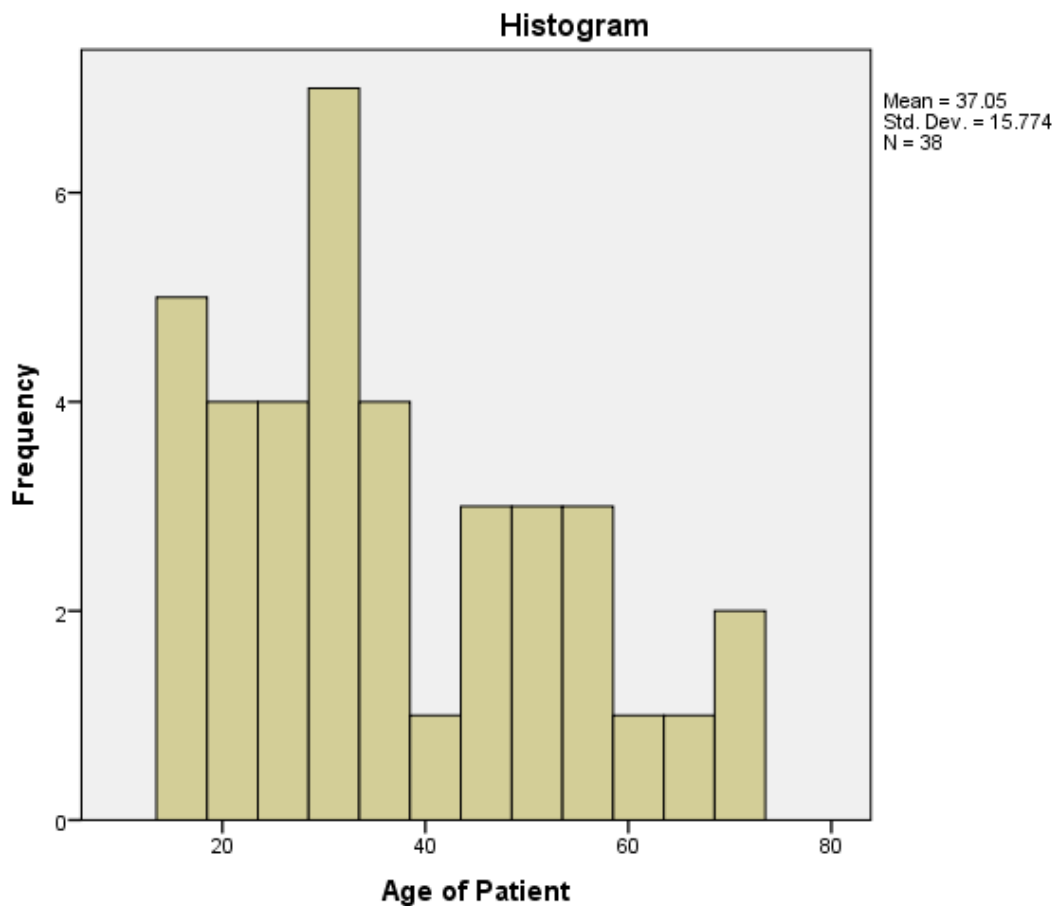


Figure 1. showing age distribution of patients with open fracture who have culture and sensitivity admitted at AaBET hospital during the study period.

Twenty-six of the patients (68.4%) were male and twelve (31.6%) were female and most of the patients were from Addis Ababa and Oromia (81.5%). (Table 1)

Variable		Count	%
Sex of Patient	Male	26	68.4
	Female	12	31.6
Address of Patient	Addis Ababa	17	44.7
	Oromiya	14	36.8
	Amhara	4	10.5
	SNPPR	3	7.9
	Others	0	0.0

Table 1. Showing demographic data of patients with open fracture who have culture and sensitivity admitted at AaBET hospital during the study period.

Debridement was done for all patients and time of initial debridement ranges from one to seven days. Debridement was done with in first day for thirteen(34.2%) of the patient and at seventh day for two(5.3%) with a mean of 2.55 days and SD of 1.71. (Figure 2.)

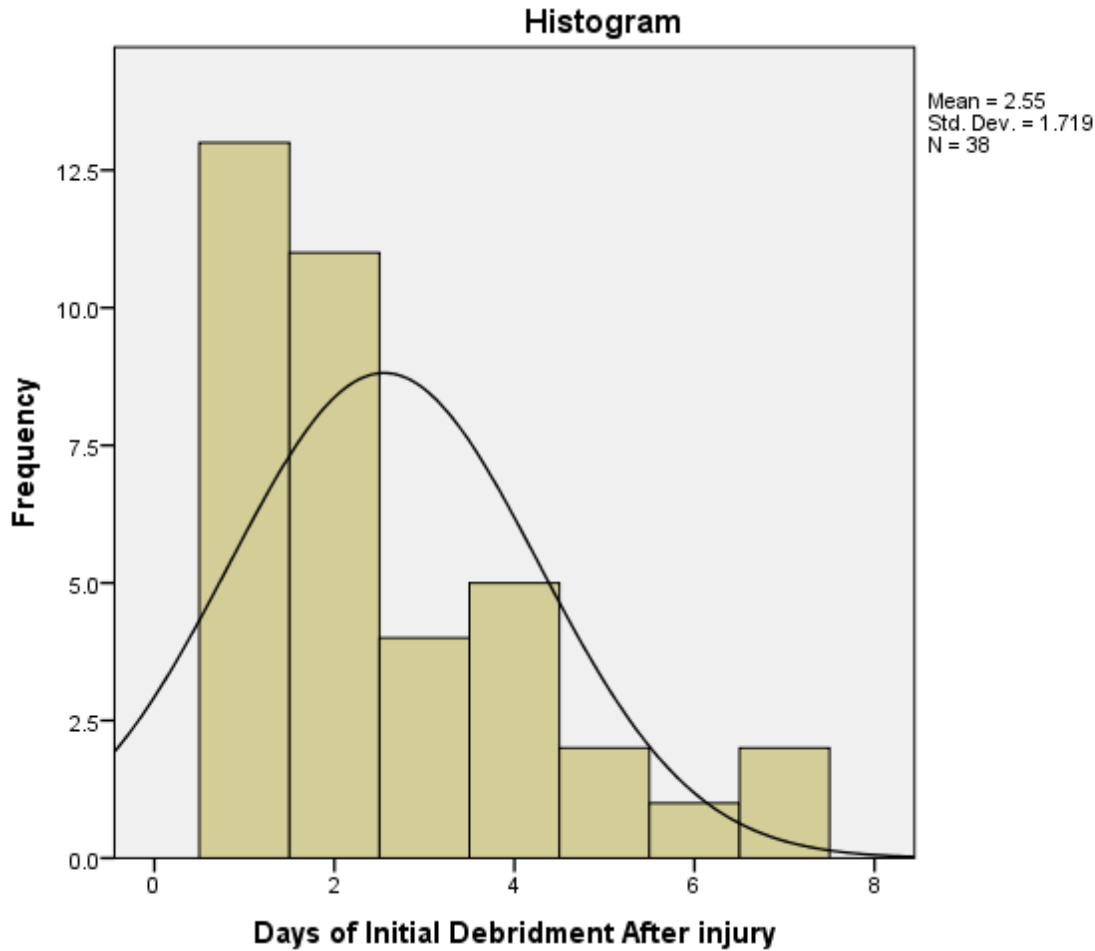


Figure 2. Figure showing time of initial debridement after injury of patients with open fracture who have culture and sensitivity admitted at AaBET hospital during the study period.

The leading cause of the injuries was automobile accident in twenty -seven (71.1%) of the cases followed by fall from height in ten (26.3%) of cases. Thirteen (34.2%) of the fractures were tibial and twelve (31.6%) were femoral fractures. Pattern of the fractures includes; 17(44.7%) transvers and 11(28.9%) oblique fracture. Twenty-four (63.2%) of the cases were Gustilo-Andersson grade I&II and external fixator was the main mode of fracture stabilization in 22(57.9%) of the cases (Table 2.)

Table 2. Fracture characteristics of patients with open fracture who have culture and sensitivity admitted at AaBET hospital.

Variables		Count	%
Cause of Injury	pedestrian	0	0.0
	automobile	27	71.1
	motorcycle	0	0.0
	bicycle	0	0.0
	fall from height	10	26.3
	industrial injury	0	0.0
	assault	1	2.6
	farm injury	0	0.0
	sport injury	0	0.0
	humerus	4	10.5
Site of Fracture	radioulnar	9	23.7
	wrist and hand	0	0.0
	pelvic	0	0.0
	femur	12	31.6
	tibiofibular	13	34.2
	ankle and foot	0	0.0
	multiple limbs	0	0.0
	transvers	17	44.7
	oblique	11	28.9
	spiral	0	0.0
Fracture Pattern	wedge	0	0.0
	segmental	0	0.0
	communited	10	26.3
	grade 1	12	31.6
	grade 2	12	31.6
	grade 3A	9	23.7
Gustilo Anderson Grade	grade 3B	5	13.2
	grade 3C	0	0.0

Out of 38 patient with open fracture 22(57.9%) were stabilized by external fixator and 10(26.3%) were stabilized with plat fixation. Of the total cases, polymicrobial are the main organisms to cultured and accounting 15(39.5%) out of 38 cases followed by S. aures accounting 11(28.9%) of the cases. Ceftriaxone in combination with metronidazole was the main drug used as prophylaxis for 14(36.8%) cases of open fracture. About 17(44.7%) of cases were sensitive for only one antimicrobial and all 38(100%) of the cases are resistant for three or mor drugs. (Table 3.)

Table 3. Methods fracture stabilization, microbial isolation and drug used for patients with open fracture who have culture and sensitivity admitted at AaBET hospital.

Variables		Count	%
Method of Fracture Stabilization	posterior gutter	0	0.0
	external fixator	22	57.9
	intramedullary nailing	6	15.8
	plating	10	26.3
	polymicrobial	15	39.5
List of Organisms	s.aures	11	28.9
	CONS	9	23.7
	E.coli	2	5.3
	other	1	2.6
Lists of Prescribed prophylaxis Drugs	only ceftriaxon	12	31.6
	ceftriaxon and metronidazol	14	36.8
	ceftriaxon, metronidazol and gentamycin	12	31.6
Sensitivity Pattern	sensitive for only one drug	17	44.7
	sensitive for two drugs	14	36.8
	sensitive for three or more drugs	7	18.4
	resistant for only one drug	0	0.0
Resistance Pattern	resistant for two drugs	0	0.0
	resistant for three or more drugs	38	100.0

Of the thirty-eight wound specimens cultured, all (100%) were culture positive. Of these, fifteen (39.5%) showed poly-microbial growth (more than one bacterial type) and twenty-three (60.5%) showed mono-microbial (single bacterial type) growth. From mono-microbial growth, *S. aureus* accounted for eleven (28.9%) of the total isolates followed by CoNS accounting nine (23.7%) of the cases. (Figure 3)

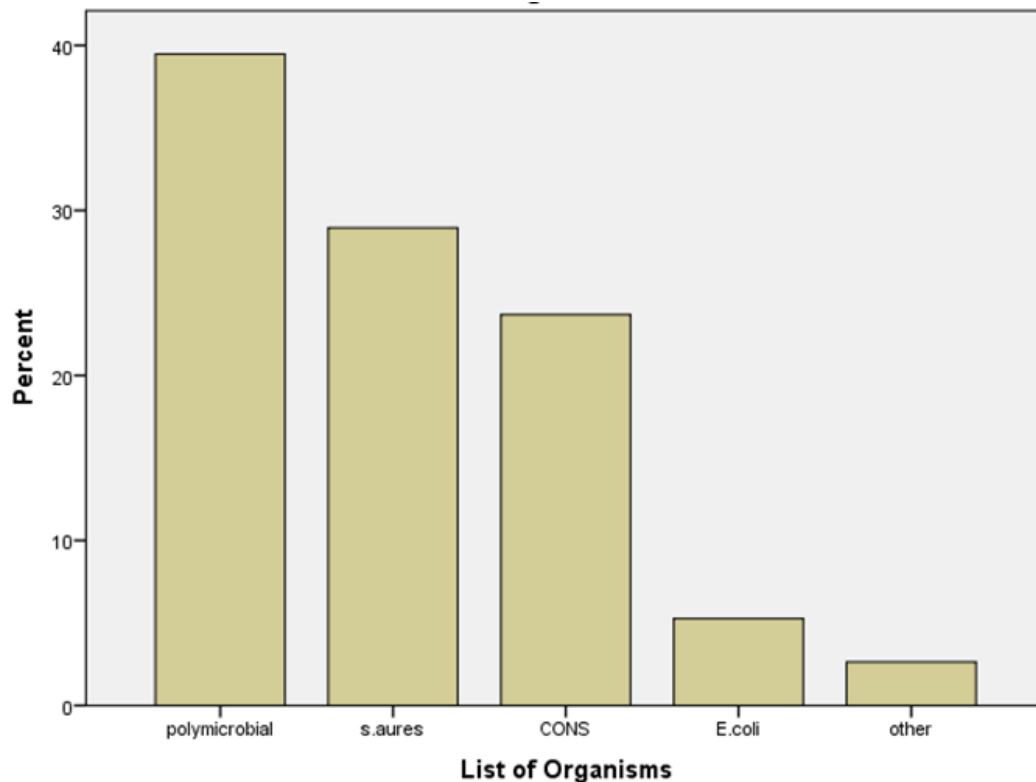


Figure 3. A Figure showing lists of microorganisms isolated from wound culture in a patient with open fracture who have culture and sensitivity admitted at AaBET hospital.

Commonly used empiric antibiotics was used for all patients with open fracture with different combination and duration. The shortest duration of empiric antibiotic used was three days and the maximum duration was twenty-six days. The mean duration of empiric antibiotics was 8.45 days with SD of 5.63. (Figure 4)

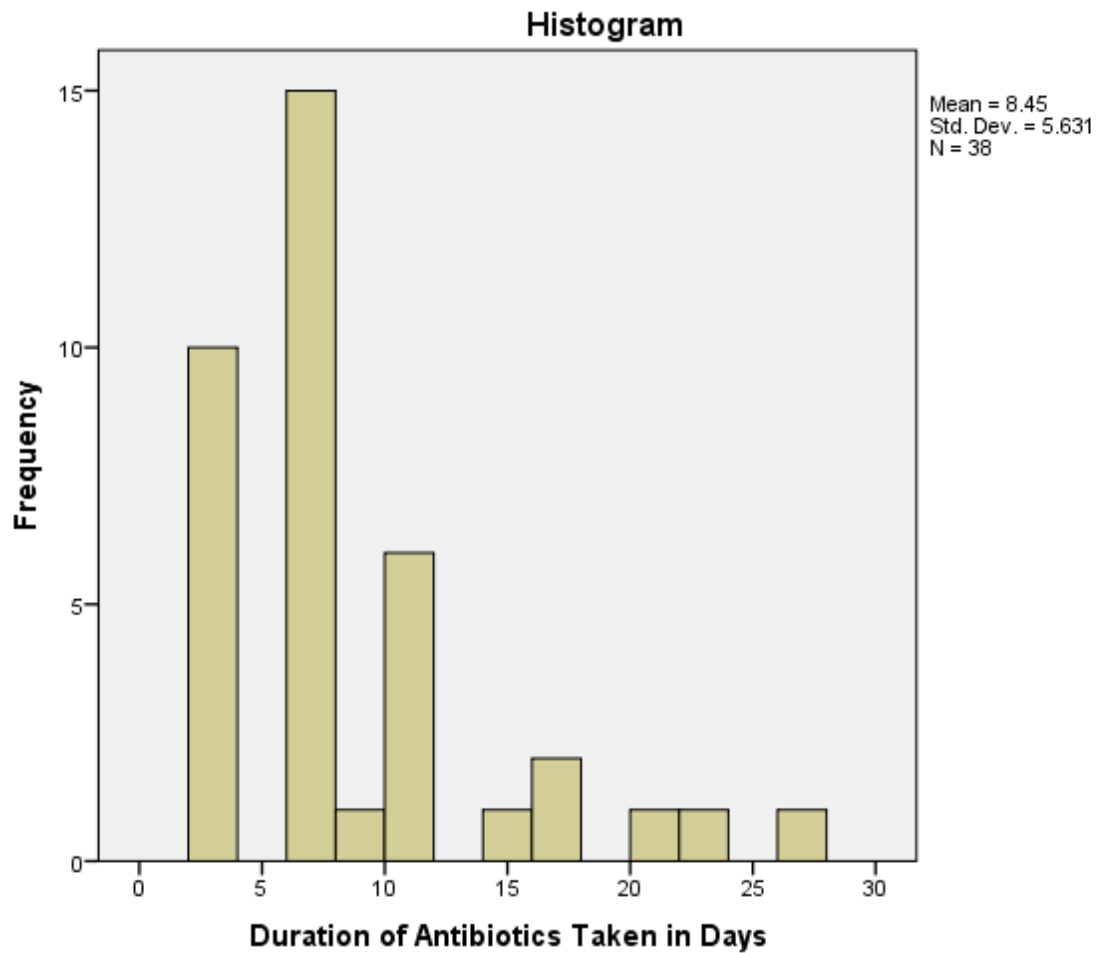


Figure 4. Figure showing duration of empiric antibiotics in a patient with open fracture who have culture and sensitivity admitted at AaBET hospital during the study period.

6. Discussion

It is well described that injury is a major burden worldwide. Road traffic crashes account for 25% of all injuries. It is estimated that for every road traffic injury (RTIs)-related death, there are up to 50 times more survivors with some type of disability. Majority of these injuries occur in low- and medium-income countries. Injuries affect all age groups but have a particular impact on young people and people in their prime working years. Male patients in the first four decades of life have often been shown to be largely affected by trauma worldwide. (23) In this study, more than sixty percent (65.5%) are under fifty years of age and male patients again comprise about 68.4% of the study population making the trend unchanged from the global perspectives. In this study the main cause for injury is RTA which accounts about 71.1% which is more higher compared to the global data.

In the study done by Thuita Macharia in 2020 on determination of bacterial isolate profile on 66 patients with open fracture, 47% of the patient get debridement with in two days and with the same study 30% of the patient had tibiofibular fracture and external fixator was the main mode of stabilization in 59% the case. Regarding the soft tissue condition, 48% of the study population were grouped under Gustilo Anderson type II.(22) In our study, initial debridement was done with an average of 2.55 days with a SD of 1.7, which is similar to the study done by Thuita Macharia. About the site of fracture and mode of stabilization, our study showed that 34% the cases were tibiofibular and 57.9 % of the cases were stabilized with external fixation. Regarding the soft tissue condition, both Gustilo Type I&II fracture type account about 31.6% for each, which is slightly lower than the study done by Thuita Macharia.

Another study at TASH by Yishak Abraham on Bacteriology of Open Fracture Wounds in Tikur Anbessa University Hospital, Addis Ababa, Ethiopia showed that 64.5% the study population were grouped under Gustilo type I&II, which has similar pattern with our study. Regarding the site of fracture tibiofibular fracture accounts 37.9%.(24)

A metaanalysis done by Juergon Masener et al in 2017, showed that even shorter than 72 hours regimes did not lead to worse infection-related outcomes, the prolonged antibiotic administration (more than 72 h) should be abandoned and a randomized trial focusing on different duration of antibiotic treatment for the most severe variants of open fractures or those with gross contamination (fresh water open fractures, farmyard trauma, open pelvic fractures, open intra-articular fractures with exposed joints, high risk hosts (i.e., those with diabetes mellitus, immunosuppressed).(9) In our study, the minimum duration of antibiotics was three days and the maximum duration was twenty-six days, with a mean of 8.45 days and a SD of 5.63, which has wide gap compared to the standard duration of antibiotics us for open fracture.

Regarding the common bacteria isolated from open fracture, the study done by Tariq Mahmood on Frequency of Common Pathogens Isolated from Open fractures of the extremities and their antimicrobial sensitivity pattern, showed that *S. aureus* is the commonest bacteria isolated.(25) In our study, we found polymicrobials account the majority(39.5%) followed by *S.aureus*(28.9%) and CoNS(23.7%).

The administration of antibiotics is now generally accepted as a prophylactic treatment of infection in compound fractures. The study of duration of the treatment was perfectly conducted by Dellinger. In his prospective trial 248 patients received different doses of the same antibiotic, from a single dose to four doses daily during 5 days. In conclusion he found no relation between the duration of the treatment and the risk of infection.(10) In our study, ceftriaxone in combination with metronidazole was the main prophylaxis drug and accounting 36.8 % of the cases. And from 38 samples take for culture and sensitivity test, almost 100% of the cases were resistant for three or more commonly used antibiotics and only 18.4% of the cases were sensitive for three or more commonly used drugs, which is similar to the study done by Thuita Macharia in Kenya on determination of bacterial isolate profile and their antimicrobial sensitivity pattern.

7. Limitation of the study

The limitation to this study is the small sample size and the retrospective analysis. A multicenter prospective study is proposed to look at a larger volume of patients to validate the findings.

8. Conclusion and Recommendation

8.1 Conclusion

Road traffic accident was the major cause of open fractures. Most of the fractures occurred in tibia and majority of the fractures were grade I&II according to modified G-A classification of open fractures. Poly-microbial was the dominant isolate followed by S.aures. Ceftriaxon, metronidazole and gentamycine were the commonly used drug and ceftriaxone in combination with metronidazole was frequently prescribed. Of the total cases, only 18.4% of the patient were sensitive for three or more commonly used antibiotics and all of the case were resistant for three or more commonly used antibiotics.

8.2 Recommendation

Efforts must be done to decrease occurrence of infection in a patient with open fracture and implementation of the institutional protocol for antibiotics for open fracture that will constantly updated based on trend of bacterial isolate profile and their suscepibility patterns.

Enhancement of the hospital infection disease control strategies to reduce infection in open fracture and to conduct focused surveillance for antimicrobial resistance.

The government to put in place policies aimed at curtailing injudicious acquisition and use of antibiotics in the country.

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10. Annexes

1. Data Collection Format

1. Case ID: _____ MRN: _____

2. Age: _____ Address: _____

3. Sex

a. Male

b. female

4. Date of injury _____

5. Date of admission _____

6. Date and time of initial debridement Date _____

7. Hours or days after initial debridement _____

8. Cause of injury.

a. Pedestrian

b. Automobile

c. Motorcycle

d. Bicycle

e. Fall from heightf. Industrial injury

f. Assault

g. Fallen on by weight

h. Farm injury

i. Sport injury

9.Site of the open fracture

- a. humerus
- b. radioulnar
- c. wrist and hand
- d. pelvic
- e. femur
- f. tibiofibular
- g. ankle and foot

10.Size of Wound _____cm

11. Fracture pattern:

- a. Simple.Transverse
- b.Oblique
- c.Spiral
- d.Wedge
- e.Segmental
- f.Comminuted

11. Gustilo-Andeson grade

- a. Grade-I
- b. Grade-II
- c. Grade-III(A,B,C)

12.Method of fracture stabilization

a. posterior gutter

b.External fixation

c.Intramedullary nailing

d.Plating

13.culture results:

a.Growth(Yes/No) If yes, list organism(s)

b.Sensitivity pattern _____, _____, _____

c.Resistance pattern _____, _____, _____

d.List of prescribed antibiotics _____, _____, _____

e.Duration of Prophylactic antibiotics _____

2. Dummy Tables

Table 1. Demographic details of the patients

SN	Demographic detail	Number	percentage
1	Total patients	38	100
2	Male	26	68.4
3	Female	12	31.6
4	Tibio fibular	13	34.2
5	Femur	12	31.6
6.	Radio ulnar	9	23.7
7	Humerus	4	10.5
8	Mean age	(age in years)	

Table 2. Address of the study subjects

SN	Address of Residence	Number	Percentage
1	Addis Ababa	17	44.7
2	Oromia	14	36.8
3	Amhara	4	10.5
4	SNNPR	3	7.9
5	Total	38	100%

Table 3.. Gustilo- Anderson classification

SN	GA classification	Number	Percentage
1	Type I	12	31.6
2	Type II	12	31.6
3	Type III-A	9	23.7
4	Type III-B	5	13.2
5	Type III-C	0	0

Table 4. Mechanism of injury

SN	Cause	Number	Percentage
1	Assault	1	2.6
2	Fall from height	10	26.3
3	RTA	27	71.1

Table 5. Methods of initial management

SN	Cause	Number	Percentage
1	External fixator	22	57.9
2	ORIF(plat)	10	26.3
3	IMN	6	15.8

Table 6. Fracture pattern

SN	Fracture pattern	Number of patients	Percent
1	Transvers	17	44.7
2	Oblique	11	28.9
3	Communitied	10	26.3

Table 7. list of isolated microorganisms

SN	list of isolated microorganisms	Number of patients	Percent
1	Poly-microbial	15	39.5
2	S.aures	11	28.9
3	CoNS	9	23.7
4	E.coli	2	5.3
5	Other	1	2.6

Table 8. prescribed antibiotic

SN	prescribed antibiotic	Number of patients	Percent
1	Only Ceftriaxon	12	31.6
2	Ceftriaxon with meetronidazol	14	36.8
3	Ceftriaxone, metronidazole and gentamycin	12	31.6

Table 8. Sensitivity Pattern

SN	prescribed antibiotic	Number of patients	Percent
1	Sensitivity for only one drug	17	44.7
2	Sensitivity for two drugs	14	36.8
3	Sensitivity for three or more drugs	7	18.4

Table 8. Resistance Pattern

SN	Resistance Pattern	Number of patients	Percent
1	Resistant for only one drug	0	0
2	Resistant for two drugs	0	0
3	Resistant for three or more drugs	38	100