KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY KUMASI, COLLEGE OF HEALTH SCIENCES DEPARTMENT OF CLINICAL AND SOCIAL PHARMACY

ANTIBACTERIAL USE AND RESISTANCE PATTERN AT THE ACCIDENT AND EMERGENCY DEPARTMENT OF KOMFO ANOKYE TEACHING HOSPITAL

By

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MARCH, 2015

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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 FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE IN CLINICAL PHARMACY

MARCH, 2015

DECLARATION

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

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Certified by:

Dr. Kwame Ohene Buabeng	**……**	**……**
Head of Department &Project Supervisor	**Signature**	**Date**

DEDICATION

This work is dedicated to the almighty God and to my family for their immerse support throughout this course.

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My greatest gratitude goes to the almighty God for giving me the strength to go through my MSc. programme. I wish to thank the Head of Department of Emergency medicine-Komfo Anokye Teaching Hospital (KATH), Dr. George Oduro and Head of Clinical MicrobiologyKATH, Prof. E. Frimpong for giving me the permission to carry out this research. Not forgetting my immediate boss and Head of Pharmacy at the Emergency Medicine directorate, Mr. Michael Assenso for his support through the programme. Special thanks to all my colleagues at work especially Pharm. Lesley Boatey, Pharm. Afia Nkansah-Sarkodie, Pharm. Akua Afriyie Appiah and Pharm. Grace Sobotie for their help. I also thank my parents for the support and love they have shown towards my education and career to date. I further wish to say a big thank you to my supervisors, Dr. Kwame Ohene Buabeng and Dr. Alex Owusu-Ofori for their support and guidance, without them this thesis would have been nearly impossible. Finally, I cannot forget the contribution of all my lecturers at the Department of Clinical and Social Pharmacy, KNUST especially Mr. Joseph Attakorah in helping me through this programme.

ABSTRACT

Background and Objectives: Antimicrobial resistance is a major problem all over the world due to indiscriminate and inappropriate use of antimicrobials both in healthcare facilities and in communities. The Accident and Emergency Department (AED) serves as a major area where antimicrobial therapy is initiated for severe infections but data on use of antimicrobial agents in these setting are lacking in Africa. This study aim was to determine the appropriateness of antibacterial use as well as antibacterial resistance patterns of commonly isolated bacteria at AED of Komfo Anokye Teaching Hospital (KATH).

Methodology: This was prospective observational study undertaken from 1st March to 30th April, 2014. Two hundred and eighty-two patients at the AED wards were selected by systematic random sampling from 1119 patients exposed to antibacterials out of total 1942 admitted within the study period. These patients were then followed on daily for data on antibacterial use. From 85 of the admitted patients, 90 specimens were taken for culture and sensitivity testing at the Medical Microbiology laboratory of KATH. The specimens included blood (n=37), others such as ascitic fluid, pleural fluid and knee joint aspirate (n=28), urine (n=15), cerebrospinal fluid (n=5) and wound swab (n=5). Appropriateness of antibacterial use was assessed based on recommendations

in the Standard Treatment Guidelines-2010 of Ghana and other international standard guidelines accepted globally and adapted by clinicians at KATH.

Results: In all 1119 out of 1942 patients encountered within the study period were prescribed antibacterials, representing a prevalence of 57.6%. Of the 282 sampled, 61.7% (n=174) were on curative antibacterial therapy and 38.3% (n=108) were on prophylactic therapy. Cefuroxime was the most prescribed antibacterial agent (DDD/100days: parenteral 36.119; oral 75.850) and Doxycycline (DDD/100days: oral 16.689) was the least prescribed. Seventy percent (n=196) of antibacterial prescriptions were considered appropriate based on recommendations in the approved standard guidelines. For those patients on curative antibacterial therapy who were followed (n=123), 15.4% (n=19) died, 56.1% (n=69) had improvement in their clinical status and general well-being, and 28.5% (n=35) had their symptoms worsening.

Twenty-six percent (n=23) of the 90 specimens recorded bacterial growth. The most common isolates were *E. coli (n=10),* Coagulase Negative *Staphylococcus* (n=6, possibly contaminants of blood and ascitic fluid specimens), *Klebsiella spp* (n=4), *Pseudomonas spp* (n=2) and MRSA (n=1). Over 70% of the *E. coli* isolates tested were resistant to ceftriaxone, cefuroxime, ciprofloxacin and cotrimoxazole. The *Klebsiella* isolates were resistant to cefuroxime, cotrimoxazole and ceftriaxone.

Conclusion: The rate of antibacterial prescribing at AED was high, with a third of the prescriptions considered inappropriate. *Klebsiella* and *E coli* isolates from patient samples sent to the laboratory were resistant to broad spectrum antibacterial agents like ceftriaxone and cefuroxime. Antimicrobial agents should therefore be used more responsibly, guided by culture and sensitivity data for definitive therapy. This would minimize morbidity and mortality from infectious diseases as well as the risk of emergence and spread of antimicrobial resistance in hospitals.

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LIST OF ABBREVIATIONS

AED	Accident and Emergency Department
ATC	Anatomical, Therapeutic and Chemical
CDC	Centers for Disease Control and Prevention
CDU	Clinical Decision Unit
CHRPE	Committee on Human Research, Publication and Ethics
CNS	Coagulase Negative *Staphylococcus*
C/S	Culture and Sensitivity testing
CSF	Cerebrospinal fluid
DDD	Defined Daily Dose
HIV	Human Immunodeficiency virus
ICU	Intensive Care Unit
KATH	Komfo Anokye Teaching Hospital
KBTH	Korle Bu Anokye Teaching
KNUST	Kwame Nkrumah University of Science and Technology

MRSA	Methicillin Resistance *Staphylococcus aureus*
SATS	South African Triage Scale
SME	Surgical and Medical Emergency
SPSS	Statistical Package for Social Sciences
STG	Ghana Standard Treatment Guidelines-2010
TEWS	Triage Early Warning Score
UTIs	Urinary Tract Infections
WHO	World Health Organization

CHAPTER ONE

1.1 INTRODUCTION

Inappropriate use of antibacterial agents is a global health concern because of the increasing rate of bacteria resistance to antibacterial agents and poor treatment outcomes from antimicrobial therapy (1). In 2001, the World Health Organization (WHO) announced a global strategy involving all stakeholders to combat the emergence and spread of antimicrobial resistance (2). Also on 7th April, 2011 during the World Health Day, WHO further reiterated a policy package to combat the spread of antimicrobial resistance with a call ―to action today to protect our antibiotics tomorrow‖ (3). In 2013, the Centers for Disease Control and Prevention (CDC) in its maiden report on antimicrobial resistance threats in the United States reiterated the global threat of antibacterial resistance (4).

In Ghana, there is paucity of data on the appropriateness of use of antibacterial agents in the clinical setting although resistance of bacteria to some of these agents is high. Newman *et al* (2006) in their study established that commonly isolated bacteria in Ghana including *Staphylococcus aureus* and *Salmonella typhi* were multidrug resistant (5,6). A study also done in Korle bu Teaching hospital identified nasal colonization of drug resistant strains in children under five (7). Another study by Sanaa *et al* in 2013 identified the presence of resistant strains of *Staphyloccocus aureus* isolates to most of the commonly used antibacterial agents in three hospitals in Kumasi (8).

The hospital and societal cost of antibacterial misuse is high. In a study in Chicago involving a sample of 1391, 13.5 % had a resistant bacteria with the societal cost estimated to be $13.35 million in 2008 dollars (9).

There is a decline in development of new antibacterial agents by pharmaceutical companies (10) as result of poor return on their investments and failure of discovery of new antibacterial agents based on traditional models of discovery among other reasons (11,12). This places much responsibility on all stakeholders to protect the antibacterial agents currently in use.

In Emergency department of hospitals, because of the urgent needs of most patients‘ conditions, the interaction between patients and physicians is at times sporadic in nature. This results in most antibacterial prescriptions being empirical or prophylactic. From a study in an emergency department of a tertiary hospital in Taiwan, inadequate empirical antibacterial therapy has been shown to be associated with higher mortality rates (13). A study by Kang *et al*, also showed the increased mortality among bacteraemic patients is associated with inappropriate first antimicrobial therapy (14).

The strategic position of emergency departments makes the prompt and appropriate antibacterial therapy a major contributory factor in good patients‘ outcomes as antibacterial therapy often start at the department for most patients.

There are various means of determining outcomes of antibacterial therapy in an infection. This includes clinical cure (where resolution of signs and symptoms are used)(15,16), microbiological cure (which involves microbial eradication after treatment), economic (which includes hospital stay days) and ecological outcomes (where resistance rates of commonly isolated organism are determined)(17). However, clinical studies on antibacterial efficacy mostly use two main parameters for the study; clinical improvement/clinical cure and microbiological cure (18).

1.2 Rational of the study

Inadequate data on antibacterial use at Accident and Emergency Department (AED) of the Komfo Anokye Teaching Hospital (KATH) poses a great challenge to rational use of antibacterials in the department and KATH at large. KATH does not currently have an antibacterial stewardship program which includes antibacterial prescribing guidelines. Thus the extent of use of antibacterials whether rationally or irrationally is unknown. This study will provide evidence on the appropriateness of antibacterial use at AED and also highlight the resistance pattern of commonly isolated bacteria during the study period. This study will serve as a baseline study and a guide to the implementation of KATH antibacterial stewardship programme. It will also inform all stakeholders and policy makers in their effort towards promoting rational antibacterial use and support incorporating appropriate antibacterial use in our antimicrobial surveillance system in KATH.

1.3 Main Aim

The aim of this study is to describe antibacterial resistance patterns of commonly isolated bacteria and the appropriate use of antibacterials at the AED of KATH.

1.3.1 Specific Objectives

1. To assess the prevalence of use of antibacterials at the AED of KATH.
2. To assess the antibacterial prescription pattern at AED and calculate the DDD/100 beddays of commonly used antibacterial agents.
3. To assess the quality (or appropriateness) of antibacterial prescriptions at the AED.
4. Ascertain the extent of microbiological culture and sensitivity request at the AED.
5. Determine the sensitivity and resistance pattern of commonly isolated bacteria from specimen collected at the AED during the study period.

6. Assess the outcome (or clinical status) of patients following curative antibacterial therapy.

CHAPTER TWO

2.1 LITERATURE REVIEW

2.1.1 History of antibacterials

The use of natural product mixtures to treat infections dates from ancient times (19) and there is evidence of tetracycline in human skeleton dating back to AD 350-550 (20). The gradual acceptance of the germ theory of disease which suggested that infectious disease was caused by microbes, led to a search for a means to kill these implicated microbes. In 1907, Paul Erhlich in his search for a ―magic bullet‖ to cure infectious diseases led to the discovery of Salvarsan, the first chemical compound used in treating syphilis. In 1928, Sir Alexander Fleming observed that *Penicillin notatum* had contaminated bacterial culture plates of *Staphylococcus aureus* and there was growth inhibition of the *S. aureus* at the point of contact. This led the discovery of penicillin. However it was not until 1940, that a purification process was developed to produce sufficient quantities for clinical trials. In 1942, mass production and distribution of penicillin began (21). This marked the beginning of the ―antibiotic era‖: The term antibiotic was first used by Selman Waksman in 1941 (22).

Antibiotics, since the discovery of penicillin, have played an important role in health. However the use of antibiotics is associated with its own inherent problems. Based on the theory of evolution, it is known that microbes develop factors that enable them to resist the action of antibiotics especially on repeated exposure (23).

2.1.2 General use of antibacterials and resistance

Various studies have showed that increased and inappropriate use of antibacterials has been a major factor to the development of microbial resistance in hospitals and the community (24). In Europe, countries with high antibacterial agents consumption have high resistance rates (25). This shows the positive correlation between antibacterial use and resistance. In Ghana, antibacterial agents are one of the most prescribed agents (26). The appropriate use of antibacterials has therefore become an important factor in combating antibacterial resistance in the hospital setting. This necessitates everybody especially health professionals to ensure that antibacterial agents are used appropriately so as to minimize resistance.

There is a growing problem of antibacterial resistance in Africa and other developing countries (27–29). In Ghana, many clinically important microbes have shown resistance to most commonly used antibacterial agents to which they were initially susceptible (6,30). A study by Nys *et al* (2004) in eight developing countries including Ghana showed resistant strains of *E. coli* to cefazolin, gentamicin and ciprofloxacin (31). Quinolone resistant *E. coli* has also been found to be common in Accra, Ghana (32).

A study by Obeng-Nkrumah *et al* (2013) in Korle-bu Teaching Hospital (KBTH) which is a major referral center in Ghana with similar characteristics as KATH, found a high level of Extended-spectrum beta-lactamase (ESBL)–producing Enterobacteriaceae among neonates and adults over 65 years indicating high selective pressure associated with massive antibacterial agent use (33). Another study by Feglo *et al* at KATH also found ESBL producing strains of *E. coli* (34).

A sustained reduction of antibacterial use led to a drop of methicillin resistant *Staphylococcus aureus* (MRSA) and *Clostridium difficile* infections in a tertiary hospital in the United States

(35). This demonstrates the effect of reduced antibacterial use on resistance pattern on bacteria. A study by Bronzwaer *et al* on the relationship between antibacterial use and bacteria resistance patterns in Europe implicated the increased use of beta-lactam antibiotics and macrolides as being associated with increased bacteria resistance (25). A study in Europe also demonstrated the positive association between inappropriate antimicrobial use and resistance (36).

2.1.3 Use of antibacterial agents in emergency departments

There is scarcity of reports on antibacterial use in emergency settings in Africa. In Ghana, not much has been officially reported as the AED in KATH is a recent development. However, available reports on antibacterial use in emergency and acute care settings in other jurisdictions demonstrate a high level of inappropriate and unnecessary use of antibacterial agents. A study found 77% of antibacterial prescription changed within the first 24 hours and by 72 hours most patients had received at least 3 antibacterial agents(37). A study by Gonzales *et al* demonstrated high prevalence of indiscriminate antibacterial use in acute respiratory infections in emergency setting (38). Stone *et al* (2000) also found antibiotics commonly prescribed for emergency patients with common cold and upper respiratory tract infections (24.2%), and bronchitis (42.2%) even though they were unwarranted and ineffective (39). Though there have been reported decrease in antibacterial usage for acute respiratory tract infections in the United States from 1995 to 2000, antibacterials still accounts for half of the prescription written for these subsets of patients (40). Despite campaign effort by the Centers for Disease Control and Prevention (CDC) to combat unnecessary antibacterial use, a study by Xu *et al* (2013) found an unnecessary high use of antibacterial agents in uncomplicated upper respiratory tract infections which did not require these agents (41). In another study, emergency physicians were likely to prescribe antibiotics in acute

diarrhea because they assumed patient expected them to even though they were correct in 33% of their prescriptions (42).

Another challenging factor is the association of antibacterial prescription and patient satisfaction. In a study involving patients with acute respiratory infection in an emergency setting, some patient derived satisfaction on receiving an antibacterial prescription (43) while in others satisfaction was not related to receiving antibacterial agents (44). In another study assessing the appropriateness of antibacterial prescription in the emergency department found only 53% of antibacterial prescription appropriate and 34% following guidelines (45). A Spanish study also found 43% incorrect antibacterial prescriptions in an emergency department (46).

2.1.4 Use of Culture and Sensitivity testing in Emergency Departments

In emergency situations, it is prudent to initiate antibacterial in suspected bacterial infectious conditions before culture and sensitivity testing results of samples are ready. Though it is a standard practice to request for culture and sensitivity testing in most infectious conditions, its utility in the emergency department for pneumonia has been questioned and are said to be rarely useful in some studies in developed countries(47–49). In some of these studies with patients with bacteremic pneumonia, it was observed that blood cultures infrequently change therapy with patients with pneumonia(50–52). As a result of this, Shapiro *et al* developed a clinical decision rule to optimize the use of blood cultures in the emergency department (53). This decision rule utilizes a set of major criteria and minor criteria to classify patients as high or low risk. It is only in the high risk patients that blood cultures mostly yield positive results. However, it must be noted that positive culture results is always the key to definitive antibacterial therapy.

2.1.5 Principles of antibacterial prescribing

Various principles govern the use of antibacterials in the clinical setting. According to the British National formulary, the patient and the likely organism believed to be causing the infection are the factors that must be considered in selecting an antibacterial agent. The pharmacological/ toxicological properties as well as microbiological efficacy of the antibacterial agent must be taken into consideration whether it is for prophylaxis, empirical, or definitive therapy (16,54).

Prophylactic antibacterial therapy is when one or more antibacterial agents are given to prevent an infection. Empirical antibacterial 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. Definitive antibacterial therapy is when one or more antibacterial agents is directed against an identified microbe based on positive microbiological culture results (16). For this study, Empirical and definitive antibacterial therapy are termed Curative antibacterial therapy.

Appropriate antimicrobial prescribing as defined by 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‖ (55).

2.1.6 Methods of evaluating antibacterial use

There are various methods in determining antibacterial use in hospitals. However, the pioneering work of Kunin *et al* (1973) serves as the basis for assessing the quality of antimicrobial prescribing in health care settings (56). A flow chart by Gyssens *et al* (1992) developed based on the original

work of Kunin *et al* (56) as shown in Figure 1 below, has been used to assess all aspects of antimicrobial prescribing (57,58). Using the flow chart, an antibacterial prescription can be assessed using any of the descending roman numerals (that is from VI through O) or a combination in line with recommendations in approved guidelines.

From the flow chart, the decision to use an antibacterial agent, the indication, choice of medication, toxicity, cost, dose, dosage frequency, duration, route and time of administration in line with clinical condition as stated in approved standard treatment guidelines provides a means of assessing the appropriateness antibacterial therapy (58). A prospective clinical audit carried out in a university hospital in France using the Gyssens *et al* flow chart for evaluating antibacterial prescription appropriateness found 64% of antibacterial prescriptions inappropriate or unnecessary (59)

Point or period prevalence studies, where the proportion of patients on antibacterial agents at a specific time or period is determined, have also been used to assess the prevalence of antibacterial use at a point in time or over a period (60–64).

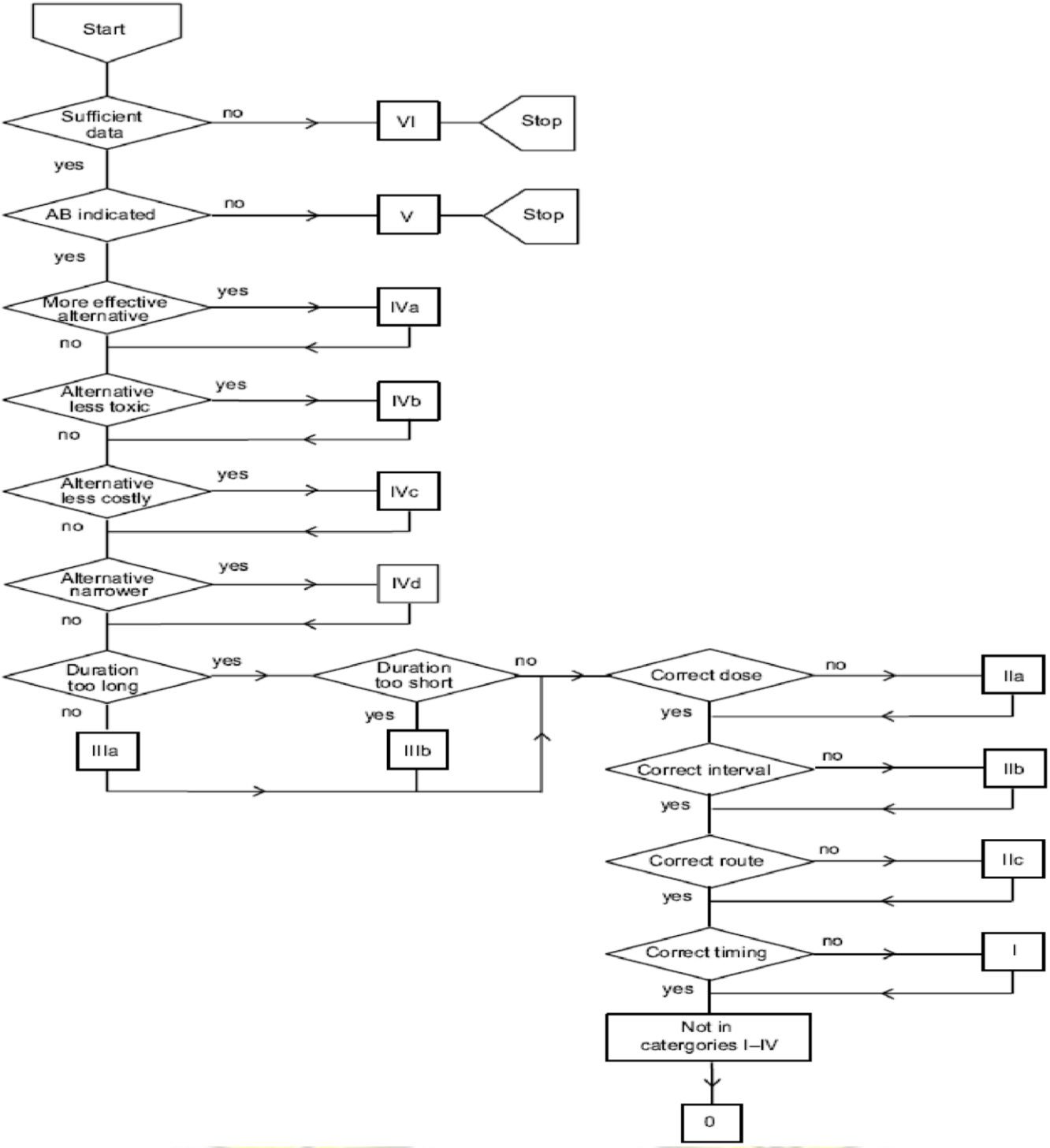

Figure 1: Flowchart for assessing the quality of antimicrobial drug prescription [by Gyssens *et al* (57,58)

AB= Antimicrobial agent

Another method such as the Anatomical, Therapeutic and Chemical (ATC) Classification /

Defined Daily Dose (DDD) methodology developed and maintained by the WHO Collaborating Centre for Drug Statistics Methodology can also be used to compare the antibacterial agents consumption between countries, hospitals or even departments within the same hospital (65,66). This method is used to determine the DDD per 100-bed days for antibacterials used within in a health care facility during a period. For example if the calculated DDD per 100 bed-days for cefuroxime use in a health care facility is 50 DDD per 100 bed-days, this implies that 50% of the patients may receive a DDD of cefuroxime every day. In Ghana, there is lack of data on antibacterial use burden based on the ATC/DDD methodology.

These methods of antibacterial use evaluation help in antibacterial stewardship with the aim of minimizing antibacterial resistance and improving treatment outcomes.

2.1.7 Antibacterial resistance

Antibacterial resistance is said to occur when a bacteria is able to withstand the action of an antibacterial agent to which it was previously susceptible (67). Antibacterial resistance can occur across all or some strains of the supposed bacteria. A bacterium can have innate or acquired resistance. Innate resistance is based on the unique genetic code of the organism giving it the ability to pass its genes to its progeny by means of reproduction (also called vertical gene transfer). Example is resistance of *E. coli* to vancomycin. Acquired resistance occurs through chromosomal mutation or horizontal gene transfer (HGT). HGT is the transfer of genes from one bacterium to another other than traditional reproduction (or vertical transfer). HGT occurs by means of mobile genetic factors such plasmids, integrons, transposons or bacteriophages through conjugation, induction and transformation. Once the bacteria have these resistance genes in their genetic make-

up, they are able to protect themselves from several antibacterial agents through a variety of resistance mechanisms (68). These resistance mechanisms include destruction of the antibacterial agent by the bacterium (e.g. beta-lactamases), modification of the antibacterial target site, bypassing the action of the antibacterial through production of alternative pathways, and prevention of the drug from reaching its target site through efflux mechanisms or decreasing its permeability into the bacterium(69,70).

Though resistance of bacteria can occur naturally, the use of antibacterial agents have been observed to hasten the process of acquired resistance by bacteria. Indiscriminate and excessive use in the clinical setting and use of antibacterials for agricultural purposes are all contributory factors to the development of resistance (71). Poor quality antibacterials have also been noted as contributing to resistance development especially in developing countries. As a result, treatment failures from poor quality antibacterials necessitate the use of reserved second line antibacterials (72). Other physical factors contributing to the spread of resistant strains include movement of patients within and among healthcare institutions, lack or inadequacy of infection control measures, and general movement of goods and people (73).

2.1.7 Combating Resistance

CDC in its 2013 annual report identified four main ways of fighting antibacterial resistance. These are infection prevention, tracking of resistance patterns, antibacterial stewardship and development of new antibacterial diagnostic testing (4). These measures are aimed at the health facility, prescribing and dispensing angle of combating antibacterial resistance.

Antibacterial stewardship are various measures implemented to promote appropriate use of antibacterials (74). Various countries have developed and implemented antibacterial stewardship program and evidence from various studies confirms the benefits of these stewardship program (75–79). Antibacterial stewardship ensures prudent use of antibacterials in health care settings and minimizes antibacterial resistance. Antibacterial ward rounds (80) of infectious disease specialist and antibacterial restriction policies(81) are all components of antibacterial stewardship program applied in various settings.

CHAPTER THREE

3.1 METHODOLOGY

3.1.1 Study design

This was a prospectively observational study with three areas of focus. These were;

a) Prevalence of antibacterial use, where the proportion of patients prescribed antibacterial agents during the study was determined.
b) Appropriateness of antibacterial use, pattern of use and patient outcomes, where data was collected prospectively from a randomly selected sample in the wards.
c) Resistance pattern of bacteria isolates to antibacterial agents, where data from all AED patients with culture and sensitivity request was assessed from the Medical Microbiology lab.

3.1.2 Study settings

KATH is a 1200 bed capacity teaching hospital located in Kumasi, the second largest city in Ghana. The study settings were the Accident and Emergency Department (AED) of KATH and the KATH medical microbiology lab.

3.1.2.1 Accident and Emergency Department (AED)

The AED is responsible for the provision of emergency medical and surgical services to mostly adult clients. The AED has three main emergency wards namely Red, Orange and Yellow wards where emergency services are provided. Patients are assigned to Red, Orange and Yellow wards based on the urgency of emergency care they require. The urgency of care is decided using the

validated South African Triage Scale (SATS) which relates a score of a patient to the assigned ward (82–84). The SATS consists of three age-specific tools. The age-specific tools are the Adult tool, Child tool and Infant tool. The Adult tool is for patients aged 12 years and above or height above 150cm. The Child tool is for patients aged 3 to 12 years or height from 96 to 150cm. The Infant tool is for patients under 3 years or height 95cm and below.. The content of each tool consists of a range of parameters with scores assigned to generate the Triage Early Warning Score (TEWS). A TEWS of above 7 admits the patient to Red which indicates the patient needs immediate treatment. A TEWS of 5-6 admits the patient to Orange indicating treatment should commence within 10 minutes. A TEWS of 3-4 admits the patient to Yellow indicating the patient needs treatment within 60 minutes. A TEWS of 0-2 is assigned the code colour Green which indicates the patient has non-emergency condition and therefore should be referred to a primary care facility. A patient brought in dead is assigned code Blue.

The parameters measured to generate the TEWS include mobility, heart rate, temperature, blood pressure, respiratory rate, trauma history and consciousness level. The TEWS also allows for a senior health professional discretion in assigning a patient to a ward (85). A patient after being triaged to a ward is assigned a folder. The attending physician documents all relevant data after assessing the health condition of the patient and may prescribe medications and/ or recommend the necessary investigation such as culture and sensitivity to be done in line with the clinical presentation of the suspected condition.

The AED Pharmacy is also an integral part of Accident and Emergency Department. Prescriptions in folders of patients on admission or detained at the AED are sent to the pharmacy and assessed to rule out any medication related problems, after which the prescribed medications are supplied to nurses to be taken back to the respective ward. In the pharmacy, patient relevant data including

dispensed medication are entered manually into the pharmacy records and also in the patients' folder before the medications are supplied. Patient records maintained in the pharmacy includes patients name, age, sex, ward, medications supplied and dates the medicines were supplied.

3.1.2.2 KATH Medical microbiology laboratory

In the Medical microbiology laboratory, specimen for culture and sensitivity testing are received on a request form signed by the physician attending to the patient from which the specimen was taken. Details on the request form include the patients name, age, sex, ward, specimen type, diagnosis/clinical summary and date of request. The specimen is given a unique code after which all data on the request form entered in the microbiology records. The specimen are then processed and when the results become available, the particular patient record is updated in the microbiology records with the help of the unique code.

3.1.3 Target population

The population targeted in this study was all patients admitted at Red, Yellow and Orange wards at AED, KATH.

3.1.4 Inclusion criteria

Patients admitted to the AED wards

3.1.5 Exclusion criteria

Patients admitted to the Critical decision unit ward (CDU), Intensive Care Unit ward (ICU), Burns Intensive Care Unit ward, Theatre recovery ward, Special awards as well as patients who were unconscious.

a) Assessing prevalence of antibacterial use

For the prevalence of antibacterial use, data on all admitted patients gathered within the study period was used.

Data collection on prevalence of antibacterial use

Data on all admitted patients were entered into a specially designed data sheet (Microsoft Excel workbook) as their folders came to the pharmacy for medication. This enabled the assessment of patients exposed to antibacterial therapy, out of the total number admitted to the AED wards within the study period.

b) Assessing appropriate antibacterial use and patient outcomes

For the appropriate antibacterial use, pattern of use and patients' outcomes, data was gathered from the sample of patients on antibacterial therapy at the AED wards.

Sample size for study participants

Since this study had three focus areas, an appropriate sample size was estimated to guide the selection of study participants for data on appropriateness of antibacterial therapy, pattern of use and patients' outcomes.

Thus assuming 50% of patients in the AED wards were exposed to antibacterial agents, using a delta (or margin of error) of 0.055 and within 95% confidence limit, a population size of

approximately 2200 patients for two months would require at least 278 participants. However, a total of 282 participants were selected to ensure an adequately powered study.

Sampling Procedure for study participants

A total of 282 patients from the AED wards were selected by means of systematic random sampling. Using the list of patients' in each of the three emergency wards supplied antibacterial agents from the pharmacy, every third of such patient was recruited after obtaining informed consent, and followed. The selection was done to reflect the wards relative patient load. The patient load is also a reflection of the bed complement of each ward with Yellow having 18 beds, Orange 12 beds and Red 6 beds. Yellow ward had the highest number of selected patients with 131 patients, followed by Orange with 104 patients and the Red with 47 patients. The patients were recruited from 1st March, 2014 to 30th April, 2014 for the study.

Data collection on appropriate antibacterial use

The data collection form (Appendix 1) for assessing appropriate use of antibacterial agents and patients clinical outcomes was evaluated for clarity and content validity by two emergency physician specialists before pretesting. In collecting this data, selected patients were followed daily for relevant data such as diagnosis, antibacterial agents prescribed and their dosages. In addition data obtained were dosage frequency and duration as well as the total number of antibacterial agents prescribed. Clarification with regards to use of any prescribed antibacterial agent whether as prophylactic or curative was sought from the prescribing clinician when required. Patient outcomes (i.e. clinical status) were assessed in that subset of patients on curative antibacterial therapy after 48hrs before being discharged home or

transferred to the other wards outside the AED. This is because most guidelines recommend a review of antibacterial therapy 48 hours after initiating therapy (86–88). Outcomes measures used included worsening or resolution of signs and symptoms following antibacterial therapy (i.e. resolution or worsening of fever, chesty cough in respiratory infections and improvement in the general wellbeing of the patient). Assessment of the patients‘ outcomes was done clinically. Death of participants who received at least a dose of an antibacterial agent for therapeutic purposes was also noted. The data was collected by four trained pharmacists who are conversant with the antibacterial protocol in the Ghana Standard Treatment Guidelines and other standard guidelines adapted for use by the clinicians. The other guidelines included CDC recommendations (89) and the BNF(54).

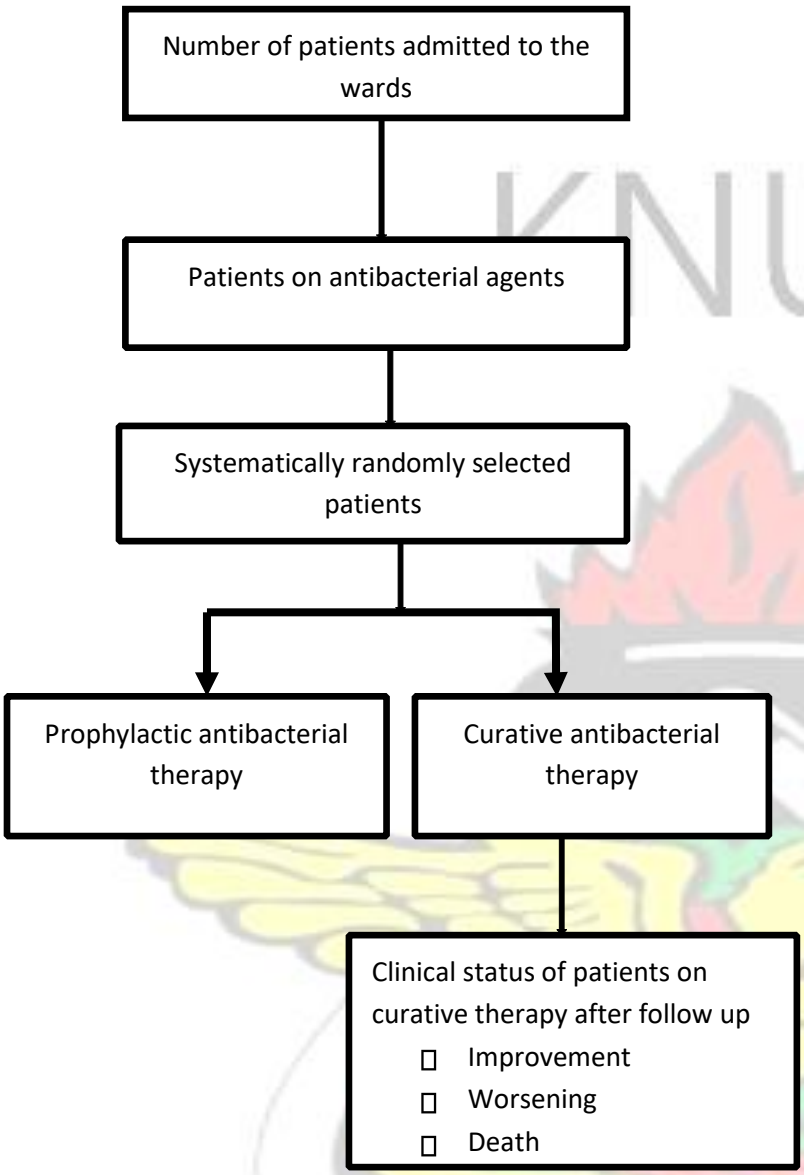

Figure 2: Study flow chart on patients included in the study and monitored for antibacterial use and outcomes

c) Determining antibacterial resistance

KATH medical microbiology lab records were used.

Data Collection of bacteria resistance patterns

The data collection form (Appendix 2) for the resistance pattern was reviewed by a clinical microbiologist for clarity and content validity and pretested before use. Data on all admitted AED patients with culture and sensitivity request was extracted daily from the Medical Microbiology lab records during the study period. The patient's age, ward, sex, specimen type, diagnosis or clinical summary, the type of isolated bacteria as well as their resistance pattern to antibacterial discs in the Medical Microbiology lab were among the information obtained. The specimen type included blood, urine, cerebrospinal fluid (CSF), wound swab and others. Others were pleural fluid, ascitic fluid, knee joint aspirate and breast aspirate. Data was collected by the principal investigator.

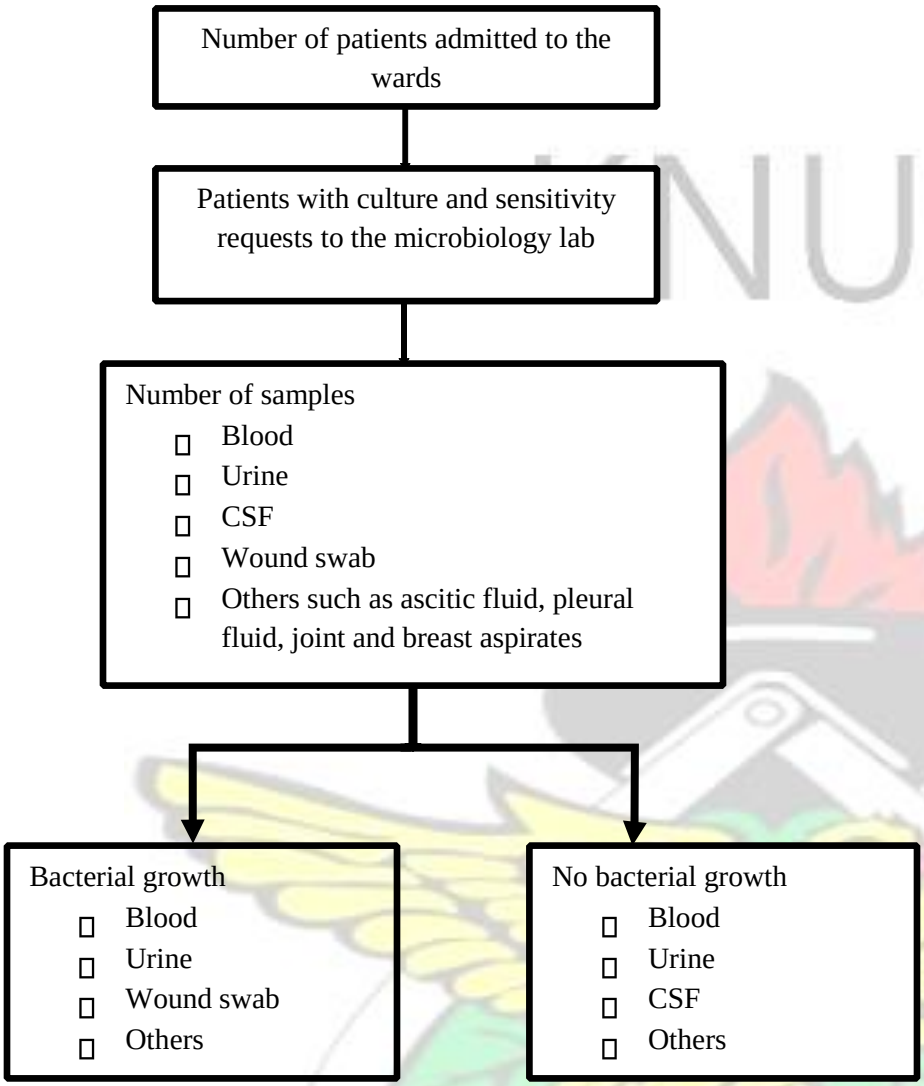

Figure 3: Study flow chart on AED patients with biological samples assessed for resistance

3.1.6 Data Analysis

All the collected data was coded, entered into SPSS version17 data base, and analyzed. Descriptive statistics including frequency and percentage was used to determine prevalence of antibacterial use. Pattern of antibacterial use was also represented as frequencies and proportions. Total number antibacterial agents prescribed to each patient were determined. Each of the indicators of

appropriate use including dose, frequency and duration was assigned a binary outcome of yes or no if correct or wrong, in relation to the patient condition and comorbidities. Descriptive analysis of resistance of bacteria isolates from collected specimen was also presented in a tabular form.

Appropriate use of an antibacterial agent was determined when the choice of selected agent, dose, and frequency was in line with the recommendations of the national standard guidelines and other international standards adapted for use at KATH. The extent of use of the commonly prescribed antibacterial agents was described by the defined daily dose/ 100 bed-days of the various agents used (Refer the formula below on how this was calculated).

Defined daily dose (DDD)/ 100 bed-days was calculated using the formula(90,91);

$$\text{DDD/100 bed-days} = \frac{\text{No. of units administered in a given period (mg) X 100}}{\text{DDD (mg) X no. of days in the period X no. of beds} \times \text{occupancy index}}$$

3.1.7 Ethical Consideration

Ethical approval (CHRPE/AP/011/14) was given by the Committee on Human Research Publication and Ethics (CHRPE), KNUST. This was after the Heads of Accident and Emergency Department and Department of Clinical Microbiology, KATH were contacted for consent to carry on the study after the objectives and rationale of the study has been explained to them. Cases of suspected inappropriate antibacterial prescribing during the course of data collection were discussed with the attending physician. Non-compliance with laboratory data was handled similarly. Anonymity and confidentially of patients data was assured throughout the study and

after.

CHAPTER FOUR

4.1 RESULTS

a) Prevalence of antibacterial use

Proportion of admitted patients exposed to antibacterial agents

A total of 1119 out of the 1942 admitted patients were prescribed antibacterial agents representing a prevalence of 57.6%. For Red ward, 112 out of 174 representing 64.4% were prescribed antibacterial agents, 60.6% (n=470) for Orange ward and 54.1% (n=537) for Yellow ward.

b) Appropriateness of antibacterial use and patient outcomes

2a. Demography of study participants

A total of 282 participants were selected to be assessed for appropriateness of antibacterial use and patients outcomes. This comprised 160 (56.7%) males and 122 (43.3%) females. There were 131 participants from Yellow, 104 participants from Orange and 47 participants from Red. The mean age of the participants was 44years with a standard deviation of 21.93. Sixty-two percent (n=174) of sampled patients were prescribed antibacterial agents for curative purposes while the remainder was for prophylaxis (Table 1).

Table 1: Prophylactic and curative use of antibacterial agents in the wards

	Antibacterial indication		
Ward	**Prophylactic**	**Curative**	**Total (%)**

Red	9	25	34(12.1%)
Yellow	64	74	138(48.9%)
Orange	35	75	110(39%)
Total	**108(38.3%)**	**174(61.7%)**	**282(100%)**

The most affected body system requiring antibacterial therapy included the gastrointestinal system (n=62) followed by genito-urinary system (n=43), respiratory system (n=50) etc. (Table 2).

Table 2: Affected body systems requiring antibacterial agents

	Antibacterial indication		
Body system affected	**Prophylactic**	**Curative**	**Total**
Gastrointestinal	33	29	62 (22%)
Cardiovascular system	5	2	7(2.5%)
Respiratory system	3	47	50(17.7%)
Central Nervous system	13	20	33(11.7%)
Endocrine system	0	1	1(0.4%)
Musculoskeletal	25	5	30(10.6)
Skin	20	22	42 (14.9%)
Genito-urinary	7	46	53(18.8%)
Blood	2	2	4(1.4%)
Total	**108(38.3)**	**174(61.7%)**	**282 (100%)**

From Table 3, hypertension and HIV infection were the most frequent comorbidities in those on antibacterial therapy at the wards.

Table 3: Comorbidities of study participants

	Antibacterial indication		
Comorbidity	**Prophylactic**	**Curative**	**Total**
Acute respiratory distress syndrome	1	0	1
Asthma	0	4	4
Cirrhosis	1	3	4
Chronic kidney disease	0	2	2
Chronic Liver disease	0	2	2
Cerebrovascular accident	0	2	2
Diabetes mellitus	0	10	10
Diabetes mellitus/Hypertension	1	12	13
Heart failure	0	1	1
Hypertension	5	16	21
Prostate cancer	0	1	1
Peptic ulcer disease	0	2	2
HIV infection	0	16	16
Systemic Lupus Erythematosus	0	1	1
Uterine fibroid	1	0	1
Total	**9**	**72**	**81**

2b. Commonly prescribed antibacterial agents

As shown in Table 4, 36.5% of sampled participants in the wards were given cefuroxime, followed by metronidazole (33.7%) and ceftriaxone (32.3%). The DDD/100-bed days of cefuroxime oral and parenteral were 75.85 and 36.12 respectively.

Table 4: Pattern of prescribed antibacterials

	Antibacterial indication			
Antibacterial agent	**Prophylactic**	**Curative**	**Total**	**DDD/100 bed-days**
Ceftriaxone	22 (7.8%)	69 (24.5%)	91 (32.3%)	35.196 (**P**)
Cefuroxime	48 (17%)	55 (19.5%)	103 (36.5%)	36.119 (**P**); 75.850 (**O**)
Metronidazole	45 (16%)	50 (17.7%)	95 (33.7%)	27.958 (**P**); 20.535 (**O**)
Amoxicillin/Clavulanic acid	21 (7.4%)	9 (3.2%)	30 (10.6%)	6.965(**P**); 23.501 (**O**)
Ciprofloxacin	22 (7.8%)	35 (12.4%)	57 (20.2%)	28.050 (**P**); 31.854 (**O**)
Clindamycin	2 (0.7%)	17 (6%)	19 (6.7%)	2.354 (**P**); 10.270 (**O**)
Azithromycin	2 (0.7%)	29 (10.3%)	31 (11%)	0.321 (**P**); 44.040 (**O**)
Flucloxacillin	0	5 (1.8%)	5 (1.8%)	0.535 (**P**); 3.123 (**O**)
Gentamicin	0	3 (1.1%)	3 (1.1%)	0.785 (**P**)
Cotrimoxazole	0	13 (4.6%)	13 (4.6%)	92.298 (**O**)
Doxycycline	0	2 (0.7%)	2 (0.7%)	16.689 (**O**)
Total	**108(38.3%)**	**174(61.7%)**	**282(100.0%)**	

P= Parenteral O=Oral

2c. Number of antibacterial agents patient were exposed to

Of the 282 study participants, 47.9% (n=135) and 44.7% (n=126) were prescribed to 1 and 2 antibacterial agents respectively. Few patients (n=21) were on 3 or more antibacterial agents (Figure 4).

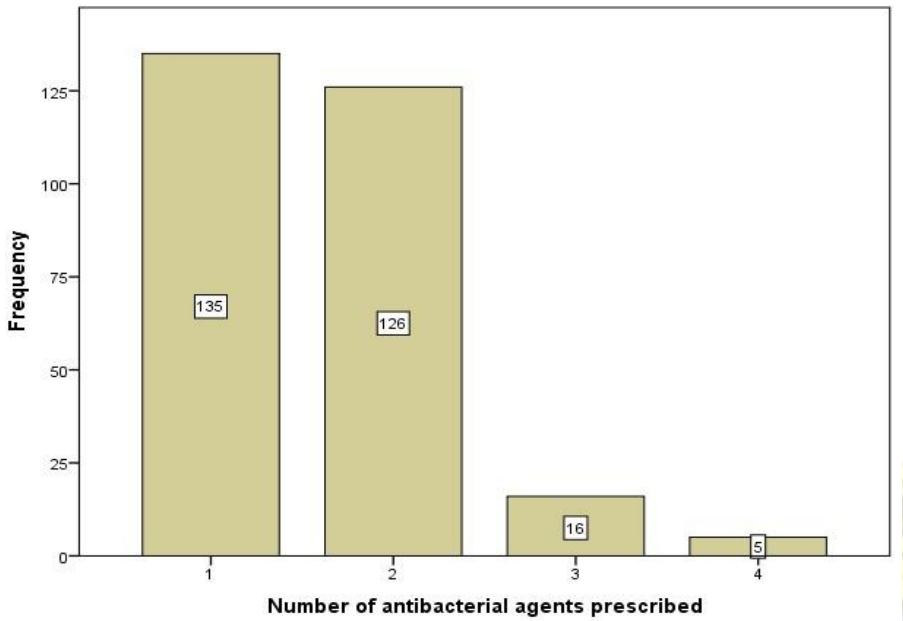

Figure 4: Number of antibacterial agents patients were exposed to.

2d. Choice of antibacterial agents used

Of the 282 participants, 72.3% (n=204) had the choice of selected antibacterial agents in line with recommendations in the standard guidelines (Figure 5).

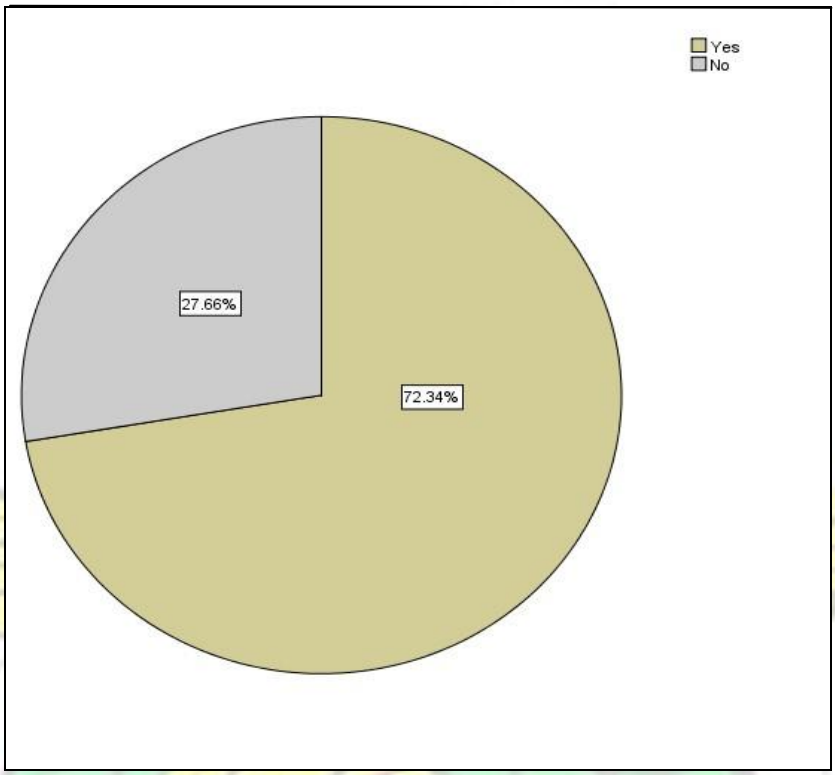

Figure 5: Choice of selected antibacterial agent(s) in line with recommendation in approved guidelines

About 70% of the study participants (n=196) had all the parameters indicative of appropriate antibacterial therapy (i.e. Correct choice of drug, correct dosage and correct dosage frequency) (Figure 6).

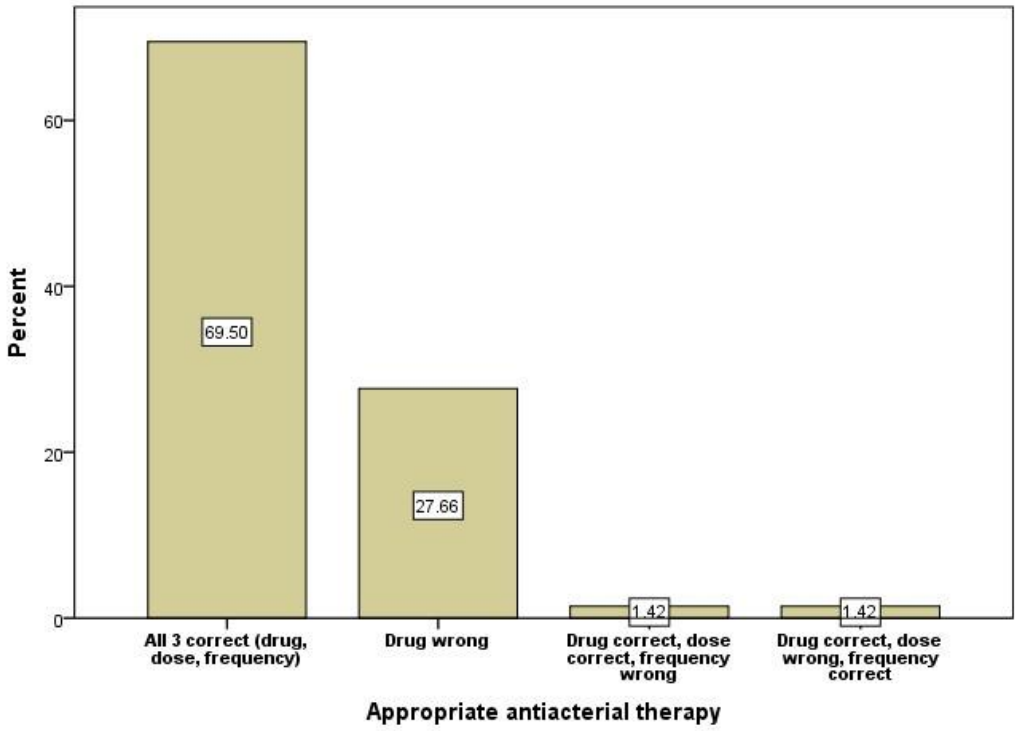

Figure 6: Appropriate antibacterial therapy as indicated by the standard guidelines

2e. Physicians request for culture and sensitivity testing

Out of the 282 study participants prescribed antibacterial agents during the study period, only 46 had request for culture and sensitivity to the Medical Microbiology lab when their folders were checked during data collection. This represented 16% of study participants (Figure 7).

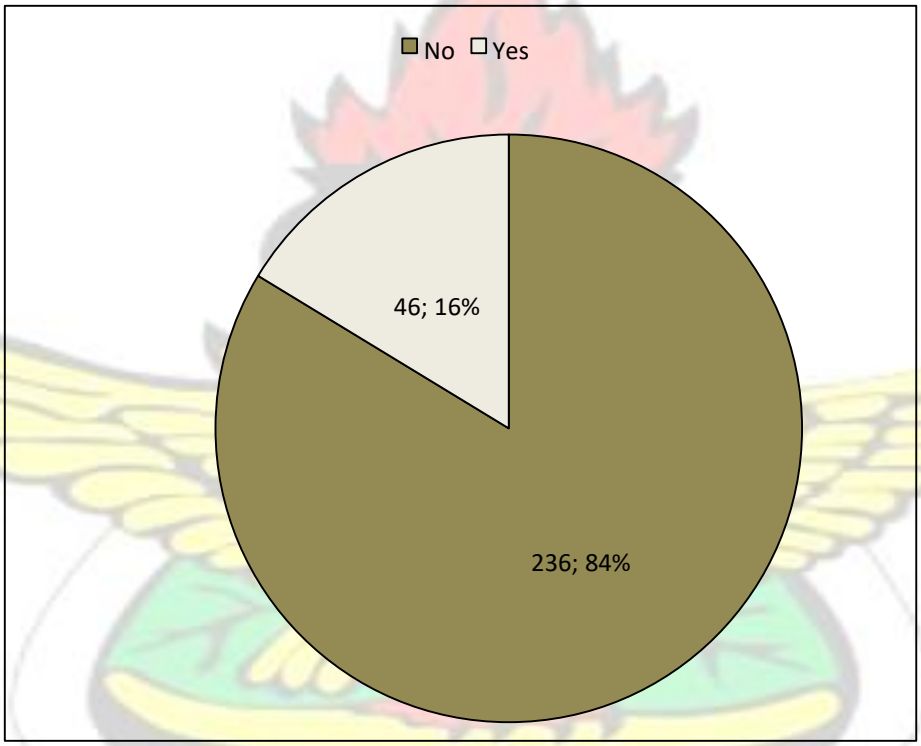

Figure 7: Request for culture and sensitivity testing

2g. Patient outcome following curative antibacterial therapy

One hundred and twenty-three (70.6%) of the 174 study participants were followed for outcomes assessment. The remaining 51 were lost to follow up. Fifty-six percent (n=69) of the patients showed improvement in their clinical status, 28.45% (n=35) had their condition worsening and 15.4% (n=19) died. Failure rates were higher in Red followed by Yellow ward (p=0.003).

Table 5: Patient clinical status following curative antibacterial therapy

Ward	Patient clinical status			Total
	Improvement	Worsening	Death	
Red	10	8	10	28 (22.8%)
Orange	29	18	7	54 (43.9%)
Yellow	30	9	2	41 (33.3%)
Total	**69 (56.1%)**	**35 (28.5%)**	**19 (15.4%)**	**123 (100%)**

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.947[a]	4	.003
Likelihood Ratio	15.169	4	.004
Linear-by-Linear Association	3.079	1	.079
N of Valid Cases	123		

a. 1 cells (11.1%) have expected count less than 5. The minimum expected count is 4.33.

c) **Resistance patterns of isolated bacteria**

3a. Patient demography and type of sample taken for culture

The mean age of all patients with samples taken to the lab was 47.51 years, with a standard deviation of 22.41 and range 18 to 88 years. Ninety specimen were taken from the patients. This include specimen from 41 patients (48.2%) from Orange, 32 (37.6%) from Yellow, and 12 (14.1%) from Red. The specimen were blood samples (37), urine samples (15), cerebrospinal fluid samples (5), wound swabs (5) and 28 others, which include ascitic fluid, pleural fluid, knee joint aspirate and breast aspirate.

3b. Isolated bacteria in the specimen types

Of the 90 specimen, there was no bacterial growth in 67. On the remaining 23 with bacterial growth, 10 isolates were *E. coli* strains, 6 were Coagulase Negative *Staphylococcus* (possibly a contaminant on the skin), 4 were *Klebsiella spp*, 2 *Pseudomonas spp* and 1 MRSA (Table 6).

Table 6: Frequency of bacterial isolates from the different specimen types

	Specimen type					
Isolated organism	**Blood**	**Urine**	**Cerebrospinal fluid**	**Wound swab**	**Others**	**Total**
E. coli	2	5	0	2	1	10
Pseudomonas spp.	1	0	0	1	0	2
Coagulase Negative Staph.	5	0	0	0	1	6

MRSA	0	0	0	0	1	1
Klebsiella spp.	0	0	0	2	2	4
No bacterial isolate	29	10	5	0	23	67
Total	**37**	**15**	**5**	**5**	**28**	**90**

Source: Microbiology lab data (March-April, 2014)

3c. Isolated bacteria and resistance to the various antibacterial agents

Over 70% of *E. coli* strains tested against ceftriaxone, ampicillin, cefuroxime and ciprofloxacin was found to be resistant. However all tested isolates of *E. coli*, CNS, *Pseudomonas spp.* and *Klebsiella spp.* were susceptible to Amikacin (Table 7)

Table 7: Isolated organisms and their resistance to the various antibacterial agents

	Resistance																
	Number of resistant isolates/ total number of that particular isolate tested (%)																
Isolated organism	**Ceftriaxone**	**Cefuroxime**	**Ceftazidime**	**Ampicillin**	**Flucloxaciilin**	**Ciprofloxacin**	**Gentamicin**	**Erythromycin**	**Cotrimoxazole**	**Cefotaxime**	**Amikacin**	**Chloramphenicol**	**Vancomycin**	**Nutrofurantoin**	**Pipemidic acid**	**Nalidixic acid**	**Total**
E. coli	3/4 (75)	7/8 (87.5)	0/1 (0)	8/8 (100)	NT	6/8 (75)	5/8 (62.5)	NT	8/8 (100)	1/2 (50)	0/8 (100)	2/2 (100)	NT	1/3 (33.3)	1/1 (100)	2/3 (66.7)	8
Pseudomonas	NT	NT	1/1 (100)	NT	NT	0/1 (0)	0/1 (0)	NT	NT	NT	0/2 (100)	NT	NT	NT	NT	NT	1
CNS	NT	2/6 (33.3)	NT	6/6 (100)	6/6 (100)	0/6 (0)	1/6 (16.7)	2/5 (40)	5/5 (100)	NT	0/1 (0)	NT	NT	NT	NT	NT	6
MRSA	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0/1 (0)	NT	NT	NT	1
Klebsiella	3/4 (75)	4/4 (100)	0/3 (0)	4/4 (100)	NT	0/4 (0)	2/3 (66.7)	NT	4/4 (100)	0/1 (0)	0/3 (0)	2/2 (100)	NT	NT	NT	NT	4
Total	6	13	1	18	6	6	8	2	17	1	0	4	1	1	1	2	20

NT = not tested. Out of the 23 isolated organisms, 3 isolated organisms were susceptible to all the antibacterial agents tested against hence no resistance information was recorded. MRSA= Methicillin Resistant *Staphylococcus aureus* CNS= Coagulase Negative *Staphylococcus*

Source: Medical Microbiology lab data (March-April, 2014)

CHAPTER FIVE

5.1 DISCUSSION

Appropriateness of antimicrobial therapy especially in clinical settings has been a major issue advocated worldwide as a means of minimizing the ever growing threat of antimicrobial resistance. From the study, it was found that more than half of the admitted patients were exposed to antibacterial therapy. This is higher than the national average of 43 % determined from the WHO assessment of pharmaceutical situation in Ghana carried out in the year 2008 (92). This can be attributed to the higher propensity to prescribe antibacterial agents in emergency departments for suspected infections than in the general clinical care settings used in the WHO assessment. This study also demonstrated that antibacterial utilization in KATH AED was also higher compared to 14.5% in an Israel emergency department (93). Also, a study in an emergency department in the Sultanate of Oman, had a 10% antibacterial use prevalence (94) and a recent study in an Indian emergency unit had 14.89% antibacterial prevalence (95). These differences in antibacterial use in these studies might be attributable to infectious disease burdens in the locality and prescribing behaviours of the prescribers. An antibiotic prevalence study carried out in a hospital in the Netherlands found that 22.9% of patients had received antibiotic in the wards which was corroborated by their hospital pharmacy data (64). Overall the proportion of antibacterial use in patient admitted to Red, Orange and Yellow wards of AED were 64.36%, 60.57% and 54.13% respectively. Based on the South African Triage Scale (SATS), the higher rate seen in Red compared to Orange and then Yellow was expected because patients in Red are considered more ill than Orange, with Orange patients being more ill than those in Yellow.

The study showed that about a third of the antibacterials written were for prophylactic purposes whilst two thirds were for curative use. This is similar to what was found in a study in Singapore

(96). However, it varied from a study in Israel where less than 10% of antibacterial use was for prophylactic purposes (97).

The most commonly prescribed antibacterial agent in the AED was cefuroxime, followed by metronidazole, ceftriaxone, ciprofloxacin, azithromycin and amoxicillin/clavulanic acid in that order. This varied from what was observed in a study conducted at the Surgical and Medical Emergency (SME) unit of Korle-bu Teaching Hospital (KBTH), Ghana which provides similar services as AED of KATH. At SME of KBTH the commonly prescribed antibacterial agent was ciprofloxacin, followed by metronidazole, amoxicillin/clavulanic acid and azithromycin in that order (98). A study in an Israeli emergency department however found cefuroxime and amoxicillin/clavulanic acid as the most prescribed antibacterial agents (99). Several factors including differences in infectious conditions burden, cost, antibacterial availability and the preferences of clinicians etc. all possibly accounted for the differences in antibacterial use.

The prescribing of one antibacterial agent in this study was 47.9% , which was lower compared to 81.3% in a Portugal emergency department (100). However more than half (52.1%) of study participants received two or more antibacterial agents. This was lower than what pertains at SME of KBTH where 62.4% received two or more antibacterial agents (98). These differences could be possibly due to differences in prescribing‘ practices within the different practice settings as well as the different pathologies in the conditions encountered necessitating the use of monotherapy or combination therapy.

About 30% of antibacterial therapy was considered inappropriate. This indicates that a relatively high proportion of patients needing antibacterial therapy were at risk of treatment failure because of inappropriate selection and use of antibacterial agents. This creates the conditions for the

selection of resistant strains, increase the risk of toxicity from unnecessary exposure and also patient‘s condition could worsen with the use of wrong drug and sub-optimal doses. A study by Hang-Chen *et al* at a university hospital in Taiwan reported the effect of inappropriate antibacterial therapy on increase mortality in patients with blood streams infections (13).

Request for culture and sensitivity (C/S) testing among AED patients on antibacterial therapy was low in this study, suggesting a low use of definitive antibacterial therapy. Such approach to therapy could have implications for the development of bacterial resistant strains as a result of overexposure to antibacterial therapy which may not be needed. At the same time infections which are poorly targeted could worsen because the pathogen would not respond to the agent selected. This could result in treatment failure and high rate of deaths from infections. Some of the factors that could have led to the low use of C/S by prescribers may be the time lag in processing samples and difficulty in accessing results. C/S results are written manually and kept locally at the KATH medical microbiology lab thus is not readily accessible at the point of decision making.

Slightly more than half of the patients involved in this study responded favourably to the antibacterial therapy. However, about a third had their symptoms worsening and the rest dying. Inappropriate antibacterial therapy coupled with the issue of antibacterial resistance are all factors that could have contributed to the worsened patient symptoms and even death.

The Red ward recorded the highest numbers of deaths compared to Orange and Yellow. This was expected since the life-threatening and complicated cases are admitted to Red.

Organisms were isolated from 23 of the biological specimen sent to the Medical microbiology laboratory from the AED. Blood specimen accounted for most of the biological specimen sent for culture and sensitivity testing. Among the organisms were isolates of Coagulase Negative

Staphylococcus (CNS). CNS may not be a true pathogen but a common contaminant because it is usually part of the normal skin flora and was maybe cultured because of defective skin preparation before blood specimen were taken. However, all the CNS isolates, were resistant to flucloxacillin, ampicillin, benzylpenicillin and cotrimoxazole. *E. coli* was the most commonly isolated organism in urine and is known to account for most urinary tract infections (UTIs). Isolated *E. coli* was resistant to ceftriaxone (i.e. all 3 tested isolates), ciprofloxacin, gentamicin and cotrimoxazole which are mostly used in treatment of UTIs. Resistance of *E. coli* to these antibacterial agents have been reported in other hospitals in Kumasi (101). *Klebsiella* which was the third most commonly isolated organism was resistant to cefuroxime, ampicillin, chloramphenicol and cotrimoxazole. One of the factors that might have contributed to the resistance of the above organisms is the high usage of these antibacterial agents in our clinical settings and also in community outlets. All the organisms tested against Amikacin were susceptible. Amikacin is used as second line therapy for bacterial infections in most hospitals in

Ghana because it is expensive, highly nephrotoxic and not readily available in most facilities. This shows that non-excessive and prudent use of antibacterial agents can offer some protection against even drug resistant pathogens.

5.2 LIMITATIONS OF THE STUDY

Twenty percent (n=51) of patients on curative antibacterial therapy were lost to follow up in the outcomes assessment as result of being discharged or transferred outside the AED within 24 hours of admission. This made it difficult to determine the outcomes in such patients. However, the number of patients assessed represents a fair presentation of the outcome assessment.

The specimens sent to KATH Medical microbiology lab and the isolated organisms were small in number. Larger number of samples or carrying this study over a much longer period (6 months to 1 year) could have resulted in more isolates to enable a better understanding of antibacterial resistance patterns at the AED.

CHAPTER SIX

6.1 CONCLUSION

This study has shown that a high proportion of patients were exposed to antibacterial therapy at the AED of KATH. A third of antibacterial prescribing was considered inappropriate. The use of culture and sensitivity testing to guide therapy was low coupled with the presence of resistant pathogens to broad spectrum antibacterial agents like ceftriaxone and cefuroxime. The study has provided a good perspective in understanding antibacterial use practices at AED of KATH, and also a foundation to establish and/or strengthen antimicrobial stewardship programmes at the hospital.

6.2 RECOMMENDATIONS

1. Efforts should be made to ensure that antibacterial therapy should be guided by culture and sensitivity data.
2. There should be periodic reminders of all prescribers and clinical pharmacists in the hospital on resistance trends of clinically important microbes.
3. KATH management should computerize medical microbiology reports for easy access and use for health professionals involved in management of microbial infections.

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APPENDICES

APPENDIX 1: DATA COLLECTION FORM FOR WARD DATA (Tick where appropriate)

Study ID……[ ][ ][ ]

SECTION A: PATIENTS DETAILS

1. Age ……..[ ][ ]years
2. Gender……[1][ ]Male [2][ ]Female
3. Ward……[1][ ]Red [2][ ]Yellow [3][ ]Orange

SECTION B: ANTIBACTERIAL USE

4. Current medical diagnosis/ Comorbidities ……

5. Indication for use of antibacterial agent(s)……..[1][ ] Prophylactic [2][ ] Therapeutic

6. Antibacterial information (Name, dose, frequency, duration & route of administration)

Date	Name, dose frequency, duration and route of administration	Comments/ reasons for any change of antibacterial agent

7. Number of antibacterial agents prescribed for patient……[ ][ ]

8. Are the antibacterial agents used for the condition in line with what is recommended in the STG and other guidelines? [1][ ] Yes [2][ ] No

9. Is there any request for culture and sensitivity testing? [1][ ]Yes [2][ ] No

10. Is there an improvement the condition of patient after 48hrs?

[1][ ] resolution of symptoms (including fever, cough, etc. or general well-being of the patient)

[2][ ] worsening symptoms

[3][ ] Death after exposure to antibacterial therapy

APPENDIX 2: DATA COLLECTION FORM FOR MICROBIOLOGY LAB

Study ID……..... [ ][ ][ ]

1. Age ……[ ][ ]years
2. Gender…… [1][ ]Male [2][ ]Female
3. Ward……[1][ ]Red [2][ ]Yellow [3][ ]Orange
4. Specimen type

   [1][ ] Blood [2][ ]Urine [3][ ]Sputum [4][ ]Cerebrospinal fluid [5][ ]wound swab

   [6][ ]Others. Specify…….
5. Clinical summary

   ……

   ……

   ……

   ……
6. Bacteria Isolate (s)……..
7. Susceptibility (key: _s‘ = sensitive and _r‘ = resistant nt= not tested)

   [1][ ]Ceftriaxone [2][ ]Cefuroxime [3][ ] Ceftazidime [4][ ]Ampicillin [5][ ]Flucloxacillin

   [6][ ]Amoxicillin/Clavulanic [7][ ] Benzylpenicillin [8][ ]Ciprofloxacin

   [9][ ]Gentamicin [10][ ]Erythromycin [11][ ]Doxycycline [12][ ]Azithromycin

   [13][ ]Metronidazole [14][ ] Cotrimoxazole [15][ ] Amikacin [16][ ] Cefotaxime

   [17][ ] Chloramphenicol [18][ ]Vancomycin [19][ ]Cefoxitin [20][ ]Nitrofurantoin

   [21][ ]Pipemidic acid [22][ ]Nalidixic acid [23][ ]Others. Specify……

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/011/14

29th January, 2014.

Mr. Daniel Appiah
Pharmacy Department-
Accident and Emergency
Komfo Anokye Teaching Hospital
Post Office Box 1934
KUMASI.

Dear Sir,

LETTER OF APPROVAL

Protocol Title: ***"Antibiotic Use and Resistance at the Accident and Emergency Department, KATH."***

Proposed Site: ***Accident and Emergency Department, KATH and Department of Clinical Microbiology, KATH.***

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 24th December, 2013 from the Komfo Anokye Teaching Hospital (study site) indicating approval for the conduct of the study in the Hospital.
- A Completed CHRPE Application Form.
- Research Proposal.
- Data Collection Form.

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 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,

Rev. Prof. John Appiah-Poku
Honorary Secretary
FOR: CHAIRMAN

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