Evaluation of Antibiotic Utilization in Surgical Ward of University of Gondar Teaching Hospital, Northwest Ethiopia

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Thesis Submitted to the Department of Pharmacy, College of Public Health and Medical Sciences, Jimma University in Partial Fulfillment for the Requirements of the Degree of Master of Science (M.Sc) in Clinical Pharmacy

September 2013

Jimma, Ethiopia

Jimma University

College of Public Health and Medical Sciences

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September 2013

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Abstract

Background: *The use of antibiotics in surgical patients for both the prophylaxis and treatment of infections is a reasonable practice; however characterized by unsuitable practices such as unnecessary use for prolonged duration, use of broad-spectrum antibiotics and administering at wrong time. Following this, emergence of resistance, adverse drug reactions and increase cost of health care are major outcomes of inappropriate antibiotic use. Hence, studying the evaluation of antibiotics usage is therefore a helpful technique to improve the appropriateness of antibiotics use.*

Objective: *to evaluate the antibiotics utilization in surgical ward of University of Gondar teaching hospital, Northwest Ethiopia*

Patients and Method: *Hospital based cross sectional study was conducted in surgical wards of University of Gondar Teaching Hospital from March11- May10, 2013 and data were collected by using pre tested standard data collection form, face-to-face interview and observation. Subsequently, the appropriateness of the antibiotics usage was evaluated using Ethiopian standard treatment guideline for general hospital and American Society of Health System Pharmacists, 2010 guideline and surgery lecture note for health officers students for Ethiopia 2004. Descriptive statistics, bivariate analysis and multivariable logistic regression tests were analyzed by using SPSS version 20.0.*

Result: *A total 271 patients medical records were evaluated of whom 211(77.9 %) were for prophylaxis and 60(22.1%) for therapy. 163 prophylactic and 59 therapeutic prescriptions included in the analysis, of these 160(98.2%) of prophylactic and 43 (72.9%) therapeutic prescriptions were inappropriate. The most common reason of inappropriate therapeutic antibiotics included: inappropriate indication, choice, dose and duration of antibiotics were 1 (1.7%); 38 (64.4%); 38 (64.4%); and 43(72.9%) respectively. Moreover, most characteristics of inappropriate prophylaxis were inappropriate indication; choice, dose, duration and starting time of antibiotics were 45(24.2%), 160(98.2%), 121(74.2%), 128(78.5%) and 76(46.4%) respectively. Female patients were 3.998 times more likely received*

inappropriately antibiotics as compared to those males (AOR 95%CI 3.998(1.022-15.642). The inappropriate usage of antibiotics in emergency surgical procedure 94(97.9%) was higher than elective procedure 107 (86.5%), (AOR 95% CI= 6.395(1.363-29.992), P=0.019). Empirical prescriptions were inappropriate 93% than prescriptions based on available laboratory results 50%, (AOR 95% CI=8.090(1.420-46.078, P=0.019). Unavailability of antibiotics were 5.435 times more likely inappropriate than antibiotics available at the time of prescriptions, (AOR 95%CI=5.435(1.094-27.022, P=0.038).

Conclusion and recommendations: *Significant amounts of antibiotics were prescribed inappropriately in surgical ward of university of Gondar teaching hospital. To improve appropriate use, ensure availability of antibiotics, encouraging prescribers to use laboratory investigation for prescribing, provision of continuous education and escalation of short-term training of prescribers for appropriate use of antibiotics and preparation of surgical specific evidence-based protocols, guidelines, should be taken into consideration.*

Key word: *Antibiotics utilization, evaluation, surgical ward, University of Gondar*

Acknowledgement

First and foremost, I would like to praise the almighty God for his mercy and his assistance in the way of my entire academic journey.

I would like to express my sincere and heartfelt gratitude to my advisers, Mr.Gizat Molla, Mr.Tsegaye Tewelde and Bayew Tsega for their unreserved supervision, constructive advice, timely comments and encouragement throughout the whole process of the research. Their encouragement and positive attitude always appreciate

I am also sincerely thankful to Mr. Belay yimam and Getachew Tarekegn for their valuable information, constrictive advice and motivation

I would also like to thank department of pharmacy of Jimma University for giving me the opportunity to conduct this research.

I would like to extend my immense gratitude to my family, Mr.Tesfahun Assefa and Mr.Desta Shumye for their love, encouragement, motivation and patience through all my challenges. Without your never-ending support, I would not be here so thank you all very much

My special thank are forwarded to the supervisor, data collectors and study participants, university of Gondar teaching hospital management and surgical ward staff.

To all those who I may have not mentioned by name but have contributed in one way or the other to the completion of this research, thank you.

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Acronyms and Abbreviations

ADRs	Adverse Drug Reactions
AMR	Antimicrobial Resistance
ASA	American Society of Anesthesiology score
ASHP	American Society of Health System Pharmacists
DUE	Drug Use Evaluation
FMHACA	Food, Medicines and Health Care Administration and Control Authority
IDSA	Infectious Diseases Society of America
HIV	Human Immunodeficiency Virus
MCH	Maternal and Child Health
MRSA	Methicillin-Resistant Staphylococcus aureus
MSSA	Methicillin-susceptible Staphylococcus aureus
SSI	Surgical Site Infection
UoG	University of Gondar
UoGTH	University of Gondar Teaching Hospital
USA	United State of America
UTI	Urinary Tract Infection
WHO	World Health Organization

1. Introduction

1.1. Background

Antibiotics are among the most frequently used drug worldwide, particularly utilized in developing countries, where on average, 35% of the total health budget [1]. The most commonly prescribed drugs among hospitalized patients especially in intensive care and surgical department [2]. Antibiotics are one of the pillars of modern medical care and play a major role in both the prophylaxis and treatment of infectious disease. The use of antibiotics as prophylaxis and/ or therapy for selected surgical procedures is one of the measures used to prevent the development of a surgical site infection [3]. Ideally, antibiotic prophylaxis and/or therapy used for surgery should achieve the following goals: prevent postoperative infection of the surgical site, prevent postoperative infections morbidity and mortality, reduce the duration and cost of health care, produce no adverse effects, and have no adverse consequences for the normal flora of the patient or the hospital [4, 5].

To achieve these goals, antibiotics should be active against the pathogens most likely to contaminate the wound, given in an appropriate dose and at a time that ensures adequate concentrations at the incision site during the period of potential contamination, safe, and administered for the shortest effective period to minimize adverse effects, development of resistance, and cost. Other factors, such as the surgeon's experience, the length of the procedure, hospital and operating room environments, and the underlying medical condition of the patient, has strong impact on wound infection rates. Medical conditions associated with an increased risk of postoperative infection include extremes of age, under nutrition, diabetes, recent operation. Antibiotics prophylaxis may be justified for any procedure if the patient has an underlying medical condition associated with a risk of wound infection [6]. These variables should consider in evaluations of infection-control problems. Incorrect implementation of any of these factors can influence the rate at which infections at the surgical site occurs. Therefore, it is very important to be aware of what should been done in surgical prophylaxis in order to establish improvement strategies [7]. In spite

of widespread knowledge about the effectiveness of antibiotic prophylaxis and treatment, its administration is often inappropriate.

The uses of antibiotic therapy and prophylaxis in hospitals have been reported to be inappropriate or not indicated in 9 to 64% [8]. Reasons for inappropriate use of antibiotics include uncertainty of differential diagnoses; lack of training, experience; lack of knowledge of local epidemiology of antibiotics resistance; unnecessary use of broad-spectrum antibiotics; administering at wrong time; and continuing for too long. Uses of single dose have been found to be as effective as multiple doses and cost effective to patients [9]. The recommended duration of prescribed antibiotics prophylaxis for caesarean section has reduced from ≥ 5 days to 3 days then to 24 hrs and finally to a single dose [10].

Prescriptions should considered inappropriate when there are contraindicated existing medical conditions, potential drug interactions, known documented allergies, wrong doses prescribed, inadequate monitoring, two drugs prescribed for a patient when only one is necessary, drugs prescribed for which there is no indication [11].

Inappropriate prescribing of antibiotics, for both in-patients and outpatients, are the cause of drug resistance, adverse effects and unacceptable economic loss. It is estimated that up to fifty percent of all antibiotics use is inappropriate, resulting in an increased risk of side effects, higher costs and higher rates of antimicrobial resistance in community pathogens [12]. The emergence of antibiotic resistance limits the therapeutic options for treatment of bacterial infections and contributes to the global specter of post antimicrobial era in which some of the most effective tools such as antibiotics, and anti-malarial loss their effectiveness [13].

Concern about escalating rates of inappropriate use of antibiotics, drug-resistant organisms and spiraling expenditure on broad-spectrum antibiotics has induced most hospitals to implement a range of measures [14-24] These include supervision of their use by infectious disease consultants and/or clinical pharmacist [14, 15], provision of continuing education regarding appropriate antimicrobial drug use [19], and implementation of automatic stop orders. [21, 22, 24]. Another method increasingly

used in this era of cost constraints and quality assurance is drug utilization evaluation [27]. Pharmacists adapted this tool to assess appropriateness of usage of various medications [16, 17]. Drug use evaluation is a system of ongoing, criteria-based evaluation of drug use that helps ensure that medicines are used appropriately at individual level. A DUE is drug- or disease - specific and it can structure to assess the actual process of prescribing, dispensing or administering a drug [27]. Because of their expertise in drug therapy management, clinical pharmacists play a leading role in describing the relationship between drug use and patient outcomes using prospective DUE [11, 28].

The purpose of a DUE is generally to detect possible problems with and improve drug use. Drug use evaluations have traditionally focused on drugs with frequent side effects, complicated dosing regimens. Very few drug use evaluations have addressed broadest-spectrum antibiotics, and none has included all three last-line agents. Drug use evaluation can be done either prospectively or retrospectively [29].

Prospective DUE involves comparing drug orders with criteria and conducting the intervention before the patient receives the drug. Its main advantage is its preventive potential, and it should be used when non-compliance with criteria will have the most serious consequences. The impact of this approach is noticeable immediately, and physicians may become accustomed to the monitoring as a "double check." Various drug use problems can be detected and prevented from occurring with prospective monitoring, such as: incorrect dosage, inappropriate dosage form/route of administration, incorrect duration of therapy, drug-drug interactions, therapeutic duplication, drug-disease contraindications, and drug-allergy and other side effects, and incorrect laboratory/monitoring orders [30].

1.2. Statement of the problem

The potential inappropriate use of antibiotics is becoming a concern worldwide with their increment in quantity and variety [31]. Inappropriate and indiscriminate use of antibiotics can potentially lead to a number of problems. These problems include rapid emergence of resistance, selection pressure on resistant microorganisms, increased number of adverse drug events, treatment failures, occurrence of preventable morbidity and mortality and increased drug-related costs [32, 33].

The estimated annual number of surgical operations worldwide is 234 million, i.e., one operation for every 25 people [34]. A rate of 0.4-0.8% deaths and 3-16% complications means that at least 1 million deaths and 7 million disabling complications occurred each year worldwide [35].

Many studies have shown that the use of antibiotic prophylaxis and /or treatment in some surgical procedures can reduce surgical site infections. In the past three decades, different researches have reported that as much as 50% of all use of antibiotics in hospitals is inappropriate [2]. Approximately 30-50% of antibiotic use in hospitals is now for surgical prophylaxis, however, between 30-90% of this prophylaxis is inappropriate, that increases emergence of antimicrobial resistance, adverse effect and increase cost of health care [36].

The study conducted in Iran on evaluation of prophylactic antibiotic administration at the surgical ward of a major referral hospital, 2010 indicate that the average extra cost per patient due to misuse of antibiotics was 92 528 (SD 133 650) rials, which is approximately equal to US$ 9. The total extra cost due to misuse of antibiotics during the 15-day period was 15 267 170 rials (US$ 1471) [37]. Prospective drug utilization evaluation of three broad-spectrum antimicrobials: cefepime, piperacillin-tazobactam and meropenem in Israel, in 2001 showed that amount to inappropriately spent sums of £3498 on cefepime, £2832 on piperacillin tazobactam and £7049 on meropenem, totaling £13 379 over the 6 months of the study [38]. The effect of inappropriate antibiotics on mortality is similar; a 42% mortality rate was seen when the antibiotics

prescribed did not cover the causative organisms, compared to17.7% in those whose antibiotics were effective against the pathogens isolated [39].

The development of bacterial resistance to antibiotics has become a major problem throughout the world and mainly driven by the selective pressure imposed by inappropriate antibiotic use [40-44]. Once antibiotics resistance emerges, it can have a significant impact on patient morbidity and mortality, as well as increased health care costs [45, 46]. Surgical site infection due to MRSA have been associated with a higher mortality rate than similar infections due to MSSA with the mean attributable cost of MRSA infection ranging from $9275 to $13,901 [47, 48]. Annual losses stemming from antimicrobial resistance are estimated to range from 21 000 million to 34 000 million dollars in the United States of America [49] and about 1500 million euro's in Europe [50]. A recent study in Thailand, in 2010 antibiotics resistance was responsible for at least 3.2 million extra hospitalization days and 38 481 deaths, and for losses amounting to 84.6–202.8 million US$ in direct medical costs and more than US$ 1333 million in indirect costs [51].

The world health assembly in May 2005 warned that the antibiotics resistance was rapidly increasing, with resistance of up to 70-90% to original first-line antibiotics (penicillin, ampicillin, cotrimoxazole, and cephalosporin) for pneumonia (pneumococcal), gonorrhea, and hospital infections staphylococcus aures [52, 53].

The study conducted on antibiotics resistance in pathogens causing nosocomial infections in surgery and intensive care wards in Madagascar indicate that the frequencies of resistance were high, particularly in enterobacteriaceae; however, the rate of staphylococcus aures isolates resistant to oxacillin (13.6 %) was moderate and all these isolates were susceptible to glycopeptides. The percentages of isolates susceptible to ceftazidim were 81.8% for E. coli, 60.9% for klebsiella, and 52.5% for enterobacter. Resistance to third-generation cephalosporins was due to extended spectrum betalactamases [54].

Irrational use of drugs, resistance of antibiotics is a wide spread phenomenon in Ethiopia health care system for a long time. A study done by FMHACA, bacteria that

are commonly involved in causing infections to human beings showed an increase in 17-30 % resistance rate to commonly used first line antibiotics (erythromycin, chloramphenicol, and cotrimoxazole) from 2003 to 2007 [55,56].

A study conducted on postoperative surgical site bacterial infections and drug susceptibility patterns at university of Gondar teaching hospital, Ethiopia, showed that. The prevalence of methicillin resistant staphylococcus aureus was 9 (34.6%). 17(77.3%) and 1 (4.5%) of coagulase negative staphylococcus were methicillin and vancomycin resistant, respectively. Coagulase negative staphylococcus 41(41.8%), staphylococcus aures 19 (19.4%) and pseudomonas-aeruginosa 16 (16.3%) were the major isolates from 75 sites of the hospital environment with an isolation rate of 41(54.7%). The prevalence of methicillin resistant staphylococcus aures from the environment was 2 (2.0%). This study demonstrated high level of multi-drug resistance [57].

Prospective study done on the pattern of antibiotic usage in surgical in-patients of University of Gondar teaching hospital, Ethiopia in 2002, showed that patients received antibiotics for prophylaxis and treatment purposes mainly on empirical basis. This approach of antibiotics use is leading to inappropriate use of these drugs [58].

The tool to reduce these problems is education, promotion of rational prescribing methods, and the embellishment of therapeutic and prophylactic protocols developed by examining each hospital's most prevalent infections, together with the local rate of bacterial resistance and antibiotics use evaluations [59]

Limited studies were conduct on pattern of antibiotics use in surgical ward in Ethiopia, but as far as my knowledge concerned, no research has done on the Evaluation of antibiotics utilization in surgical ward in UoGTH. Therefore, this study tries to evaluate the use of antibiotic prophylaxis and treatment in surgical ward of the UoGTH. It is hope that this research will play a paramount role in bringing the issue of antibiotic utilization of the hospital and the situation and level of the trends in antibiotic utilization.

2. Literature review

2.1. Literature review

The study conducted on different patterns of inappropriate antimicrobial use in surgical and medical units at a tertiary care hospital in Switzerland: A prevalence survey, in 2008. Showed that, 1577 patients of whom 700 (44.4%) had antimicrobials, receiving 1270 prescriptions. 958 (75.4%) prescriptions were for therapy and 312 (24.6%) for prophylaxis. 37.0% of therapeutic and 16.6% of prophylactic prescriptions were found to be inappropriate. Most frequent characteristics of inappropriate treatments included: No indication (17.5%); incorrect choice of antimicrobials (7.6%); incorrect application of drugs (9.3%); and divergence from institutional guidelines (8%). Characteristics of inappropriate prophylaxes were no indication (9%); incorrect choice of antimicrobials (1%); duration too long (6.7%). Patterns of inappropriate antimicrobial varied widely in the different hospital units; empirical prescriptions were more frequently incorrect than prescriptions based on available microbiological results [8].

A study done in a Swiss hospital in 2011 on the misuse of antibiotics showed that 173 of the 695 inpatients present (25%) were on antibiotics and 60 of the 128 (47%) were considered inappropriate, of which 17 (28%) lacked any indication for antibiotic use. The rates of mis-use were higher in surgery than in medicine (58 vs. 34%; OR = 2.5 [95% CI: 1.1–5.9]), and higher for prophylaxis than for treatment (72 vs. 41%; OR = 4.1 [95% CI: 1.3–15.5]) [61].

A study conducted on, antibiotic administration in patients undergoing common surgical procedures in a community teaching hospital in U.S.A, indicate that we reviewed the charts of 211 randomly selected patients who underwent elective (*n* =132) or emergency (*n* = 79) procedures during 1996. The operations included gastrectomy (*n* = 22), appendectomy (*n* = 27), open (*n* = 5) or laparoscopic (*n* = 27) cholecystectomy, colectomy (*n* = 28), hysterectomy (*n* = 8), laparotomy for intestinal obstruction (*n* = 11), mastectomy (*n* = 26), and ventral hernia repair (*n* = 37). A total of 17 antibiotics used for prophylaxis and 21 for therapy. Inappropriate use of

antibiotics more common in emergency procedures 62/79 (79 %) than elective procedures overall percent were 94/132 71%, over all 156 patients (74%) the administration considered inappropriate. Eight patients in the inappropriate group developed diarrhea (two cases of *Clostridium difficile*-induced colitis) compared to two cases of diarrhea in the appropriate group (non-significant). The average duration of administration after elective and emergency operations was 3.3 and 5.7 days, respectively [62].

A study done on antibiotics use in a Brazilian hospital in 2004; found out that the surgical use of antibiotic prophylaxis was indicated in 73.2% of the surgeries. The antibiotics most used for prophylaxis were first generation cephalosporins. In 78.9 % of the surgeries, the antibiotics were correctly chosen. In 15.9% of the surgeries, the initial antibiotic administration correctly timed. The use of antibiotics in the post-operative period was appropriate in 29.8% of the cases. The independent risk factors for surgical site infection, as determined by logistic regression analysis adjusted to class of wound risk, were the choice of antibiotic used prophylactically and the duration of antibiotic treatment in the post-operative period. Those who received appropriate prophylactic antibiotics had a lower rate of SSI than those who received inappropriate antibiotics [RR=0.49/95%; CI=0.25-0.90]. Patients who received prophylactic antibiotics correctly in the post-operative period had a lower risk of SSI than those who did not [RR=0.21/95%; CI=0.70-0.63]. The mean length of hospital stay was shorter among patients whose prophylactic treatment was correctly employed than among for which it was not [6.1 (±9.8) and 11.1 (±13.5) days, p=0.25] [63].

The study conducted on the appropriateness of antibiotic prophylaxis administered before surgery at a major referral hospital in Shiraz Iran, in 2010, against the American Society of Hospital Pharmacists (ASHP) guidelines. Of 155 patients included in the analysis, 98% received prophylactic antibiotic before surgery; according to ASHP guideline, prophylaxis was needed in only 106 (68.4%). Of these 106, only 8 patients received the correct antibiotic regimen. The commonest regimens administered were cefazolin + gentamicin (47.6%), cefazolin (20.5%) and cefuroxime (8.5%). Antibiotic prophylaxis continued in 83% of cases, while this was necessary in only 37%. In only 1 surgical procedure were all evaluated parameters correct [37].

The study conducted on prophylactic use of antibiotics for clean operative procedures in the department of surgery China, showed that, a total of 2000 cases with clean operative procedures were randomly selected from January 2011 to June 2011 and reviewed. Results showed all patients received prophylactic use of antibiotics (100%), which was performed at 0.5 to 2 h before surgery in 1204 cases (60.2%), at >2 h before surgery in 452 cases (22.6%), before and during surgery in 19 cases (0.95%) and after surgery in 325 cases (16.25%). Cephalosporin antibiotics were the most frequently used in 1883 cases (94.15%). Combination of application of antibiotics were been found in 254 cases (12.7%). The indications for prophylactic use of antibiotics in patients undergoing clean operative procedures are extensive, high-level antibiotics are used, the time of antibiotic delivery is improper and the post-operative application of antibiotics is long [64].

A study of prospective drug utilization evaluation of three broad-spectrum antimicrobials: cefepime, piperacillin-tazobactam and meropenem in Israel, in 2001 showed that overall, 205 patients received 271 courses with one of these antibiotics, for a total of 709 defined daily doses (DDD) of cefepime, 543 of piperacillin-tazobactam, and 680 of meropenem(8.3, 6.3 and 7.9 DDD/1000 admission days respectively). Of these 271 courses, 234 were appropriate (86%). Treatment continued for 55 days in 60%, of which 88% were appropriate (NS). Of the 271 courses, 210 (77%) were empirical (83% appropriate), while 61 (23%) were based on a relevant culture result (97% appropriate) ($p < 0.001$) [38].

Regarding the problem in developing countries, a prospective study on an audit of prophylactic surgical antibiotic use in a Sudanese teaching hospital indicate that A total of 1,768 patients with mean age 37.8 ± 14 years were recruited (females, 83.3 % of total) who underwent 1,814 surgical interventions. Of these 1,277 (70.4 %) of procedures were clean-contaminated. A total of 1,758 patients (99.4 % of total) received antibiotics for prophylaxis; 1,730 patients (97.9 %) were given antibiotics in the operating room; for 1,288 (74.5 %) of cases the antibiotics were considered ‘recommended’, while for 442 (25.5 %) they were not. Out of the patients for whom prophylaxis was recommended and was given, 725(56.3 %) of patients received a broad-spectrum antibiotic or unnecessary combination, 913 (70.9 %) received a sub

therapeutic dose, 120 (9.3 %) were given the first preoperative dose within the proper time window, and 1,250 (97 %) of patients had an extended duration of prophylaxis. Compliance with all criteria was achieved in only 47(2.7%) of observed prescriptions [4].

A three month (from Jan.-Mar.2002) prospective study done on the pattern of antibiotic usage in surgical in-patients of University of Gondar teaching hospital, Ethiopia showed that out of 236 patients who have been admitted to the surgical ward during the study period, 167(70.8%) received antibiotics for prophylaxis (32%) and treatment (38.8%) purposes mainly on empirical basis. The study investigated that average number of antibiotics per patient was 2.17 for prophylaxis and 2.18 for treatment; and the mean duration of therapy was 3.2 days for prophylaxis and 8.7 days for treatment. Moreover, in the study, frequently prescribed antibiotics found to be ampicillin, chloramphenicol and gentamicin [58].

Conceptual Framework

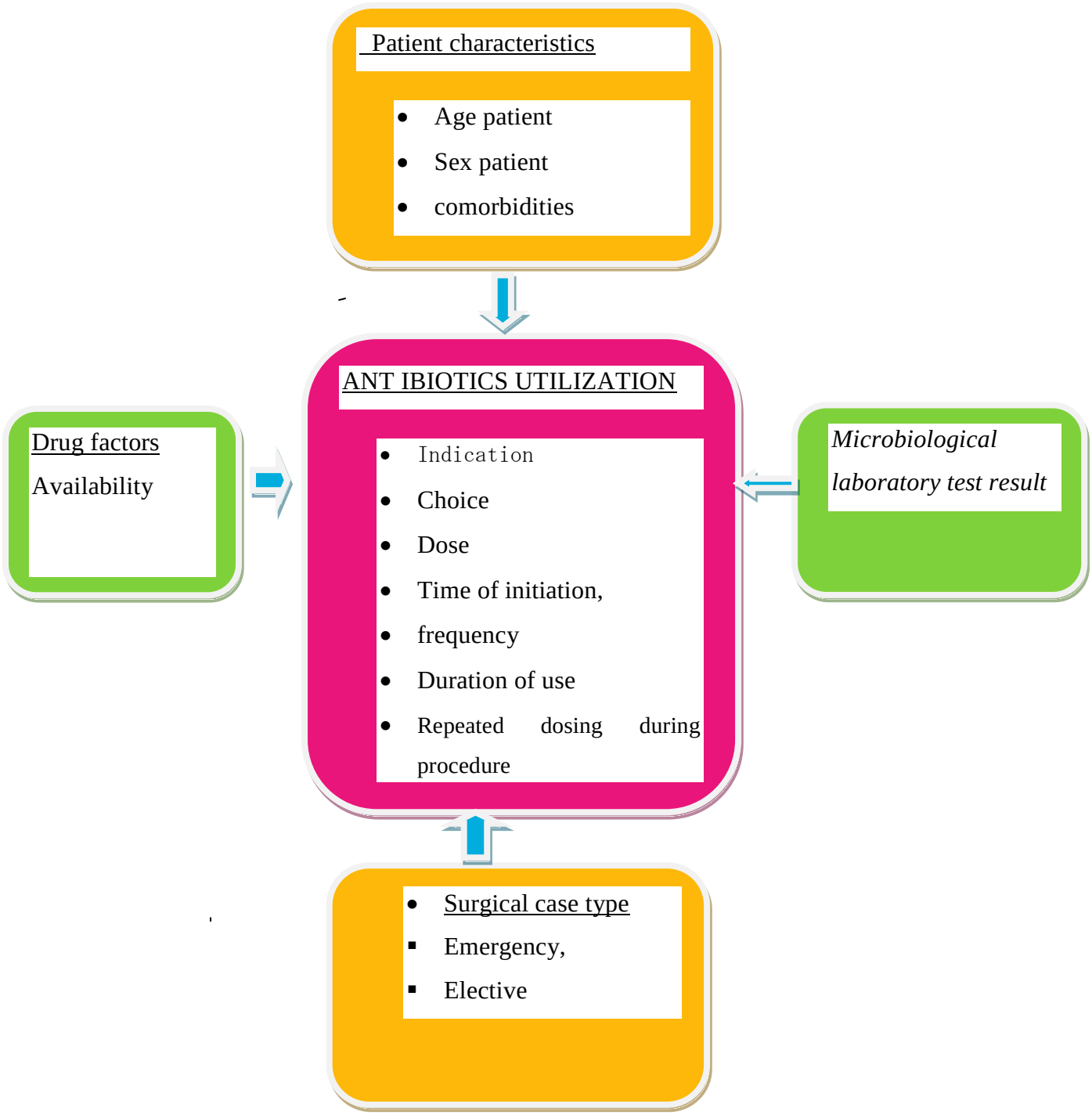

Fig1. A model is showing the interaction of variables that affect utilization of antibiotics.

2. 2 Significance of the study

The findings of this study will help to show the magnitude of inappropriate use of antibiotics, to improve rational prescribing of antibiotics in surgical ward of UOGTH using the ASHP and Ethiopia standard treatment guideline, 2010 and to identify antibiotics use related problems, which can significantly reduce cost of medications, emergence of ADR, prevention of resistance.

In addition, the study will enhance the capacity to look for possible solutions such as educational intervention, changes in norms among providers to favor appropriate antibiotic prescribing, increase adherence to appropriate antibiotic use prescribing guidelines among providers, design and implementation or revising standard treatment guidelines based on international standards, with regard to antibiotics use and associated factors.

This study will in general help the health management in particular those looking after the University of Gondar teaching hospital, understand the extent of the problem with regard to antibiotics use in surgical ward.

Finally, this research will be use as a base line for further studies in the future at regional and national level.

3. Objectives of the study

3.1 General objective

- ✓ To evaluate the antibiotics utilization in surgical ward of University of Gondar teaching hospital, Northwest Ethiopia, from March 11-May10, 2013.

3.2. Specific objectives

- ✓ To determine the magnitude of inappropriate antibiotic use with respect of indications, choice, dose, frequency, duration and starting time
- ✓ To determine the distribution of use of antibiotics with respect to different patient characteristics, surgical specialties
- ✓ To identify type of antibiotics commonly prescribed inappropriately
- ✓ To identify the predictors of inappropriate antibiotic use

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4. Patients and Methods

4.1. Study area and Period

The study was conducted in UoGTH, Gondar, from March 11 - May 10, 2013. The hospital is located in Gondar town, which is the capital city of north Gondar zone in Amhara regional state. The town is located at about 724 kms far from Addis Ababa. According to 2011 central statistical agency of Ethiopia report (CSAoE 2011), the town has a total population 227,100.

UoGTH has 466 beds for inpatient service at five wards such as medical, pediatric, gynecology/obstetric, ophthalmology and surgical wards and provides health services for outpatients at 14 outpatient departments, namely, medical, pediatric, surgery, gynecology/obstetric, MCH, antenatal care, under 5,HIV service, tuberculosis, psychiatry, dental, ophthalmology, physiotherapy and ear, nose and throat. Surgical ward is the one among these wards and provide health care services with 2 rooms, 80 beds and 7 consultant and senior physician, 10 resident, 28 nurse and 16 anesthetists. The hospital provides primary and referral health care services for nearly 5 million people living in Gondar town and neighborhood werdas and zones.

4.2. Study design

Hospital based prospective cross sectional study design was employed for this study.

4.3. Population

4.3.1. Source population

All patients who were admitted to surgical ward of university of Gondar teaching hospital

4.3.2 Study population

All surgical patients who were admitted to in surgical ward of UoGTH, from March 11-May 10, 2013.

4.4. Inclusion and Exclusion criteria

4.4.1. Inclusion criteria

All surgical patients who were admitted to surgical wards who are willing to participate were included in this study.

4.4.2. Exclusion criteria

Those patients unable to provide necessary information, incomplete medical records were not included in this study.

4.5. Sample size and Sampling technique

The patients were consecutively included in to the study based on inclusion and exclusion criteria during the study period.

4.6. Study variables

4.6.1. Independent variables

- Age of patient
- Sex of patient
- Co morbidity
- Availability of antibiotics
- Microbiological laboratory result
- Surgical case type (emergency, elective)

4.6.2. Dependent variable

- Antibiotics utilization (indication, choice, dose, time of initiation, frequency and duration of use)

4.7. Data collection techniques and instruments

4.7.1 Data collection techniques

Data collection instrument used in this study was a pre tested standard data collection form, face-to-face interview using structured questioner and observation. Three data collectors who are 2 B.Sc nurse, 1 B.Sc anesthetist and one supervisor B. Pharm were recruited from wards of the hospital; data collectors and supervisor were trained for two days by the principal investigator to ensure quality of data collection. They were giving an orientation on the protocol and specific details concerning participation in the study. Prior to study commencement, they were carrying out practice sessions with authentic respondents. These preliminary interviews, review patient recorders observed and reviewed by the principal investigator.

4.7.2. Data collection instrument

Data collected from review of patient medical records, face-to-face interview using structured questionnaire and observation. The clinical information were included in data collection format were the antibiotics regimen such as drug name, dose, frequency, route, duration, time of initiation, and indication. Any microbiological results, whether the prescription were be based on those results or empirical and susceptibility test, and surgical case type (emergency or elective) and date of admission and discharge, tentative and final diagnosis was collected from patients' records. The questionnaire focuses on the demographic characteristics of patients; Patients interviewed using the Amharic version of structured questionnaire.

Data relevant to the following questions assessed: Do the procedure justify prophylaxis/treatment? Is the timing of the administration correct? Is appropriate antibiotic chosen? Is the number of doses correct? Is the duration of prophylaxis/treatment correct? Is the dose interval appropriate?. Procedures should classify as either elective or emergency.

4.8. Data analysis

The collected data were code, cleared and checked for completeness and entered to SPSS for windows version 20.0 statistical software. A descriptive analysis was performed on the demographic and clinical data, including sex, age, infection and its classification, variables for prescribing antibiotics, such as dose, duration of antibiotic treatment. Frequencies, percentages, mean and standard deviations were used to describe descriptive variables. Binary logistic regression was used to see the association between independent variable and dependent variable. Those variables with a p value < 0.25 in bivariate analysis was a candidate for multivariate analysis and those variables with a p value < 0.05 were considered as significant in multivariate analysis. Odds ratio and confidence interval of 95 % were used to see the strength of association.

Appropriateness of antibiotic prophylaxis and treatment evaluated as per guidelines of Ethiopia general hospital STG and American Society of Health-system Pharmacists, 2010, guidelines and surgery lecture note for health officers students for Ethiopia 2004. These guidelines provide evidence based recommendations to the practitioners for rational use of prophylactic and therapeutics antibiotics.

4.9. Data quality assurance

To assure the quality of the data great emphasis was given in designing data collection instrument for its simplicity and understandability. The questionnaire was developed in english and translates to Amharic and later back translated to English for its consistency and desired results. Data collectors and supervisor were trained for two days intensively on contents of medical records, part of the record, which is valuable to the study, data collection methods and ethical concerns

A pretest was done on 12 patients to make sure that whether the study was feasible in this way and to see if the data collection format is appropriate and consistent with the patient medical record when gathering the intended information.

The principal investigator was also closely supervising the activity on daily basis. At the end of each data collection day the principal investigator was checked the completeness of filled interview and whether recorded information makes sense to ensure the quality of data collected. Besides this, the principal investigator was entered carefully to clean the data before the commencement of the analysis.

4.10. Ethical consideration

The study was conducted after ethical clearance letter received from research and ethics review committee of the Jimma University College of public health and medical sciences. Formal letter of permission was obtained from the hospital's director and head of the surgical ward of University of Gondar teaching hospital. All patients in the study were asked for their willingness to participate in the study. Information was giving to all participants about the objective, the contents of the study, as well as their right to refuse. The study was done with care not to interfere with the normal service given to the patients. Besides, to this all the information were collected from the study subjects handled confidentially and data was used for the research purpose only, additionally confidentiality of all the data to be gained were seriously respected.

4.11. Dissemination of findings

The result of the study disseminated to staffs of Jimma University, College of public Health and Medical Sciences graduate School, department of pharmacy, UoG, concerned bodies in the area of study and present to professional associations like Ethiopia pharmacy association, Further efforts will be made to publish on national or international peer reviewed journal.

4.12. Definition of terms and operational definition

4.12.1. Definition of terms

Antibiotics: defined as any therapeutics agent produced by microorganisms or made synthetically that selectively destroy or inhibit the growth of microorganisms (28).

Clean surgical procedures: (primarily closed, elective procedures involving no acute inflammation, no break in technique, and no transection of gastrointestinal, oropharyngeal, genitourinary, biliary, or tracheobronchial tracts (28).

Clean-contaminated procedures: (procedures involving transaction of gastrointestinal, oropharyngeal, genitourinary, biliary, or tracheobronchial tracts with minimal spillage or with minor breaks in technique; clean procedures performed emergently or with major breaks in technique; reoperation of clean surgery within seven days; or procedures following blunt trauma (28).

Contaminated procedures: (clean-contaminated procedures during which acute, non purulent inflammation is encountered or major spillage or technique break occurs; procedures performed within four hours of penetrating trauma or involving a chronic open wound) (28).

Dirty procedures: (procedures performed when there is obvious preexisting infection [abscess, pus, necrotic tissue present]; preoperative perforation of GI, oropharyngeal, biliary, or tracheobronchial tracts (28).

Prophylactic antibiotic: Defined as a brief course of an antibiotics initiated before, during, or after an operation in order to reduce intraoperative microbial contamination to a level that will not overwhelm host defense and result in infection (28)

Therapeutic antibiotic*:* The use of antibiotics that reduce the growth or reproduction of bacteria, including eradication therapy (28)

4.12.2. Operational definitions

Appropriate antibiotic use: shall mean correct use of all criteria of antibiotics with respect to indication, choice, time of initiation, dose, frequency and interval duration in the light of proper clinical situations as per protocol of Ethiopia General hospital STG and ASHP, 2010 guidelines.

Duration of prophylaxis: appropriate if given as single-dose prophylaxis or prophylaxis ending within 24 hours or less, with the exception of cardiothoracic procedures (up to 72 hours' duration) is recommended by our STG and ASHP guidelines and inappropriate if extended postoperatively treatment.

Duration of treatment: appropriate if given on proper duration based on the light of proper clinical situations as per protocol of Ethiopia general hospital STG, 2010 guideline.

Inappropriate antibiotic use: refers to incorrect administration with respect to indication, choice, time of initiation, dose, and interval duration in the light of proper clinical situations as per protocol of ASHP guideline and Ethiopia STG, 2010.

Indication: appropriate decision- making regarding use or non-use of antibiotics prophylaxis or treatment

Medical record: can be defined as a record that contains patient information, medical condition, drug prescribed, laboratory values, nursing notes, and anesthesia evaluations

Time of administration of the first preoperative dose/s **of prophylaxis**: 'too early' if given 30 minute before incision made; 'appropriate if given within 30–60 min before incision 'late' if given greater than 60 min before the incision.

5. Result

5.1. Patient characteristics

A total of 271 admitted patients' medical records were evaluated during the two-month study period. One hundred fifty (55.4%) of them were males and one hundred twenty one (44.6%) were female with mean age of 33.99±18.74 years. Majority of patients 202(74.5%) were in the age group 14-65 years (Table1).

Table 1: Age and sex distribution of surgical inpatients in UoGTH, Gondar, March11-May 10, 2013, (n=271).

Age group(years)	**Sex of the patients**		**Total**
	Male N (%)	**Female N (%)**	**N (%)**
<14 years	29(10.7)	11(4.1)	40(14.8)
14-65 years	100(36.9)	102(37.6)	202(74.5)
>65 years	21(7.8)	8(2.9)	29(10.7)
Total	150(55.4)	121(44.6)	271(100)

In this study two hundred and seventy one surgeries were conducted during a two-month period, of these 160（59%) were elective and 111(41%) emergency operations. The most commonly performed surgical specialties were gastrointestinal, orthopedic, head and neck, and urology accounting for 41.3%, 21.4%, 10.7%, and 9.6% of the surgeries respectively (Table 2).

Table 2: Type of surgeries performed in surgical ward of university of Gondar teaching hospital, Gondar , March 11-May 10, 2013, (n=271).

Surgical specialty	Number	Percent
Gastrointestinal	112	41.3
Orthopedics	58	21.4
Cardiothoracic	8	3.0
Head and neck	29	10.7
Urology	26	9.6
Others	38	14
Total	271	100.0

*others [breast carcinoma, vaginal carcinoma, abdominal hysterectomy etc**]**

5.2. Number and Type of Antibiotics Prescribed

Of the 271 evaluated patients, 222 (81.9%) had received one or combinations from eight different types of antibiotics, of which 163 (73.4%) prescriptions were for prophylaxis and 59 (26.6%) for treatment. The most frequently prescribed prophylactic antibiotics regimen were ceftriaxone 98(60.1%), ampicillin 29(17.8%), Cloxacillin 10 (6.1%), ceftriaxone with metronidazole 13(8%), all preoperative prophylactic antibiotics were administered by intravenous route. Moreover, for therapeutic purpose, Cloxacillin 13(22%) ceftriaxone 3(5.1%), ceftriaxone with metronidazole 18(30.5%), and Cloxacillin with chlorampinicol 15 (25.4%) were the most commonly prescribed antibiotics regimen per patient either as a single agent or in combination (Table 3).

Table 3: List of antibiotics regimen used in surgical ward of UoGTH, Gondar, March 11- May 10, 2013, (n= 222).

Type of antibiotics regimen	Indication		Total N (%)
	Prophylaxis N (%)	Treatment N (%)	
Ceftriaxone	98 (60.1)	3 (5.1)	101(45.4)
Ampicillin	29(17.8)	0	29(13.1)
Cloxacillin	10(6.1)	13(22)	23(10.3)
Chlorampinicol	1(0.6)	0	1(0.4)
Gentamicin	1(0.6)	0	1(0.4)
Ciprofloxacillin	3(1.9)	0	3(1.4)
Ceftriaxone & metronidazole	13(8)	18(30.5)	31(14)
Ceftriaxone &Cloxacillin	1(0.6)	0	1(0.4)
Ceftriaxone , metronidazole & Cloxacillin	1(0.6)	1(1.7)	2(0.8)
Ceftriaxone , metronidazole & gentamicin	0	2(3.4)	2(0.8)
Cloxacillin & chlorampinicol	2(1.2)	15(25.4)	17(7.6)
Cloxacillin &metronidazole	1(0.6)	4(6.8)	5(2.3)
Ampicillin &metronidazole	3(1.9)	0	3(1.4)
Ciprofloxacillin & metronidazole	0	1(1.7)	1(0.4)
Ceftriaxone,crystallin penicillin & metronidazole	0	2(3.4)	2(0.8)
Total	163	59	222

There were 70.3% single and 29.7 % prescriptions of combination antibiotic was used for the admitted patients, with the maximum number of antibiotics being three for their treatment and prophylaxis. 142 (87.1%) and 15/59 (25.4%) of patients received a single antibiotics, 20/163 (12.3%) and 39/59 (66.1%) of patients received two antibiotics and 1/163 (0.6%) and 5/59 (5.8%) patients received three antibiotics for prophylaxis and treatment respectively (Table 4).

Table 4: Use of patients to antibiotics for prophylaxis and treatment in surgical ward, UoGTH, Gondar, March 11 –May 10, 2013.

No. of antibiotics in combinations	**Prophylaxis N= (163) (%)**	**Treatment N= (59) (%)**
One	142 (87.1%)	15 (25.4%)
Two	20 (12.3%)	39 (66.1%)
Three	1 (o.6%)	5 (8.5%)

5.3. Distribution of antibiotic utilizations in different age groups

Among 222 prophylactic and therapeutics prescriptions, those within the age group of 14-65years were received the highest percentage of antibiotics 166 (74.8%), followed by those age group below 14 years 32 (14.4%), and age group greater than 65 years were 24 (10.8%), table 5 showed that the use of antibiotic in the various age groups.

Table 5: Distribution of Antibiotic usage in different age groups admitted the surgical ward of UoGTH, Gondar, March 11-May 10, 2013.

Age (years)	**Number of antibiotic prescriptions**	**Percent of total antibiotic prescription**
<14	32	14.4
14-65	166	74.8
> 65	24	10.8
Total	222	100

5.4 Distribution of antibiotics utilization and diagnosis in surgical specialties

The most frequent diagnoses, for which prophylaxis and therapeutics antibiotics were prescribed, include gastrointestinal (appendicitis, peritonitis, obstruction, penetrating abdominal trauma), orthopedics [fracture and bone infections, (osteomyelitis, pyomyesitis, and abscess], urology (BPH, urinary tract infections) and head and neck (fracture, injury, hematoma, hyperthyroidism). Antibiotic usage more common in gastrointestinal 99/222(44.6%), and followed by orthopedics 49(22.1%) (Table 6, 7).

Table 6: Prophylactic antibiotics regimen used by surgical specialties in surgical ward of UoGTH, Gondar, March 11-May 10, 2013, (n=163).

Surgical specialty	Antibiotics regimen administered	N	Total
Gastrointestinal	Ceftriaxone	63	79
	Ampicillin	4	
	Cloxacillin	1	
	Gentamicin	1	
	Ceftriaxone & metronidazole	7	
	Ceftriaxone , metronidazole & Cloxacillin	1	
	Ampicillin & metronidazole	2	
Orthopedics	Ceftriaxone	6	16
	Cloxacillin	6	
	Chlorampinicol	1	
	Cloxacillin & chlorampinicol	1	
	Cloxacillin & metronidazole	1	
	Ceftriaxone & metronidazole	1	
Cardio-thoracic	Ceftriaxone	2	4
	Ampicillin	1	
	Cloxacillin & chlorampinicol	1	
Head and neck	Ceftriaxone	6	14
	Ampicillin	1	
	Ceftriaxone & metronidazole	2	
	Cloxacillin	3	
	Cloxacillin& metrindazole	1	
	Ampicillin & metronidazole	1	
Urology	Ceftriaxone	15	18
	Ciprofloxacin	3	
Others	Ceftriaxone	5	31
	Ampicillin	23	
	Ceftriaxone & metronidazole	3	

Table 7: Therapeutic antibiotics regimen used in operations performed in surgical ward of UoGTH, Gondar, March 11-May 10, 2013, (n=59).

Surgical specialty	Antibiotics regimen administered	N	Total
Gastrointestinal	Ceftriaxone	2	20
	Ceftriaxone & metronidazole	15	
	Ceftriaxone , metronidazole & Cloxacillin	1	
	Cloxacillin	1	
	Ceftriaxone , c. penicillin & metronidazole	1	
Orthopedics	Ceftriaxone	1	33
	Cloxacillin	11	
	Ceftriaxone & metronidazole	1	
	Ceftriaxone , metronidazole & gentamicin	2	
	Cloxacillin & chlorampinicol	13	
	Cloxacillin& metronidazole	4	
	Ceftriaxone, c. penicillin & metronidazole	1	
Cardio-thoracic	Cloxacillin & chlorampinicol	2	3
	Ceftriaxone & metronidazole	1	
Head and neck	Cloxacillin	1	1
Urology	Ciprofloxacin & metronidazole	1	1
Other	Ceftriaxone & metronidazole	1	1

5.5. Evaluation of appropriateness of therapeutics and prophylactic antibiotics utilizations

Out of the 222 evaluated prescriptions, 160(98.2%) of prophylactic and 43(72.9%) of therapeutic prescriptions were found to be inappropriate. The inappropriate antibiotic prescription was more common in prophylactic 98.2% than therapeutics prescriptions 72.9%. The overall inappropriate antibiotics prescriptions were 203 (91.4%) (Table 9).

Table 8: Evaluation of prophylactics and therapeutic antibiotics use in surgical ward of UoGTH, Gondar, March 11-May 10, 2013.

Type of prescription	Evaluation of prophylaxis and treatment utilization		Total
	Appropriate	Inappropriate	
Prophylaxis	3(1.8%)	160(98.2%)	163(73.4%)
Treatment	16(27.1%)	43(72.9%)	59(26.6%)
Total	19(8.6%)	203(91.4%)	222(100%)

The results of this study demonstrate that most common indicators of prophylaxis and therapeutics included were.

Indication

0f the 211 prophylactic candidates, 45/211(21.3%) were inappropriate prophylactic indication, of which 5/45 not candidate of prophylactic but given, 40/45 were a candidate of prophylactic antibiotics but not administered. In addition, of the 60 therapeutic antibiotics candidate 59 indication were appropriate while inappropriate indication were 1(1.7%) of patient (Table 9, 10).

Table 9: Evaluation of prophylactic and therapeutics antibiotic indication with different wound classification in surgical ward of UoGTH, Gondar, March-May, 2013

Variable	Antibiotics usage						Total
	Prophylaxis			Treatment			
	Clean N (%)	clean-contaminated N (%)	Total N (%)	Contaminated N (%)	Infected N (%)	Total N (%)	
Req & adm	8(3.8)	150(71.1)	158(73.9)	31(51.6)	28(46.7)	59(98.3)	217
Not req & not adm	8(3.8)	0	8(3.8)	0	0	0	8
Req but not adm	17(8.1)	23(10.9)	40(19)	1(1.7)	0	1(1.7)	41
Not req but adm	5(2.3)	0	5(2.3)	0	0	0	5
Total	38(18)	173(82)	211	32(52.3)	28(46.7)	60	271

N.B: req-required, adm-administered

Starting time

Concerning the timing of the antibiotics administration 76(46.6%) of the patients were given their prophylactic antibiotics in proper time while 87/163 (53.4 %) of the patients were given their prophylactic antibiotics incorrect time. Of which timing was earlier than recommended in 10(6.1%) procedures and later in 77 (43.3%) (Table 10).

Antibiotic choice

Out of the patients who had prophylaxis given 3(1.8%) antibiotic choice was appropriate and 160(98.2%) choices of prophylactics inappropriate and patients who had therapeutics antibiotics given 21(35.6%) was appropriate and 38(64.4%) inappropriate choice such as broad spectrum, ineffective, or unnecessary combinations (Table 10).

Dose of antibiotics

Regarding the dose administered, 42(25.8%) the dose of prophylactic antibiotics was appropriate and 121 (74.2 %) patients were given inappropriate dose of prophylactics; of these 121(74.2%) the dose of prophylactic was higher than recommended (over doses). In addition, out of 59 therapeutic prescriptions 21(35.6%) the dose of therapeutic antibiotics was appropriate and 38(64.4 %) patients were given inappropriate, of these16 (27.1%) was under dose and 22(37.3%) over dose (Table 10).Moreover all surgeries conducted lasting 3 hour or less due to this additional dose prophylactic antibiotics not administered to all surgical patients .

Duration

In 163 prophylactics prescriptions 35(21.5%) duration was appropriate and 128(78.5%) was inappropriate duration, duration of prophylaxis were extended beyond single doses were 128(78.5%). Moreover, 16(27.1%) duration of therapeutics antibiotics was appropriate and 43(72.9%) duration was inappropriate (Table 10).

Frequency

Out of 163 prophylactics prescriptions 42(25.8%) dose interval was appropriate and 121(74.2%) was inappropriate and 21(25.6%) therapeutics dosing interval was appropriate and 38(64.4%) inappropriate (Table 10).

Table 10: Summary of Evaluation of the appropriateness of antibiotics prophylaxis and treatment in surgical ward of UOGTH, Gondar, March 11-May 10, 2013

Criteria	Evaluation	Prophylaxis	Treatment	Total
		N (%)	N (%)	(%)
Indication	Appropriate	166(78.7)	59 (98.3)	83
	Inappropriate	45(21.3)	1(1.7)	17
Choice	Appropriate	3(1.8)	21 (35.6)	10.8
	Inappropriate	160 (98.2)	38 (64.4)	89.2
	Narrow	-	8(13.6)	
	Broad/ineffective	160(98.2)	30(50.8)	
Dose	Appropriate	42 (25.8)	21(35.6)	28.4
	Inappropriate	121 (74.2)	38 (64.4)	71.6
	Under dose	--	16(27.1)	
	Over dose	121 (74.2)	22(37.3)	
Frequency	Appropriate	42 (25.8)	21 (35.6)	28.4
	Inappropriate	121 (74.2)	38 (64.4)	71.6
Duration	Appropriate	35(21.5)	16 (25.4)	22.5
	Inappropriate	128(78.5)	43 (72.9)	77.5
	Short	---	23(40.7%)	
	Extended	128(78.5%)	20(33.9%)	
Starting time	Appropriate	76(46.6 %)	---	46.6
	Inappropriate	87(53.4%)	---	53.4
	early	10(6.1%)	----	
	late	77(47.3%)	----	

5.6. Evaluation of appropriateness antibiotics usage in surgical specialties

Two hundred twenty two surgical procedures included the analysis, among these the inappropriate antibiotic prescriptions more common in gastrointestinal procedures and followed by orthopedics surgical specialties (Table 11).

Table 11: Evaluation of prophylactic and therapeutics antibiotics among the procedures in which it indicated, according to antibiotic choice, time of starting, number of doses and duration, by specialties in surgical ward of UOGTH, March-May, 2013

Surgical Specialties	Inappropriate choice		Inappropriate dose		Inappropriate frequency		Inappropriate duration	
	Number		Number		Number		Number	
	P	T	P	T	P	T	P	T
Gastrointestinal	79	18	56	19	56	19	61	18
Orthopedics	16	17	12	16	12	16	12	22
Cardio-thoracic	4	1	3	1	3	1	4	1
Head and neck	14	1	10	1	10	1	10	1
Urology	15	1	12	1	12	1	12	1
Others	32	0	28	0	28	0	29	0
Total	160	38	121	38	121	38	128	43

N.B: p-prophylaxis, T-treatment

5.7. Evaluation of type of antibiotics

Eight single and combinations of different antibiotics were prescribed among these the highest rate of inappropriate single and combination antibiotics regimen purpose was for ceftriaxone 101(100%), ampicillin 29(100%) and ceftriaxone with metronidazole 30(96.8%) and cloxacillin with chlorampinicol 15(88.2) respectively. Most frequent indication for ceftriaxone use was prophylaxis 98/101 (99%) in UoGTH. Even though it has not recommended for surgical prophylaxis in Ethiopian STG and ASHP guideline.

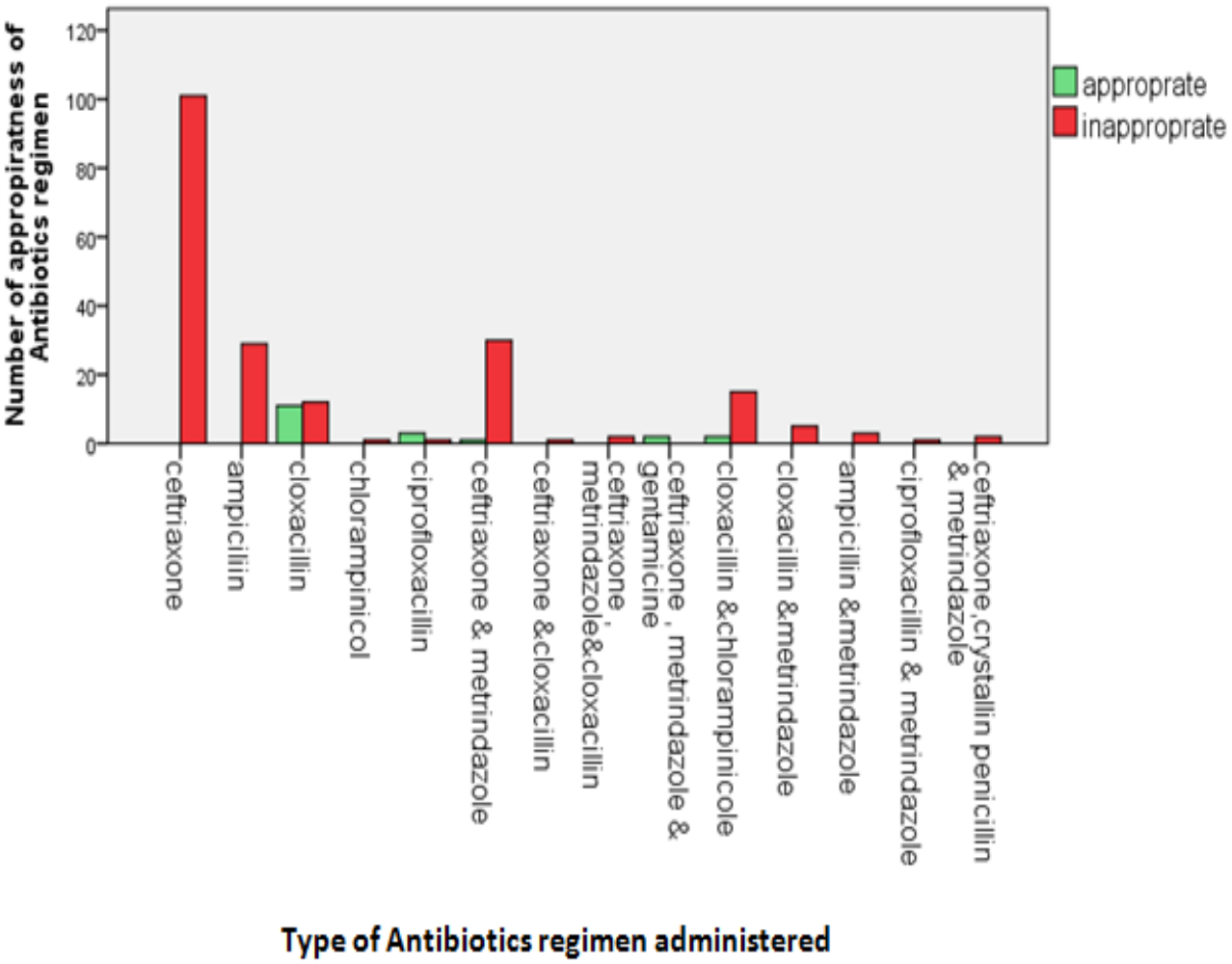

Figure 2: Evaluation of appropriateness of antibiotics regimen used in prophylaxis and treatment in surgical ward of university of Gondar teaching hospital, Gondar, March 11-May 10, 2013, (n = 222).

5.9. Factors associated with appropriateness of antibiotics utilizations

The identified factors that contribute to antibiotics utilization were patients' factors (age, sex and co-morbidity), drug factor (availability), surgical case type (emergency, elective) and microbiological laboratory result (empiric, laboratory-based prescription).

5.9.1. Patients, drugs and surgical case type related factor

Of 222 patients, 124 were male; of these 108(87%) prescriptions were inappropriate and 98 females patients received antibiotics out of these 95(96.9%) prescriptions were inappropriate. Binary logistic regression analysis showed that female patients were 4.691 times more likely received antibiotics inappropriately than male patients (COR 95% CI 4.691(1.326-16.598) ($P < 0.017$).

Among 222 the study participants age grouping less than 14 years received 32(14.4%) antibiotics, of these 4 prescription was appropriate and 28 inappropriate. Age group of 14-65 was 166(74.8%), of these 13 was received appropriate prescriptions and 153 was inappropriate and age grouping greater than or equal to 65 was 24(10.8%), out of these 2/24 was received appropriate antibiotics and 22/24 was received inappropriate prescription. Binary logistic regression analyses showed that age of the patients were there is no-significant value of $p > 0.05$. This result showed that there was no significant association between age of patient and the antibiotics utilization.

In this study 51 co-morbid conditions was recorded, of these patients 11(4.1%) of which were diabetes maliaitus, 3(1.1%) Retroviral Infection, 5(1.8%) malnourished, two (0.7%) asthma, 30(11.1%) cases ASA score 3 and 4. Of 51 comorbidities 19 case antibiotics required and administer while 32 cases require antibiotics but not indicated, these were most common in gastrointestinal surgical procedures and 220 cases were without comorbidities. Antibiotics prescribed for patient with comorbidities 82.1% was slightly less inappropriate than patient without comorbidities, (COR 95% CI 2.191(0.577-8.324) ($P < 0.249$) (Table 11).

With regards to the availability of antibiotics, 207(93.2%) antibiotics prescriptions available at the time of prescription, however 15(7.8%) prescribed antibiotics were not available. The likelihood of inappropriate antibiotic use were higher if prescribed antibiotics are not available when compared to availability of prescribed antibiotics, [COR 95% CI 4.655(1.326-16.598)] ($P < 0.017$). In addition, out of 19 antibiotics recommended by Ethiopia STG and ASHP guidelines for this research purpose 5/19(26.3%) antibiotics were not available and not included the recent 2012, university of Gondar teaching hospital drug list.

In this study, of the 222 therapeutic and prophylactic prescriptions only 8 (4.5%) patients used antibiotics were based on laboratory investigation results, however, 214 prescriptions were therefore made empiric basis on the likely infecting pathogen. Empirical prescriptions were more frequently inappropriate 93% than prescriptions based on available microbiological results 50%. [COR 95% CI 13.267(3.014-58.393)] ($P < 0.001$).

In this study, 271 surgeries performed on hospitalized patients evaluated during the two-month period; 59 % were elective while 41% were emergency operations. Two hundred twenty two surgical procedures included in the analysis, of these 96 (43.2%) were emergency and 126 (56.8%) electives procedures. However, antibiotics usage in emergency procedures were more frequently inappropriate 94/96 (97.9%) than elective procedures 109/126 (86.5%) [COR 95%CI = 7.477(1.684-33.204)] - ($P < 0.008$).

Table 12: Bivariate logistic regression analysis of factors affecting antibiotics utilization at University of Gondar teaching hospital, Gondar, 2013

Variable	Appropriateness of antibiotic		COR(95%CI)	P-values
	Inappropriate	Appropriate		
Sex	203	19		
Male	108	16	1.000*	
Female	95	3	4.691 (1.326-16.598)	0.017
Age	203	19		
0-14yrs	28	4	0.636(0.107-3.800)	0.392
14-65yrs	153	13	1.070(0.236-5.063)	0.932
>65yrs	22	2	1.000*	
Availability	203	19		
Yes	192	15	1.000*	
No	11	4	4.655(1.326-16.598)	0.017
Microbiological test	203	19		
Yes	4	4	1.000*	
No	199	15	13.267(3.014-58.393)	0.001
Surgical case type	203	19		
Emergency	94	2	7.330 (1.651-32.555)	0.009
Electives	109	17	1.000*	
Comorbidities	203	19		
Yes	16	3	1.000*	
No	187	16	2.191(0.577-8.324)	0.249

NB *-reference

5.10. Multivariable analysis of independent predictors with antibiotics utilizations

Bivariate analysis showed that sex, co morbidity, availability antibiotics, surgical case type and microbiological laboratory test were candidate for multivariate logistic analysis. Accordingly, in the multivariate logistic analysis; the antibiotics utilization was more likely to be inappropriate in females than those with males. This analysis indicate that female patients were 3.998 times more likely to have inappropriately received antibiotics as compared to those males (AOR 95%CI 3.998(1.022-15.642), the antibiotics utilizations in emergency surgical procedures were 6.395 times more likely to have inappropriate than in electives procedures, (AOR 95%CI= 6.395(1.363-29.992). Prescriptions without microbiological laboratory test results (empiric) was 8.090 times more likely to have inappropriate compared to those prescriptions with microbiological laboratory test results (AOR 95 % CI=8.090(1.420-46.078). Similarly, not availability of antibiotics in this hospital were 6.221 times more likely to have inappropriately prescribed than antibiotics available at the time of prescription (AOR 95%CI =5.435(1.094-27.022), (Table 19). However, other factors such as age of the patient and comorbidities were not significantly to independently predicted inappropriate utilizations.

Table 13: Independent predictors of inappropriate antibiotic use among surgical cases in University of Gondar Teaching Hospital, 2013

Variable	Frequency of Appropriateness of antibiotics		AOR(95%CI)	P–value
	Inappropriateness of antibiotics	Appropriateness of antibiotics		
Sex	203	19		
Male	108	16	1.000*	
Female	95	3	3.998(1.022-15.642)	0.046
Surgical case type	203	19		
Emergency	94	2	6.395 (1.363-29.992)	0.019
Electives	109	17	1.000*	
Microbiological laboratory test	203	19		
Yes	4	4	1.000*	.
No	199	15	8.090(1.420- 46.078)	0.019
Availability	203	19		
Yes	192	15	1.0000*	
No	11	4	5.435(1.094- 27.022)	0.038

6. DISSCUSION

For more than 30 years, different researchers have reported that as much as 50% of antibiotic usage in hospitals is inappropriate. Emergence of resistant, adverse drug reactions and excessive strain on already limited pharmacy budgets are major outcomes of inappropriate antibiotic use [2, 12]. The proper use and effectiveness of antibiotic prophylaxis and treatment in surgical procedures depends on appropriate choice, timing of the initial administration, the number of dosages administered during surgery, and post-operative drug use [6]. The present study attempts to evaluate the appropriateness of antibiotics prescriptions in surgical wards.

All parameters of the appropriateness of the antibiotics prophylaxis and treatment, such as indication, choice of the antibiotics, the timing of administration of the first dose, and the duration of the prophylaxis, analyzed.

The results of this study indicate that the prophylactic antibiotics fulfillment with all stated evaluation criteria was achieved in only 1.8%, this result were consistent with those of similar studies done in Brazil 5.1% [61], Sudan 2.7% [4], and Iran 0.9% [37] respectively. However, the finding in this study was lower than study conducted at Switzerland 16.6% [8]. This could be due to unavailability of key prophylactic antibiotics, be lack of awareness of our STG and ASHP guidelines by prescribers such as medical resident and interns and reflected the impact from an absence of individual surgical guidelines

The finding of this study shows the therapeutic antibiotics fulfillment with all stated evaluation criteria achieved in only 27.1%. This finding was lower than with those similar studies done in Switzerland 37.0% and Brazil 73% [8, 61]. These may be due to unavailability of antibiotics; wrong interpretation or absences of microbiological laboratory test based prescriptions, and lack of awareness of our STG guidelines by prescribers

In the present study the indication of prophylactic antibiotics were inappropriate 21.3%.This finding consistent with that similar study done in Sudan 25.5% [4].

However the result of this study was significantly higher compared with a similar study done in Switzerland 2.1% [8], and Brazil 1.1% [61].This may be the lack of understanding of prescriber to distinguish which surgical cases need antibiotics or not and not considering the comorbidities conditions and the prescriber lack of awareness of on our STG and ASHP guidelines

In this study the indication of therapeutics antibiotics were inappropriate 1(1.7%), this result is in contrast with that similar study done in Switzerland 30.3% [8]. This is may be due to the prescriber lack awareness of which surgical case requires antibiotics therapy or not

The choice of appropriate antibiotics for specific patients should take into account not only comparative efficacy but also adverse-effect profiles and patient drug allergies. The chosen antibiotics must reflect local, disease-specific information about the common pathogens and their antibiotics susceptibility, types of incision, and risk factors [28]. Our STG and ASHP guidelines promote the use of narrow spectrum antibiotics for surgical prophylaxis. Cefazolin used as first choice in clean and give tolerable coverage for many clean-contaminated operations as well. However, for procedures of the alimentary tract, genitourinary tract and Hepatobiliary system, coverage should additionally influenced by site-specific flora, such as gram-negative and anaerobic microorganisms. In such cases, second generation cephalosporins cefotetan or cefoxitin is a suitable agent [28].

In the present study, ceftriaxone prescribed as a single antibiotic to almost greater than half of all the patients who were received antibiotics prophylaxis 98(60.1%), this was inappropriate as per Ethiopia STG and ASHP guidelines. In this study the choice of prophylactic antibiotic complied with our and ASHP guidelines in only 1.8 % of the surgical procedures. This result was lower than those similar studies done in Iran and Brazil with the rate of 7.5% and 78.9% respectively [37, 61]. Moreover, in the present study 63.4 % of therapeutics antibiotics choice in surgical procedures did not comply with our STG. Although the findings in this study higher than study conducted at Switzerland, where rate of 10.9 % [8]. The reason for this could be, due to specially unavailability of key prophylaxis antibiotics such as cefazolin, cefuroxime cefoxitin.

The physicians' choices were based on personal preference instead of using guidelines, limited experience on physicians such as medical inters, residents on antibiotics choices as they are on diagnosing diseases and surgical procedures and may be due to the unavailability of clinical pharmacist to assist physicians in correct choice of antibiotics according to guidelines

The starting Time of antibiotic prophylaxis administration is critical. According to our and ASHP guidelines, prophylactic use of antibiotics should be performed 30 to 60 minutes before surgery. The first dose should always give before the skin incision performed. For longer procedures, re administration of the antibiotics was indicating at intervals of one or two times the half-life of the drug. This ensures adequate tissue levels throughout the duration of the procedure, however administered too late or too early reduces the efficacy of the antibiotic and may increase the risk of SSI [13, 28]. In this study 76 (46.6 %) of the patients were giving their antibiotics in the right time. This result was higher than with those studies in, Brazil and Sudan where the rate of 15.7 % [60] and 9.3 % [4] respectively, however this finding was lower than the study done in Switzerland 99 % [8]. This could be, in some patients the first dose of prophylaxis was given in the ward instead of in the operating room, the patient not arrives in surgical room on time, some surgery postponed after administration of antibiotics due to small number of senior surgeons, and lack of understanding by prescriber about the most encouraging timing of dosing

It is generally accept as good practice that the dose of an antibiotic required for prophylaxis is the same as that for the therapy of infection. For many types of commonly performed surgery, there is consistent evidence that a single dose of antibiotics with a long enough half-life to achieve activity throughout the operation is adequate, except in special circumstances for example, prolonged surgery, major blood loss [28]. In this study, the majority of patients the doses of prophylaxis were extend 121/163 (74.2%). This result was in agreement with that study done in Sudan 70.9% [4]. But this findings not agreement with study done in Brazil where the rate of 11.1 % [60] and also in the present study the therapeutics dose of patients were inappropriate 64.4%, this findings not in line with those similar study done in Switzerland, Brazil where the rate of 9.5% [8], 15.7% [61] respectively. This may be the prescriber

extended beyond single doses due to fear of infection or to get positive clinical outcomes.

In general, single-dose prophylaxis, or prophylaxis ending within 24 hours or less, with the exception of cardiothoracic procedures (up to 72 hours' duration) is recommend by our STG and ASHP guidelines. Extended use of prophylactic and therapeutics antibiotics has been associated with the emergence of resistance and can contribute to unnecessary disturbance of the microbial flora. In this study the majority of patients the duration of prophylaxis extended beyond single doses 128/163(78.5%). This result lower than with those similar studies in Sudan 97% , However this result in contrast with those similar study done in Switzerland, Brazil where the rate of 10.6 % [8], 15.7% [61] respectively. Moreover, the duration of administration of therapeutics antibiotics, 74.6 % of the patients were given their antibiotics in the improper duration, this result was higher compared with that similar study done in Switzerland where the rate of 6.6% [8]. This may be prescribers due to fear of infection or to get positive clinical outcomes, the courses of prophylactic antibiotics are carried through into the postoperative phase for prolonged periods, and courses of treatment are continued for periods much longer than needed.

This study also tried to assess the relationship between patient characteristics, surgical case, availability of antibiotics and microbiological laboratory result with antibiotics utilizations

Patient characteristics

The present study showed that sex of the participants had a significantly associated with inappropriate antibiotics utilization, antibiotics prescribed for female patients were 3.998 times more likely to have inappropriate than those males patients [AOR 95 % CI 3.998 (1.022-15.642) (P= 0.046)].

Laboratory investigation

Antibiotic have two purposes. They are empirical and definitive therapy. Microbiologic culture-based therapy is an important factor in decreasing inappropriate antibiotic usage and reduces antibiotics resistance. In this study, empirical prescriptions were more frequently incorrect 93% than prescriptions based on microbiological laboratory results 50%, AOR 95% CI [8.090 (1.420-46.078) (P < 0.019)]. The present finding was higher than those similar studies done in university Hospital Zurich, Zurich, Switzerland, empirical antibiotic therapy was inappropriate in 42.6% and laboratory based antibiotic therapy was inappropriate in 27.4% (P=0.001) and in Israel empirical were 17% inappropriate, based on a relevant culture result 3% inappropriate (p < 0.001) [39]. These might be due to lack of knowledge of prescriber such as medical resident and interns using of laboratory test based prescription; or wrong interpretation of microbiological results.

Availability

In this study, only 15(7.8%) prescriptions antibiotics not available and 207(93.2%) prescriptions were available at the time of prescription. Unavailability of antibiotic in the pharmacy during prescription were 5.435 times more likely inappropriately prescribed than available antibiotics at the time of prescriptions , AOR 95 % CI [5.435(1.094-27.022) p=0.038]. Moreover, most key prophylaxis antibiotics used for surgery recommended by our STG and ASHP guidelines 5/19, (26.3%) prescriptions like cefazolin, cefuroxime, ceftizoxime, cefotetan and cefoxitin were not available for use and these antibiotics not included even the recent drug list of university Gondar of teaching hospital. These might be due to these recommended antibiotics specially used for prophylaxis of surgical site infections are missing. This seems a reason for prescribers to depend on ceftriaxone leading high prescription rate of this otherwise valuable antibiotic. Provision of first generation cephalosporins such as cefazolin and second-generation cephalosporins such as cefotetan and cefoxitin will improve the rationality of preoperative medications.

Surgical case type

In this study, 96 (43.2%) were emergency and 126 (56.8%) electives procedures were performed. The likely hood of in appropriate antibiotic use in emergency procedure 94 (97.9%) is higher than that of elective procedure 109(86.3%), AOR (95% CI) 7.330 (1.651-32.555) (P=0.017). The present finding was higher than with that study in community teaching hospital, USA, emergency procedures was inappropriate in 62/79 (79%) and elective procedure was inappropriate in 94/132 (71%) [64]. this might be due to emergency conditions the prescriber not consider about the appropriate time, dose, and duration of administrations and even in some emergency cases not administer antibiotics

6.1. Strength and limitation of the study

6.1.1. Strength of the study

- ✓ The findings of the present study were not restricted to the information which was available in the medical records; it includes face- to- face interview and observation.
- ✓ The present study can provide as base line information for continuous prescription evaluation in the hospital
- ✓ The study was conducted prospectively

6.1.2. Limitation of the study

The possible limitations of the present study were

- ✓ The number of patients in the present study was limited.
- ✓ Furthermore, qualitative study on physician, patient knowledge not conducted to investigate the possible reasons behind the problems seen at the surgical ward.

7. CONCLUSIONS

The finding of the present study indicates that significantly high level of the inappropriate use of antibiotics in surgical ward of University of Gondar teaching Hospital. The majority of inappropriateness was seen with choice, duration, dose and frequency of therapy

In this study age group of 14-65 years were received the highest percentage of antibiotics 74.8%, and inappropriate antibiotics utilization more common in this age group. The most common performed surgical specialties were gastrointestinal and in this specialty inappropriate antibiotics usage more common than other specialties.

In the present study, highest rate of single inappropriate antibiotic prescription purpose was noted for ceftriaxone with 101(100 %), ceftriaxone were prescribed to almost greater than half of all the patients who received prophylaxis antibiotics (98 of 163), which was inappropriate as per Ethiopia STG and ASHP guidelines. For surgical prophylaxis, it is important to select an antibiotic with narrowest antibacterial spectrum to reduce the emergence of resistance.

The results of this study demonstrate that inappropriate prescription of antibiotics common in female patients. In addition, unavailability of most key prophylactic antibiotics used for surgery recommended by our STG and ASHP guidelines like cefazolin, ceftizoxime and these antibiotics not included even the recent drug list of the hospital. This may be prescribers to depend on ceftriaxone leading high prescription rate of this otherwise valuable antibiotic.

The present study showed that most of the antibiotics were prescribed empirically these may lead to empirical prescriptions were judged more often as inappropriate. And inappropriate use of antibiotics more common in emergency procedures than elective procedures

8. RECOMMANDATIONS

Based on the finding of this study the following recommendations suggested

- **To stakeholders**
  - ✓ **The UoGTH drugs and therapeutics committee** can play an important role in
  - ➢ Multidisciplinary development, implementation and revising of surgical specific evidence-based antibiotics prescription protocol , guidelines, formulary, will increase the awareness of the need for surgical specific medications
  - ➢ Ensure the availability of antibiotics and will include most key antibiotics used in surgical prophylaxis in the hospital drug list such as, cefazolin, cefotetan and ceftizoxime will improve the rationality of preoperative medications.
  - ➢ Setting continuous antibiotics use evaluation studies
  - ✓ **To the hospital management**
  - ➢ Provide continuous educations and escalation of short-term training of prescribers in the management of surgical cases, will improve the judiciousness of the overall management of antibiotics usage
  - ➢ Facilitate the involvement of clinical pharmacist in case management processes
- **To prescriber**
  - ➢ Prescriber use antibiotics with concern specially in emergency surgical procedure, female patients and gastrointestinal procedures
  - ➢ Prescriber may enhance adherence to guidelines
  - ➢ Prescriptions and orders should be regularly checked and supervised by senior physicians
- **To researchers**
  - ➢ The present study on evaluation of antibiotics utilization in surgical ward patients can provide as base line information for continuous prescription evaluation in the hospital. However detailed and longitudinal antibiotics use evaluation research with larger sample size with longer period will be conduct to investigate the cause of inappropriate prescription and to find relevant solution for it

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Annex I: Data collection format

I. Demographic Information

Questionnaire for evaluation of antibiotics utilization in surgical ward of UoGTH, in 2013

Section I Demographic Information			
S.N	**Questions**	**Response**	**Skip**
1	Cared number	_____	
2	Name of hospital	_____	
3	Sex? What is your weight?	☐ Male ☐ Female ---------kilogram	
4	How old are you?	_____ Years	
5	Where is your permanent residence?	☐ **Rural**: Town------Wereda _____ Kebele _____ ☐ **Urban**: Town _____Wereda _____ Kebele _____	

አኒክስ ፣ የመረጃ መስብስቢያ ቅጽ

አኒክስ ፣ የታካሚው መረጃ መጠይቅ

ክፍል ፣	የማህበራዊ እና ኢኮኖሚያዊ መረጃ መጠይቅ	
ተ.ቁ	ጥያቄ	መልስ
1	የካርድ ቁጥር----------	
2	የሆስፒታሉ ስም----------	
3	ጾታ	ወንድ-------- ሴት---------
4	እድሚህ ስንት ነው ---------- ክብደትህ ስንት ነው----------	----------አመት ------- ኪሎ ግራም
5	ቋሚ የመኖሪያ አድራሻ የት ነው	ከተማ --------ወረዳ----- ቀበሌ---------- ገጠር ---------- ከተማ--------ወረዳ----- ቀበሌ----------

Clinical Information

Data collection format for evaluation of antibiotics utilization in surgical ward of UoGTH, Gondar town, in 2013

Surgical information						**Case type**		**Antibiotics used(Regimen* with Indication)**												Availability of antibiotics		Evaluation	
								prophylaxis								Treatment							
Surgical procedure	Comorbidities	ASA	Laboratory test data	Duration of operation	Intra operative time	Emergency	Elective	Diagnosis	Drug name	Indication	Choice	Dose	Frequency	Duration	Starting time	Additional dose	Diagnosis	Drug name	Choice	Dose	Frequency	Duration	Yes	No	Appropriate	inappropriate

Remark Antibiotics use evaluated based on (1) indication for antibiotic therapy (2) choice (3) time of initiation (4) frequency of administration, (5) dose, and (6) duration of the antibiotics as per protocol of ASHP guideline and Ethiopia General hospital STG, 2010

ANNEX II

Checklist of availability of antibiotics were recommended by Ethiopia STG and ASHP, 2010 guidelines for in this research with UoGTH recent 2012 drug list and UoGTH pharmacy store.

Recommended prophylaxis and therapeutics antibiotics by Ethiopia STG and ASHP,2010,guidelines			Availability of antibiotic in UoGTH ,2012drug list				Availability of drug on UoGTH pharmacy store from Mar 11- may 11,2013			
			Available		Not available		Available		Not available	
Name of antibiotics	Route		Route		route		Route		Route	
	Parenteral	Oral	Parenteral	Oral	Parenteral	Oral	Parenteral	Oral	Parenteral	Oral

አኒክስ III የስምምነት ቅጽ

ጅማ ዩኒቨርሲቲ

የህብረተሰብ ጤናና የህክምና ሳይንሶች ኮሌጅ

የፋርማሲ ትምህርት ክፍል

የስምምነት መግለጫ

ቀን _____ የመጠይቅ መለያ ቁጥር_____

እንደምን አደሩ /ዋሉ?

ስሜ አቶ/ሲ/ር_____ይባላል፡፡የስራ ባልደረባዬ ደግሞ አቶ/ሲ/ር_____ይባላል/ትባላለች፡፡

ዛሬ በጎንደር ሪፈራል ሆስፒታል በቀዶ ጥገና ዋርድ ስለ አንቲባቲክ መድኃኒት አጠቃቀም ምን ይመስላል የሚለውን ጥናት ለ ማድረግ መረጃ እንሰበስባለን፡፡

የመጠይቁ አለማም በጎንደር ሪፈራል ሆስፒታል በቀዶ ጥገና ዋርድ አንቲባቲክ መድኃኒት አጠቃቀም ምን እንደሚመስል መረጃ ለመሰብሰብ ነው፡፡

የሚሰበሰበው መረጃ ሙሉ በሙሉ በምስጢር የሚያዝ መሆኑን እናረጋግጥለዎለታልን፡፡ የዕርስዎም ስም እና መለያ አድራሻ አይመዘገብም፡፡መረጃ መስጠት ካልፈለጉ መብትዎ ነው፡፡ መመለስ ያልፈለጉትንም ጥያቄ መዝለል/ ማለፍ ይችላሉ፡፡ ይሁን እንጂ የእርስዎ ትብብር ትክክለኛ ምላሽ ምርምሩ እንዲሳካ ያደርገዋል፡፡ ስለዚህ ለሚቀርብልዎት ጥያቄ ትክክለኛና ፍቃደኛ ሆነው፡ በትዕግስት እንዲመልሱልን እንጠይቀዎታለን፡፡ መጠይቁ እስከ 10 ደቂቃ ሊወስድ ይችላል፡፡

በዚህ ጥናት ላይ በመሳተፍ ላደረጉልን አስተዋፅኦ በቅድሚያ ታላቅ ምስጋና እናቀርባለን፡፡

በጥናቱ ውስጥ ለመሳተፍ ፍቃደኛ ነዎት? አዎ_____ ይቀጥሉ አይለሁም_____አመስግነው መጠይቁን ያቋርጡ፡፡

የስምምነት ፍቃዱን የወሰደው/ የተቀበለው ጠያቂ ስም ና ፊርማ_____

የቃለመጠይቁ ውጤት

1.የተሟላ _____2. ከፊል የተሟላ _____3. ፍቃደኛ ያልሆኑ _____4. ሌላ_____

የመረጃ ሰብሳቢ ስም_____ ፊርማ_____የተቆጣጣሪ ስም_____ ፊርማ_____