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DEPARTMENT OF CLINICAL AND SOCIAL PHARMACY

ASSESSMENT OF ANTIBIOTIC USE AT TAMALE TEACHING HOSPITAL

By

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B. PHARM (HONS)

A THESIS SUBMITTED TO THE DEPARTMENT OF CLINICAL AND SOCIAL PHARMACY, FACULTY OF PHARMACY AND PHARMACEUTICAL SCIENCES, KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE IN CLINICAL PHARMACY

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DECLARATION

I hereby declare that this submission is my work towards a Master's degree in Clinical Pharmacy, and that to the best of my knowledge, it contains no material previously published by any other person, nor has it been accepted for the award of a degree in any University, except where due acknowledgement has been made in the text.

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DEDICATION

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ABSTRACT

Background and Objectives: Antimicrobial resistance is a major problem worldwide due to indiscriminate and widespread use of antimicrobials both in healthcare facilities and in communities. Tamale Teaching Hospital (TTH) is a major referral center for hospitals in and around the northern parts of the country. This study therefore seeks to investigate and evaluate the pattern of antibacterial medicines prescribed for infections management, and the quality of use of these agents at the hospital.

Methodology: This was a non-randomised observational study undertaken from June 2 to July 14, 2015. The design was cross-sectional and duration of data collection was six (6) weeks. Four hundred (400) in-patients from all the four directorates of the hospital were selected. The patients involved in the study were either diagnosed of having an infection or prescribed antibacterials and consented to participate in the study. The patients were then followed on daily basis for data on antimicrobial use until they were discharged, transferred out of the hospital or died. Appropriateness of antibacterial use was evaluated based on recommendations in the Standard Treatment Guidelines of Ghana (STG) 2010 and British National Formulary (BNF 69). The latter was recognized universally and adopted by clinicians at TTH.

Results: The most common infections diagnosed were respiratory tract infections (16.5%, n=66), gastrointestinal tract infections (16.5%, n=66), sepsis (10.2%, n=41) and infections associated with spontaneous vaginal delivery (8.8%, n=35). In all, 1120 out of 3572 in-patients encountered within the study period were prescribed antibacterial agents representing a prevalence of 31.35%. Almost all the prescriptions (99.8%, n=876) were from the Essential Medicines List (EML), 99.2% (n=871) was also based on the

National Health Insurance Medicines List (NHIML). 45.3% (n=181) of the patients were prescribed 2 antibacterials, 24.0% (n=96) and 22.0% (n=88) were prescribed 3 and 1 antibacterial(s) respectively. The remaining (8.7%, n=35) were on 4 or more antibacterial agents. The most prescribed antimicrobial was metronidazole (26.3%, n=232), followed by Amoxicillin/Clavulanic acid (15.7%, n=139), then ceftriaxone (15%, n=132), cefuroxime (11.4%, n=101) and ciprofloxacin (11%, n=97). 79% (n=316) of the participants prescriptions were in line with recommendations in STG 2010 and BNF 69, and 21% (n=84) was not. Ninety one percent had their symptoms resolved after antibacterial therapy (n=364), and 9.0% (n=36) still had symptoms after antibacterial therapy. Of the 400 patients recruited, only 27 (6.8%) had samples taken for culture and sensitivity tests to guide antibacterial therapy. Common hospital flora including *Escherichia coli* and *Staphylococcus Aureus* were isolated and found to be resistant to CAGN (Co-trimoxazole, Ampicillin, Gentamycin, Nalidixic acid) and C2CFAG (Cefuroxime, Co-trimoxazole, Flucloxacillin, Ampicillin, Gentamycin) respectively. The average length of stay was 6.1days with 41.5% (n=166)) spending 1-3 days and 35% (n=140) spending 4-7 days at the hospital, and the remaining 23.5% spending more than 7 days at the hospital.

Conclusion: About a third of all in-patients within the study period were exposed to anti-bacterial therapy. Majority (close to four-fifths) of the treatments were in line with recommendations in the STG 2010 and BNF 69. Resistance to common hospital flora was identified in the few cases supported by culture and sensitivity test. As much as possible, culture and sensitivity data should be used to guide antimicrobial therapy at the hospital; this would improve the quality of infectious disease management and reduce risk of spread of antimicrobial resistance in hospitals.

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LIST OF ABBREVIATIONS

AMs	Antimicrobials
ANOVA	Analysis of Variance
ASID	American Society of Infectious Diseases
BNF	British National Formulary
C2C3CAGT	Cefuroxime, Ceftriaxone, Co-trimoxazole, Ampicillin, Gentamycin, Tetracycline
C2CA	Cefuroxime, Co-trimoxazole, Ampicillin
C2CFAG	Cefuroxime, Co-trimoxazole, Flucloxacillin, Ampicillin, Gentamycin
CAGN	Co-trimoxazole, Ampicillin, Gentamycin, Nalidixic acid

CDC	Centre for Disease Control
CipG	Ciprofloxacin, Gentamycin
DTC	Drugs and Therapeutics Committee
EML	Essential Medicines List
ESID	European Society of infectious Diseases
GITI	Gastrointestinal tract Infections
ICU	Intensive Care Unit
ICU-HAI	Intensive Care Unit Hospital Acquired Infection
INCan	Instituto Nacional de Cancerologia
KBTH	Korle Bu Teaching Hospital
MDR	Multi-Drug Resistant
MRSA	Methicillin-Resistant *Staphylococcus aureus*
NHIA	National Health Insurance Authority
NHIML	National Health Insurance Medicines List
RTI	Respiratory Tract Infections
SD	Standard Deviation
SDA	Seventh Day Adventist
SPSS	Statistical Package for Social Sciences

SSIs	Surgical Site Infections
STG	Standard Treatment Guidelines
SVD	Spontaneous Vaginal Delivery
TTH	Tamale Teaching Hospital
USA	United States of America
UTI	Urinary Tract Infections
WB	World Bank
WHO	World Health Organisation

ASSESSMENT OF ANTIBIOTIC USE AT TAMALE TEACHING HOSPITAL

CHAPTER ONE

1.1 INTRODUCTION

Infectious diseases remain among the commonest cause of deaths globally especially in Sub-Saharan Africa (World Health Organisation, 1995). In Africa, communicable diseases account for more than 70% of the burden of ill health, in contrast to about 10% in industrialised countries (World Bank, 1993).

Improper use of antimicrobial agents also have been identified as one of the worldwide health concerns due to the growing rate of resistance of common pathogenic organisms to otherwise effective agents, and poor treatment outcomes from antimicrobial therapy (Carlet et al., 2012). The problem of antimicrobial resistance is much worse in low and middle income countries (Okeke et al., 2005;) (levy, 1998). More so due to the high burden of infectious diseases in Africa, antibiotics are amongst the most frequently prescribed and extensively used medicines in hospitals and in community-based medicine outlets (Syed et al., 2014; Shankar et al., 2003). Of individuals who receive antibiotics, over 30% have been found not to have a prescription from a registered clinician before accessing the antibiotics, and more than one in five obtain the antibiotics from an informal dispenser (Vialle-Valentin et al., 2012).

In emergency settings in hospitals, considering the urgent requirements of most patients' conditions, the interaction between prescribers and patients may be irregular in nature. This results in a greater number of antibacterial prescriptions being empirical and/or for prophylactic purposes. From a study in an emergency department of a tertiary hospital in Taiwan, empirical antibacterial therapy has been shown to correlate with high mortality rates (Chen et al., 2013). A study by Kang and associates (2005) also showed evidence of increased mortality among bacteraemic patients with inappropriate first antimicrobial therapy (Kang et al., 2005). Also findings from rational use of medicines survey 2008, in Ghana, showed that in public health facilities the percentage of patients that were prescribed antibiotics was 43.3%, a figure which is high compared to WHO recommended standards (Arhinful, 2009).

Two leading factors that have been shown to contribute to antimicrobial resistance include unnecessary use of antimicrobials (AMs), adding to an augmented selection pressure, and insufficient infection control practices in the health system, favouring the spread of resistant microorganisms (Okeke, 2010). Of the two stated factors, antibiotic use has largely been identified as the main selective pressure fueling antimicrobial resistance (Malhotra-Kumar et al., 2007) (Goossens et al., 2005). As antibiotics are important to treat infections, their use usually requires more resources, and inappropriate use further exposes patients to the added risk of side effects, whilst under-prescribing may be related with poor health outcomes and greater risk of complications from untreated infections (Peterson et al., 2007). Therefore patients who receive AMs may have an increased risk of acquiring infection from resistant microorganisms (Costelleo et al., 2010) and such infections may be associated with increased mortality and morbidity (Shanthi and Sekar, 2009) (Woodford and Livermore, 2009).

Several studies in Africa have stated the occurrence of resistant strains of bacteria, including reports from Nigeria, (Dada-Adegobola and Muili, 2010) Uganda, (Andabati and Byamugisha, 2010) Tanzania, (Moyo et al., 2010) Zimbabwe, (Mbanga, Dube and

Munyanduki, 2010) and Ghana, (Edoh and Alomatu, 2008) all presenting high levels of resistance to antimicrobial agents. A study in the Tamale Teaching Hospital on susceptibility of bacterial agents to frequently used antimicrobial drugs in children with sepsis identified coagulase negative, coagulase positive *Staphylococci, Salmonella* and *Klebsiella* as major causative microorganisms of bloodstream infection among children at the hospital. Even though both gram-negative and gram-positive bacteria showed very low susceptibility to ampicillin, tetracycline and co-trimoxazole, the gram negative rods were fairly susceptible to gentamicin and third-generation cephalosporins (Acquah et al., 2013). In Ghana, antimicrobial prescribing is mostly empirical because of relative absence of suitable laboratory facilities required for carrying out culture and sensitivity testing in numerous healthcare facilities. Even in situations where appropriate laboratories exist, microbiological investigations may not be carried out to guide therapy (Newman et al., 2011). Understandably, lack of surveillance data of susceptibility of antimicrobial agents, will result in empirical management that may not be effective yet costly. The effect of antibacterial mistreatment in hospital and the social damage may be high to individual patients and the entire health system. In a study in Chicago involving a sample of 1391, 13.5% had resistant bacteria with social cost approximated to be 13.35 million dollars in 2008 (Roberts et al., 2009).

Another challenge is the drop in investment and development of new antibacterial agents by pharmaceutical groups (Spellberg et al., 2004). Antimicrobial agents are products of low return on their economic interest and failure of discovery of new agents are established on conventional models of discovery amid other reasons (Livemore, 2011;

Davies, 2006). Only a handful of new agents, few of which are novel, being introduced into clinical practice each year (Chambers, 2006). This places much responsibility on all key players to safeguard the antimicrobial agents currently in use.

Outcomes of antibacterial therapy can be determined using various means: This includes clinical assessment of cure (where resolutions of signs and symptoms including temperature is used) (Buabeng, 1999; Leekha, Terrell and Edson, 2011), microbiological cure (which embroils negative growth for culture after antimicrobial therapy), economic (which embroils prolonged hospital stay days and high cost of care) and ecological (where resistance rates of regularly isolated organisms are determined) (Davey et al., 2005). However, studies on antibacterial effectiveness mostly use two main frameworks; clinical improvement/cure and microbiological cure (Havey, Fowler and Daneman, 2011). In 2001, the World Health Organisation (WHO) released a global strategy engaging all stakeholders to deal with the occurrence and spread of antimicrobial resistance (WHO, 2001). To handle the problem of antimicrobial resistance, the WHO suggested the adoption of some intervention strategies. These consist of developing pointers to monitor and assess the effect of resistance to antimicrobial agents, creating a national task force and designing reference microbiological laboratory facilities that would bring together effective surveillance of antimicrobial resistance among common pathogens (WHO, 2001). However, lack of effective use of resources often constrains execution in several developing countries where therapeutic alternatives also turn out to be relatively narrow. Owing to the fact that antibiotics are among the most frequently prescribed drugs in hospitals in Ghana and their use/misuse are among the important factors for the development and spread of microbial resistance, an assessment of their use in a hospital setting is therefore important. Evidence from such a project would provide the necessary guidance for the review and implementation of antimicrobial stewardship programs in health care facilities.

1.2 Problem statement

Although antibiotics are useful for the management of infectious diseases, which are prevalent especially in Sub-Saharan Africa (World Bank, 1993), their quality of use have been recognised as the main selective pressure leading antimicrobial resistance (Malhotra-Kumar et al., 2007; Goossens et al., 2005). Also, the use of antibiotics motivates patients to reconsult and thus exposed to the added risk of side effects, whilst under-prescribing may be related with poor outcomes to therapy and increased risk of complications from unmanaged microbial infections (Peterson et al., 2007).

It has been observed that close to half of the patients that visit public health facilities in Ghana are prescribed antibiotics, this is quite high, and also significant proportion of such patients may not require antibiotics to meet their health care needs. There is therefore the need to step up or actively promote rational use of activities to improve the quality of prescribing and use of antibiotics for best outcomes (Arhinful, 2009). More so there is paucity of documented findings on the pattern and quality of use of antibiotics in TTH in particular. This study therefore seeks to determine the pattern and quality of use of antibiotics in TTH. The findings of which will be used to guide the formulation of policies to improve antibiotic use at the hospital.

1.3 Research questions to be considered in this study

1. What types of infections are seen at the hospital?
2. What is the prevalence of antibiotic use in the hospital?
3. How many antibiotics are prescribed per patient?
4. What is the pattern of antibiotics prescribing?
5. Are antimicrobial prescriptions guided by culture and sensitivity?
6. What is the appropriateness of the treatment regimens prescribed?
7. What is the cost of antibiotics prescribed per patient?
8. Are treatment regimens based on definitive diagnosis?
9. What is the treatment outcome of patients with bacterial infections managed in the hospital?

1.4 Main Aim

The aim of this study was to assess the prescribing of antimicrobials in the management of bacterial infections and its utilization among hospitalized patients at Tamale Teaching hospital.

1.4.1 Specific Objectives

1. To identify the types of infectious diseases presented at the hospital within the study period.

2. To determine the prevalence of use of antibacterial agents within the study period.

3. To determine the pattern and types of antibacterial agents prescribed for patients at the hospital.

4. To assess if the selection of antimicrobials for prescribing is in conformity to recommendations in Standard Guidelines like the National Treatment Guidelines and the British National Formulary.
5. To assess patients response to antibacterial treatment (using outcome measures like symptoms resolution, length of hospital stay and overall wellbeing of the patients after therapy).

CHAPTER TWO

2.1 LITERATURE REVIEW

2.1.1 History of antibacterial Agents

Many infectious diseases once regarded incurable and lethal are now responsive to treatment with antimicrobial agents. Antimicrobial agents are remarkably powerful with specific activity owing to their selectivity for targets which are either unique to prokaryote and fungal microorganisms or much more important in these organisms than in humans (Betram, Susan and Anthony, 2012).

The usage of natural mixtures to manage infections dates from ancient times (Lindbald, 2008) and there is confirmation of tetracycline in human skeleton dating back to AD 350-550 (Bassett et al., 1980). The steady acceptance of the germ theory of disease which proposed that infectious disease was generated by microbes, led to a search for a means to kill these implicated microbes. In 1907, Paul Erhlich in his inquiry for a “magic bullet” to treat infectious diseases led to the introduction of Salvarsan, the initial chemical compound used in treating syphilis. In 1928, Sir Alexander Fleming detected that *Penicillin notatum* had contaminated bacterial culture plates of *Staphylococcus aureus* and there was increased inhibition of the *S. aureus* at the point of connection. This led to the discovery of penicillin. Nonetheless it was not until 1940, that a refinement process was introduced to produce ample quantities for the purpose of clinical trials. In 1942, mass manufacturing and delivery of penicillin began (Aminov, 2010). This marked the inception of the “antibiotic era”: the phrase antibiotic was originally used by Selman Waksman in 1941 (Clardy, Fischbach and Currie, 2009; Waksman, 1973).

Antibiotics, since the introduction of penicillin, have played a critical role in health. Notwithstanding, the use of antibiotics is correlated with its own fundamental problems. Established on the concept of evolution, it is accepted that microbes establish factors that facilitate them to resist the activity of antibiotics exclusively on repeated exposure (D'Costa et al., 2011).

2.1.2 The use of antibiotics in health systems

Antibiotics only treat infections caused by bacteria and so should not be prescribed for infections of viral origin including most coughs and colds. Infections due to viruses are by far more common than those due to bacteria. Owing to the fact that there is growing resistance of bacteria to antimicrobial therapy and resistant bacteria are selected out by the use of antibacterials, antibacterial utilization is recommended only when absolutely necessary. If bacterial infections stay unmanaged, this could lead to worsening of disease and even death. In critical infections due to bacteria, hospitalized patients may be put on intravenous broad-spectrum antibiotics to commence therapy. Antibiotics should be changed as soon as culture and sensitivity tests confirm the causative organism to an agent which is active against the specific pathogen(s). The patient’s antibacterial agent may be changed to an oral form usually after 48 hours of intravenous treatment, if there is clinical improvement. (Moran et al., 2005).

In Ghana, antibacterial agents are one of the highest prescribed medications in hospitals and clinics (Bosu and Ofori-Adjei, 2000). The correct use of antibacterials has accordingly become a critical factor in fighting antibacterial resistance in the hospital setting. This requires everybody, notably health professionals to establish that antibacterial agents are used judiciously so as to curtail resistance. Antibiotics are linked with various side effects, of which some are class related, but mainly the reactions are specific to the agent in that individual (Cunha, 2001). Antibiotics when not appropriately used leads to increased risk of antibiotic resistance and other adverse outcomes (Maha et al., 2014). Some common side effects include gastrointestinal problems, oral and/or vaginal thrush and skin rashes (Cunha, 2001).

Reports regarding utilization of antibiotics have shown that 30% of hospitalised patients are given antibiotics (Natwaani, 1998; Aswapokee, Vaithayapichet and Heller, 1990) and administration of these agents to patients who are uninfected accounts for about 60% of irrational antibiotic usage (Wilkowske, 1991; McGowan J and Finland, 1974).

In a study to evaluate the rational use of antibiotics by Ozlem Tunger *et al*, 2000 in a University Hospital in Turkey, irrational use of antibiotics was 54.3% which was high according to the Kunin and Jones criteria. During the study, antibacterials were administered to 16.6% of hospitalized patients; 14.07% and 39.79% of surgical and medical patients received treatment respectively. The brief prophylactic antibacterial use in patients undergoing surgical procedures accounted for the lesser use in surgical than was observed in the medical wards. The rate of positive cultures obtained from samples was 41.1%, yet only 4.7% of patients were given appropriate antibacterials that were in line to results of the culture. The study revealed that antibacterials were not used appropriately empirically (51.5%) and for prophylactic reasons (67.9%) than when culture results were considered respectively). Cephalosporins were found to be given to 26.1% of patients, often inappropriately. It was also shown that, the use of three antibacterials was often not appropriate, and prolonged the hospital stay to twice as long in these patients which, consequently increased the hospital infection risk and cost of the treatment (Ozlem et al., 2000).

Easier control programmes that include methods for restricting antibiotic use must be developed and implemented in hospitals where antibiotics are used frequently (Jorgensen, 1993; Natwaani and Davey, 1992; Kunin et al., 1990).

Studies in Africa have suggested high use of antibiotics in communities. Studies were conducted to probe the use of antibiotics in five national household surveys to ascertain the main causes of antibiotic use in the community using the WHO methodology. Data from Ghana, Gambia, Nigeria, Kenya, and Uganda surveys were combined. In all countries except The Gambia, antibiotic consumption was similar to that of rates of antibiotic use in higher-income settings, where acute morbidity is lower and availability of antibacterial agents is not a problem (Vialle-Valentin et al., 2012). More than 30% of patients taking antibiotics obtain these agents without prescription from designated prescribers, stressing the multidimensional role of attendants who serve function as both prescribers and dispensers of medicines in resource-limited settings (Wafula F.N. and Goodman CA , 2010). Upper respiratory symptoms were a key predictor of use of antibiotics in each survey, indicative of the fact that systematic use of antibiotics for upper respiratory symptoms also occurs frequently in communities in Africa, as in other parts of the world despite enormous scientific evidence against such practice (Lars et al., 2010). Also, when in quest of healthcare outside the home, the odds of being managed with antibiotics were constantly lesser when fever was reported as the main symptom and in the majority of surveys greater when gastrointestinal symptoms were presented. The systematic empiric management of diarrhoea with antibiotics and of fever with antimalarials reveals potentially inappropriate practices (Crawley J, Mtove G and Nosten F, 2010).

Studies in Africa point to high use of antibiotics in hospitals. A study was conducted in Egypt in 2011 to determine the prevalence and characteristics of antibiotic use in 18 hospitals. Out of a total of 3408 patients who were included, 59% of them received at least one antibiotic. The most frequently prescribed antibiotics being the third generation cephalosporins (28.7% of prescriptions).The prevalence of antibiotic use in Egyptian hospitals was high. (Maha et al., 2014). Similarly, a high percentage was reported in Sudan (30 to 60%) (Sachs and Tomson, 1992).

Average percentage of prescription encounters containing antibiotics was 50.10% in a study conducted in Osun state in Nigeria (Babalola et al., 2011).

In another study to evaluate the quality of prescriptions with antibiotics in Government Hospitals in Yemen indicated that the average percentage of prescriptions with antibiotics was 51.0% (AbdulKareem, Izham and Abdo-Rabbo, 2011). Also a study carried out in Cambodia showed the percentage of antibiotics use to be high (10.0% to 66.0%) (Chareonkul and Boonshuyar, 2002). Conversely, the average proportion of antibiotic use in Malaysia was lower (23.2%) (Saleh, 2004).

In Ghana, antibiotic prescribing patterns studied from 700 retrospective outpatients clinical records from seven government health facilities in the Wassa West district showed that high value of 60% of the patients were prescribed antibiotics (Bosu and

Ofori-Adjei, 2000). Another study conducted at public health facility dispensaries and public health facilities in Ghana in 2008 also showed a value 43.3% (Arhinful, 2009). A study in Korle-Bu Teaching Hospital showed 62.4% of the patients received more than one antibacterial agent during the period under consideration (Acheampong, 2009). In a study in Kumasi, 82% of the prescriptions given to the patients contained antibiotics. The average number of antibiotics per prescription was 1.6. It also presented Ciprofloxacin as the most commonly prescribed antibiotic followed by cefuroxime and ceftriaxone. With regards to combination therapy, ciprofloxacin and metronidazole were the most prescribed and also used by the patients (Boadu, 2014).

2.1.3 Antimicrobial agents used for bacterial infections

Globally, antibiotic consumption increased from 54,083,964,813 standard units to 73,620,748,816 standard units, representing 36% between 2000 and 2010. Brazil, Russia, India, China, and South Africa accounted for 76% of this upsurge. Antibiotic consumption varied significantly with season in most countries. There was increased utilisation of carbapenems (45%) and polymixins (13%), two last-resort classes of antibiotic drugs (Van Boeckel et al., 2014). A study revealed that Cephalosporins were the most commonly prescribed antibacterial agents followed by the penicillins (Palikhe, 2004).

In Africa, an evaluation of drug use pattern using WHO prescribing indicators as a guide at a Teaching Hospital in South Ethiopia revealed that the most frequently prescribed antibiotics were amoxicillin, ampicillin, gentamicin and chloramphenicol with proportions of 16.4%, 15%, 14.9% and 11.6% respectively (Desalgen, 2013). In Ghana, a study carried out at Korle Bu Teaching Hospital in 2009 showed Ciprofloxacin (23.3%), Metronidazole (22.3%) and Co-Amoxyclav (19.4%) as the antibiotics prescribed mostly (Acheampong, 2009).

2.1.4 Quality of Antibiotic prescribing

A study showed that, even though 80% of the antibiotic agents were evaluated as appropriate therapy for the stated infection, majority of the patients were managed without microbiological confirmation of the pathogenic agent and, for these patients; clinicians were not able to specify the causative pathogen against which therapy was intended in half of the antibiotic courses they started. Only 7% of antibiotics prescribed for conventional surgical prophylaxis satisfied all the criteria used to evaluate the appropriateness of choice of medicine and the method as well as timing of its administration (Moss et al., 1981).

A study conducted in paediatric hospital of Kathmandu valley showed that 121 patients were diagnosed with diseases of infectious origin and managed with antibacterials; samples were obtained for culture in just 24 (19.8%) cases to identify the causative microorganisms. Positive culture results were shown for only 13 samples. Significant difference was realised between disease encountered and age group of patients (Palikhe, 2004).

In a study by Boadu, 145 patients who received antibiotics during a study; none of the prescriptions was guided by culture and sensitivity results, thus antibiotics were given empirically (Boadu, 2014).

2.1.5 Principles of antibacterial prescribing

Different principles govern the use of antibacterial agents in the clinical setting. According to the BNF 69, before choosing an antibacterial two key factors notably the likely causative organism and the patient must be considered (British Medical Association Royal Pharmaceutical Society, 2015) . Patient factors which must be considered include susceptibility of antibacterial infection (i.e. whether immunosuppressed), capacity to tolerate drugs by mouth, ethnic origin, severity of illness, , history of allergy, renal and hepatic function, age, if on other medicines and whether female, if gravid, lactating, or taking an oral contraceptive. The confirmed or probable causative pathogen and its antibacterial sensitivity, in relation to the patientrelated parameters will propose one or more antibacterial agent, the ultimate choice reliant on the bacteriological, pharmacological and toxicological characteristics. The site as well as type and severity of infection and disease determine the dose, route of administration and duration of treatment. (Leekha, Terrell and Edson, 2011; British Medical Association Royal Pharmaceutical Society, 2015).

Reasonable economy can be attained by the use of local policies which, usually limit the antibacterial agents that may be used with adequate bacterial spectrum, and reduce the development of resistant pathogens (British Medical Association Royal Pharmaceutical Society, 2015).

Precepts that should be considered before initiating antibacterial therapy include:

1. Viral infections should not be managed with antibiotics. However, secondary bacterial infections may be treated using antibacterials (British Medical Association Royal Pharmaceutical Society, 2015);
2. Culture and sensitivity test should be conducted. (British Medical Association Royal Pharmaceutical Society, 2015) (Dellinger et al., 2008);
3. Data of prevalent pathogens and their current sensitivity is of immense importance in selecting an antibacterial agent before microbiological confirmation is ready. In general, unless there is clear clinical manifestation narrow-spectrum antimicrobials are favored over broad-spectrum antimicrobials (British Medical Association Royal Pharmaceutical Society, 2015);
4. The dosage of an antibacterial agent changes in relation to various parameters such as age, weight, renal function, hepatic function, and severity of bacterial infection (British Medical Association Royal Pharmaceutical Society, 2015);
5. The severity of bacterial infection usually determines the route of administration of an antibacterial agent. Near-fatal infections necessitate treatment using intravenous agents. Antibacterial agents with good bioavailability may be given by mouth even for some serious infections. When using the oral route is impossible or if absorption is inadequate, the parenteral administration is also appropriate (British Medical Association Royal Pharmaceutical Society, 2015) (Leekha, Terrell and Edson, 2011; Baddour et al., 2005);

The nature of infection and the response to therapy determines the duration of therapy. Courses should not be unduly prolonged as they may encourage microbial resistance, may cause side effects, and are costly (British Medical Association Royal Pharmaceutical

Society, 2015). The optimal duration of antibiotic therapy for many infections is well defined, such as for UTIs and pneumonia (Therapeutic Guidelines Limited. Antibiotics, 2010). However, it may be surprising to learn there is a lack of randomised clinical trials to establish the course of therapy for many common infections (Horsburgh et al., 2013). It is difficult to change prescribing practices to shorten antibiotic courses without strong evidence supporting the safety and efficacy (Rice, 2008).

2.1.6 Antibiotic Prophylaxis

Prophylactic antibacterial therapy is when one or more antibacterial agents are given to avoid an infection. (Leekha, Terrell and Edson, 2011). Antibiotic prophylaxis may be regarded as primary or secondary prophylaxis, or eradication. The avoidance of an initial infection is considered as primary prophylaxis whilst the avoidance of reappearance of a previous infection is regarded as secondary prophylaxis. Eradication refers to the removal of a colonized pathogen to avert the occurrence of an infection (Dale et al., 2013).

Even though antimicrobial prophylaxis has a significant role in decreasing the frequency of surgical site infections (SSIs), basic infection prevention and control strategies are among other factors that should be heeded to as well as (Ehrenkranz and Pfaff, 1991) doctor’s know-how and technique, preoperative preparedness, length of the procedure, perioperative care, environments of both hospital and operating-room, sterilization of instruments, and the fundamental medical condition of the client as these may have a significant bearing on SSI rates (Anderson et al., 2008; Mangram et al., 1999). Prophylaxis with antimicrobial may be acceptable for any procedure if the patient has a principal medical condition linked with a much risk of SSI or if the client is immunosuppressed (Dale et al., 2013).

Surgical procedures linked with high risk of infection may benefit from antibacterial prophylaxis including contaminated procedures and in some clean operations where grave consequences of bacterial infections are real, even if infection is not likely, for instance prosthetic implants. The choice to use prophylaxis hinges on the cost of management, and the morbidity affiliated with infection matched with the cost and morbidity linked with using prophylaxis. Use of antibacterial prophylaxis is necessary for most clean-contaminated operations. When antibacterial agents are used for dirty procedures or established infections, it is referred to as treatment of presumed infection but not prophylaxis (Dale et al., 2013).

Preferably, an antibacterial drug for surgical prophylaxis should (i) avert both SSI and SSI-linked morbidity and mortality, (ii) decrease the duration and price tag of healthcare (when the expenditures linked with the treatment of SSIs are deliberated, costeffectiveness of prophylaxis turns out to be obvious), (Alerany, Campany and Monterde, 2005; Allerberger, Garies and Jindrak, 2009) (iii) yield no side effects, and (iv) have no undesirable consequences regards the microbial flora of the client or healthcare facility (Voit et al., 2005). To accomplish the goals mentioned above, an antibacterial drug should be (i) active against the likely pathogens which could contaminate the surgical site, (ii) administered in a right dosage and at the right time that ensures ample serum and tissue concentrations lasting the duration of potential contamination, (iii) safe, as well as (iv) given for the shortest effective time to reduce adverse effects, development of bacterial resistance, and expenditure (Mangram et al., 1999; Gorbach et al., 1992; Kallman and Friberg, 2007).

Several studies have shown the importance of prophylactic antibacterials to reduce morbidity associated with infections in women going through high-risk surgical operations. A study in United States of America indicates that gynaecologic surgeons commonly use prophylactic antibacterial agents for hysterectomy when required, but a significant number also employ prophylactic antibacterial agents in low-risk surgical operations though proof of efficacy is absent. The added cost of the antibacterials (alongside the risk for antibacterial resistance and antibacterial-associated complications) does not warrant this use. Evidently, more-frequent antibacterial use is not necessarily superior (Rebar, 2013).

2.1.7 Empirical therapy

Empirical therapy is when one or more antibacterial agents are given in a situation where the microbe is unknown at the start of therapy but guided by the local sensitivity data of possible organisms (Leekha, Terrell and Edson, 2011). Various studies have established that the early institution of antimicrobial therapy active against the causative pathogen is life-saving in patients with severe sepsis. (Ferrer et al., 2009; GarnachoMontero et al., 2003). The surviving sepsis campaign strongly endorses starting antibiotic therapy within the first hour of recognition of severe sepsis, after suitable specimens have been obtained for cultures (Dellinger et al., 2008). Septic shock occurs in 10% of intensive care unit (ICU) patients with nearly 60% mortality rate (Ferrer et al., 2009). Early and adequate administration of antibiotics increases survival in severe sepsis and septic shock patients

(Torres et al., 1990). A research on the benefit of appropriate empiric antibiotic treatment in patients with bloodstream infection concluded that appropriate empiric antibiotic treatment was related with a significant drop in fatality in patients with bloodstream infection. (Leibovici et al., 1998).

According to the Surviving Sepsis Campaign, key recommendations regards appropriate empiric use of antibiotics include; blood cultures before treatment with antibacterial, administration of broad-spectrum antibiotic therapy within 1 hour of diagnosis of septic shock and severe sepsis without septic shock, reassessment of antibiotic therapy with microbiology and clinical data to narrow coverage, when appropriate a usual 7-10 days of antibiotic therapy guided by clinical response (Dellinger et al., 2008).

Empiric antibiotic therapy, when inappropriately carried out can be disadvantageous to the health of the patient. It may lead to increased morbidity and mortality, and also increase bacterial resistance (Goldmann et al., 1996) and may occur as a consequence of under recognition of the infections with antimicrobial-resistant organisms (Pazos et al., 2004).

Definitive antibacterial therapy is when one or more antibacterial agents are directed against an identified microbe based on positive microbiological culture results (Leekha, Terrell and Edson, 2011).

2.1.8 Appropriate antimicrobial prescribing

Appropriate antibiotic prescribing as defined by Centre for disease control (CDC) is "prescribing antimicrobials only when they are likely to be beneficial to the patient, selecting agents that will target the likely pathogens, and using these agents at the correct dose and for the proper duration" (Besser, 2003). Inappropriate therapy mostly occur as a result of the under recognition of the infections with antimicrobial-resistant organisms (Pazos et al., 2004). This is evidenced in drug resistant gram-positive bacteria, such as the most frequent MRSA which are significantly associated with the inappropriateness of empirical antimicrobials. Mical *et al.*, 2010 demonstrated that inappropriate antimicrobials in MRSA septicemia obviously increased a risk for mortality (Mical et al., 2010).

2.1.9 Use of culture and sensitivity to guide the prescribing and use of antibiotics

Utilization of antibiotics in ambulatory and inpatient settings is greatly influenced by microbiological, as well as economic and cultural factors. The non-pharmacologic factors are important to healthcare professionals and policy makers due to clinical and financial burden of inappropriate prescribing of antibiotics, including over use, avoidable adverse effects, and the increasing incidence of resistant microorganisms. Patient motivations involve the desire for a tangible product as a reward of clinical interaction coupled with inappropriate views of the effectiveness of antibacterial agents, particularly in infections due to viruses. The desire to satisfy patient demand and lack of information by prescribers explains physicians' behavior. Marketing campaigns targeted at both patients and physicians further serve to escalate demand, in particular for newer, more expensive agents. Studies of antibiotic use patterns in outpatient and inpatient care settings consistently show considerable inappropriate prescribing, which is likely to worsen the occurrence of resistant microorganisms (Avron and Daniel, 2000).

Numerous studies have indicated that culture and sensitivity test is usually not carried out even though this is required for definitive treatment of bacterial infections in most cases.

A study in Kathmandu Valley revealed among 121 patients clinically diagnosed with infectious diseases and treated with antibiotics, that specimens were taken for culture in only 24 cases (19.8%) to identify pathogenic organisms. Of the 24, only 13 specimens showed positive culture results (Palikhe, 2004).

In another study carried out at the surgical and emergency unit of the Korle-Bu Teaching hospital, Ghana only 39% of prescribers requested for Culture and Sensitivity test; 5.1 % of which had the results before starting antibacterial therapy (Acheampong, 2009). One more study conducted at Seventh Day Adventist hospital in Kumasi showed that out of 145 patients who received antibiotics during the study, none of the prescriptions was guided by culture and sensitivity test results. (Boadu, 2014). In Emergency situations it is wise to commence antibacterial therapy empirically whilst awaiting culture and sensitivity results.

2.1.10 Methods of evaluating antibacterial use

The development of resistance to antibacterial agents is of global concern (Wise et al., 1998). Selective pressure caused by antibacterial agents is the lead factor for the development of resistance. The most frequently used drugs in healthcare facilities include antibacterial agents. About 30% of inpatients in developed countries will be managed with antibacterial agents. In a country like Netherlands, although antibiotic utilization and microbial resistance rates are low, it is largely established that antibacterial prescribing is usually below optimal, (Cars, Molstad and Melander, 2001; Marchese and Schito, 2000). Inadequate education in antimicrobial therapy for managing infections is the main cause leading to inappropriate prescribing of antibacterial agents. Usually, the prescription of these agents with low toxicity is baseless because of uncertainty about the diagnosis of the prescribers; `drugs of fear' (Kunin, Tupasi and Craig, 1973). A lot of clinicians are not entirely aware that their warranted or unwarranted utilization of antimicrobial agents adds to the problem of microbial resistance (van der Meer and IC, 2001). In surveys, some findings have revealed 15% of antibacterial utilization medical and surgical wards to be baseless (Gyssens et al., 1996; Gyssens et al., 1997).

For appropriate antimicrobial utilization, preferably, the prescriber should try to identify the type of infection and the most likely causative pathogen (Kunin, Tupasi and Craig, 1973). Studies have showed that clinicians hardly have a clear suggestion on the causative pathogen when treating infections. A study by Willem *et al* in a university hospital with an antibiotic order form, which required the stating of a causative pathogen, 26.7% cases were left unanswered (Blok et al., 1996) . Some years past, a flow chart was developed to evaluate the quality of antimicrobial prescribing (Gyssens et al., 1992).This flow chart (Figure 1), adopted from the original criteria of Kunin *et al*. (Kunin, Tupasi and Craig, 1973), gives room for s the evaluation of all areas of antimicrobial utilisation, as there are: justifications of the prescription, more effective choices, less toxic choices, less expensive choices and agents with a narrower spectrum .Also duration of therapy and dosing, as well as route of administration and dosing interval, and lastly timing, are taken into consideration. . This flow chart can be used for detailed studies regards antimicrobial prescribing in all areas involving antimicrobial utilization in including hospitals, as well as a training tool for students in medicine., Initial empiric treatment can be assessed with this chart, and also definite therapy, once culture and sensitivity results are known (van der Meer and IC, 2001).

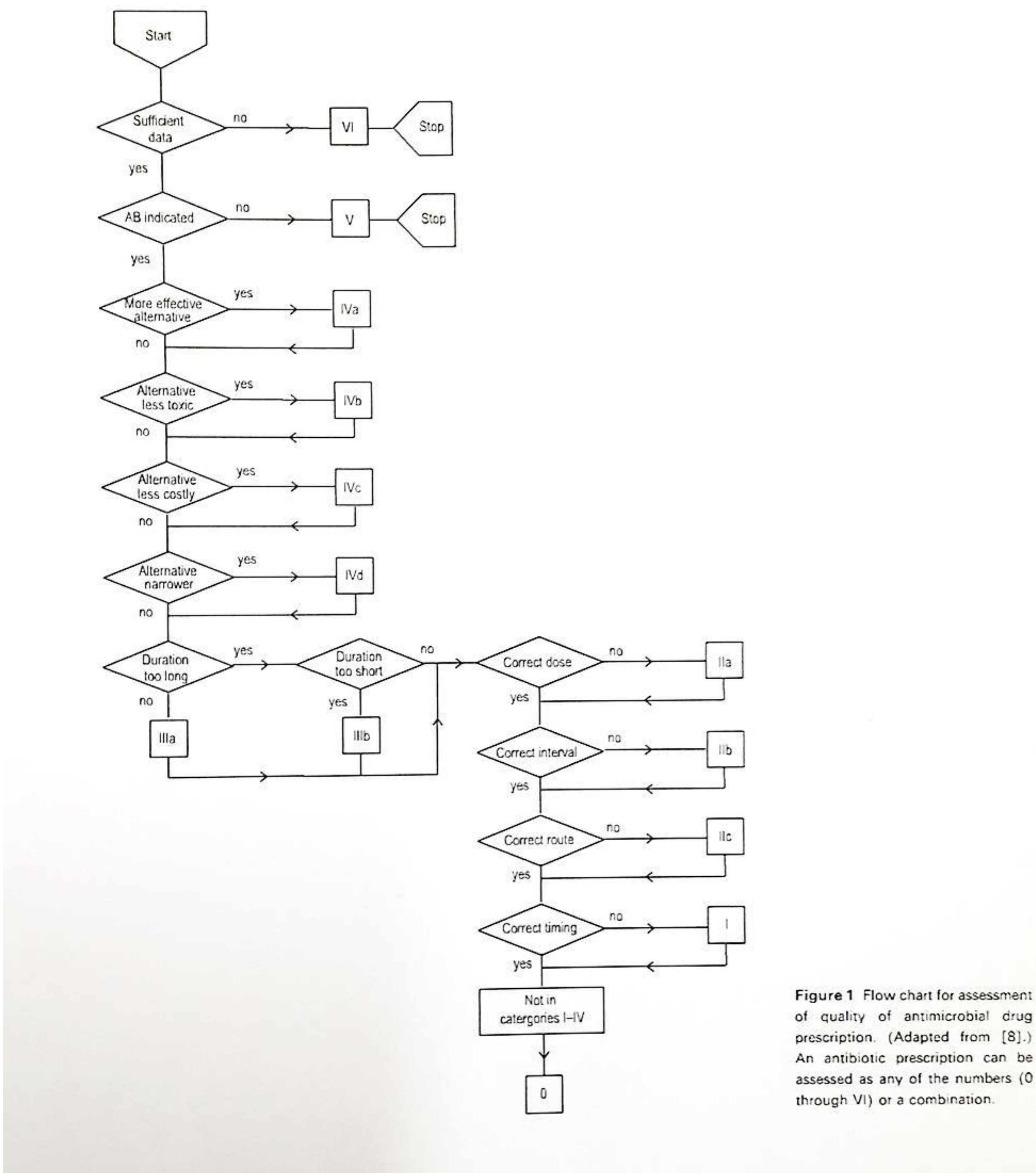

Figure 1 Flow chart for assessment of quality of antimicrobial drug prescription. (Adapted from [8].) An antibiotic prescription can be assessed as any of the numbers (0 through VI) or a combination.

Figure 1: Flow Chart for assessment of quality of antimicrobial drug prescription (van der Meer and IC, 2001).

2.1.11 Antimicrobial Resistance

The development of resistant organisms has been identified as the key issue threatening the continued success of antimicrobial agents. As long as antimicrobials are in usage, selection of resistant microorganisms is an inevitable consequence. The inappropriate and overuse use of antibiotics in patients has powered a major rise in prevalence of multi-drug resistant pathogens (Betram, Susan and Anthony, 2012; Kapril, 2005). Diverse studies have revealed that escalated and improper use of antibacterials have been a leading factor to the occurrence of microbial resistance in hospitals and the society (Karras, 2006). In Europe, countries with tremendous antibacterial agents' utilization have great resistance rates (Bronzewaer, 2002) thus showing positive correlation between resistance and antibacterial use.

It has been reported that up to around 70% of pathogenic bacteria in hospitals show resistance to at least one most frequently used antibiotic for managing bacterial infections (Gupta, Hooton and Stamm, 2001). Methicillin resistant *Staphylococcus aureus* (MRSA) is a special problem for patients suffering from skin diseases, surgical wounds and ulcers. A number of these resistant organisms have spread over wide geographic areas as a consequence of patients moving to seek medical attention in various countries. (Betram, Susan and Anthony, 2012).

A constant reduction of antibacterial handling led to a decline of methicillin resistant *Staphylococcus aureus* (MRSA) and *Clostridium difficile* infections in a tertiary hospital in the United States (Cook et al., 2011). This demonstrates the consequence of decreased antibacterial use on resistance pattern on bacteria. A study by Bronzwaer *et al* on the link between antibacterial use and bacterial resistance patterns in Europe involved the heightened use of beta-lactam antibiotics and macrolides as being correlated with increased bacteria resistance (Bronzewaer, 2002). A study in Europe also established the positive correlation between incorrect antimicrobial use and resistance (Adriaenssens et al., 2014). Studies also show that antibiotics are usually used empirically where there is evidence of any infection and for purposes of prophylaxis (Moellering, 1995; Wilkowske, 1991).

According to a study conducted in the National Cancer Institute of Mexico, Instituto Nacional de Cancerologia (INCan), located in Mexico City, the emergence of multidrugresistant (MDR) bacteria poses a difficult task for physicians, who have limited therapeutic options (Cornejo-Juarez et al., 2015). Studies have also shown that Intensive care unit hospital acquired infection (ICU-HAI) rates are higher than in general hospital wards due to the complex interactions between the patient's underlying diseases, comorbidities, severity of illness, type of ICU, length of stay, and use of multiple invasive devices. (K. Inweregbu, J. Dave and A. Pittard, 2005) (Erbay et al., 2003). The risk of infection with MDR bacteria has been related to a number of factors, including previous antimicrobial therapy, cross-transmission, and length of hospital stay (Pekka Ylipalosaari et al., 2006).

A study in Ghana in various hospitals including two Teaching hospitals, seven regional hospitals, and two district hospitals from December 2002 to December 2003 showed the most prevalent pathogen in the country was *Escherichia coli*, followed by *Staphylococcus aureus*, *Klebsiella species*, and *Pseudomonas aeruginosa* (Newman et al., 2011). High percentage of resistance was observed for tetracycline, co-trimoxazole, ampicillin, and chloramphenicol. Another study conducted by Duredoh Freeman George *et al* in 2010 to determine the antibiotic resistance patterns of *Escherichia coli* isolated from Tafo, Kumasi-South, and Suntreso Hospitals in Kumasi in Ghana also showed that 90.7% of the *E. coli* isolates exhibited resistance to ampicillin while 6.2% and 3.1% showed intermediate and sensitive respectively. Regards co-trimoxazole, 78.4% of the isolates showed resistance while 9.3% and 12.4% exhibited intermediate and sensitive responses respectively. *E. coli* (28.6 to 46.4%) isolates were found to be resistant to gentamicin, ciprofloxacin and ceftriaxone while 14.4% to 47.4% presented intermediate responses (Duredoh et al., 2012).

Studies have shown that when antibiotics are given in low doses (Guillemot et al., 1998) and for longer than normal duration it leads to the development of antibiotic resistant organisms (Therapeutic Guidelines Limited. Antibiotics, 2010; Rice, 2008; Nasrin et al., 2002; Guillemot et al., 1998).

Poor compliance to antibiotic therapy also contributes to antibacterial resistance. A study in Europe found that non-adherence to antibiotics for acute cough or lower respiratory tract infection is common, with over half of patients who were prescribed antibiotics not adhering to the full course, and over 40% not taking any of the prescribed course (Nick et al., 2012).

Though resistance of bacteria can take place naturally, the adoption of antibacterial agents have been noticed to hasten the development of acquired resistance by bacteria. Extensive and extreme use in the clinical setting and use of antibacterials for agricultural functions are all contributory elements to the development of resistance (Stokowski, 2010). Poor quality antibacterials have also been acclaimed as adding to resistance development notably in developing countries. As a result, treatment deficiencies from poor quality antibacterials require the use of second line antibacterials (Okeke, Lamikanra and Edelman, 1999). Alternative physical circumstances adding to the spread of resistant strains comprise movement of patients within and among healthcare institutions, absence or shortage of infection control measures, and regular movement of goods and people (Levy, 2002)

2.1.12 Combating Resistance

Centre for disease control (CDC) in its annual report (2013) established four main ways of encountering antibacterial resistance. These are infection prevention, tracking of resistance patterns, antibacterial stewardship and improvement of new antibacterial diagnostic testing (CDC, 2013). These measures are directed at the health facility, prescribing and dispensing angle of combating resistance. Antibacterial stewardship programmes are diversified measures enforced to promote appropriate use of antibacterials (Ashiru-Oredope et al., 2012). Different countries have developed and implemented antibacterial stewardship programmes and data from various studies affirms the benefits of these stewardship programmes (DiazGranados, 2012; Nathwani et al., 2011; Kaki et al., 2011; MacDougall and Polk, 2005). Antibacterial stewardship safeguards practical use of antibacterials in health care settings and reduces antibacterial resistance. Antibacterial ward rounds (Boyles et al., 2013) of infectious disease specialist and antibacterial restriction policies (Tunger et al., 2009) are all components of antibacterial stewardship program applied in various settings.

CHAPTER THREE

3.1 METHODS

3.1.1 Study area

The study was carried out in all four clinical directorates (Medicine, Paediatrics, Surgery and Obstetrics and Gynaecological) of the hospital. The hospital is the only teaching tertiary health institution located in the northern sector of Ghana, and in Tamale, the Northern Regional capital. It serves as a referral center for hospitals in and around the northern Ghana and in neighbouring countries such as Togo, Burkina-Faso and La Cote d'ivoire. All the four clinical directorates offer both in-patient and out-patient services.

In the year 2013, the Directorates of Medicine, Pediatrics, Surgery and Obstetrics and Gynaecology attended to 2,505, 3,667, 3,099 and 9,069 inpatients respectively. The common conditions seen in the year 2013 at the hospital include: Liver disease, pneumonia, malaria, peptic ulcer disease, urinary tract infection, neonatal sepsis, gastroenteritis, malnutrition, upper respiratory tract infection, hypertension, typhoid fever, head injuries, anaemia, congestive cardiac failure, chronic kidney disease, asthma, fractures, road traffic accidents among others (TTH BIOSTATISTICS REPORT, 2013).

3.1.2 Study design

The study was a cross-sectional, observational study where in-patients diagnosed as having infections were identified, tracked and had their clinical notes/folders reviewed for data for a period of six weeks, starting from June 2, 2015 to July 14, 2015.

3.1.3 Sample size

The sample size was calculated using a proportion of 43% prevalence of antibiotic use in Ghana in a study conducted by Arhinful *et al*, in the year 2009, and assuming a 95% confidence limit and an estimated delta of 0.05, a minimum of 380 patients was be required for this study. An estimated sample size of 400 was used.

3.1.4 Sampling method and data collection instrument

Every patient that fell within the inclusion criteria and consented to participate in the study was recruited. The variables that were captured and reviewed in the study using the data collection instrument developed included patients' demographic information such as age, gender, weight, educational background and occupation (questions 3, 4, 5, 6 and 7). Questions 8.I, 8.II and 8.III used to extract information about whether antibiotics were prescribed, number of antibiotics and total medicines per prescription respectively, which addressed objective 1. Question 9 was used to extract information on patients' infection type which addressed objective 2. Question 10 was used to extract data on type of antibiotics prescribed which addressed objective 3. Question 11 was used to extract information on antibiotics prescribed from EML and NHIML. Question 12 was used to extract information on appropriateness of antibiotics prescribed according to STG and BNF. Questions 13, 14, 15 and 16 were used to extract data on antibiotic prescription changes, reasons for the change of prescription, antibiotics prescribed after prescription changes and number of times antibiotic prescription was modified respectively. Questions 17, 18, and 19 were used to obtain information on request for culture and sensitivity test, culture and sensitivity test results and organisms isolated and antibiotics resistant to respectively. Question 20 was used to extract data on appropriateness of dose of prescribed antibiotic, route of administration, dosing frequency and duration of therapy respectively. Questions 21 and 22 were used to extract data on total cost of both medicines and antibiotics prescribed respectively. Questions 11- 22 were used to address objective 4. Question 23, 24, and 25 were used to obtain information on length of hospital stay, symptom resolution and cure of bacterial infection based on confirmation with bacteriology report respectively to address objective 5. The details of the variables that were reviewed are presented in Appendix I. The sampling was continued until the last patient was reviewed based on the timeline for the study.

3.1.5 Eligibility criteria

3.1.6 Inclusion Criteria

All patients admitted within the study period and diagnosed of an infection or prescribed antibacterials were included, as long as they consented to participate in the study.

3.1.7 Exclusion Criteria

Patients who were not hospitalized were excluded as well as those who or their relatives refused consent to participate in the study.

3.1.8 Ethical considerations

Names and addresses of prescribers were not recorded to ensure that their identities were not exposed. Data collection sheets were kept under lock and key and will be kept for at least three years. The computer that was used for the data entry had a password and was therefore secured. Data obtained was used exclusively for purposes of this study.

Permission was sought from the heads of the directorates before data collection started. Ethical clearance was also sought from the Committee on Human Research, Publication and Ethics of the Kwame Nkrumah University of Science and Technology, Kumasi.

3.1.9 Data handling and analysis

The data captured was entered into Statistical Package for Social Sciences (SPSS) Version 20.0 database and examined, cleaned and analyzed. Various relevant tables and figures were created from the data to allow for easy analysis and interpretation. Mean and standard deviation were used to describe continuous variables with normal distribution whiles median and interquartile rage were used to describe continuous variables with skewed distribution. Categorical variables were described with frequencies and proportions in tables and appropriate charts i.e. Bar Charts and Pie Charts. Various hypotheses testing such as t-test, chi squared test and analysis of variance (ANOVA) depending on the type of data obtained were used to test the level of significance of the interventions instituted. A 95% confidence interval was used to assess the level of significance where P-value < 0.05 was seen as statistically significant of the assumed hypotheses.

CHAPTER FOUR

4.1 RESULTS

4.1.1 Socio-Demographic Characteristics of the Participants

Four hundred participants were recruited for this study, of which 205 (51.2%) were males and 195 (48.8%) females. The mean age of the participants was 26.4 years, with a standard deviation of 21.96. Majority of the patients were within the age group of 19 to 35 years 39.8 (n=159).

More than half of the patients had no formal education 229 (57.2%), about 16% (n=65) had primary education 65 (16.2%), and 13.5% had tertiary education (n= 54). The mean length of admission at the hospital was 6.1 days with a standard deviation of 6.7. Close to half of the patients 41.5%, (n=166) were admitted for 1 to 3 days (Table 1).

Table 1: Summary of demographic characteristics of participants

Factor, N=400	Number	Percentage
Age(years)	Mean(**SD*) = 26.4 (21.96)	
Less or equal to 5	101	25.3

6 – 18	41	10.3
19 – 35	159	39.8
36 – 60	61	15.3
61 and above	38	9.5
Length of admission (days)	Mean(**SD*) = 6.1 (6.7)	
1 – 3	166	41.5
4 – 7	140	35.0
8 – 14	67	16.8
15 and above	27	6.8
Sex		
Male	205	51.2
Female	195	48.8
Education		
No formal education	229	57.3
Primary	65	16.2
Junior High School	22	5.5
Senior High School	30	7.5
Diploma	38	9.5
First Degree	16	4.0
Occupation		
Businessman/woman	63	15.8
Teaching	20	5.0
Farming	62	15.5
Student	87	21.8
Unemployed	2	0.5
House wife	35	8.8
Public Servant	10	2.5
Health Care Professional	4	1.0
Artisan	34	8.5
Security	3	0.8
Others	80	20.0

***SD* = standard deviation**

4.1.2 Total number of antibacterials prescribed

About 45.3% of the patients (n=181) were prescribed 2 antibacterials, 24.0% (n=96) and 22.0% (n=88) were prescribed 3 and 1 antibacterial(s) respectively. One patient (0.3%) had 8 antibacterials prescribed. The details are summarized in Figure 2.

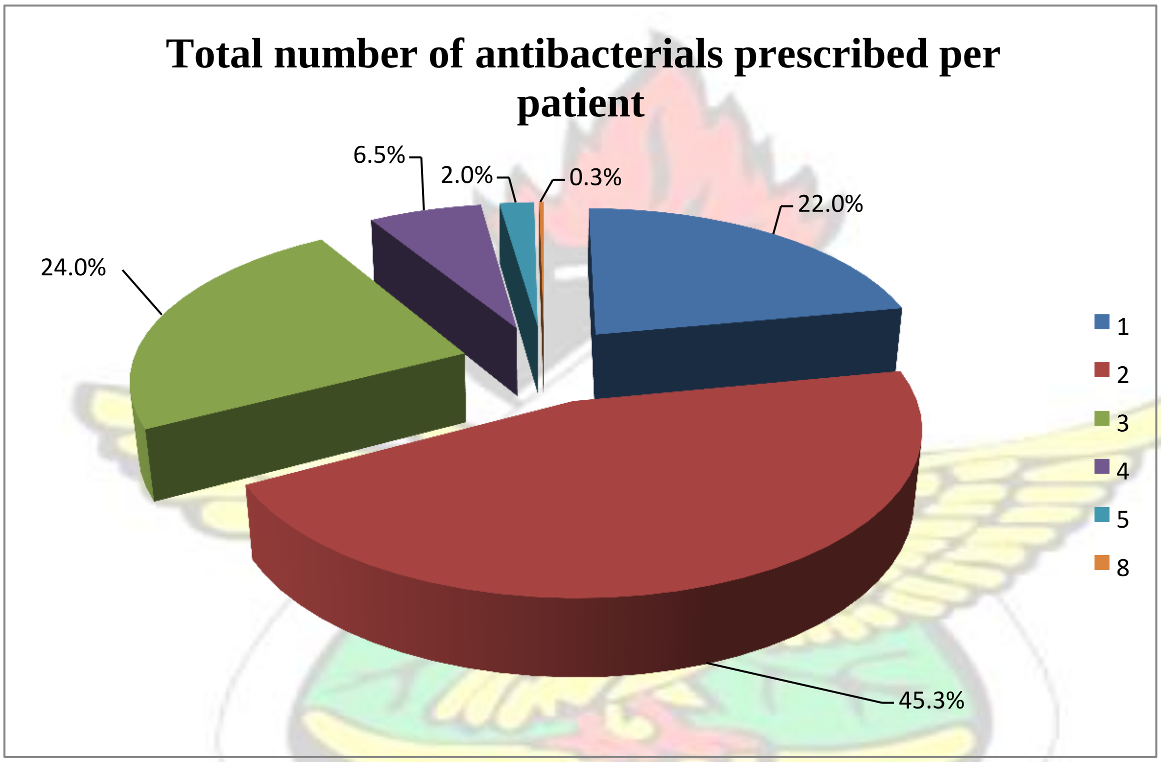

Figure 2: Total number of antibacterials prescribed per participant

4.1.3 Total number of medicines per patient's prescription

In 18.8% of the participants (n=75), 6 medicines were prescribed, which included an antibacterial agent. The least number of medicines prescribed was 1, this was observed in 3 (0.8%) of the participants. The highest number of medicines encountered on a prescription was 19, but this was found in only 1 participant (0.3%).

4.1.4 Prevalence of Antibiotic use

Total number of inpatients on antibacterials within study period (A) = 1120

Total number of inpatients within study period (B) = 3572

Therefore Prevalence of Antibiotic use $= \frac{A \times 100\%}{B}$

$$= \frac{1120 \times 100\%}{3572}$$

$$= \mathbf{31.35\%}$$

4.1.5 Conformity of Antimicrobial Therapy to Standard Guidelines

Most of the treatment regimen (65.2%, n= 261) prescribed were in line with recommendations in both the National Standard Treatment Guideline (STG) 2010 and the British National Formulary (BNF 69). About 21% (n=84) were on treatment regimen that was different from that stated in STG 2010 or BNF 69.

Over 93% of the antibacterial therapy was done empirically. However, in 6.8% of the patients (n=27), culture and sensitivity results were requested to guide the antimicrobial therapy. About 35% of the patients (n=138) had their antimicrobial medication changed. However, only 3 of the patients (2.2%) had their therapy informed by results of culture and sensitivity testing (Table 2).

Table 2: Summary of data on participants regarding therapy, antibacterial change and the use of culture and sensitivity data to guide therapy

Factor, N=400	**Number**	**Percentage**
Antibacterials therapy conforming to Standard Guidelines		
STG alone	7	1.8
BNF alone	48	12.0
STG and BNF	261	65.2
None	84	21.0
Change in Antibacterial		
Yes	138	34.5
No	262	65.5
Reason for Change in Antibacterial		
Condition worsened	6	4.3
No Improvement	76	55.1
Culture and Sensitivity Results Guided	3	2.2
Discharged on oral medication	53	38.4
Culture and Sensitivity Request		
Yes	27	6.8
No	373	93.2
Culture and Sensitivity Results		
Yes	16	59.3
No	11	40.7
Details of Culture and sensitivity results		
Growth	6	37.5
No Growth	10	62.5
Organism Isolated		
Citrobacter diversus	1	16.7
Enterobacter spp,	2	33.3
Escherichia coli	2	33.3
Staphylococcus aureus	1	16.7

4.1.6 Antibacterials Prescribed for Participants

The most common prescribed antimicrobial agents was metronidazole (26.1%, n=232), followed by Amoxicillin/Clavulanic acid (15.7%, n=139), then Ceftriaxone (15%, n=132). The rest were, Cefuroxime and Ciprofloxacin (11.4%, n= 101), and 11.0%, n=97 respectively. The details of the types of antibacterials prescribed are summarized in fig. 3 below.

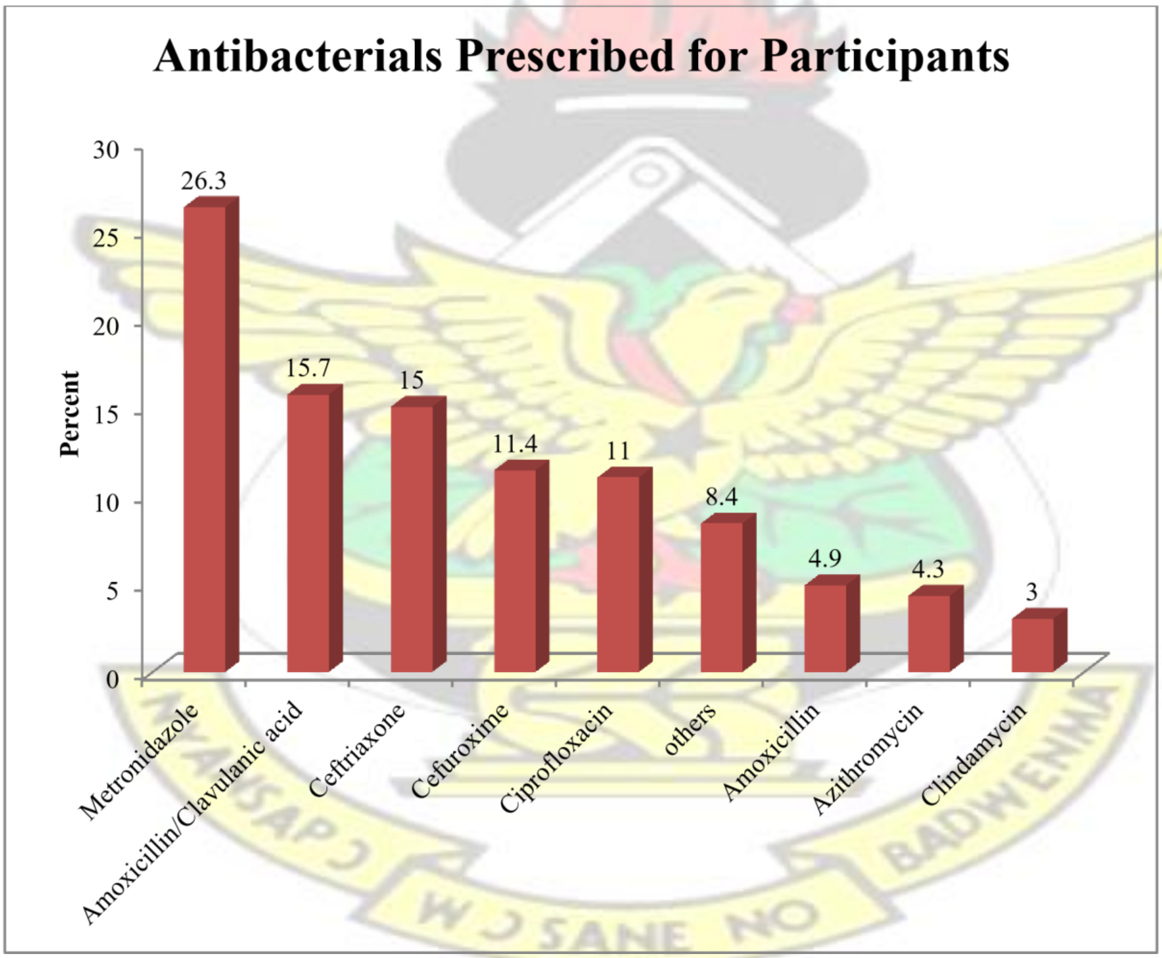

Figure 3: Antibacterial agents prescribed for study participants

4.1.7 Pharmacological Class of Antibacterials Prescribed

Cephalosporins were the most frequently prescribed antibacterials (28.6%, n=250), followed by Nitro imidazole (26.3%, n=230), then Penicillins (22.6%, n=198) and Fluoroquinolones (10.9%, n= 95). The least was chloramphenicol (0.1%, n=1) as shown in figure 4.

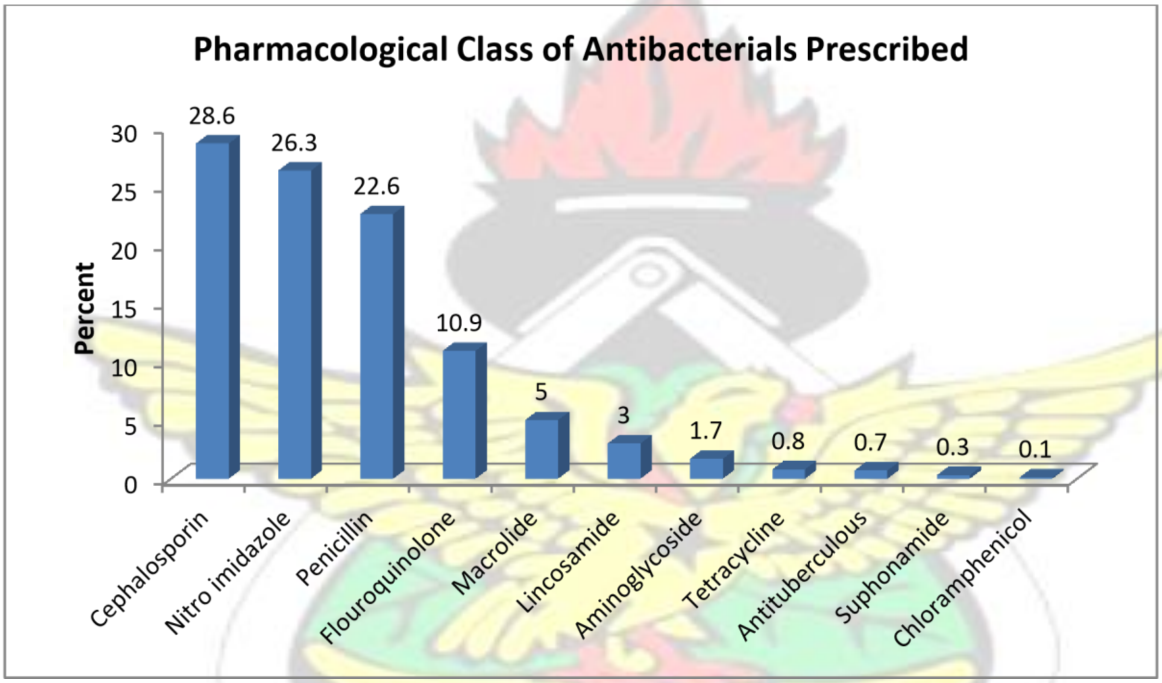

Fig.4: Pharmacological class of antibacterials prescribed for participants

4.1.8 Prescribing pattern from medicines list

Almost all the antibacterial agents (99.8%) were listed on the Essential Medicines List (EML) of Ghana. Also 99.2% of the prescribed antibacterial agents were found on the National Health Insurance Medicines List (NHIML) as shown in table 3.

Table 3: Summary of antibacterial prescribing pattern from medicines list

Factor, N=878	Number	Percentage
Prescribing from EML		
Yes	876	99.8
No	2	0.2
Prescribing from NHIML		
Yes	871	99.2
No	7	0.8

4.1.9 Number of Times Antibacterials Changed

Of the 138 participants whose antibacterial prescriptions changed, 75.4% (n= 104) were changed once while 18.1% (n=25) and 6.5% (n=9) were changed two and three times respectively (Fig 5).

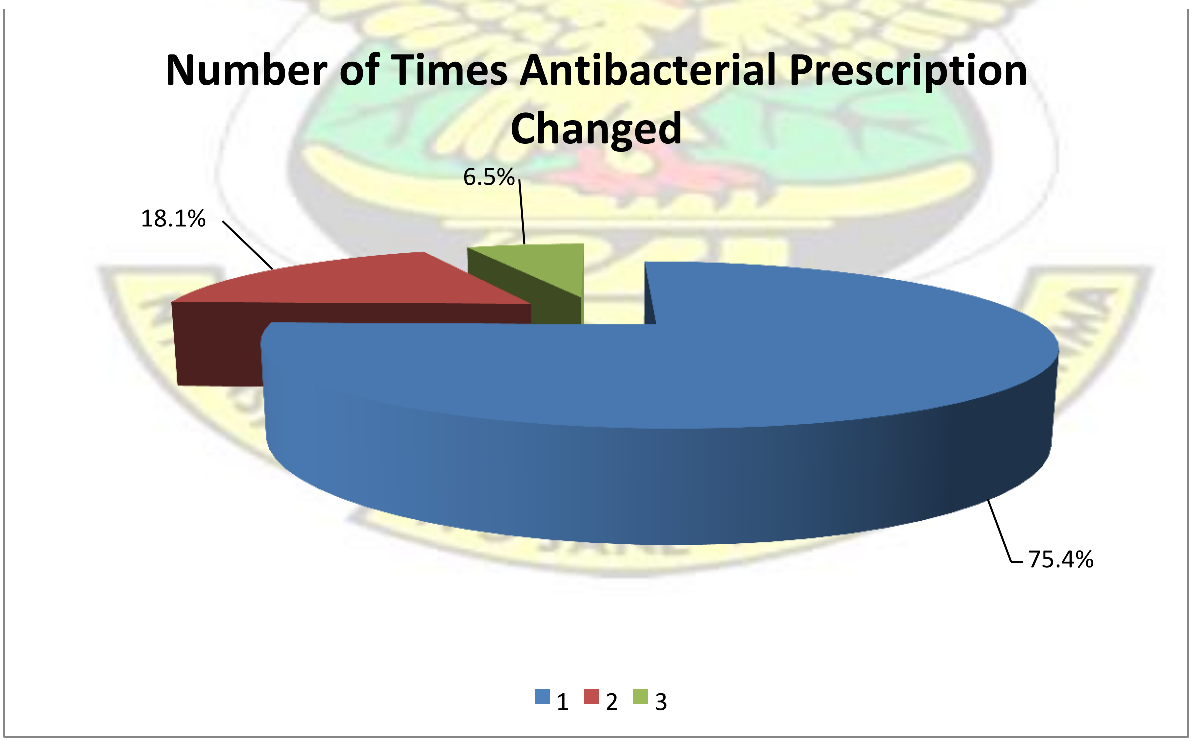

Fig. 5: Number of times antibacterial prescription was changed

4.1.10 Appropriateness of Antibacterial treatment regimen

According to the national standard treatment guidelines 2010, 99.6% (886) of the antibacterial prescriptions and their use were appropriate among the study participants.

4.1.11 Cost of Medicines and Antibacterials

Total Cost of Antibacterials Prescribed = GH₵ 23,570.05

Total Cost of Medicines Prescribed = GH₵ 52,482.52

Percentage of Antibacterial (Cost) $= \frac{23,570.05}{52,482.52} \times 100\%$

= **44.9%**

Cost of Antibacterials Prescribed per patient = GH₵ $\frac{23,570.05}{400}$

= **GH₵ 58.93**

4.1.12 Outcome of Antibacterial Treatment

There was symptoms resolution in majority of the participants 364 (91.0%) compared with those whose symptoms did not resolve 36(9.0%). Also in majority of the participants 399 (99.8%) cure was not confirmed with bacteriology report as shown in table 4.

Table 4: Summary of therapeutic outcomes and how it was measured

Factor, N=400	Number	Percentage

Symptom Resolution		
Yes	364	91.0
No	36	9.0
Cure Confirmed with bacteriology report		
Yes	1	0.2
No	399	99.8

4.13 Infections classification

The most common infections were respiratory tract and gastrointestinal tract infections diagnosed in 66 (16.5%) patients each, followed by sepsis 41 (10.2%) as shown in table 5.

Table 5: Infections Classification

Factor, N=400	Number	Percentage
Respiratory Tract Infections	66	16.5
Urinary Tract Infections	34	8.5
Skin and Soft Tissue Infections	19	4.8
Gastrointestinal Tract Infections	66	16.5
Caesarean Section	29	7.2
Inguinal Hernia	12	3.0
Bone and Joint Infections	25	6.2
Abdominal Infections	20	5.0
Cranial Infections	17	4.2
Others	36	9.0
Spontaneous Vaginal Delivery	35	8.8
Sepsis	41	10.2
Total	400	100.0

4.1.14 Isolated organisms and resistant antibacterial agents

Cross tabulation of organisms isolated with resistant antibacterial agents showed that

Citrobacter diversus was found to be resistant to (Cefuroxime, Co-trimoxazole, Ampicillin). *Enterobacter spp., Enterococcus spp., E. coli and Staphylococcus aureus* were found to be resistant to C2C3CAGT, CipG, CAGN and C2CFAG respectively (refer Table 6). There was a statistically significant association between isolated organism and resistant antibacterial agents (p<0.001).

Table 6: Isolated organisms and resistant antibacterials

	Resistant Antibacterials					
Factor	**C2CFAG**	**C2CA**	**C2C3CAGT**	**CipG**	**CAGN**	**p value**
Organism Isolated						<0.001
Citrobacter diversus	0(0.0)	1(100%)	0(0.0)	0(0.0)	0(0.0)	
Enterobacter spp.	0(0.0)	0(0.0)	1(100)	0(0.0)	0(0.0)	
Enterococcus spp.	0(0.0)	0(0.0)	0(0.0)	1(100%)	0(0.0)	
E coli	0(0.0)	0(0.0)	0(0.0)	0(0.0)	2(100)	
Staph. Aureus	1(100)	0(0/0)	0(0.0)	0(0.0)	0(0.0)	

KEY: C2CFAG – Cefuroxime, Co-trimoxazole, Flucloxacillin, Ampicillin, Gentamycin

C2CA – Cefuroxime, Co-trimoxazole, Ampicillin

C2C3CAGT – Cefuroxime, Ceftriaxone, Co-trimoxazole, Ampicillin, Gentamycin, Tetracycline

CipG – Ciprofloxacin, Gentamycin

CAGN – Co-trimoxazole, Ampicillin, Gentamycin, Nalidixic acid

4.1.15 Culture and Sensitivity Request and Symptom Resolution

From cross tabulation of culture and sensitivity request with symptom resolution, 6.8% (n = 27) patients culture and sensitivity were requested for, 6.0% (n = 24) had their symptoms resolved. Conversely, of 93.2% (n = 373) whose culture and sensitivity were not requested for, 85.0% (n = 364) had their symptoms resolved. A *p*-value of 0.69 shows there is no statistical significance between culture and sensitivity request and symptom resolution.

Table 7: Culture and Sensitivity Request and Symptom Resolution

			Symptom Resolution		Total	*p*-value
			Yes	No		
Culture and Sensitivity Request	Yes	Count	24	3	27	0.69
		% of Total	6.0%	0.8%	6.8%	
	No	Count	340	33	373	
		% of Total	85.0%	8.2%	93.2%	
Total		Count	364	36	400	
		% of Total	91.0%	9.0%	100.0%	

4.1.16 Culture and Sensitivity results and Symptom Resolution

From cross tabulation of culture and sensitivity results with symptom resolution, of 27 requests for culture and sensitivity, 16 had the culture and sensitivity results. 40.7% (n = 13) had their symptoms resolved while 3 patients still had symptoms even after antibacterial therapy. On the other hand, 40.7% (n = 11) of the patients did not have culture and sensitivity results and yet had their symptoms resolved (p=0.11), suggesting that the difference was not statistically significant.

Table 8: Culture and Sensitivity results and Symptom Resolution

			Symptom Resolution Yes	Symptom Resolution No	Total	*p* - value
Culture and Sensitivity Results	Yes	Count	13	3	16	0.11
		% of Total	48.1%	11.1%	59.3%	
	No	Count	11	0	11	
		% of Total	40.7%	0.0%	40.7%	
Total			24	3	27	
		% of Total	88.9%	11.1%	100.0%	

CHAPTER FIVE

5.1 DISCUSSION

5.1.1 Patient Demographics

The results obtained from the study provide useful information about the pattern of antibacterial agents use at the four main departments of Tamale Teaching Hospital. The socio-demographic characteristics of the participants revealed that more than half of the participants were males (n=205, 51.2%). This observation seems to suggest that antibacterial agents were prescribed to male patients more than females. This could possibly be due to the fact that male patients presented with more infectious diseases within the study period. Although the difference between the proportions of males prescribed antibacterials to that of females was not statistically significant, this observation was similar to that reported by Falagasa *et al.* which suggested that antibiotics are frequently prescribed for males than females (Falagasa, Mourtzoukoua and Vardakasa, 2007). The relative high antibiotic prescribing among the male gender may be attributed to males having a slightly overall likelihood of developing respiratory tract infection than females (Falagasa, Mourtzoukoua and Vardakasa, 2007) as indicated in [table 1]. The suggested higher prevalence of overall likelihood of developing respiratory tract infection in males has also been attributed to lifestyle practices such as smoking. Smoking is common among males whiles it is frowned upon in many communities and it is an uncommon behaviour among females (World Health Organisation, 2011).

The study also revealed that the mean age of participants was 26.4 years, with a standard deviation of ±21.96 years. Also two-fifths of the patients were within the age group of 19 to 35 years (n=159, 39.8%) followed by patients less than 5 years (n=101, 25.3%). This finding suggests that the youthful population reported with more infections than the other age groups. However, it has been posited by Brittain-Long that children are more vulnerable to infections than adults due to their poorly developed adaptive immune system (Brittain-Long, 2010). The contrasting result with this study could be attributed to the fact that the youthful population may have been involved in employment and vocations that may have made them susceptible to infections. About 57.3% (n=229) of the study population had no formal education which could also mean that they may have little knowledge on infection prevention practices. Also the relatively high proportion of antibacterial prescribing in children less than 5 years may be as a result of the vulnerability of children to infections. It has been reported that children are more exposed to infections than adults as they easily catch infections both at school and play grounds (Fleming et al., 1987).

5.1.2 Pattern of prescription of antibacterial agents and quality of use

This study revealed high adherence to prescribing from the Essential Medicines List (EML) and National Health Insurance Medicines List (NHIML) by the prescribers. The medicines were also largely available for use in the hospital. The close to 100% adherence of prescribing from the EML attest to the fact that the various in-service training programmes instituted by the hospital management through the National Health Insurance Authority (NHIA) has impacted positively on the prescribing pattern in the hospital. The 99.8% antimicrobial prescribing from the EML is also an improvement over the national data of 94.3% (Gyansa-Lutterodt et al., 2005). This high adherence to prescribing from the EML also attests to the acceptability of the national policy by medical practitioners in the hospital. Again the 99.2% of antibacterials prescribed from the NHIML is an indication that prescribers are largely adhering to the national guidelines. This could also be due to the periodic review and expansion of the list by the National Health Insurance Authority (NHIA) in the year 2009, 2011 and 2013 to include almost all the drugs selected as essential medicines for use in Ghana. However, the (n=7, 0.8%) of antibacterials prescribed outside the NHIML could be due to pressure exerted on prescribers by patients or the influence of medical representatives of pharmaceutical companies (Macfarlane et al., 1997; Scott et al., 2001; Brennan et al., 2006). The study also shows that although almost all the antibacterials were prescribed from both the EML and the NHIML, about four-fifth (79%) of the patients prescribed antibacterials were in line with recommendations in the Standard Guidelines (STG 2010 and BNF 69). The remaining fifth (21%) was not in conformity to recommendations in STG 2010 or BNF 69. This probably may be due to clinicians' expectation of effectiveness of antibacterial agents rather than guided by evidence based practice (Damoiseaux et al., 1999).

The prevalence of antibacterial use was 31.35% of hospitalised patients, this was lower compared to the national average of 43.3% (Arhinful, 2009), 62.4% in Korle-Bu Teaching Hospital (Acheampong, 2009) and 83% in Seventh Day Adventist Hospital, Kumasi (Boadu, 2014). This was also lower compared to similar studies in Egypt 59% (Maha et al., 2014), Sudan 30-60% (Sachs and Tomson, 1992) and Nigeria 50.10% (Babalola et al., 2011). Similar studies beyond Africa also showed higher prevalence, Yemen 51.0% (AbdulKareem, Izham and Abdo-Rabbo, 2011). The low prevalence of antibiotic use could be attributed to better infection prevention and control practices by healthcare practitioners at TTH. Conversely the average proportion of antimicrobial use in Malaysia was lower 23.2% (Saleh, 2004).

Many of the antibacterial agents were prescribed for respiratory tract infections (RTI) and gastrointestinal tract infections (GITI). These were followed by sepsis, infections associated with spontaneous vaginal delivery (SVD) and urinary tract infections (UTI). It has been suggested that antibiotics are mostly prescribed for RTIs and similar pattern did emerged from the results of this study (Gonzales, Steiner and Sande, 1997; Berman, Zaran and Rybak, 1992; Lars et al., 2010). Again similar pattern for the indications of antibacterials were observed in the United Arab Emirates, where close to half of antibacterial agents were prescribed for respiratory tract infections and gastrointestinal infections (Kuyvenhoven, de Melker and van der Valden, 1993). Therefore appropriate mechanisms designed to enable prescribers distinguish between viral respiratory tract infections and RTIs that really require the use of antibacterials will be useful to improve the use of antibacterials. The high antibacterial prescribing for RTIs could also be attributed to lack of request for culture and sensitivity which would have enabled prescribers to identify infections which require antibacterial therapy.

It was realised from the study that culture and sensitivity tests were requested in only (n=27, 6.8%) of the patients [table 2]. Of the 27 requests, results were received for only 11 and 6 of which showed growth. This finding is consistent with a study conducted in Kathmandu Valley, Nepal where it was also reported that antibiotics were prescribed for at least 93% of hospitalized patients although only a small number of the patients given antibiotics had a proven bacterial infection. The study further revealed that among 121 patients diagnosed with infectious diseases and managed with antibiotics, specimens were taken for culture in only 24 cases (19.8%) to identify pathogenic organisms. Only 13 specimens showed positive culture results (Palikhe, 2004). These findings suggest that conscious effort is required from health system managers to imbibe the habit of prescribing antibiotics based on culture and sensitivity results. Antibiotic prescribing based on culture and sensitivity results is said to minimise the likelihood of development of antibiotic resistance as well as improving treatment outcomes (Leekha, Terrell and Edson, 2011).

The average cost of antibacterial prescribed per patient was GH₵58.93. The study also shows that the 31.35% prevalence of antibiotic prescribed constituted 44.9% of the total cost of medicines used during the study period. This proportion of antibiotic cost is relatively lower than those reported from other studies which suggest that cost of antibiotics constitute more than 50% of health care cost (Berman, Zaran and Rybak, 1992).

5.1.3 Types of antibacterial agents and their Pharmacological Class

Metronidazole was the most frequently prescribed antibacterial agent (n= 232, 26.3%). This could be due to the fact that it was used in many combination therapies for the treatment of wide variety of infections including GIT, Sepsis, SVD, Skin and Soft Tissue and Abdominal Infections. Amoxicillin/Clavulanic acid was the second most frequently prescribed antibiotic (15.7%) observed from the study. This was followed by ceftriaxone, cefuroxime and ciprofloxacin with proportions of 15%, 11.4% and 11% respectively. It can also be deduced from figure 3 that metronidazole, Amoxicillin/Clavulanic acid and ceftriaxone alone constitute more than half i.e. 57% of the antibacterial agents prescribed. These findings will also serve as a useful data for the microbiology unit in determining which antibacterial agents are used for culture and sensitivity test as well as monitoring resistance patterns in the hospital.

Consequently, cephalosporin was the commonest pharmacological class prescribed 28.6% largely as a result of frequent prescribing of ceftriaxone and cefuroxime. This was followed by nitro-imidazole, penicillin and fluoroquinolone. Similar findings were reported in studies conducted in Egypt where cephalosporins were mostly prescribed (Maha et al., 2014). The relative safety of the penicillins and the cephalosporins coupled with the fact that they have been widely used, could account for their high usage at inpatient departments. The finding of this study also conforms to what was reported by Palikhe, 2004, which suggest that cephalosporins were the most commonly prescribed antibacterial agents followed by penicillins (Palikhe, 2004).

Conversely, a study in Korle-Bu Teaching Hospital by Acheampong revealed that Ciprofloxacin, a fluoroquinolone was the most commonly prescribed antibacterial followed by metronidazole a nitro-imidazole (Acheampong, 2009). Also, it is reported in the United States of America that Zithromax (azithromycin), which belongs to the pharmacological class of macrolide is the commonest prescribed antibiotic (DeNoom, 2011). This claim is in contrast to the findings of this study. This contrasting finding could be due to the fact that the manufacturer of Zithromax is an American company with a strong presence in the USA. Therefore the intense promotion of the product may influence the prescribing pattern. Another factor could be due to the sensitivity pattern of microorganisms in the health centres where the antibiotics were prescribed from.

5.1.4 Appropriateness of Dosage Regimen of Antibacterial treatment

As high as 99.6% appropriateness of dosage regimen was observed with antibacterials prescribed during the study period. The high degree of appropriate antibiotic use demonstrated by this study is in sharp contrast to general reported utilization of antibiotics which posits that in many centres providing healthcare services, the percentage of antibiotics that are inappropriately prescribed remain very high (Kunin, 1981). However, since inappropriate antibacterial prescribing can result in increased cost to both the patient, the facility and the state, increased tendency of development of resistance or even fatality in clinical practice, the 0.4% inappropriateness of the dosage regimen calls for vigilance on the part of the hospital's pharmacists to thoroughly ascertain the appropriateness of all prescriptions before they are filled.

5.1.5 Outcome of Antibacterial therapy

There was symptom resolution in majority of the patients (n=364, 91%). It also emerged from the study that there was statistically significant association between isolated organisms and resistance to antibacterials. For instance *Escherichia coli* was found to be resistant to CAGN – Co-trimoxazole, Ampicillin, Gentamycin, Nalidixic acid whilst Citrobacter *diversus* was resistant to C2CA – Cefuroxime, Co-trimoxazole, Ampicillin [table 6]. This finding provides useful information for the choice of antibacterial for the treatment of susceptible isolated organisms. The average length of admission at the hospital was 6.1 days. A little over two-fifths of patients i.e. 41.5 %, (n=166) were admitted for 1 to 3 days. This relative short hospital stay goes to support the finding that treatment was in accordance to treatment guidelines.

5.2 LIMITATIONS OF THE STUDY

American Society of Infectious Diseases (ASID) and European Society of Infectious Diseases (ESID) guidelines were not accessible to the researcher and thus appropriateness of antimicrobial use could not be assessed based on the above mentioned guidelines, which some of the prescribers claimed there were using.

Only few patient samples were obtained and sent to the laboratory for culture and sensitivity testing to guide therapy. The pathogenic organisms thus isolated were also small in number. Larger numbers of specimens and conducting the study over a much longer period (example 6 months) could have yielded more isolates to enable a clearer understanding of antibacterial resistance pattern at TTH.

CHAPTER SIX

6.1 CONCLUSION

The top three infectious diseases seen at the hospital within the study period were respiratory tract infections, gastrointestinal tract infections and sepsis.

About a third of all inpatients during the study period were exposed to antibacterial agents. The most frequently prescribed agent was metronidazole, followed by Amoxycillin/clavulanic acid, Ceftriaxone, Cefuroxime, Ciprofloxacin, Amoxicillin, Azithromycin and Clindamycin.

The patients' treatment regimen for the microbial infections was mostly in line with recommendations in standard guidelines like the National Treatment Guidelines 2010 and British National Formulary 69th Edition.

Majority of the patients had their symptoms resolved after therapy, except for about a tenth whose symptoms worsened or died after the antimicrobial therapy.

Microbial resistance to common hospital flora was found in the few cases where culture and sensitivity was used to guide therapy.

Also majority of the patients spent less or equal to seven (7) days in the hospital after being successfully managed on antibacterial therapy.

6.2 RECOMMENDATIONS FOR POLICY, PRACTICE IMPROVEMENT AND FURTHER RESEARCH

1. The findings obtained in this study are of relevance to the development of local guidelines for antimicrobial therapy, and thus improve the quality and cost effectiveness in the management of microbial infections.
2. This study has shown the need to use culture and sensitivity data to guide antimicrobial therapy among the hospitalized patients, and thus save lives and minimize the risk of the emergence and spread of antimicrobial resistance at the hospital.
3. Further research is recommended to assess the level of microbial resistance to the antimicrobial agents often stocked and used in the hospital.

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APPENDICES

APPENDIX 1: DATA COLLECTION TOOL ASSESSMENT OF PRESCRIBING AND USE OF ANTIBIOTICS AT TAMALE TEACHING HOSPITAL

A. PATIENT DEMOGRAPHICS

1. Study Identification Number

2. Directorate: I. Medicine II. Paediatric III. Surgery IV. Obstetrics & Gynaecology

3. Age of patient (years)

4. Gender: I. Male II. Female

5. Weight (kg)

6. Patient's highest level of education

I. Up to Primary Class 6 II. Basic Education III.Secondary

IV. Tertiary

a. Diploma b. First degree c. Second degree d. Third degree

V. No formal education

7. Occupation (Please state)……………………………………………………………………

B. ANTIBIOTIC PRESCRIBING & USE

8. i. Has antibiotic(s) been prescribed for the patient?

I. YES ☐ II. NO ☐

If yes to 8 ii. Total number of antibiotic(s) prescribed ☐

iii. Total number of medicine(s) prescribed ☐

C. TYPE OF INFECTION(S)

9. What condition(s) is/are the antibiotic(s) recommended for?

……………………………………… …………………………………………..

……………………………………….. ………………………………………..

……………………………………… …………………………………………..

………………………………………… ……………………………………………

D. TYPE OF ANTIBIOTIC(S) PRESCRIBED/USED

10. Name and class of antibiotic prescribed

Antibiotic	Class

E. QUALITY OF ANTIBIOTIC PRESCRIBING/ USE

11. Are the antibiotics prescribed included in the Essential Medicines List (EML) and the National Health Insurance Medicines List (NHIML)? Indicate appropriately.

Antibiotic	EML		NHIML	
	Yes	No	Yes	No

12. Are the antibiotic(s) prescribed indicated as shown in the Standard Guidelines (Standard Treatment Guidelines (STG), British National Formulary (BNF), American Society of Infectious Diseases (ASID) or European Society of infectious Diseases (ESID))? Tick all applicable.

Antibiotic	**STG**	**BNF**	**ASID**	**ESID**

13. Was antibiotic prescription changed? I. YES ☐ II. NO ☐

14. If yes, what was the reason for the change?

i. Condition worsened ☐ ii. No improvement ☐ iii. Culture and sensitivity results guided ☐ iv. Others ☐

(specify)...

……………………………………………………………………………………………

………..

15. Antibiotics prescribed after change of prescription

Antibiotic	**Class**

16. How many times was antibiotic prescription modified?…………

17. Are there any requests for culture and sensitivity tests?

I. YES ☐ II. NO ☐

18. If yes, are there any culture and sensitivity test results?

I. YES ☐ II. NO ☐

19. a. If yes to 18, indicate

I. Growth ☐ II. No Growth ☐

19. b. if growth, indicate

i. Organism(s) isolated………………………………………………………………

………………………………………………………………………………………

II. Antibiotic (s) resistant to…………………………………………………………..

………………………………………………………………………………………

20. Is the treatment regimen of the prescribed antibiotic appropriate?

Please tick Yes or No for the various data points highlighted appropriately.

Antibiotic	**Dose**		**Route**		**Frequency**		**Duration**	
	Yes	No	Yes	No	Yes	No	Yes	No

21. What is the total cost of the medicines including antibiotics prescribed?

GHC………….

22. What is the cost of antibiotic(s) prescribed? GHC…………….

F. TREATMENT OUTCOMES

23. What is the length of stay in hospital after admission for infection management?

……………….days

24. Are there symptoms resolution after antibiotic therapy? I. YES ☐ II. NO ☐

25. Was cure of bacterial infection confirmed with bacteriology report?

I. YES ☐ II. NO ☐

APPENDIX 2: COPY OF CERTIFICATE OF AUTHORIZATION TO

CONDUCT RESEARCH IN TTH

Department of Research & Development
Tamale Teaching Hospital

TTH/R&M/SR/13/113
25/02/2015

TO WHOM IT MAY CONCERN

CERTIFICATE OF AUTHORIZATION TO CONDUCT RESEARCH IN TAMALE TEACHING HOSPITAL

I hereby introduce to you **MR. HAMIDU ABDULAI**, an MSc student in clinical Pharmacy at Kwame Nkrumah University of Science and Technology (KNUST), who has been duly authorized by Management to conduct a study titled, "**ASSESSMENT OF ANTIBIOTIC USE AT TAMALE TEACHING HOSPITAL (TTH)**".

Please accord him the necessary assistance to be able to complete his study work. If in doubt, kindly contact the Research Unit at the 2nd floor of the administration block or on Telephone 0209281020. In addition, kindly report any misconduct of the Researcher to the Research Unit for necessary action, please.

Thank You.

ALHASSAN MOHAMMED SHAMUDEEN
(HEAD, RESEARCH & DEVELOPMENT)

APPENDIX 3: COPY OF ETHICAL APPROVAL LETTER

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY
COLLEGE OF HEALTH SCIENCES
SCHOOL OF MEDICAL SCIENCES / KOMFO ANOKYE TEACHING HOSPITAL
COMMITTEE ON HUMAN RESEARCH, PUBLICATION AND ETHICS

Our Ref: CHRPE/AP/324/15

23rd September, 2015.

Mr. Hamidu Abdulai
Post Office Box 1538
Tamale
NORTHERN REGION.

Dear Sir,

LETTER OF APPROVAL

Protocol Title: ***"Assessment of Antibiotic Use at Tamale Teaching Hospital."***

Proposed Site: ***Tamale Teaching Hospital-Directorates of Paediatrics, Medicine, Surgery and Obstetrics & Gynaecology.***

Sponsor: ***Principal Investigator.***

Your submission to the Committee on Human Research, Publications and Ethics on the above named protocol refers.

The Committee reviewed the following documents:

- A notification letter of 25th February, 2015 from the Tamale Teaching Hospital (study site) indicating approval for the conduct of the study in the Hospital.
- A Completed CHRPE Application Form.
- Participant Information Leaflet and Consent Form.
- Data Collection Tool.

The Committee has considered the ethical merit of your submission and approved the protocol. The approval is for a fixed period of one year, renewable annually thereafter. The Committee may however, suspend or withdraw ethical approval at anytime if your study is found to contravene the approved protocol.

Data gathered for the study should be used for the approved purposes only. Permission should be sought from the Committee if any amendment to the protocol or use, other than submitted, is made of your research data.

The Committee should be notified of the actual start date of the project and would expect a report on your study, annually or at the close of the project, whichever one comes first. It should also be informed of any publication arising from the study.

Thank you Sir, for your application.

Yours faithfully,

Osomfuor Prof. Sir J. W. Acheampong MD, FWACP
Chairman

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