

**COSTS OF ANTIBIOTICS PRESCRIBING ERRORS TO CLIENTS: A CASE  
OF UBUNGO MUNICIPAL HEALTH FACILITIES, DAR ES SALAAM,  
TANZANIA**

**By**

**Bwire, Nicholas Bwire**

**A Dissertation Submitted in Partial Fulfilment of the Requirements for the  
Examination of Masters of Science in Project Management, Monitoring and  
Evaluation in Health of the Muhimbili University of Health and Allied sciences**

**October 2021**

**MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES**

**SCHOOL OF PUBLIC HEALTH AND SOCIAL SCIENCES**

**DEPARTMENT OF DEVELOPMENT STUDIES**



**COSTS OF ANTIBIOTICS PRESCRIBING ERRORS TO CLIENTS: A CASE  
OF UBUNGO MUNICIPAL HEALTH FACILITIES, DAR ES SALAAM,  
TANZANIA**

**By**

**Bwire, Nicholas Bwire**

**A Dissertation Submitted in Partial Fulfilment of the Requirements for the  
Examination of Masters of Science in Project Management, Monitoring and  
Evaluation in Health of the Muhimbili University of Health and Allied sciences**

**October 2021**

**CERTIFICATION**

The undersigned, certify that he has read and hereby recommended for acceptance by the Muhimbili University of Health and Allied Sciences, a dissertation entitled “**Costs of Antibiotics Prescribing Errors to Clients: A Case of Ubungo Municipal Health Facilities, Dar es salaam, Tanzania**” in partial fulfillment of the requirements for examination of Masters of Science in Project Management, Monitoring and Evaluation in Health at Muhimbili University of Health and Allied Sciences.

---

**Prof. Phares G.M. Mujinja, BA (Hons), CIH, MPH, MA (Econ),**

**PhD. (Supervisor)**

**Date:** \_\_\_\_\_

**DECLARATION**

I, **Bwire, Nicholas Bwire**, hereby declare that this dissertation is my own original work and has not been submitted or currently being submitted for a similar degree in any other University.

Signature..... Date.....

**COPYRIGHT**

©

“This dissertation is copyright material protected under the Berne Convention, the Copyright Act of 1999 and other international and national enactments, in that behalf, on intellectual property. It may not be reproduced by any means, in full or in part, except for short extracts in fair dealing; for research or private study, critical scholarly review or discourse with an acknowledgement, without the written permission of the Directorate of Postgraduate Studies, on behalf of both the author and the Muhimbili University of Health and Allied Sciences.”

### ACKNOWLEDGEMENT

I would like to cordially express my sincere gratitude's to the almighty God for his power, everlasting love and blessings of good health and strength to accomplish the work.

I would like to express my sincere and special gratitude to my supervisor **Prof. Phares G.M. Mujinja** for his tireless effort and support, patience and professional guidance and constructive comments from the earlier drafts of the proposal to the final dissertation report.

I would like to extend my gratitude to my classmates, academic and non-academic staff of the School of Public Health and Social Sciences for their support and contribution in the development of the dissertation.

I would like to extend my gratitude to Ubungo Municipal Authority, especially to Municipal Executive Director, Municipal Medical Officer and entire management for allowing me to conduct this study. I would like to pass my deepest thanks to all health care facilities staff involved in the study for their tireless support.

**DEDICATION**

This work is dedicated to my lovely daughters; Nathalia, Emilly and Elvina as well as my lovely brothers and sisters for their coolness, tolerance and encouragement during my study at Muhimbili University of Health and Allied Sciences.

## TABLE OF CONTENTS

CERTIFICATION .....	1
DECLARATION.....	2
COPYRIGHT .....	3
ACKNOWLEDGEMENT .....	4
DEDICATION .....	5
LIST OF TABLES .....	9
ABBREVIATIONS .....	10
DEFINITIONS OF TERMS .....	11
ABSTRACT .....	12
CHAPTER ONE.....	15
1.0 INTRODUCTION: .....	15
1.1 BACKGROUND: .....	15
1.2 PROBLEM STATEMENT:.....	16
1.3 CONCEPTUAL FRAMEWORK:.....	17
1.4 STUDY RATIONALE:.....	18
1.5 MAIN RESEARCH QUESTION: .....	18
1.6 RESEARCH QUESTIONS:.....	18
1.7 BROAD OBJECTIVE:.....	19
1.8 SPECIFIC OBJECTIVES:.....	19
CHAPTER TWO.....	20
2.0 LITERATURE REVIEW: .....	20
2.1 INTRODUCTION .....	20
CHAPTER THREE .....	23
3.0 METHODOLOGY: .....	23
3.1 Study Area: .....	23
3.2 Study Design:.....	23
3.3 Population: .....	24
3.4 Sample size: .....	24
3.4.1 Sample size calculations:.....	24
3.4.2 Inclusion Criteria: .....	25



3.4.3 Exclusion Criteria:.....	25
3.4.4 Sampling Procedures:.....	25
3.5 Research Instruments-Validity and Reliability: .....	26
3.6 Data Collection Method: .....	26
3.6.1 Data Collection: .....	26
3.6.2 Data management & Storage:.....	26
3.6.3 Data Analysis: .....	27
3.7 Ethical issues: .....	28
CHAPTER FOUR.....	29
4.0 RESULTS.....	29
4.1 Socio-Demographic Characteristics.....	29
4.2 The Most Commonly Prescribed Antibiotics.....	29
4.5 Errors of Omission .....	33
4.6 Errors of Commission .....	36
4.7 Costs Attributed by Prescribing Errors .....	37
CHAPTER FIVE.....	41
5.0 DISCUSSION .....	41
5.1 General Discussion: .....	41
Prescription Errors: .....	41
5.2 Most Common Prescribed Antibiotics.....	42
5.3. Costs attributed by Prescribing Errors: .....	42
CHAPTER SIX.....	44
6.0 STUDY LIMITATIONS AND MITIGATION: .....	44
6.1 Conclusion .....	44
REFERENCES: .....	45
APPENDICES: .....	48
Appendix I: Rating Scale Tool at Hospital Level. ....	48
Appendix II: Rating Scale Tool at health Centre Level.....	49
Appendix III: Rating Scale Tool at health Centre Level.....	51
Appendix IV: Informed Consent (English Version) .....	53
Appendix V: Informed Consent (Kiswahili Version) .....	55

FOMU YA KUJIUNGA KWA HIARI KATIKA UTAFITI.....	55
Appendix VI: Approval for Ethical Clearance .....	58
Appendix VI: Introduction Letter to Study Site. ....	60
Appendix VII: Research Permit at Study Sites. ....	61
Permit at Hospital Level .....	61
Permit at Health Centre Level .....	62
Permit at Dispensary Level .....	63

## LIST OF TABLES

Table 1: Distribution of Patient's Age in Relation to the Prescription .....	29
Table 2: Frequency of Distribution of Antibiotics. ....	30
Table 3: Distribution of Prescription Containing Antibiotics Vs Prescriber Position	30
Table 4: Prescription Error .....	<b>Error! Bookmark not defined.</b>
Table 5: Distribution of Prescription Errors Vs Prescriber's Position .....	33
Table 6: Prescription Error of Omission .....	33
Table 7: Prescription Error Related to Antibiotics .....	35
Table 8: Distribution of Patient's Age Vs Error of Omission Related to Prescriber ..	35
Table 9: Distribution of Patient's Age Vs Error of Omission Related to Antibiotics.	36
Table 10: Prescription Error of Commission .....	36
Table 11: Distribution of Patient's Age Vs Errors of Commission .....	37
Table 12: Distribution of Costs of Antibiotics Vs Prescription Errors .....	38
Table 13: Implied Costs due to Prescribing Errors .....	38
Table 14: Distribution of Patient's Age Vs implied Costs due to Errors of Omission	39
Table 15: Distribution of Patient's Age Vs implied Costs due to Errors of Commission.....	39
Table 16: Distribution of Implied Costs (Tshs) of Antibiotics Vs Prescriber Position .....	40

**ABBREVIATIONS**

NEMLT	National Essential Medicine List for Tanzania
OPD	Out Patient Department
PPS	Probability Proportional to Size
STG	Standard Treatment Guidelines
WHO	World Health organization
AMO	Assistant Medical Officer
CO	Clinical Officer
USD	United State Dollar
TSHS	Tanzania Shillings
UK	United Kingdom
SPSS	Statistical Package for Social Sciences
IRB	Institutional Review Board
MUHAS	Muhimbili University of Health and Allied Sciences
REC	Research and Ethics Committee
FCA	Financial- Cost- Analysis

### DEFINITIONS OF TERMS

<b>Antibiotic:</b>	Medicine that fight bacterial infections by killing the bacteria or making it hard for the bacteria to grow and multiply. [4,23]
<b>Drug-drug interaction:</b>	Is an alteration in duration or magnitude of pharmacological effects of one medication due to the concomitant use of another medication. [4,23]
<b>Duplicate therapy:</b>	Two or more medications prescribed for the same indication or purpose without a clear distinction of when one agent should be administered over another. [24]
<b>Error:</b>	Is something done which is considered to be incorrect or wrong. [4]
<b>Implied cost:</b>	Is an opportunity costs resulting from using an asset instead of renting it out or selling it. [25]
<b>Polypharmacy:</b>	Is the use of two or more medications of the same or similar pharmacological actions to treat different conditions. [21,26,27]
<b>Prescription error:</b>	Is any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in control of the health care professional, patient or consumer. [4,27]
<b>Prescription:</b>	Legal instruction written by a medical practitioner that authorizes a patient to be issued with a medicine or treatment. [4,27]
<b>Wrong dose:</b>	Is the prescribed dose of medication greater than or less than 10% of the recommended by the guidelines. [4,28]
<b>Wrong duration:</b>	The medication prescribed for a duration other than that recommended in the guidelines. [4,28]
<b>Wrong frequency:</b>	Is the medication prescribed in a frequency other than that recommended by the guideline. [4,28]

<b>Wrong route</b>	The prescribed medication is administered by the route other than the recommended route mentioned in the guidelines. <sup>[4,28]</sup>
<b>Economic Evaluation</b>	A way to identify, increase, evaluate and compare the costs and results of programs and policies. <sup>[30]</sup>
<b>Cost-Benefit Analysis</b>	A way to compare the costs and benefits of an intervention, where both are expressed in monetary units. <sup>[30]</sup>
<b>Kappa Statistics</b>	A statistic that is used to measure inter-rater agreement for qualitative items. <sup>[31]</sup>
<b>Standard Error</b>	Statistical term that measures the accuracy with which a sample distribution represents a population by using standard deviation. <sup>[31]</sup>

## **ABSTRACT**

**Background:** Implied costs to clients associated with antibiotics prescribing errors of omission and commission have been reported in health facilities. Prevalence of 2.0% to 94.0% is reported worldwide and 55.1% proportional of prescribing errors has been

reported in Tanzania. Adverse drug events, high morbidity and mortality rate, elevation of antibiotics costs to clients are the results of antibiotics prescribing errors.

**Broad objective:** To assess the costs associated with antibiotics prescribing errors to clients attending health facilities in Ubungo Municipality.

**Methods:** The study was conducted in health facilities located in Ubungo Municipality with 1-public hospital, 3-health centers and 16-dispensaries. Descriptive cross-sectional study was employed to review prospective prescriptions with one or more antibiotics at the OPD. Target population were prescribers in Ubungo municipality and Study population were prescriptions with one or more antibiotics. Quantitative technique was used to collect prescriptions with one or more antibiotics from a hospital, 3-health centers and 3-dispensaries. Prescriptions were picked and screened for errors of omission and commission immediately before handling to the dispensers by two pharmacists each with a rating scale tool.

Data collected were treated by using Statistical Package for Social Sciences (SPSS-20) software. Costs associated with antibiotics prescribing errors of omission and commission was calculated as the difference between the costs of actual antibiotics and the costs of optimal antibiotics.

**Results:** A total of 21 antibiotics were prescribed in Ubungo municipal health facilities out-patient pharmacies on 20<sup>th</sup> of May to 5<sup>th</sup> of June 2021 (2 weeks). Penicillin group of antibiotics have the highest frequency of use whereas Aminoglycosides being the lowest. A total of 2,632 prescription errors out of 418 prescriptions at a proportional of 0.78 was recorded.

Prescribing errors affecting direct costs of antibiotics are 665 (186 omission errors related to antibiotics and 479 commission errors). Implied costs of antibiotics due to prescription errors is 47.3% of the actual costs and optimum costs is 52.7% of the actual costs before ruling out prescription errors. Therefore, prescription errors tend to double the optimum costs of antibiotics in Ubungo municipal health facilities and make difficult to treat a patient of productive age. The mean costs for treating a patient with antibiotics regardless of prescription errors was 10,142.73 Tshs and when prescription errors were sorted out, the mean costs were 5,346.44 Tshs. Intern doctors were reported

to cause more implied costs (34.3%) of the total implied costs followed by registrar (22.1%) and Clinical officers (20.0%).

**Conclusion:** Implied costs of antibiotics prescription errors to clients is reported in Ubungo municipal health facilities. The findings indicate the presence of significant prescription errors of omission and commission at the proportion of 0.78 in study site, it highlights a need of conducting educational programmes among all prescribers especially interns in order to improve their prescribing skills. Prescription errors tend to double the costs of antibiotics at the health facilities.



## CHAPTER ONE

### 1.0 INTRODUCTION:

#### 1.1 BACKGROUND:

Prescription is a legal instruction written by registered medical practitioner that authorizes a patient to be issued with medication. <sup>[4,27]</sup> Two types of prescription exist, includes; *Simple prescription* and *Complex prescription*. *Simple prescription* is written for a single component and *complex prescription* is written for more than a single component and requiring compounding by the pharmacist. The prescription is divided into *Superscription* (name, address, weight and age of patient), *Inscription* (name, strength and frequency of medication), *subscription* and *signature*. <sup>[3]</sup> Medical prescription can be written in the form of paper-based and electronic format. Error free prescription requires the superscription, inscription, subscription and signature parts to be filled, medication interactions and polypharmacy taken care of.

Prescribing practices in Tanzania is guided by World Health Organization (WHO) Good Prescribing Practice and Standard treatment guidelines (STG) that act as quick references. WHO guideline has started six steps for good prescribing to achieve a desired treatment of clinical conditions: understanding problem of the patient, establishing specific therapeutic objectives, determination of standard treatment of choice, providing information, instructions and warning signs about the medication of choice to patients plus monitoring the effects of treatment of choice. <sup>[1]</sup> Good implementation of the guidelines prevents occurrence of potential adverse events, minimizes costs of treatments to patients and reduce the costs of provision of health services by the health facility.

The Guidelines restricts the use of antibiotics in health facilities and provide the most appropriate instructions for use basing on the level of health care delivery. Studies carried in developing countries report 47.5% to 100% of antibiotics use which is contrary to WHO recommended value of 20.0% to 25.4%. <sup>[2,11,16]</sup> The eight classes of antibiotics (Penicillins, Cephalosporins, Macrolides, Tetracyclines, Fluoroquinolones,

Aminoglycosides, Nitroimidazoles and Sulphonamides) are grouped into ACCESS (prescribed at all levels), WATCH (prescribed only in Council hospitals) and RESERVE (prescribed at tertiary levels such as National, Zonal, Referral and Specialized Hospitals).

Prescribing error is the incorrect selection (based upon indications, contraindications and other factors), dose, route of administration, rate of administration, frequency or duplication of medications. <sup>13]</sup> Prescribing errors of omission and commission have been reported in medical practices. Errors of omission are caused by incomplete prescription form in relation to the prescriber or patient or medication, errors of commission are due to wrong information about the prescribed medicine. <sup>14]</sup> Many people fail to access health services and complain on increased costs of treatment.

### **1.2 PROBLEM STATEMENT:**

Antibiotics prescription errors in daily medical prescribing practices by using traditional hand written prescriptions have been reported in different health facilities.<sup>15]</sup> Worldwide prevalence is reported to range from 2.0% to 94.0%,<sup>16]</sup> in Tanzania about 55.1% prevalence of prescribing errors has been reported.<sup>17]</sup> Antibiotics prescribing errors lead to increased number of adverse drug events such as resistance, high morbidity and mortality rate, elevation of medication costs to clients and the health facility, length of hospital stay increases due to adverse reactions attributed by antibiotics prescribing errors. Prescribing errors can be associated with inadequate prescribing knowledge & skills, physical & mental wellbeing (stress), confusion with drug names (Trade names), influence from senior doctors, diagnostic uncertainties (prescriber cannot differentiate between viral and bacterial infections), unreasonable patient demands of a certain antibiotics, failure to follow prescribing policies related to drug use (Guidelines) and failure to follow drug specific instructions.

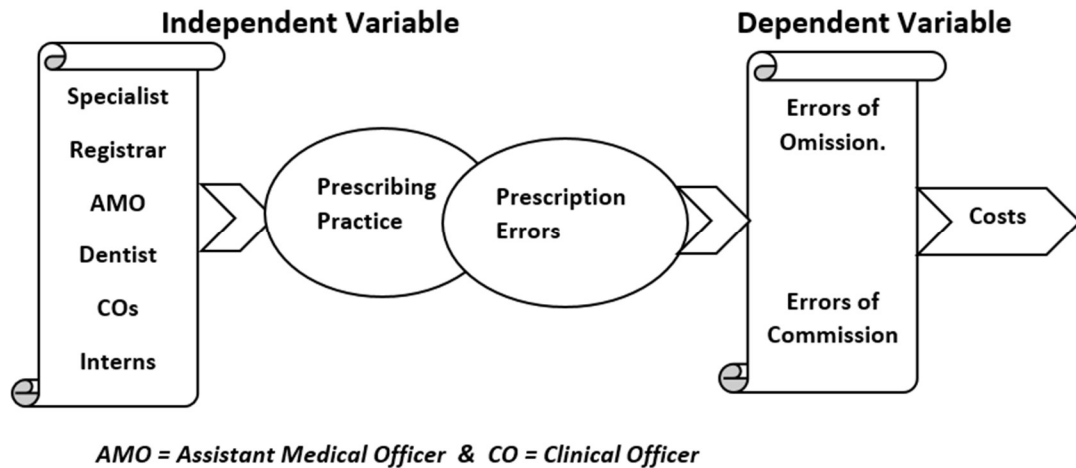
The country has introduced the use of Standard Treatment Guidelines (STG) in line with World Health Organization (WHO) Good Prescribing practice and local

prescribing guideline example Muhimbili National Formulary. Studies on adherence to standard treatment guideline (STG) among prescribers is reported to be sub-optimal. [8,11] Use of clinical pharmacists/pharmacists during doctors ward round has been reported to reduce prescribing errors in health facilities. Prescribing error is referred to as incorrect or inappropriate drug selection (based on indications, contraindications and other factors), dose, route of administration, frequency of medication or duplication of medication. [4]

Antibiotics such as Ceftriaxone, Metronidazole and Penicillin-Cloxacillin are the most prescribed at all levels of health facilities for treatment of existing community acquired infections [9,10,11] and therefore, encounter many prescribing errors, causing elevation of medication costs that threaten people to seek health services. To the best of my knowledge, no study reporting the associated costs of prescribing errors incurred by clients and the health facilities in Tanzania. However, my study will focus on the costs associated with antibiotics prescribing errors to clients attending health facilities. Reported antibiotics prescribing errors in daily medical practice lead to increased adverse drug events, elevation of medication costs to clients and delivery of health services among health facilities in Dar es Salaam.

### **1.3 CONCEPTUAL FRAMEWORK:**

Inappropriate prescribing practices at health facilities are associated with prescription errors of omission and commission that lead to implied costs to clients attending health services. [4,20]



#### 1.4 STUDY RATIONALE:

The study is designed to assess the implied costs of antibiotics resulting from prescription errors of omission and commission that face the clients when attending health services in public health facilities located in Ubungo Municipality. The findings will help the Government through the Ministry of Health and other stakeholders to enforce the use of recommended prescribing guidelines and consider for on job training regarding proper prescribing to reduce unnecessary costs of medication to clients.

#### 1.5 MAIN RESEARCH QUESTION:

What are the costs of antibiotics to clients associated with prescribing errors in Ubungo Municipal Health facilities?

#### 1.6 RESEARCH QUESTIONS:

1. What is the proportion of antibiotics prescribing errors in Ubungo Municipal Health facilities?
2. To what extent do errors of omission result into implied antibiotics costs to clients?
3. To what extent do errors of commission result into implied antibiotics costs to clients?

**1.7 BROAD OBJECTIVE:**

To assess the costs associated with antibiotics prescribing errors to clients in Ubungo Municipal Health facilities.

**1.8 SPECIFIC OBJECTIVES:**

1. To assess the proportion of antibiotics prescribing errors in Ubungo Municipal Health facilities.
2. To determine the implied costs of antibiotics to clients associated with errors of omission in Ubungo Municipal health facilities.
3. To determine the implied costs of antibiotics to clients associated with errors of commission in Ubungo Municipal health facilities.

## CHAPTER TWO

### 2.0 LITERATURE REVIEW:

#### 2.1 INTRODUCTION

#### **Assessment of proportion of antibiotics prescribing errors in Ubungo Municipality.**

##### **Global:**

A study in Pakistan about antibiotic prescribing practices and errors among hospitalized pediatric patients suffering from acute respiratory tract infection reports on Penicillin (52.4%), Cephalosporin (16.8%) and Macrolides (8.9%) as the most prescribed antibiotics. About 40.8% of the cases of antibiotic prescribing errors related to wrong dose 19.9%, wrong frequency 18.9% and duplicate therapy 18.1%. Prescription errors are most common in lower respiratory tract infections. <sup>[12]</sup> Assessment of prescription pattern and prescription errors in outpatient department at tertiary care district hospital in Nepal reports a total of 2,448 drugs are prescribed. The number of drugs per encounter is 3.2, percentage of encounter with antibiotics and injection is 37.9% and 0.7%. Percentage of medication prescribed by generic names is 2.9% and from National essential medicine list of Nepal is 21.3%. The average prescription errors are 0.3 and the total of 249 drug interactions is in 19.1%, failure to mention prescriber signature is 19.2% and failure to mention diagnosis is 39.2%. <sup>[10]</sup> Prescribing errors are reported both Globally, Regionally and Tanzania (55.1%), this necessitates the study to assess the prevalence of antibiotics prescribing errors in health facilities located in Ubungo Municipality.

##### **Africa:**

Antibiotic use in public hospitals in Kenya indicates 3590 hospitalized patients on antimicrobials of which 3145 (94%) patients of the 3363 antimicrobial prescriptions are antibiotics. Only two patients are treated based on antibiotic sensitivity tests, out of 1502 patients with single diagnosis, 805 (53.6%) receive appropriate treatment. Physical availability of treatment guidelines is high when compared the odds of

receiving appropriate treatment. <sup>[13]</sup> Medication prescribing errors among hospitalized pediatric patients in Ethiopia included 384 pediatric patients in the study, whereas 241 (63%) are males and 241 (62.7%) patients treated basing on empirical diagnosis while 10 (2.6%) pediatric patients have co-morbid diseases. The study indicates antibiotics as the medications with more prescribing errors. <sup>[14]</sup>

### **Tanzania:**

A study in Tanzania reports 71.6% of medications are prescribed in brand names. The most prescribed in brand names are combinations of vitamin supplements and antibiotics. <sup>[15]</sup> Reports on occurrence of errors of omission and commission committed in medical practices; Intern doctors 25.6%, resident doctors 14.5%, registrar doctors 12.1% and specialists 3.3% out of 242 prescriptions studied. <sup>[4]</sup> Antimicrobial use across six referral hospitals reports on the use of antibiotics for treatment of Community acquired infections (39.8%), whereas 2 patients out of 591 patients is given antibiotics based on culture and sensitivity. <sup>[4,11,16, 17]</sup> About 99.6% of prescriptions in Dar es Salaam report one or more errors which are grouped into errors of omission and errors of commission, prevalence of prescription errors is 55.1%. <sup>[7]</sup>

### **Determine of implied costs of antibiotics associated with errors of omission and commission in Ubungo Municipal health facilities.**

#### **Global:**

A study of 180 articles in Australia, reports 78 prescribing errors whereas errors of commission are the most encountered (incorrect drug selection 61.50% and wrong drug 24.40%). The costs of antibiotics before intervention by pharmacists is 267 USD (equivalent to 619,173.00Tshs). costs of antibiotics after ruling out prescribing errors is 229.353 USD (equivalent to 531,869.61Tshs). <sup>[18]</sup> Economic impact on medication errors from review of 16 articles out of 4572 articles in UK indicates that, prescribing errors of omission and commission contributed to economic impact in monetary terms ranging from €2.58 (equivalent to 7, 258.933Tshs.) to €111,727.08 (equivalent to 314, 348, 608.663Tshs). <sup>[19]</sup> Cost analysis of Hospital admission related to medication in UK

states the average medication costs for one preventable medication-related hospital admission to be €5441 (equivalent to 15,308,471.14Tshs), average production loss costs for one admission is €1712 (equivalent to 4,816,780.48Tshs) for a person younger than 65 years. Combining medication costs and costs of production losses, gives €6009 (equivalent to 16,906,561.86Tshs) for one preventable, medication-related hospital admission for all ages. <sup>[20]</sup>

A study in Israel on costs of appropriate and inappropriate use of antibiotics in the emergency department indicates inappropriate costs of antibiotics to be 1109 USD (equivalent to 2,571,771.00 Tshs) out of total antibiotics costs of 8452 USD (equivalent to 19,600,188.00 Tshs) and annual total antibiotics costs is 73,532 USD (equivalent to 170520708.00Tshs). Annual total inappropriate costs are 9648 USD (equivalent to 22,373,712.00 Tshs). <sup>[21]</sup> Prescribing errors of omission and commission are reported both Globally, Regionally and Tanzania. Prescribing errors cause unnecessary costs of medication to clients as global reports indicate and therefore, similar study is required in Africa and Tanzania where more errors of omission and commission are reported.

### **Africa:**

A study in Ethiopia reports on presence of prescription errors in health facilities. <sup>[14]</sup> To the best of my knowledge, no observed study in Africa that reports on costs associated with general prescribing errors in health facilities as well as the costs associated with antibiotics prescribing errors of omission and commission.

### **Tanzania**

Many studies in Tanzania report on presence of prescription errors of omission and commission as well as quality of drug prescriptions. <sup>[4,7,29]</sup> To the best of my knowledge, no observed study in Tanzania that reports on costs associated with general prescribing errors in health facilities as well as the costs associated with antibiotics prescribing errors of omission and commission basing on regions.



## CHAPTER THREE

### **3.0 METHODOLOGY:**

This is an economic evaluation that employ financial- cost- analysis approach to assess the costs of antibiotics prescription errors to clients against hand written prescriptions.

### **3.1 Study Area:**

The study was conducted in health facilities located in Ubungo Municipality, Dar es Salaam, which has only one public hospital, three health centers and sixteen dispensaries. According to Ubungo municipal profile 2016, average number of patients served in hospital, health centers and dispensaries are 950, 450 and 80 per day respectively.

### **3.2 Study Design:**

Descriptive cross-sectional hospital based study was employed because of short duration provided for the study. Prospective prescriptions with one or more antibiotics were reviewed at the Outpatient Pharmacy Departments in Ubungo Municipal health facilities. All legal medical prescriptions (prescriptions from allowed individuals) containing one or more antibiotics were screened for prescription errors of Omission related to prescriber (patient name, date of prescription, patient address, patient registration number, age of patient, weight of patient, diagnosis prescriber signature and code number), errors of omission related to antibiotics (dose, strength, frequency duration and route of administration) and errors of commission (wrong dose, wrong strength, wrong name of antibiotic, use of generic name, overlooked drug-drug interaction and polypharmacy).

Two pharmacists (persons who are professionally qualified to prepare and dispense medicinal drugs) each with a rating scale tool adopted from the previous study [22,23] and adjusted by the author to suit the study were used to score the elements that make errors of omission and commission encountered in the prescriptions. The study had one

independent variable (Prescribers) and dependent variable is prescribing errors that comprised errors of omission and commission

### **3.3 Population:**

Target population were prescribers in Ubungo Municipality and Study population were prescriptions with one or more antibiotics at the Outpatient Departments in the health facilities located in Ubungo Municipality, Dar es Salaam.

### **3.4 Sample size:**

Sample size required by the study was 418 prescriptions with one or more antibiotics (268 from hospital, 42 from each health center and 8 from each dispensary). This was obtained by taking proportional of prescribing errors in Dar es Salaam to be 55.1% started in previous study <sup>[7]</sup> plus 10% for more accuracy.

#### **3.4.1 Sample size calculations:**

Proportional Sampling Formula:

Prevalence (p) of prescribing error was 55.1%. <sup>[6]</sup> Using 95% confidence level (z=1.96) and margin of error 5%.

$$\text{Sample Size (n)} = (Z\text{-Score})^2 \times (p) \times (1 - p) / (\text{Margin of Error})^2$$

Where;

Prevalence (Population) is 55.1% (0.551)

Confidence level of 95% represents Z-Score of 1.96

Standard deviation of 50% (0.5)

Margin of error of  $\pm 5\%$  (0.05)

$$\text{Sample size} = (1.96)^2 \times (0.551) (1-0.551) / (0.0025)$$

= 380 + 38 prescriptions were collected for review in Ubungo Municipality.

Health Facility				Procedures
Name	Available	Average Pop. Served daily	Required by study	
Hospital	1	950	1	= $(950/1480) \times 418$ = 268 prescriptions
Health centre	3	450	3	= $(450/1480) \times 418$ = 127 prescriptions
Dispensary	16	80	3	= $(80/1480) \times 418$ = 23 prescriptions

#### 3.4.2 Inclusion Criteria:

- Public health facilities in Ubungo Municipality, which have been operating before data collection.
- All prescriptions from the outpatient departments with one or more antibiotics.

#### 3.4.3 Exclusion Criteria:

- All prescriptions not properly seen or written in a bad hand writing.
- All torn medical prescriptions.
- All Electronic medical prescriptions if any.

#### 3.4.4 Sampling Procedures:

Probability Proportional to Size technique was employed to select One hospital, 3-health centers and 3-dispensaries for the study so as to attain the required sample size of prescriptions containing one or more antibiotics (418).

Sample size of prescriptions required by the study was 418 (268 from hospital, 42 from each health center and 8 from each dispensary).

**3.5 Research Instruments-Validity and Reliability:**

A pilot study was conducted to pre-test the rating scale tool before the commencing of data collection. Two graduate and registered pharmacist were employed for data collection using rating scale tools.

**3.6 Data Collection Method:**

A quantitative data collection technique was employed in both health facilities in Ubungo Municipality. Prescriptions with one or more antibiotics, written on the day of data collection were picked and recorded immediately when the patient handled it to the pharmacists/dispensers at the Outpatient Pharmacies of the sampled health facilities. The prescriptions were screened for prescribing errors of omission and commission by the two pharmacists.

A data collection tool adopted and adjusted to include elements of the prescription form was applied to measure errors of omission and commission by indicating (√) sign for the appropriate response and recommendations in line with the guidelines. A special software from Medscape were used to check for any medication interaction (Online reference for physicians and healthcare professionals that can be installed in the device, medications are insulted into the software to see if any drug-drug interaction exists). The average costs of antibiotics were collected from the hospital pharmacies under study and nearby community pharmacies.

**3.6.1 Data Collection:**

Data collection from hand written legal medical prescriptions was done by two pharmacists and the principal investigator was blinded (prevented to know some information so as to eliminate bias).

**3.6.2 Data management & Storage:**

Data collected were stored both manually and electronically to allow retrieval when necessary and locked in a shelf with a lock and password respectively and only the researcher have access to the collected data.

### 3.6.3 Data Analysis:

Data collected by two pharmacists were cleaned, sorted and then exported into Statistical Package for Social Sciences (IBM SPSS-20 Statistics) software. Then descriptive analysis was conducted and the results were presented as frequency or percentages.

Interrater reliability analysis was conducted using Cohen's kappa statistics to measure consistency among raters. Both data were exported into SPSS-20 software and Cross tabulation was conducted by taking errors observed by rater one against errors observed by rater two. Kappa and standard error values of Omission and Commission were computed and recorded.

$[Kappa (k) = \text{Observed Agreement} - \text{Expected Agreement} / (1 - \text{Expected Agreement})]$ .

Cohen's kappa (Landis & Koch, 1977) interpretation is given below; <sup>[31]</sup>

<b>Kappa-value</b>	<b>Strength of Interpretation</b>
< 0	Poor agreement
0.00 – 0.20	Slight agreement
0.21 – 0.40	Fair agreement
0.41 – 0.60	Moderate agreement
0.61 – 0.80	Substantial agreement
0.81 – 1.00	Almost perfect agreement

Proportion of antibiotics prescription errors was calculated by taking number of agreed prescription errors, divided by total number of sample size

ie;  $[Proportion = \text{No. of agreed prescription errors} / \text{Total sample size}]$ .

$[No. of errors per prescription = \text{observed prescription errors} / \text{Total sample size}]$ .

Implied costs associated with antibiotics prescription errors was computed from errors of omission related to antibiotics and errors of commission.

#### 1<sup>st</sup> step: Calculating Average Prices for antibiotics:

Types of antibiotics encountered on the prescriptions were recorded and simple survey was conducted in several health facilities and community pharmacies to obtain the average prices of antibiotics.

**2<sup>nd</sup> step: Costing of Antibiotics:**

Type of antibiotics, dose, strength of antibiotics and frequency of use were checked and evaluated by pharmacists. Then, each prescription was given actual cost and optimum costs according to the prices obtained after the simple survey.

**3<sup>rd</sup> step: Prescription Error Agreement analysis:**

Both prescriptions from two raters were exported in SPSS-20 to obtain the agreement of prescription errors and total number of errors with their corresponding prices. Total actual costs and optimum costs of antibiotics for the prescriptions agreed to have errors were recorded. Mean, median and range for both actual and optimum costs of antibiotics were recorded.

**4<sup>th</sup> step: Calculating the implied costs:**

The difference between total actual costs of antibiotics and total optimum costs of antibiotics recommended during evaluation of antibiotics prescriptions by two pharmacists were computed by using Ms Excel 2016. <sup>[20]</sup> average costs of antibiotics with prescribing error and without prescribing error were recorded.

ie; *[Implied costs=Total actual costs of antibiotics–Total optimum costs of antibiotics]*.

**3.7 Ethical issues:**

The ethical clearance with Reference No. DA 282/298/01 C/MUHAS-REC-05-2021-603 was obtained from MUHAS Research and Ethics Committee, written consent/permission was sought from both district medical officers and the hospital in-charges before commencing of data collection. Neither the real names of the prescribers nor the clients were in the report, this was for ensuring confidentiality.

## CHAPTER FOUR

### 4.0 RESULTS

A total of 21 antibiotics were prescribed in the 418 prescriptions that were collected, rated by two pharmacists at Ubungo Municipal health facilities out-patient pharmacies on 20<sup>th</sup> of May to 5<sup>th</sup> of June 2021 (2 weeks).

#### 4.1 Socio-Demographic Characteristics

Prescriptions with one or more antibiotics were collected from male (49.8%) and female (50.2%) patients of different age groups who attended to the health facilities in Ubungo Municipality (Table 1).

<b>Table 1: Distribution of Patient's Age in Relation to the Prescription</b>		
<b>Sex</b>	<b>Frequency</b>	<b>Percent (%)</b>
Male	208	49.8
Female	210	50.2
<b>Total</b>	<b>418</b>	<b>100.0</b>
<b>Age (Years)</b>	<b>Frequency</b>	<b>Percent (%)</b>
0 – 5	42	10.0
6 – 10	57	13.6
11 – 20	46	11.0
21 – 30	82	19.6
31 – 40	86	20.6
41 – 50	69	16.5
> 50	36	8.6
<b>Total</b>	<b>418</b>	<b>100.0</b>

#### 4.2 The Most Commonly Prescribed Antibiotics

Total of 21 antibiotics from the eight groups were prescribed (Penicillin, Cephalosporin, Macrolide, Quinolones, Tetracycline, Sulfonamides, Aminoglycosides

and Nitroimidazole), among them 125 prescriptions contained two antibiotics and 8 prescriptions contained three antibiotics. Antibiotics of the penicillin group have the highest frequency of use while Aminoglycosides being the lowest frequently used. Other classes of antibiotic were variably used in Ubungu health facilities (**Table 2**).

<b>Class of Antibiotics</b>	<b>n (%)</b>	<b>Frequency</b>
Penicillin	77 (33.3%)	273
Tetracycline	2 (9.5%)	17
Cephalosporin	3 (14.3%)	50
Quinolones	2 (9.5%)	30
Macrolides	2 (9.5%)	27
Sulfonamides	1 (4.8%)	29
Aminoglycosides	1 (4.8%)	2
Nitroimidazole	3 (14.3%)	107
<b>Total</b>	<b>21</b>	<b>535</b>

The result shows that, Intern doctors wrote many prescriptions (145) with one or more antibiotics from eight classes followed by registrar (93) and Clinical officers (84). Many prescriptions containing Penicillin and Nitroimidazole group of antibiotics were written by Intern doctors and the registrar (**Table 3**).

	<b>I</b>	<b>A</b>	<b>R</b>	<b>S</b>	<b>C</b>	<b>D</b>	<b>Total %</b>
Penicillin	73	37	47	11	44	2	52.2
Tetracycline	5	2	3	1	2	0	3.0
Cephalosporin	13	7	8	2	8	1	9.3
Quinolones	8	4	6	2	5	0	6.0
Macrolides	7	4	5	1	5	0	5.3
Sulfonamides	8	4	5	2	5	0	5.7



Aminoglycoside	2	0	0	0	0	0	0.5
Nitroimidazole	29	14	19	4	17	1	20.1
<b>Total %</b>	<b>34.7</b>	<b>17.2</b>	<b>22.2</b>	<b>5.5</b>	<b>20.6</b>	<b>0.96</b>	<b>100</b>

*I= Intern doctor, A= Assistant medical officer, R= Registrar, S= Specialist,  
C= Clinical officer and D= dentist*

### 4.3 Prescription Errors

A total of 418 prescriptions were collected and analyzed, out of which 2,632 prescription writing errors were agreed by two pharmacists and recorded with an average of 6.3 errors per each prescription, among them 2,153 (1,967 related to prescriber and 186 related to antibiotics) were error of omission and 479 were errors of commission. A total of 324 (proportion is 78 out of 100 prescriptions) prescriptions with one or more antibiotics were agreed by both two raters to have prescription errors of omission and commission (**Table 4 (a) & (b)**).

<b>Table 4(a): Prescription Error of Omission (N=2,153)</b>			
<b>(i) Prescription Error Related to Prescriber (n=1,967)</b>			
Percent	Error per Prescription	Kappa-value	Standard Error
74.7	4.7	0.827	0.023

<b>Table 4(a): Prescription Error of Omission (N=2,153)</b>			
<b>(ii) Prescription Error Related to Antibiotics (n=186)</b>			
Percent	Error per Prescription	Kappa-value	Standard Error
7.1	0.4	0.811	0.026

<b>Table 4(b): Prescription Error of Commission (N=479)</b>			
Percent	Error per Prescription	Kappa-value	Standard Error
18.2	1.2	0.821	0.023

The result shows that, errors of omission related to prescribers and antibiotics were committed by Intern doctors (34.1%) followed by Registrar (22.0%), Clinical officers (20.3%), Assistant medical officer (17.2%), Specialists (5.0%) and Dentists (1.3%). Whereas errors of commission were as follows; Intern doctors (34.3%) followed by Medical doctor (22.1%), Clinical officers (19.9%), Assistant medical officer (17.3%), Specialists (5.1%) and Dentists (1.2%) (**Table 5**).

<b>Table 4: Distribution of Prescription Errors Vs Prescriber's Position</b>				
<b>Status</b>	<b>No. of Prescription</b>	<b>Prescribing Errors</b>		
		<b>Errors of Omission</b>		<b>Errors of Commission</b>
		<b>Related to Prescriber (x4.71)</b>	<b>Related to Antibiotics (x0.44)</b>	<b>x1.15</b>
Interns	143	672.1	63	164.5
AMO	72	338.4	32	82.8
Resident	92	432.4	41	105.8
Specialist	21	98.7	9.2	24.2
Clinical Officer	85	400	37.4	95.2
Dentist	5	24	3.2	5.75
<b>Total Error</b>	<b>418</b>	<b>1,967</b>	<b>186</b>	<b>479</b>

*4.71= Error of omission related to prescriber per each prescription, 0.44= error of omission related to antibiotics per each prescription and 1.15= Error of commission per each prescription.*

#### **4.5 Errors of Omission**

Among 2,153 omission errors, 1,967 omission errors related to prescriber (4.7 errors per each prescription) were found. These were due to failure in mentioning patient's names (n=39, 2.0%), followed by date of prescription (n=69, 3.5%), patient's address (n=382, 19.4%), patient's registration number (n=409, 20.8%), patient's age (N=218, 11.1%), patient's weight (n=416, 21.1%), diagnosis (405, 20.6%) and prescriber's signature (n=29, 1.5%) respectively (**Table 6**).

#### **Table 5: Prescription Error of Omission**

<b>Prescription Error Related to Prescriber (N=1,967)</b>			
	<b>N(%)</b>	<b>kappa-value</b>	<b>Standard Error</b>
Missing Patient's Name	39 (2.0%)	84.7%	0.04
Missing Date of Prescription	69 (3.5%)	91.0%	0.03
Missing Patient's Address	382 (19.4%)	88.4%	0.04
Missing Patient's Registration Number	409 (20.8%)	71.0%	0.14
Missing Patient's Age	218 (11.1%)	89.4%	0.02
Missing Patient's Weight	416 (21.1%)	-0.2%	0.00
Missing Diagnosis	405 (20.6%)	-0.8%	0.01
Missing Prescriber's Signature	29 (1.5%)	77.5%	0.06
<b>Total</b>	<b>1,967</b>		

About 186 were omission errors related to antibiotics (0.4 error per each prescription) that were found due to missing antibiotic dose (n=17, 9.1%), strength of antibiotics (n=49, 26.3%), frequency of medication (n=3, 1.6%), duration of medication (n=7, 3.8%) and route of administration (n=110, 59.1%) respectively

**Table 6: Prescription Error Related to Antibiotics**

	N(%)	kappa-value	Standard Error
Missing Dose	17(9.1%)	63.9%	0.07
Missing Strength of Antibiotics	49(26.3%)	82.9%	0.04
Missing Frequency	3(1.6%)	46.8%	0.12
Missing Duration	7(3.8%)	75.1%	0.05
Missing route of Administration	110 (59.1%)	85.6%	0.03
<b>Total</b>	<b>186</b>		

The result shows many errors of omission related to prescriber that were encountered to patients with age group ranging from 21 to 40 years and less errors to children with under five years of age (**Table 8**).

<b>Table 7: Distribution of Patient's Age Vs Error of Omission Related to Prescriber</b>								
								Total
Age (Years)	0 – 5	6 – 10	11 - 20	21 - 30	3 – 40	41 - 50	> 50	
Error	171.1	240	320.1	383.6	420.9	340.3	181.0	1,967
(%)	8.7%	12.2%	11.7%	19.5%	21.4%	17.3%	9.2%	100.0 %

The result shows many errors of omission related to Antibiotics that were encountered to patients with age group ranging from 21 to 40 years and less errors to children with under five years of age (**Table 9**).

								Total
<b>Age (Years)</b>	<b>0 – 5</b>	<b>6 - 10</b>	<b>11 - 20</b>	<b>21 - 30</b>	<b>31– 40</b>	<b>41 - 50</b>	<b>&gt; 50</b>	
Count	14.9	23.4	19.9	37.9	40.4	33.5	16	186
(%)	8.0%	12.6%	10.7%	20.4%	21.7%	18.0%	8.6%	100.0%

#### 4.6 Errors of Commission

A total of 479 errors of commission were reported with an average of 1.1 errors per prescription. The commission errors were due to wrong dose of antibiotics (n=59, 12.3%), wrong strength of antibiotics (n=77, 16.1%), wrong name of antibiotics (n=124, 25.9%), drug-drug interaction (n=3, 0.6%), use of brand names of antibiotics (n=201, 42%) and wrong frequency of medication (n=15, 3.1%) respectively (**Table 10**).

	<b>N(%)</b>	<b>kappa-value</b>	<b>S E</b>
Wrong Dose of antibiotics	59 (12.3%)	79.3%	0.04
Wrong Strength of Antibiotics	77 (16.1%)	84.9%	0.03
Wrong Name of Antibiotics	124 (25.9%)	84.5%	0.03
Drug-Drug Interaction	3 (0.6%)	74.8%	0.17
Use of Brand Name of Antibiotics	201 (42.0%)	92.1%	0.02
Wrong Frequency	15 (3.1%)	57.2%	0.08
<b>Total</b>	<b>479</b>		

*SE= standard error*

The result shows many errors of commission that were encountered to patients with age group ranging from 21 to 40 years and less errors to children with under five years of age (**Table 11**).

								Total
<b>Age (Years)</b>	<b>0 – 5</b>	<b>6 - 10</b>	<b>11 - 20</b>	<b>21 - 30</b>	<b>31 - 40</b>	<b>41 - 50</b>	<b>&gt; 50</b>	
Count	41.7	59.9	52.2	99.2	92.3	85.7	44.1	479
(%)	8.7%	12.5%	10.9%	20.7%	20.1%	17.9%	9.2%	100.0%

#### **4.7 Costs Attributed by Prescribing Errors**

Prescription errors were grouped into two categories; Omission and Commission errors. Omission error related to prescriber (n=1,967 74.7%), omission error related to antibiotics (n=186, 7.1%) and Commission errors (n=479, 18.2%). However, prescribing errors affecting direct costs of antibiotics are errors of omission related to antibiotics and errors of commission. Therefore, total prescription errors affecting direct costs of antibiotics are 665 (186 omission errors and 479 commission errors).

From the results, total actual costs of antibiotics with prescription errors were 4,239,660.00 Tshs that give an average costs of 10,142.73 Tshs per each prescription with prescribing error. Optimal costs of antibiotics without prescription errors were 2,234,810.00 Tshs giving an average costs of 5,346.44 Tshs per each prescription. The total implied costs of antibiotics due to prescribing error were 2,004,850 Tshs resulting to an average costs of 3,014.81 Tshs per each prescribing error and average costs of 4,796.29 Tshs per each prescription with prescribing error. The mean costs for treating a patient with antibiotics regardless of prescription errors at Ubungu health facilities was 10,142.73 Tshs and when prescription errors were sorted out, the mean costs were 5,346.44 Tshs (**Table 12**).

	<b>Actual Costs of Antibiotic (Tshs)</b>	<b>Optimal Costs of Antibiotic (Tshs)</b>
Mean	10,142.73	5,346.44
Median	4,900.00	4,000.00
Range	399,050.00	22,800.00

*Tshs = Tanzania shillings*

The results indicated a total of 317 (75.8%) prescriptions had actual costs of antibiotics equal to the optimal costs of antibiotics after ruling out the prescription errors. The remaining 101 (24.2%) prescriptions had lower optimal costs of antibiotics and there was no prescription with higher optimal costs of antibiotics compared to the actual costs. However, intern doctors were reported to cause more implied costs (34.3%) of the total implied costs followed by registrar (22.1%) and Clinical officers (20.0%) (Table 13).

**Table 12: Implied Costs due to Prescribing Errors**

		<b>Implied Costs due to Prescribing Errors</b>				
<b>Prescriber's Status</b>	<b>No. of Prescription</b>	<b>Errors of Omission</b>		<b>Errors of Commission</b>		<b>Total Costs</b>
		<b>Related to Antibiotics (x0.44)</b>		<b>(x1.15)</b>		
		<b>No. of Errors</b>	<b>Costs (Tshs)</b>	<b>No. of Errors</b>	<b>Costs (Tshs)</b>	<b>Costs (Tshs)</b>
Interns	143	63	189,933.03	164.5	497,936.25	687,869.28
AMO	72	32	96,678.92	82.8	249,626.27	346,305.19
Registrar	92	41	123,907.21	105.8	318,966.90	442,874.11
Specialist	21	9.2	27,736.25	24.2	72,958.40	100,694.65



Clinical Officer	85	37.4	112,959.89	95.2	287,009.91	399,969.80
Dentist	5	3.2	9,747.39	5.75	17,335.16	27,082.55
<b>Total</b>	<b>418</b>	<b>186</b>	<b>560,982.69</b>	<b>479</b>	<b>1,443,862.89</b>	<b>2,004,849.58</b>

0.44= error of omission related to antibiotics per each prescription,  
1.15= error of commission per each prescription and Tshs = Tanzania shillings.

The result shows high implied costs of antibiotics encountered to patients with age group ranging from 21 to 40 years and less implied costs to children with under five years of age attributed by errors of omission (Table 14).

Age (Years)	Errors	Implied Costs (Tshs)
0 – 5	14.9	44,920.669
6 – 10	23.4	70,546.554
11 – 20	19.9	59,994.719
21 – 30	37.9	114,261.99
31 – 40	40.4	121,798.324
41 – 50	33.5	100,996.135
>50	16	48,236.96
<b>Total</b>	<b>186</b>	<b>524,201.201</b>

Tshs= Tanzania shillings

The result shows high implied costs of antibiotics encountered to patients with age group ranging from 21 to 40 years and less implied costs to children with under five years of age attributed by errors of commission (Table 15).

Age (Years)	Errors	Implied Costs (Tshs)
0 – 5	41.7	125,717.577
6 – 10	59.9	180,587.119

11 – 20	52.2	157,373.082
21 – 30	99.2	299,069.152
31 – 40	92.3	278,266.963
41 – 50	85.7	258,369.217
>50	44.1	132,953.121
<b>Total</b>	<b>479</b>	<b>1,480,648.801</b>

*Tshs= Tanzania shillings*

The results show high implied costs of antibiotics to clients were caused by Intern doctors and registrar. Penicillin was the group of antibiotics that contributed high implied costs due to Intern doctors (**Table 16**). The discussion will focus on cases where optimal costs of antibiotics was lower than the actual costs.

<b>Table 15: Distribution of Implied Costs (Tshs) of Antibiotics Vs Prescriber Position</b>							
	<b>I</b>	<b>A</b>	<b>R</b>	<b>S</b>	<b>C</b>	<b>D</b>	<b>Total Costs</b>
Penicillin	350,129.2	17,7462.7	22,5425.6	52,759.2	211,036.8	9,592.6	1,026,406.1
Tetracycline	23,981.5	9,592.6	14,388.8	47,96.3	9,592.6	0	62,351.8
Cephalosporin	62,351.8	33,574.0	38,370.3	9,592.6	38,370.3	4,796.3	187,055.3
Quinolones	38,370.3	19,185.2	28,777.7	9,592.6	23,981.5	0	119,907.3
Macrolides	33,574.0	19,185.2	23,981.5	4,796.3	23,981.5	0	105,518.4
Sulfonamides	38,370.3	19,185.2	23,981.5	9,592.6	23,981.5	0	115,111.0
Aminoglycoside	9,592.6	0	0	0	0	0	9,592.6
Nitroimidazole	139,092.4	67,148.1	91,129.5	19,185.2	81,536.9	4,796.3	402,888.4
<b>Total Costs</b>	<b>695,462.1</b>	<b>345,332.9</b>	<b>446,055.0</b>	<b>110,314.7</b>	<b>412,480.9</b>	<b>19,185.2</b>	<b>2,004,849.2</b>

*I= Intern doctor, A= Assistant medical officer, R= Registrar, S=Specialist, C= Clinical officer, D=Dentist Tshs= Tanzania shillings*

## CHAPTER FIVE

### 5.0 DISCUSSION

#### 5.1 General Discussion:

Antibiotics prescription errors in daily medical prescribing practices by using hand written prescriptions have been reported in different health facilities. <sup>[5]</sup> Result indicates proportional of prescribing errors to be 0.78, among 21 antibiotics prescribed, penicillin group is the most prescribed antibiotic (65.3%) and aminoglycosides being the least (0.5%) whereas other groups were variably prescribed for treatment of community acquired infections in Ubungo municipality health facilities out-patient departments. Prescription errors affecting the costs of antibiotics are Omission errors related to antibiotics and errors of commission at an average cost of 3,014.81 Tshs per each prescription error. The result reports implied costs of antibiotics caused by prescription errors to be 47.3% of the actual costs and optimum costs is 52.7% of the actual costs. Results indicates huge number of prescribers who spend long time on filling prescription papers, some patients are given inappropriate dose of antibiotics and some antibiotics with high prices in government health facilities than private and community pharmacies.

#### Prescription Errors:

The result indicates a very high proportional antibiotics of prescribing errors 0.78 in Ubungo municipal health facilities out-patient departments. The findings reveal presence of inappropriate use of antibiotics by clients that facilitates the increase of antibiotics resistance. The study suggests presence of low prescribing knowledge and little cooperation among prescribers and pharmacists to control prescription errors. Therefore, findings indicate increased prescription errors when compared to a study conducted in Dar es Salaam that report proportion of 0.55 <sup>[7]</sup> and another study reports the proportion of 0.40 <sup>[12]</sup>. Errors Omission were 81.8% and Commission 18.2%, they were mainly contributed by use of brand names of antibiotics, inappropriate dose and writing wrong name of antibiotics. The results of the study build on the existing evidence of a study conducted in Tanzania that reports proportional of 0.71 of

prescriptions contained medicines prescribed using brand names whereas proportional of antibiotics prescribed by brand names were 0.27 [15].

The result reports many prescription errors of omission and commission committed by Intern doctors (34.2%) followed by residents (22.0%), Clinical officers (20.3%), Assistant medical officers (17.2%), Specialists (5.0%) and Dentists (1.2%). The findings highlight on time serving strategies done by prescribers on not filling some parts of paper prescription and hence increased errors of omission, also little or no on service training that lead to knowledge exchange. Study in Tanzania reports error of omission being 98.9% and error of commission 1.1%, Therefore high control of errors of omission and less control of errors of commission in Ubungo municipal health facilities exist. Both results of the two studies reveal the prescribing errors committed by Intern doctors (25.6%) and residents (14.5%). [4]

### **5.2 Most Common Prescribed Antibiotics**

Among 21 antibiotics prescribed in Ubungo municipal health facilities, penicillin group was the most prescribed (65.3%) and group with a lot of prescription errors. The findings stand on the truth that; penicillins have high resistance and necessitate the shift of treatment to stronger antibiotics which are more expensive. Comparative results were reported in a study conducted in Pakistan that indicated frequency of penicillin use to be 52.4%. [12] Tanzania and Kenya reported high frequency use of antibiotics 39.8% and 94.0% respectively [4,11,16,17]. Comparative studies in developing countries report 47.5% to 100% of antibiotics use which is contrary to WHO recommended value of 20.0% to 25.4%. [2]

### **5.3. Costs attributed by Prescribing Errors:**

Prescription errors affecting the costs of antibiotics were Omission errors related to antibiotics (n=186) and errors of commission (n=479). Implied costs of antibiotics due to prescription errors is 47.3% of the actual costs and optimum costs is 52.7% of the actual costs before ruling out prescription errors. Therefore, prescription errors tend to double the optimum costs of antibiotics in Ubungo municipal health facilities and make

difficult to treat a patient of productive age. Omission errors related to patients have no effect to direct costs of antibiotics but indirectly can limit pharmacist's intervention to control commission errors such as assessing diagnosis in relation to the type of antibiotics given or age/weight of the patient with size of the dose, therefore lead to increased antibiotics costs to clients. However, costs associated with prescription errors may cause some people fail to attend medical services which may result to low production and poverty. Comparative study conducted in Australia reports the higher costs of antibiotics before intervention by pharmacists to be 267 USD (equivalent to 619,173.00Tshs) and implied costs to be 37.647 USD (equivalent to 87,303.393) <sup>[18]</sup> which is 14.1% of the total costs of antibiotics, similar study in Israel indicates inappropriate costs of antibiotics to be 1109 USD (equivalent to 2,571,771.00 Tshs) out of total antibiotics costs of 8452 USD (equivalent to. 19,600,188.00 Tshs). <sup>[21]</sup> which is 13.1% of the total costs of antibiotics.

Therefore, Ubungo health facilities have three times more prescription errors when compared to Australia and Israel which have three times less. Patients aged 21 to 40 years are more affected by prescription errors of omission and commission whereas children under five years are less affected by prescription errors. It is more expensive to treat a patient of productive age with antibiotics (especially penicillin group) in Ubungo municipal health facilities when compared to Israel and Australia. However, the annual costs of antibiotics derived from the study results by multiplying the 2 weeks' value by 26 (52/2). The actual annual total costs of antibiotics were 110,231,160 Tshs and the annual total implied costs of antibiotics was 52,126,100 Tshs. Intern doctors contribute about 34.3% of the implied costs of antibiotics to clients followed by residents (22.1%), Clinical officers (20.0%), Assistant medical officer (17.3%), Specialists (5.0%) and Dentists (1.4%).

## CHAPTER SIX

### **6.0 STUDY LIMITATIONS AND MITIGATION:**

The study was cross-sectional which has very short follow up period to observing the outcomes of prescribing errors such as adverse drug events and mortalities. Data from electronic prescriptions were not considered, therefore limited opportunity to identify new type of prescription error that would have been caused by electronic prescriptions. No qualitative information collected that could have identified underlying problems in the observed errors.

### **6.1 Conclusion**

Implied costs of antibiotics prescription errors to clients is reported in Ubungo municipal health facilities. The findings indicate the presence of significant prescription errors of omission and commission at the study site which highlights a need of conducting educational programmes among all prescribers especially interns in order to improve their prescribing skills. Prescription errors tend to double the costs of antibiotics at the health facilities.

### **6.2. Recommendations:**

There must be a control of prescribing antibiotics by limiting the level of prescriber since in this study 34.3% of all implied costs were due to intern doctors. Effective intervention methods to reduce prescribing errors such as persuasive or on job training and restrictive methods have positive impacts on improving antibiotic prescribing practices in health facilities. The Government through the Ministry of Health has to enforce the use of electronic prescription practices in health facilities. Further studies are warranted to find out what factors cause prescribers to write prescription with errors.

**REFERENCES:**

1. Vries, T., Richir, M. & Tichelaar, J. (2012). WHO Guide to Good Prescribing. The Politics of Medicines (e-Encyclopaedia): Overtoon 60(2)1054 HK Amsterdam, Netherlands: Advanced Access to Medicines for Everyone, Everywhere.
2. Jande, M., Kongola, G., and Mwangi, J. W. (2012). Drug Prescribing pattern in Two Hospitals in Mwanza, Northwest, Tanzania: East and Central Africa Journal of Pharmaceutical Sciences Vol. 15 (2012) 63-68.
3. David, C. et al. (2019). The Top Ten Prescribing Errors in practice and How to avoid them. The Pharmaceutical Journal.
4. Aristides, B. Audax and Eva, P. Muro. (2019). Evaluation of Prescription Dispensed in the Outpatient Pharmacies of a University Teaching Hospital in Moshi, Kilimanjaro, Tanzania: African Health Research Journal.
5. Jianhui, Y. et al. (2019). Prescribing Error in Electronic Prescriptions for Outpatients Intercepted by Pharmacists and the Impact of Prescribing Workload or Error Rate in a Chinese Tertiary-care Women and Children's Hospital, China. BMC Health Services Research.
6. Assiri, AA. (2018). What is the Epidemiology of Medication errors, Error – related Adverse Events and Risk factors for Errors in Adults managed in Community Care Context? A Systematic Review of the International literature. BMJ Open.
7. Mugoyela, V. et al. (2008). Extent of Occurrence of Prescribing Errors in a private Tertiary-Care Hospital in Dar es Salaam, Tanzania. Tanzania Medical Journal.
8. Anne, KW. et al. (2020). Adherence to Standard Treatment Guideline among Prescribers in Primary health care facilities in Dodoma, Tanzania: Research Square
9. Gasson, J. et al. (2018). Antibiotic Prescribing Practice and Adherence to Guidelines in Primary Care in the Cape Town Metro district, South Africa: SAMT Research Vol. 108, No.4.

10. Rajeev, S. and Srijana, P. (2019). Assessment of Prescription pattern and prescription error in outpatient Department at Tertiary Care District Hospital, Central Nepal: *Journal of Pharmaceutical Policy and Practice*.
11. Seni, J., Mapunjo, SG. And Witternauer R, et al. (2020). Antimicrobial uses across six referral hospitals in Tanzania: A point prevalence survey. *BMJ Open* 2020; 10: e042819.doi: 10. 1136/bmjopen-2020-042819.
12. Iftikhar, S. (2019). Antibiotic Prescribing Practices and Errors among Hospitalized Pediatric Patients Suffering from Acute Respiratory Tract Infections. A Multicenter Cross-Sectional study in Pakistan: *Medicina*, 2019 Feb; 55(2) 44. Doi: 10. 3390/medicina55020044.
13. Maina, M. et al. (2020). Antibiotic Use in Kenya Public Hospitals: Prevalence, Appropriateness and Link to Guideline Availability, Kenya: *International Journal of Infectious Diseases*.
14. Fedaku, G. et al. (2019). Medication Prescribing Errors among Hospitalized Pediatric Patients at Nekemte Referral Hospital, Western Ethiopia: Cross-Sectional study: *BMC Research Notes*.
15. Ombeni, K. et al. (2020). The Magnitude of Prescribing Medicines by Brand Names at Muhimbili National Hospital, Dar es Salaam, Tanzania. *Sage Journals*. <https://doi.org/10.1177/2399202619900148>.
16. Urassa, DP., Mwangu, M., and Makwi, JK. (2013). Utilization of Standard Treatment Guideline at Primary Health facilities, Magu district, Tanzania: *East African Journal of Public Health*.
17. Farzin, AJ. et al. (2020). Role of Pharmacists in Reducing Antibiotics Prescribing Errors in an Emergency Department, Australia. *Journal of Pharmacy Practice and Research*.
18. Elaine, KW. et al. (2017). Economic Impact of Medication Errors: A Systematic Review, London, UK: *Pharmcoepidemiology and Drug Safety*. <https://doi.org/10.1002/pds.4188>.



19. Anne JL. (2011). Preventable Hospital Admissions Related to Medication (HARM): Cost Analysis of the HARM study, USA: Research Gate. DOI: 10.1016/j.jval.2010. 10. 024.
20. Moyinoluwa, O. et al (2010). Costs of Appropriate and Inappropriate Use of Antibiotics in the Emergency Department, Israel. IMAJ. Vol. 12.
21. Kristine, EF. et al. (2017). Common ED Medication Errors: Polypharmacy. Santa Barbara Collage Hospital. EmDocs.
22. Easwaran, V. (2016). Assessment of Completeness and legibility of Prescriptions Received at Community Pharmacies. Andhra Pradesh, India. Journal of Health Research and reviews in Developing Countries.
23. Medlineplus (2021), Trusted health information for You, US National Library of Medicine.
24. Stanford Healthcare (2016), Patient Safetygram & Therapeutic duplication.
25. Boyce P (2020), Explicit and Implicit Costs Definition, Boyce Wire.
26. Masnoon et al. (2017) What is Polypharmacy? A Systematic Review of definitions. BMC Geriatrics.
27. Pharmacy Act (2011) The United Republic of Tanzania.
28. Cavel G.F, (2019) Magnitude Error: A Review of Wrong Dose Medication Incidents Reported to a UK Hospital Voluntary Incident Reporting System. BMJ.
29. Giveness M, et al (2019) Quality of Drug Prescription in Primary Healthcare Facilities in Mwanza, North-western Tanzania. Tanzania Journal of Health Research.
30. Centers for Disease Control and Prevention: Office of the Associate Director for Policy and Strategy.
31. Landis, J.R et al (1977) Measurement of Observer Agreement for Categorical Data. Biometrics 33:159-174

**APPENDICES:****Appendix I: Rating Scale Tool at Hospital Level.****RATING TOOL FOR ANTIBIOTICS PRESCRIBING ERRORS (Hospital level)**

Name of Antibiotics.....



Prescriber Status:

 Intern doctor  Ass. Medical Officer,  Registrar  Specialist,  Clinical officer

The number represents the values: **1- Yes, 2- No & 3- Not clear**. Insert (√) sign for the appropriate response and remarks in line with the **Guidelines (WHO & STG)**.

1. Errors of OMISSION related to Prescriber	Responses			Remarks
	1	2	3	
Missing Patient's Name				
Missing Date of Prescription				
Missing Patient's address				
Missing Patient's Registration Number				
Missing Patient's Age				
Missing Patient's Weight				
Missing Diagnosis				
Missing Prescriber's Signature				
<b>Total Score</b>				

2. Errors of OMISSION related to Antibiotics	Responses			Remarks
	1	2	3	
Missing Dose				
Missing Strength of Antibiotics				

Missing Frequency				
Missing Duration				
Missing Route of Administration				
<b>Total Score</b>				

1. Errors of COMMISSION	Responses			Remarks
	1	2	3	
Wrong Dose of Antibiotics				
Wrong Strength of Antibiotics				
Wrong Name of antibiotics				
Overlooked Drug-Drug Interaction				
Use of Brand Name of Antibiotic				
Wrong Frequency of Medication				
<b>Total Score</b>				

### Appendix II: Rating Scale Tool at health Centre Level

#### RATING TOOL FOR ANTIBIOTICS PRESCRIBING ERRORS (Health Centre level)

Name of Antibiotics.....



Prescriber Status:

Intern doctor  Ass. Medical Officer,  Registrar  Specialist,  Dentist  Clinical officer.

The number represents the values: **1- Yes, 2- No & 3- Not clear**. Insert (√) sign for the appropriate response and remarks in line with the **Guidelines (WHO & STG)**.

3. Errors of OMISSION related to Prescriber	Responses			Remarks
	1	2	3	
Missing Patient's Name				
Missing Date of Prescription				

Missing Patient's address				
Missing Patient's Registration Number				
Missing Patient's Age				
Missing Patient's Weight				
Missing Diagnosis				
Missing Prescriber's Signature				
<b>Total Score</b>				

4. Errors of OMISSION related to Antibiotics	Responses			Remarks
	1	2	3	
Missing Dose				
Missing Strength of Antibiotics				
Missing Frequency				
Missing Duration				
Missing Route of Administration				
<b>Total Score</b>				

2. Errors of COMMISSION	Responses			Remarks
	1	2	3	
Wrong Dose of Antibiotics				
Wrong Strength of Antibiotics				
Wrong Name of antibiotics				
Overlooked Drug-Drug Interaction				
Use of Brand Name of Antibiotic				
Wrong Frequency of Medication				
<b>Total Score</b>				

### Appendix III: Rating Scale Tool at health Centre Level.

#### RATING TOOL FOR ANTIBIOTICS PRESCRIBING ERRORS (Dispensary level)



Name of Antibiotics.....

Prescriber Status:

Intern doctor,  Ass. Medical Officer,  Registrar  Specialist,  Dentist

Clinical officer

The number represents the values: **1- Yes, 2- No & 3- Not clear**. Insert (√) sign for the appropriate response and remarks in line with the **Guidelines (WHO & STG)**.

5. Errors of OMISSION related to Prescriber	Responses			Remarks
	1	2	3	
Missing Patient's Name				
Missing Date of Prescription				
Missing Patient's address				
Missing Patient's Registration Number				
Missing Patient's Age				
Missing Patient's Weight				
Missing Diagnosis				
Missing Prescriber's Signature				
<b>Total Score</b>				

6. Errors of OMISSION related to Antibiotics	Responses			Remarks
	1	2	3	
Missing Dose				
Missing Strength of Antibiotics				
Missing Frequency				

Missing Duration				
Missing Route of Administration				
<b>Total Score</b>				

3. Errors of COMMISSION	Responses			Remarks
	1	2	3	
Wrong Dose of Antibiotics				
Wrong Strength of Antibiotics				
Wrong Name of antibiotics				
Overlooked Drug-Drug Interaction				
Use of Brand Name of Antibiotic				
Wrong Frequency of Medication				
<b>Total Score</b>				

## Appendix IV: Informed Consent (English Version)



ID No: .....

### **Introduction**

Greetings!

My name is **Bwire Nicholas Bwire** a student of Master of Science in Project Management, monitoring and evaluation in health at Muhimbili University of Health and Allied Sciences (MUHAS).

### **Purpose of the Study:**

To evaluate the costs associated with antibiotics prescribing errors at Ubungo health facilities.

### **Methods of the study:**

Rating Scale tool will be employed to collect data from the prescriptions at the outpatient departments in health facilities located in Ubungo Municipality.

### **Participation:**

If you agree with this study, allow me to reach the outpatient pharmacy for data collection.

### **Confidentiality:**

To ensure confidentiality, no names will be associated with the research findings in any way, and your identity as a participant will be known only to the researchers.

### **The expected benefits:**

There are no direct benefits for your participation, however, the information collected will help the hospitals and the Ministry of Health to improve the implementation of the guideline recommended in prescribing practices.

### **Risk:**

No harm is expected as a result of participation in the study.

### **Right to withdraw:**

You should be aware that you are free to decide not to participate or to withdraw at any time without affecting your relationship with the researcher.

**Whom to contact:**

In case of any question or query concerning this study, please contact

The principal investigator

Bwire N. Bwire

MUHAS

P.O BOX 65001

Dar es salaam

Phone number: 0714475206

Email: [nicbwire78@gmail.com](mailto:nicbwire78@gmail.com)

or

Supervisor of the study

Prof. Phares Mujinja,

MUHAS

P.O BOX 65001,

Dar es salaam

Phone number:0739281171,

Email: [profmujinja@gmail.com](mailto:profmujinja@gmail.com)

And If you have any question about your rights as participants you may contact

Dr Bruno Sungunya

Chairperson of Research and Publications Committee

MUHAS.

P.O Box 65001

Dar es Salaam-Tanzania

Tel +2552150302-6.

**Signature:**

I.....have read the contents of this form and understood it, my questions have been adequately answered, I agree to participate in this study.

Signature of Participant.....Date.....

Researcher's Signature..... Date.....



**Appendix V: Informed Consent (Kiswahili Version)**

FOMU YA KUJIUNGA KWA HIARI KATIKA UTAFITI

FOMU NAMBA: .....

**Utangulizi**

Salamu!

Mimi naitwa **Bwire Nicholas Bwire** ni mwanafunzi wa shahada ya uzamili katika ufuatiliaji na tathmini ya usimamizi wa mradi katika chuo kikuu cha Afya na sayansi Shirikishi, Muhimbili

**Malengo ya Utafiti:**

Kutathimini gharama zitokanazo na makossa ya uandishi wa dawa (antibiotics) kwa wagonjwa.

**Njia za utafiti:**

Utafiti huu utahusisha kutazama karatasi zilizo andikwa na kupewa mgonjwa ili akanunue dawa.

**Ushiriki:**

Iwapo unaruhusu utafiti huu kufanyika, naomba uniruhusu nifike kwenye duka la dawa la kituo cha afya.

**Usiri:**

Ili kuzingatia usiri jina lako halitokea katika matokeo ya utafiti huu na utambulisho wako utafahamika kwa mtafiti tu.

**Faida za utafiti:**

Hakuna faida ya moja kwa moja utakayoipata katika utafiti huu ila taarifa zitakazopatikana katika utafiti huu zitawasaidia mamlaka za serikali na wizara ya afya kuboresha utekelezaji wa mwongozo wa uandishi wa dawa za binadamu Tanzania.

**Madhara ya utafiti:**

Hakuna madhara yatakayokupata kutokana na ushiriki wako katika huu utafiti

**Kukubali kwa hiari kushiriki katika utafiti:**

Ushiriki katika utafiti huu ni hiari na una haki ya kuniruhuss ama kutokuniruhus na haitaharibu mahusiano baina yako na mtafiti

**Mawasiliano:**

**Kama una swali lolote kuhusu utafiti huu, Tafadhali wasiliana na**

Mtafiti Mkuu

Bwire N. Bwire

Chuo kikuu cha Afya na sayansi Shirikishi, Muhimbili

S.L.P. 65001,

Dar es salaam

Simu ya Mkononi: 0714475206,

Barua Pepe: [nicbwire78@gmail.com](mailto:nicbwire78@gmail.com)

Au

Msimamizi wa Utafiti

Prof. Phares Mijinja

Chuo kikuu cha Afya na Sayansi Shirikishi, Muhimbili

S.L.P. 65001,

Dar es salaam

Simu ya Mkononi: 0739281171,

Barua Pepe: [profmujinja@gmail.com](mailto:profmujinja@gmail.com)

Na kama utakuwa na swali lolote kuhusu haki yako kama mshiriki katika utafiti huu  
wasiliana na

Dr Bruno Sungunya

Mwenyekiti wa Kamati ya Utafiti na Uchapishaji

Chuo kikuu cha Afya na Sayansi Shirikishi, Muhimbili

S.L.P 65001

Dar es Salaam

Tanzania

Tel +2552150302-6.



**Sahihi kwa wanaokubali:**

Mimi.....nimesoma fomu hii na kuelewa lengo  
la utafiti huu na maswali yangu yamejibiwa na sasa nakubali kwa hiari yangu kujiunga  
na utafiti huu.

Sahihi ya mshiriki.....Tarehe.....

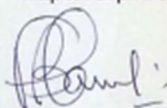
Sahihi ya Mtafiti..... Tarehe.....

## Appendix VI: Approval for Ethical Clearance

	<p><b>UNITED REPUBLIC OF TANZANIA</b>          MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY          MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES  <b>OFFICE OF THE DIRECTOR - RESEARCH AND PUBLICATIONS</b></p>	
<p>Ref. No.DA.282/298/01.C/ <span style="float: right;">Date: 13/05/2021</span></p> <p><b>MUHAS-REC-05-2021-603</b></p> <p>Bwire Nicholas Bwire,          MSc. PMMEH,          School of Public Health and Social Sciences  <b>MUHAS</b></p> <p><b>RE: APPROVAL FOR ETHICAL CLEARANCE FOR A STUDY TITLED: Costs of Antibiotics Prescribing Errors: A Case of Ubungo Health Facilities, Dar es Salaam, Tanzania.</b></p> <p>Reference is made to the above heading.</p> <p>I am pleased to inform you that the Chairman has on behalf of the University Senate, approved ethical clearance of the above-mentioned study, on recommendations of the Senate Research and Publications Committee meeting accordance with MUHAS research policy and Tanzania regulations governing human and animal subjects research.</p> <p>APPROVAL DATE: 13/05/2021          EXPIRATION DATE OF APPROVAL: 12/05/2022</p> <p><b>STUDY DESCRIPTION:</b>  <b>Purpose:</b>          The purpose of this descriptive cross-sectional study is to assess the costs associated with antibiotics prescribing errors to patients in Ubungo health facilities. Prospective prescriptions with one or more antibiotics will be reviewed at the OPD. Two pharmacists each with a rating scale tool for scoring errors of omission and commission.</p> <p>The approved protocol and procedures for this study is attached and stamped with this letter, and can be found in the link provided: <a href="https://irb.muhas.ac.tz/storage/Certificates/Certificate%20-%20542.pdf">https://irb.muhas.ac.tz/storage/Certificates/Certificate%20-%20542.pdf</a> and in the MUHAS archives</p>		

**The PI is required to:**

1. Submit bi-annual progress reports and final report upon completion of the study.
2. Report to the IRB any unanticipated problem involving risks to subjects or others including adverse events where applicable.
3. Apply for renewal of approval of ethical clearance one (1) month prior its expiration if the study is not completed at the end of this ethical approval. You may not continue with any research activity beyond the expiration date without the approval of the IRB. Failure to receive approval for continuation before the expiration date will result in automatic termination of the approval for this study on the expiration date.
4. Obtain IRB amendment (s) approval for any changes to any aspect of this study before they can be implemented.
5. Data security is ultimately the responsibility of the investigator.
6. Apply for and obtain data transfer agreement (DTA) from NIMR if data will be transferred to a foreign country.
7. Apply for and obtain material transfer agreement (MTA) from NIMR, if research materials (samples) will be shipped to a foreign country,
8. Any researcher, who contravenes or fail to comply with these conditions, shall be guilty of an offence and shall be liable on conviction to a fine as per NIMR Act No. 23 of 1979, PART III section 10 (2)
9. The PI is required to ensure that the findings of the study are disseminated to relevant stake holders.
10. PI is required to be versed with necessary laws and regulatory policies that govern research in Tanzania. Some guidance is available on our website <https://drp.muhas.ac.tz/>.






Dr. Bruno Sunguya  
Chairman, MUHAS Research and Ethics Committee



Cc: Director of Postgraduate Studies

**Appendix VI: Introduction Letter to Study Site.**


	<p><b>UNITED REPUBLIC OF TANZANIA</b>  <b>MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY</b>  <b>MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES</b>  <b>OFFICE OF THE DIRECTOR – POSTGRADUATE</b>  <b>STUDIES</b></p>	
<p>Ref. No. HD/MUH/T.768/2019</p>		<p>17<sup>th</sup> May, 2021</p>
<p>DISTRICT MEDICAL OFFICER,          UBUNGO DISTRICT,          P.O BOX 55068,          DSM-TANZANIA.</p>		
<p><b>Re: INTRODUCTION LETTER</b></p>		
<p>The bearer of this letter is Bwire Nicholaus Bwire (HD/MUH/T.768/2019), a student at Muhimbili University of Health and Allied Sciences (MUHAS) pursuing MSc. Project Management Monitoring and Evaluation in Health.</p>		
<p>As part of his studies he intends to do a study titled: <b>“Costs of Antibiotics Prescribing Errors: A Case of Ubungo Health Facilities, Dar es Salaam, Tanzania”</b>.</p>		
<p>The research has been approved by the Chairman of University Senate.</p>		
<p>Kindly provide him with the necessary assistance to facilitate the conduct of his research.</p>		
<p>We thank you for your cooperation.</p>		
<div style="display: flex; align-items: center;">  <div> <p><i>Ms. Victoria Mwanilwa</i></p> <p><b>For: DIRECTOR, POSTGRADUATE STUDIES</b></p> </div> </div>		
<p>cc: Dean, School of Public Health and Social Sciences, MUHAS          cc: Bwire Nicholaus Bwire</p>		

## Appendix VII: Research Permit at Study Sites.

### Permit at Hospital Level

**UBUNGO MUNICIPAL COUNCIL**  
ALL CORRESPONDENCES TO BE ADDRESSED TO THE MUNICIPAL DIRECTOR

Tel: 0222 - 926341  
Fax: 0222 - 926342  
Email: info@ubungomc.go.tz  
Website: www.ubungomc.go.tz  
In reply please quote:



P.O. BOX 55068  
DAR ES SALAAM  
TAREHE: 20/05/2021

Ref. No. UMC/R/01/25

**MEDICAL OFFICER IN CHARGE,  
SINZA HOSPITAL,  
UBUNGO MUNICIPAL COUNCIL.**

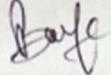
**REF: RESEARCH PERMIT**

Refer to the above heading.

DMO's office is pleased to inform you that:- **Bwire Nicholaus Bwire** Who is from **Muhimbili University of Health and Allied Sciences**, Has been given a permit to perform the Research work in your Facility starting from **18 May, 2021 to 30 May, 2021**. The Research is titled "**Costs of Antibiotics Prescribing Errors to Patients:A case of Ubungo Health Facilities,Dar es salaam,Tanzania.**"

Kindly receive and provide the necessary assistance in order to enable him to fulfill the purpose of her research.

Best Wishes,


  
DR. Peter J. Nsanya  
**MUNICIPAL MEDICAL OFFICER  
UBUNGO MUNICIPAL COUNCIL**

NB: Please share report with MMOH Office at the end of your study

## Permit at Health Centre Level

**UBUNGO MUNICIPAL COUNCIL**  
ALL CORRESPONDENCES TO BE ADDRESSED TO THE MUNICIPAL DIRECTOR

Tel: 0222 - 926341  
Fax: 0222 - 926342  
Email: info@ubungomc.go.tz  
Website: www.ubungomc.go.tz  
In reply please quote:



P.O. BOX 55068  
DAR ES SALAAM  
TAREHE: 20/05/2021

Ref. No. UMC/R/01/26

MEDICAL OFFICER IN CHARGE,  
KIMARA HC, MBEZI HC, MAKURUMLA HC,  
UBUNGO MUNICIPAL COUNCIL.

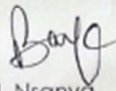
**REF: RESEARCH PERMIT**

Refer to the above heading.

DMO's office is pleased to inform you that:- **Bwire Nicholas Bwire** Who is from **Muhimbili University of Health and Allied Sciences**, Has been given a permit to perform the Research work in your Facility starting from **18 May, 2021 to 30 May, 2021**. The Research is titled "**Costs of Antibiotics Prescribing Errors to Patients: A case of Ubungo Health Facilities, Dar es salaam, Tanzania.**"

Kindly receive and provide the necessary assistance in order to enable him to fulfill the purpose of her research.

Best Wishes,

  
DR. Peter J. Nsanya  
MUNICIPAL MEDICAL OFFICER  
UBUNGO MUNICIPAL COUNCIL

NB: Please share report with MMOH Office at the end of your study



## Permit at Dispensary Level

**UBUNGO MUNICIPAL COUNCIL**  
ALL CORRESPONDENCES TO BE ADDRESSED TO THE MUNICIPAL DIRECTOR

Tel: 0222 - 926341 Fax: 0222 - 926342 Email: info@ubungomc.go.tz Website: www.ubungomc.go.tz In reply please quote:		P.O. BOX 55068 DAR ES SALAAM  TAREHE: 20/05/2021
---	---	---

Ref. No. UMC/R/01/27

**HEALTH FACILITY IN CHARGES,  
MANZESE DISP,GOBA DISP,MABIBO DISP  
UBUNGO MUNICIPAL COUNCIL.**

**REF: RESEARCH PERMIT**

Refer to the above heading.

DMO's office is pleased to inform you that:- **Bwire Nicholas Bwire** Who is from **Muhimbili University of Health and Allied Sciences**, Has been given a permit to perform the Research work in your Facility starting from **18 May, 2021 to 30 May, 2021**. The Research is titled "**Costs of Antibiotics Prescribing Errors to Patients:A case of Ubungo Health Facilities,Dar es salaam,Tanzania.**"

Kindly receive and provide the necessary assistance in order to enable him to fulfill the purpose of her research.

Best Wishes,

  
 DR. Peter J. Nsanya  
**MUNICIPAL MEDICAL OFFICER  
UBUNGO MUNICIPAL COUNCIL**

NB: Please share report with MMOH Office at the end of your study