A COST ANALYSIS OF IGRA-BASED COMMUNITY ACTIVE CASE FINDING FOR TUBERCULOSIS AMONG ADOLESCENTS IN URBAN SETTINGS

Helga Mutasingwa (MD)

Master of Science in Health Economics and Policy

Muhimbili University of Health an Allied Sciences

October 2024

Muhimbili University of Health and Allied Sciences

School of Public Health and Social Sciences

A COST ANALYSIS OF IGRA-BASED COMMUNITY ACTIVE CASE FINDING FOR TUBERCULOSIS AMONG ADOLESCENTS IN URBAN SETTINGS

By

Helga Mutasingwa

A dissertation Submitted in (Partial) Fulfillment of the requirement for the Degree of Master of Health Economics and Policy of Muhimbili University of Health an Allied Sciences

October 2024

CERTIFICATION

The undersigned certify that they have read and hereby recommended for acceptance to Muhimbili University of Health and Allied Sciences a dissertation report entitled "**A COST ANALYSIS OF IGRA-BASED COMMUNITY ACTIVE CASE FINDING FOR TUBERCULOSIS AMONG ADOLESCENTS IN URBAN SETTINGS",** in partial fulfilment of the requirements for the degree of Master of Science in Health Economics and Policy of Muhimbili University of Health an Allied Sciences.

_____

Dr. George Ruhago

(Supervisor)

_____

Date

_____

Dr. Maryam Amour

(Co-supervisor)

_____

Date

DECLARATION AND COPYRIGHT

I, **Helga Mutasingwa** hereby declare that this **dissertation** is my original work and that it has never been presented and will not be presented to any other university for a similar or any other degree award.

Signature……..……. Date……

This dissertation is copyright material protected under the Berne Convention, the Copyright Act 1999, and other international and national enactments, on behalf of 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 acknowledgment, 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

ACKNOWLEDGMENT

The successful completion of this research is the result of dedication, support, and guidance from many individuals. First and foremost, I would like to express my deepest gratitude to God for granting me the strength, perseverance, and wisdom to navigate this challenging yet rewarding journey.

I am immensely thankful to the DETEC-TB Study team for graciously allowing me to conduct my study with them. I also extend my thanks to the Dar es Salaam Region, Ilala, and Temeke Municipalities for permitting access to the selected schools and to the adolescents who participated in my research. The cooperation and assistance provided by everyone I contacted were instrumental in collecting the data that forms the foundation of this thesis.

My sincere appreciation goes to my supervisors, Dr. Maryam Armour and Dr. George Ruhago. Your invaluable guidance, expertise, and unwavering support throughout this process were essential. I am particularly grateful for your patience with my questions, your insightful feedback that challenged me to think critically, and your encouragement during moments of doubt.

Finally, I would like to express my gratitude to the faculty at Muhimbili University of Health and Allied Sciences (MUHAS) for creating a stimulating academic environment that fostered intellectual growth.

DEDICATION

I dedicate this work to my wonderful family, whose unconditional love, support, and prayers have been my foundation throughout this journey.

Despite the numerous challenges I faced, you stood by me every step of the way, offering unwavering encouragement and strength.

ABSTRACT

Background: The increasing prevalence of TB among adolescents and the unique challenges posed by urban environments, there is a critical need to evaluate the economic implications of implementing targeted screening strategies. This study aims at exploring the costs associated with Interferon-Gamma Release Assay (IGRA)-based community active case finding, considering diagnostic tests, personnel, follow-up care, and other relevant factors. The findings of this study have the potential to inform public health policies and interventions aimed at addressing TB in this vulnerable population. By assessing the economic impact of IGRA-based community active case finding, the research contributes to the optimization of resource allocation, development of cost-effective screening programs, and the enhancement of TB control strategies in urban environments. Ultimately, the study seeks to advance our knowledge on the economic dimensions of TB control and promote evidence-based decision-making for public health initiatives targeted at adolescents.

Methods and materials: A cross-sectional descriptive study design was employed to determine the cost of actively finding TB cases among adolescents using the IGRA. Cost data was collected from provider perspective (in TZS) covering a period of 6 months. Excel based questionnaire was used to collect cost data related to the implementation of the project. In addition, face to face interviews was conducted to household heads of adolescents who were prevalent of IGRA-positive. The aim was to assess socio-economic and demographic factors that was associated with TB case identification using IGRA. After data cleaning, cost analysis was conducted using Microsoft Excel. All other quantitative data collected from the study participants were analyzed using STATA version 16. Multivariate analysis was used to determine the socio-economic and demographic characteristics associated with IGRA-positive results among adolescents.

Results: In this study, a total of 425 study participants were interviewed for socio-economic status when being screened for tuberculosis infections using IGRA, whereby 225 (52.94%) were females, with the mean age of 14 years. Majority of participants belonged to households with low socio-economic status. Majority of participants 143(40.06%) belonged to households with low socio-economic status. In doing cost analysis using 600 adolescents screened for Tuberculosis infections using IGRA, The total capital cost associated with TB

case detection using IGRA- was 4,953,936 Tshs, with equipment accounting for a large share, 65.7% of the total capital cost. Furthermore, diagnostic services cost more (2,934,388 Tshs) than screening services. The total recurrent cost associated with TB case detection using IGRA was 258,769,757 Tshs, with personnel accounting for a large share of the total recurrent cost. The unit cost of screening a TB case through IGRA-Based community active case finding in urban settings was Tshs. 439,539. Of all the cost inputs, Personnel and contracted services accounted for a large share of the overall cost of detecting a tuberculosis case, that are, 69% and 18%, respectively. In a Univariate analysis, only sex was significantly associated with IGRA-positive results. In a multivariate analysis, sex (aOR=3.69; 95% CI; 1.62 – 8.42; P<0.002) and parent status/father not alive (aOR=5.10; 95% CI; 1.28 – 20.30; P<0.021) were significantly associated with positive results (IGRA positive).

Conclusion: The findings of this study revealed that IGRA-based community active case finding is an effective tool for TB case detection, particularly in adolescent populations. Despite high vaccination rates, the prevalence of IGRA-positive cases underscores the need for ongoing TB surveillance and targeted interventions. The cost analysis reveals that while the initial investment in IGRA-based community active case finding is substantial, the comprehensive nature of the approach justifies the costs. Understanding the primary cost drivers and socio-economic factors influencing TB detection can inform more efficient and equitable TB control strategies

TABLE OF CONTENTS

CERTIFICATION i

DECLARATION AND COPYRIGHT ii

ACKNOWLEDGMENT iii

DEDICATION iv

ABSTRACT v

LIST OF FIGURES xi

ABBREVIATIONS xii

DEFINITIONS xiii

CHAPTER ONE 1

1.0 INTRODUCTION 1

1.1 Background 1

1.2 Problem statement 2

1.3 Definition of intervention 3

1.4 Conceptual Framework 4

1.5 Rationale of the study 5

1.5 Research Questions 6

1.5.1 Main Research Question 6

1.4.2 Specific Questions 6

1.6 Objectives 6

1.6.2 Broad Objective 6

1.6.3 Specific Objectives 6

CHAPTER TWO 7

2.0 LITERATURE REVIEW 7

2.1 Overview of the Interferon-Gamma Release Assays (IGRA) 7

2.2 Cost of detecting a TB Case using IGRA-Based Based Community Active case finding 7

2.3 Cost drivers associated with the use of IGRA-Based Community Active Case finding in detecting a TB case 8

2.4 Socio-economic factors associated with detecting a TB case using IGRA-Based Community Active Case finding 8

CHAPTER THREE 10

3.0 METHODOLOGY 10

3.1 Study and design issues 10

3.2 Study settings and population 10

3.3 Sample size and sampling procedure 10

3.3.1 Sampling size 10

3.3.2 Sampling procedure 11

3.4 Inclusion criteria 11

3.5 Exclusion criteria 11

3.6 Perspective and time horizon 11

Cost data was collected from the provider perspective for a period of 6 months. 11

3.7 Study variables 11

3.8 Data collection methods 12

3.9 Investigation tools, validity and reliability issues 12

3.9.1 Data collection tools 12

3.9.2 Data validity 12

3.9.3 Data reliability 13

3.10 Data analysis 13

3.11 Ethical issues 14

3.12 Study limitations and mitigation 14

CHAPTER FOUR 15

4.0 RESULTS 15
4.1 Demographic characteristics of study participants 15
4.2 Capital cost associated with TB case detection using IGRA 16
4.3 Recurrent cost associated with TB case detection using IGRA 16
4.4 Unit cost of detecting a TB case using IGRA 17
4.5 Cost drivers associated with TB case detection using IGRA 17
4.6 Socio-economic factors associated with TB case detection using IGRA 18
CHAPTER FIVE 20
5.0 DISCUSSION 20
5.1 Introduction 20
5.2 Cost of detecting a TB Case using IGRA-Based Based Community Active case finding 20
5.3 Cost drivers associated with the use of IGRA-Based Community Active Case finding in detecting a TB case 21
5.4 Socio-economic factors associated with detecting a TB case using IGRA-Based Community Active Case finding 21
CHAPTER SIX 23
6.0 CONCLUSION AND RECOMMENDATIONS 23
6.1 Conclusion 23
6.2 Recommendation 24
REFERENCES 25
APPENDICES 29
Appendix I: Consent form – English 29
Appendix II: Consent form – Swahili 31
Appendix III: Assent form – English 33

Appendix IV: Assent form – Swahili 35

Appendix V: Data collection tools – Costing questionnaire 37

Appendix VI: Socio-economic questionaries – English and SwahiliS 39

Appendix VII: Ethical Clearance 45

Appendix VIII: Letter for permit 47

Appendix IX: Permission letter 49

LIST OF TABLES

Table 1: Demographic characteristics of study participants..... 15
Table 2: Capital cost (in Tshs) associated with tuberculosis case detection using IGRA... 16
Table 3:Capital cost (in Tshs) associated with tuberculosis case detection using IGRA.... 16
Table 4: Unit cost of detecting a TB case using IGRA among 600 students 17
Table 5: Socio-economic factors associated with tuberculosis case detection using IGRA 19

LIST OF FIGURES

Figure **1:** Presenting a conceptual framework showing the relationship between study variables, adapted from Sohn et al(14). 4
Figure 2: Cost drivers associated with TB case detection using IGRA..... 18

ABBREVIATIONS

ACF	Active Case Finding
CACF	Community Active Case Finding
CAD	Canadian Dollar
ICER	Incremental Cost-Effectiveness Ratio
IGRA	Interferon-Gamma Release Assay
IRB	Institutional Review Board
LBTI	Latent Tuberculosis Infection
MoH	Ministry of Health
MUHAS	Muhimbili University of Health and Allied Sciences
ODK	Open Data Kit
TB	Tuberculosis
TST	Tuberculin Skin Test
UHC	Universal Health Coverage
UN	United Nations
USD	United States Dollar
WHO	World Health Organization

DEFINITIONS

IGRA – are blood tests that measure the immune response to Mycobacterium Tuberculosis(1).

Active Case Finding – is defined as the systematic identification of people with suspected active TB, in a predetermined target group, using tests, examinations or other procedures that can be applied rapidly. Among those whose screening is positive, the diagnosis needs to be established by one or several diagnostic tests and additional clinical assessments, which together have high accuracy(2).

Tuberculin Skin Test – is one method of determining whether a person is infected with Mycobacterium tuberculosis. Reliable administration and reading of the TST requires standardization of procedures, training, supervision, and practice (3).

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Over decades, tuberculosis (TB) has remained as a major global health threat with gaps in screening and diagnosis. The 2022 estimates shows that 10.6 million people fell ill with tuberculosis, ranking it the second leading infectious killer after COVID-19 and above HIV/AIDS(4). Tuberculosis is spread through the air when an infected individual cough, sneeze or spit. It is estimated that about 5-10% of individuals infected with tuberculosis will eventually get symptoms and develop the disease(4). Tuberculosis detection has been done by instrumental traditional methods which include Sputum Smear Microscopy for microscopic examination of Acid Fast Bacilli (AFB), Culture highly sensitive process which involves growing Tuberculosis bacteria. The other traditional method includes Chest X-ray which can identify the lung abnormalities suggestive of TB such as infiltrates or cavities and Tuberculin Skin Test (TST) which measures the body immune response to TB antigens. A positive reaction of TST indicates exposure to Tuberculosis but cannot differentiate between active and latent TB infection (2)

The impact of tuberculosis is particularly pronounced in low-and middle-income countries where population density and diverse socio-economic factors contribute to the spread of infectious diseases (4,5). It was estimated that, the low- and middle-income countries account for over 80% of tuberculosis cases and deaths (4,5). Adolescents, one among the age-groups which are often considered vulnerable, face unique challenges in terms of TB diagnosis and treatment adherence (6–8). To address this public health concern, there is a growing interest in exploring innovative and targeted strategies, such as Interferon-Gamma Release Assay (IGRA)-based community active case finding.

Tanzania is one among the 30 highest tuberculosis burden countries in the world with an estimated incidence of 208 per 100,000 population (9). The estimates from the first National Tuberculosis Prevalence Survey revealed a gap between the number of individuals estimated by WHO to develop tuberculosis and the number of tuberculosis cases that were actually identified(10). This might have been contributed by in-efficiencies of different interventions implemented by the government that aim at increasing tuberculosis notification rates in the country. To address this gap, Muhimbili University of Health and Allied Sciences is

complementing the government efforts by implementing a project using the active case finding approach with the aim of increasing tuberculosis case notification rates, and specifically among adolescents residing in urban areas, such as Dar es salaam as they are exposed to an increased risk of TB due to factors such as overcrowded living conditions, limited access to healthcare services, and potential exposure to drug-resistant strains at which the conventional passive case finding methods implemented by the government may fall short in identifying latent TB infections in this demographic(11).

This proactive approach, utilizing IGRA as a diagnostic tool for active case finding within the community, presents a promising avenue for early detection and intervention as it offers an improved specificity compared to traditional methods, measure the immune response to Mycobacterium tuberculosis, the causative agent of TB(12,13). The potential of IGRA-based community active case finding lies in its ability to identify TB infections early in adolescents, thereby facilitating prompt treatment initiation and reducing the risk of transmission within the community.

Despite its potential benefits, the implementation of IGRA-based strategies carries associated costs that need careful consideration. A comprehensive cost analysis is crucial for understanding the economic feasibility of this approach, informing resource allocation, and shaping evidence-based policies for TB control programs targeting adolescents in urban settings. Therefore, this study aims to bridge the gap in existing literature by providing a detailed cost analysis of IGRA-based community active case finding for TB among adolescents in urban settings. The findings are expected to contribute valuable insights into the economic implications of this intervention, ultimately guiding public health strategies and interventions aimed at mitigating the impact of TB on adolescents in urban environments.

1.2 Problem statement

Tuberculosis (TB) has remained a global public health concern, with a significant burden among adolescents in urban settings. The Interferon-Gamma Release Assay (IGRA) has emerged as a promising diagnostic tool for detecting latent TB infection, facilitating early intervention and preventing the progression to active disease. Despite its potential, there is a gap in the existing literature regarding cost, cost-effectiveness and feasibility of

implementing IGRA-based Community Active Case Finding strategies specifically tailored for the adolescent population in urban environments.

The current diagnostic landscape predominantly relies on traditional methods, which may present limitations in terms of accuracy, especially in regions with a high prevalence of Bacillus Calmette-Guerin (BCG) vaccination (12,13). Given the unique challenges posed by urban settings, including population density, mobility, and access to healthcare, there is a critical need to evaluate the economic implications and practicality of transitioning to IGRA-based CACF.

This study aims to address this gap by conducting a comprehensive cost analysis of implementing IGRA-based CACF for tuberculosis among adolescents in urban areas. By assessing the direct and indirect costs associated with the adoption of this innovative approach, we aim to provide valuable insights into the financial feasibility, scalability, and sustainability of integrating IGRA into routine TB screening programs targeted at the adolescent demographic.

1.3 Definition of intervention

IGRA-Based community active case finding project is implemented by the Muhimbili University of Health and Allied Sciences with the aim of complementing government efforts in increasing tuberculosis case notification rates. The project conducts tuberculosis screening among potential adolescents from secondary schools in districts with high tuberculosis notification rates in Dar es salaam basing on the eligibility criteria. The intervention package follows the same standard screening protocol by performing and interpreting assays according to manufacturer's instructions using manual microscopic counting of Spot Forming Cells. Prior to tuberculosis screening, information sessions are conducted to teachers, parents and adolescents. Recruitment takes place at school-designated special rooms and parents/guardians are invited to come to school for the consent process. Households selected for further study are visited by the study team who will obtain additional consents/assents from household members. The study nurse and doctor are responsible for active recruitment for the adolescents in school based on eligibility criteria. All newly diagnosed TB patients will be referred to the National Tuberculosis and Leprosy Program (NTLP) for treatment as per national guidelines.

1.4 Conceptual Framework

This study adapted a conceptual framework from the costing study which was conducted to determine the cost of implementing a public health intervention in resource limited settings (14). This conceptual framework shows the relationship between the dependent and independent study variables. The dependent variable is the unit cost of detecting TB Case using IGRA with two independent variables assessed separately in the programme. The unit cost of detecting a TB case using IGRA is a dependent variable of the summation of capital and re-current costs which was incurred during the implementation of IGRA Based Community active case finding. After screening for a TB using IGRA among the adolescents in the selected schools for the project, we expected to identify IGRA-positive cases. The identification of the IGRA-positive cases was dependent on the socio-economic characteristics of the study participants such as age, sex, grade/class, place of residence, no. of household members, household size and household self-reported income/wealthy.

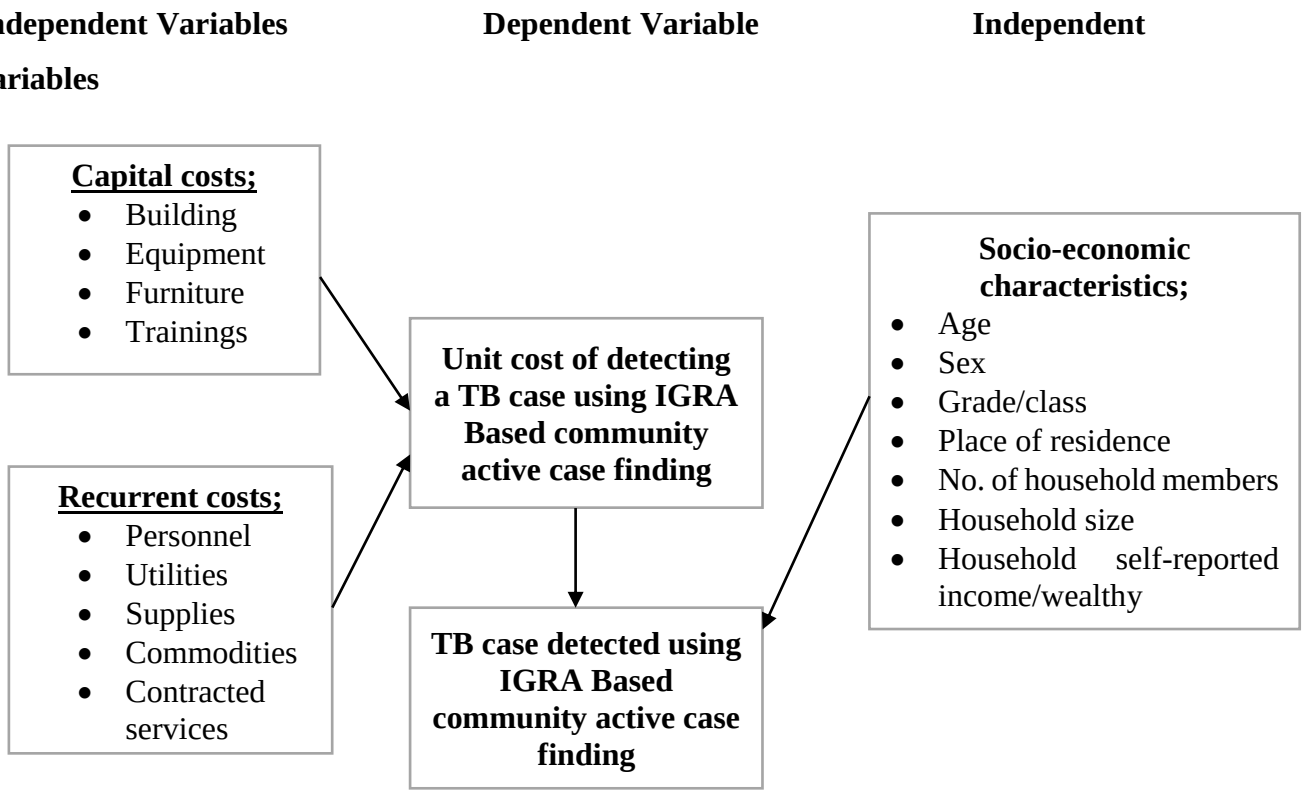


Figure **1:** Presenting a conceptual framework showing the relationship between study variables, adapted from Sohn et al(14).

1.5 Rationale of the study

The Dar es Salaam city, as a representative urban environment with high tuberculosis burden, faces unique challenges in TB control due to factors such as population density, mobility, and access to healthcare services. Adolescents, forming a substantial portion of the urban population, represent a demographic with unique characteristics and vulnerabilities that necessitate targeted interventions.

The Interferon-Gamma Release Assay (IGRA) has emerged as a promising tool for the detection of latent TB infection, providing a more specific and reliable alternative to traditional methods, especially in regions with a high prevalence of Bacillus Calmette-Guerin (BCG) vaccination. However, the practicality and cost-effectiveness of implementing IGRA-based strategies, specifically tailored for adolescents in urban settings like Dar es Salaam, have not been thoroughly explored.

Therefore, this study addressed the existing knowledge-action gap by conducting a detailed cost analysis of IGRA-Based Community Active Case Finding (CACF) for tuberculosis among adolescents involved in the project in Dar es Salaam. By focusing on this specific urban context, the research did seek to capture the nuances and challenges unique to the local healthcare infrastructure and socio-economic characteristics.

The outcomes of this study did not only contribute to the global understanding but also offered insights directly applicable to the urban settings such as Dar es Salaam. The results are expected to guide policy formulation, resource allocation, and program implementation by providing evidence-based recommendations on the economic viability and sustainability of integrating IGRA-based CACF into routine TB screening for adolescents in this specific urban setting. The findings from this research will not only contribute to the optimization of TB control strategies but will also inform policymakers, healthcare providers, and public health practitioners on the economic considerations essential for the successful implementation of IGRA-based CACF initiatives, ultimately aiding in the reduction of TB incidence and improving the overall health outcomes among adolescents in urban settings.

Furthermore, as Dar es Salaam serves as an important urban center in the fight against TB, the findings from this study may be extrapolated to inform and enhance similar initiatives in other urban areas facing comparable challenges.

1.5 Research Questions

1.5.1 Main Research Question

What is the unit cost of detecting latent TB infection using the IGRA-Based Community Active Case finding with associated socio-economic factors in detection of Tuberculosis infection in urban settings?

1.4.2 Specific Questions

1. To what extent does the capital cost influence the unit cost of detecting a TB case using the IGRA-Based Community Active Case Finding in Urban settings?
2. To what extent the re-current cost influences the unit cost of detecting a TB case using the IGRA-Based Community Active Case Finding in Urban settings?
3. What are the socio-economic factors associated with detecting a TB case using IGRA-Based Community Active Case finding in urban settings?

1.6 Objectives

1.6.2 Broad Objective

To determine the unit cost of detecting a TB case using the IGRA-Based Community Active Case finding and to assess the socio-economic factors associated with TB detection in urban settings.

1.6.3 Specific Objectives

i. To determine the capital cost of detecting a TB case using the IGRA-Based Community Active Case Finding in Urban settings.
ii. To determine the re-current cost of detecting a TB case using the IGRA-Based Community Active Case Finding in Urban settings.
iii. To assess the socio-economic factors associated with detecting a TB case using IGRA-Based Community Active Case finding in urban settings.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Overview of the Interferon-Gamma Release Assays (IGRA)

Interferon-Gamma Release Assays (IGRA) are blood tests that measure the immune response to Mycobacterium Tuberculosis(1). Due to the increasing burden of tuberculosis in the world, WHO recommended the use of Interferon-gamma release assays (IGRA) to test for TB infections and increase the probability that individuals who are identified for preventive treatment will benefit from it(1). Literature suggests that the LBTI testing using IGRA is effective at diagnosing active tuberculosis earlier and lowers the long-term risks of progression to TB(15,16). Adolescents are also at risk of TB infection, and their unique characteristics, behavior, and socio contexts can impact the success of TB control programs(8). In Tanzania, several studies have also estimated the magnitude of LTBI among adolescents to be between 15% to 19.2% with a higher prevalence among adolescents aged 16 years and above(1,6). DAR-PIAT was a trial conducted to identify TB cases among adolescents in Dar es salaam using IGRA. The study estimated that, 15% of the sample adolescents were prevalent of IGRA-positive at baseline(6)

2.2 Cost of detecting a TB Case using IGRA-Based Based Community Active case finding

The cost of detecting a TB case using IGRA varies regional wise. A study conducted in Portugal that compared the cost-effectiveness of two screening strategies for latent tuberculosis infection revealed that, it costed euro 55.21 to screen an individual for TB using IGRA(17). In addition, the test was deemed cost-effective with a slightly increased cost, that is ICER of Euro 106 per LTBI diagnosis. Similar findings were revealed in another study that was conducted in San Francisco to evaluate the feasibility, acceptability and cost of TB tests by whole-blood interferon-gamma assay which estimated the cost of US $ 33.67 per patient tested(18). In a systematic review that was conducted to determine the cost and cost-effectiveness of different TB screening strategies in high income countries estimated the cost of detecting a TB case using IGRA to be CAD 19.0, CAD 45.32, US $ 34.2, US $ 31.18, US $ 171.78, sterling pound 145.98, sterling pound 129, sterling pound 55 and sterling pound 44.83 in Canada (2007), Canada (2008), Japan (2008), USA (2009), Germany (2007),

Germany (2009), Switzerland (2007), UK (2010) and France (2010), respectively(19). Another systematic review that was conducted to determine the cost-effectiveness of Mycobacterium tuberculosis antigen-based skin test found 29 studies on the IGRA and/or the TST, which estimated an average TST costs of US $ 37.84 and US $ 89.33 for IGRA(20). Several studies have been conducted to determine the cost of IGRA. However, majority reviled findings are from the high-income countries. There is limited evidence about the cost of detecting a TB case using IGRA in low resource settings. Therefore, this study will determine the cost of detecting a TB case using the IGRA-Based Community Active Case Finding in low resource settings.

2.3 Cost drivers associated with the use of IGRA-Based Community Active Case finding in detecting a TB case

The literature suggests the following cost-drivers that are associated with IGRA-Based Active Case Finding for TB Detection, and these are test kits and laboratory expenses, training and capacity building, Human resources, logistic and transportation, community engagement and education, infrastructure and technology, quality assurance and control, monitoring and evaluation, follow-up and treatment costs as well as overhead and administrative costs(21–25). However, these evidence from the literature underscores the multifaceted nature of cost drivers associated with the use of IGRA-based Community Active Case Finding for TB detection in urban settings. Understanding these drivers is critical for policymakers, healthcare providers, and program implementers to optimize resource allocation, enhance program efficiency, and ultimately contribute to the effective control of tuberculosis in urban settings. This study will consider these cost drivers as the essential components for the successful implementation and sustainability of IGRA-based CACF initiatives.

2.4 Socio-economic factors associated with detecting a TB case using IGRA-Based Community Active Case finding

Tuberculosis (TB) continues to disproportionately affect populations worldwide based on different socio-economic factors that influence the effectiveness of IGRA-based Community Active Case Finding in detecting TB cases. Several studies have revealed the strong correlation between socio-economic characteristics and tuberculosis. The following are some of the socio-economic characteristics highlighted by the studies; income levels, access

to TB services, lower education and health literacy, employment status, health insurance status, stigma and social support, housing and living condition, cultural beliefs and perceptions(26–31). The literature highlights the intricate interplay between socio-economic factors and TB, however, there was limited evidence about adolescents' socio-economic characteristics associated with TB case detection among adolescents. Therefore, this study will determine these associations to enhance the reach and impact of IGRA-based CACF initiatives in urban settings.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Study and design issues

A cross-sectional descriptive study design was conducted alongside a trial that aims at identifying tuberculosis infection among adolescents. Costing data was collected from the selected schools using Activity Based Costing (ABC) approach. In addition to costing data, interviews were conducted to the selected study participants who were screened for TB using IGRA-Based community active case findings to determine the socio-economic factors associated with TB case detection.

3.2 Study settings and population

Costing data was collected in all eleven (11) secondary schools in Ilala and Temeke Municipal, Dar es salaam. The schools were purposively selected as they are implementing the project (IGRA-Based Community Active Case finding) in Dar es salaam. In addition, they are in districts with high tuberculosis case notification rates in Dar es salaam.

3.3 Sample size and sampling procedure

3.3.1 Sampling size

For Objective 1 and 2; to determine the unit cost, capital cost and recurrent cost I estimated the 600 subjects to be included in the project in the duration of six months.

For objective 3; to assess the socio-economic factors associated with detecting a tuberculosis infection using IGRA-Based Community Active Case finding in urban settings.

The sample size for this study was based on the Cochrane formula(32);

$n=Z2(1-p)\ p/E2$

Whereby, n=required sample size, Z-score at 95% confidence interval which is 1.96, p is the prevalence of IGRA-positive among adolescents between 10 to 14 years old obtained from a retrospective study for children <18 years old. The study estimated the proportion of positive results in children between 10 and 14 years was 42.5%, higher compared to other age groups(33).Therefore, the final sample size for the study was 432 adolescents after adjusting for a 15% non-response rate.

3.3.2 Sampling procedure

For objective 1 and 2; costing of the IGRA-Based Community Active Case finding, eleven (11) secondary schools were purposively selected due to the fact that, they are implementing the project including 600 adolescents screened in the six months of the project. For objective 3; A systemic sampling techniques was used to select 432 adolescents that were undergoing screening in the project to determine which socio-economic factors are associated with detecting a TB case using IGRA-Based Community Active Case finding in urban settings.

3.4 Inclusion criteria

The eligible participants were the adolescent aged 13 to 15 years, enrolled in a secondary school, who had consented to participate in the study with the permission from their parents/guardians who were able to complete an informed consent.

3.5 Exclusion criteria

Participants with the following characteristics were excluded from the study; seriously ill patients and those who did not provide their consent to participate in the study.

3.6 Perspective and time horizon

Cost data was collected from the provider perspective for a period of 6 months.

3.7 Study variables

Several variables were included in the study as follows; For specific objective 1 and 2, the cost variables were categorized into Capital and Re-current costs. Capital costs included all items with the lifetime of more than one (1) year, which included, building, furniture, trainings, medical and non-medical equipment. And the re-current costs included all items that were incurred on daily/monthly basis with a lifetime of less than one (1) year, for example, personnel, utilities, contracted services, medical and non-medical commodities, medical and non-medical supplies. In determining the cost of identifying a TB case using IGRA-Based Community Active Case finding, capital and re-current cost were aggregated. For the specific objective 3, several socio-economic characteristics were collected from the study participants, such as age, sex, grade/class, place of residence, no. of household members, household size and household self-reported wealthy. These characteristics were used to assess their association with IGRA-positive among adolescents in the selected

secondary schools. In addition, household self-reported income was used as a measure of household living standard.

3.8 Data collection methods

For specific objective 1 and 2, the tailored excel based questionnaire adapted from WHO Value TB tool was used to collect costing data from provider perspective. And for specific objective 3, face to face interviews was conducted to adolescents in the selected secondary schools whose results were positive after being screened with IGRA. Interviews were administered by using tablets loaded with a semi-structured questionnaires programmed in REDCap.

3.9 Investigation tools, validity and reliability issues

3.9.1 Data collection tools

For objective 1 and 2, an excel based questionnaire was used to collect financial costing data categorized into two parts, capital and re-current costs each on its own tab for screening 600 subjects. Project budget and expenditure reports was used to gather financial costing information. For the specific objective 3, pre-tested semi-structured questionnaire was used to collect socio-economic and demographic characteristics of the study participants. The questionnaire was only 1 part with several questions that was used to generate variables for assessing the associations.

3.9.2 Data validity

The study variables were thoroughly defined to ensure data validity. A comprehensive literature search was conducted prior to the development of the data collection tools. In addition, the data collection tools were adopted from other similar studies and guidelines from the WHO. This acted as a base for determining accuracy and appropriateness of the study findings proposal. A comprehensive literature review was conducted to allow for a clear understanding.

3.9.3 Data reliability

To ensure data reliability, well trained field interviewers were recruited to collect quality data. The interviewers collected data using standardized questionnaires following all the data collection procedures including observation of ethical issues. The data collection tools were also piloted for further improvement, that was; to ensure that they collect the required information.

3.10 Data analysis

A descriptive statistical analysis was conducted to address the study objectives. For specific objectives 1 and 2, Costing analysis was conducted by using Microsoft excel. All equipment and furniture costs were annuitized basing on their useful life and a discount rate 3% to obtain an annualization factors. Prices of equipment, supplies, commodities and furniture was obtained from the project budgets as well as the 2023 MSD price catalogue. Moreover, a discount rate of 3% was used to discount all capital costs as recommended by WHO(34,35). Furthermore, all costs were collected in TZS and adjusted to 2024 using GDP Deflator. For specific objective 3, analysis was conducted by using STATA version 16. A descriptive statistical analysis was used to summarize participants' socio-economic and demographic variables, that presented using the frequency tables. Principle Component Analysis (PCA) using household characteristics and asset ownership was conducted to measure household living standard, that was categorized further into wealth quintiles. In addition, chi-square test was conducted to assess which socio-economic and demographic variables were associated with TB cases using IGRA. The association was deemed significant if it was greater that the critical value, that is; a significance level of 0.05.

Table 1: Data Analysis Table

Study Objective	Analysis Method	Software
Objective 1 & 2: Costing Analysis	Costing Analysis	Microsoft Analysis
Objective 3: Socio-economic and Demographic Factors Associated with TB Cases	Descriptive Statistical Analysis Principal Component Analysis Chi Square Test	STATA Version 16

3.11 Ethical issues

The study was submitted at MUHAS – IRB for ethical clearance before data collection. In addition, other permissions were sought to all respective authorities prior to data collection. All participants were informed about the study. Assent forms were provided to all study respondents as they were below 18 years. In addition, their parents/guardians were also informed about the study and they signed a consent form as a proof of allowing their children to participate in the study and project. Their participation was voluntary and they were allowed to withdraw from the study at any point in time. No any harm was expected to study participants. For privacy and confidentiality, all respondents were provided with a study unique study identification. All collected data was stored safely in a drive whereby it was only to be accessed by the researchers involved in this study.

3.12 Study limitations and mitigation

The following the limitation were expected to be encountered by the study.

i. The study was focused on a specific urban setting or population, which could limit the generalizability of the findings to rural settings or other demographic groups.
ii. The accuracy of cost data and other variables that was used in the analysis would impact the reliability of the cost estimates. To ensure reliability, a thorough review of prices was determined in comparison with the current market prices to ensure accuracy of the data collected.
iii. In assessing household living standard, household income was expected to vary as majority of individuals in Dar es salaam are working in the informal sector. To address this, participant's parents'/guardians were to be asked to mention all sources of their income as well as expenditures on a monthly base. Due to time and engagement, only adolescents were interviewed of their family possessions and not income.

CHAPTER FOUR

4.0 RESULTS

4.1 Demographic characteristics of study participants

Table 1 below presents the socio-demographic characteristics of study participants who were screened for tuberculosis by using IGRA-based community active case finding. Of 425 study participants, 52.94% (n=225) were females, with the mean age of 14 years. 56.30% (n=219) were in form I, 79.43% (n=336) received BCG vaccine and 69.58% received any type of vaccine during their childhood. Majority of participants belonged to households with low socio-economic status.

Table 2: Demographic characteristics of study participants

Variables	Frequency (n)	Proportion (%)
Sex		
Male	200	47.06
Female	225	52.94
Grade/Class		
Form I	219	56.30
Form II	168	43.19
Form III	2	0.51
Mean age [SD]	14 [0.71]	
Received BCG Vaccine		
Yes	336	79.43
No	14	17.26
I don't know	73	3.31
Received any childhood vaccine		
Yes	295	69.58
No	7	1.65
I don't know	122	28.78
Socio-economic status		
Poorest	72	20.17
2nd quintile	71	19.89
3rd quintile	72	20.17
4th quintile	71	19.89
Wealthiest	71	19.89

4.2 Capital cost associated with TB case detection using IGRA

Table 2 below presents the capital cost (in Tshs) associated with tuberculosis case detection through IGRA-Based community active case finding in urban settings. The total capital cost associated with TB case detection using IGRA-based community active case finding was 4,953,936 Tshs, with equipment accounting for a large share, 65.7% of the total capital cost. Furthermore, diagnostic services costed more (2,934,388 Tshs) than screening services.

Table 3: Capital cost (in Tshs) associated with tuberculosis case detection using IGRA

Cost inputs	Screening (Tshs)	Diagnosis (Tshs)	Total (Tshs)
Equipment	1,169,548	2,084,388	3,253,936
Trainings	850,000	850,000	1,700,000
Total capital cost	**2,019,548**	**2,934,388**	**4,953,936**

4.3 Recurrent cost associated with TB case detection using IGRA

Table 3 below presents the recurrent cost (in Tshs) associated with tuberculosis case detection through IGRA-Based community active case finding in urban settings. The total recurrent cost associated with TB case detection using IGRA-based community active case finding was 258,769,757 Tshs, with personnel accounting for a large share of the total recurrent cost, followed by contracted services. Both, diagnostic and screening services consumed almost similar resources in identifying tuberculosis cases using IGRA-Based community active case finding.

Table 4: Capital cost (in Tshs) associated with tuberculosis case detection using IGRA

Cost inputs	Screening (Tshs)	Diagnosis (Tshs)	Total (Tshs)
Personnel	97,137,157	84,507,157	181,644,314
Non-medical materials and supplies	677,980	169,495	847,475
Medical materials and supplies	969,000	14,102,700	15,071,700
Utilities	4,529,941	4,529,941	9,059,882
Rental space	1,744,763	2,744,763	4,489,525
Contracted services	23,828,430	23,828,430	47,656,861
Total capital cost	**128,887,271**	**129,882,486**	**258,769,757**

4.4 Unit cost of detecting a TB case using IGRA

The unit cost of detecting a TB case through IGRA-Based community active case finding in urban settings was Tshs. 439,539 (*as shown in table 4*), whereas Tshs. 218,178 and Tshs. 221,361for screening and diagnostic services. Comparing the two services, diagnosis costed slightly more than screening services. Furthermore, personnel and contracted services accounted for a large proportion of the total cost.

Table 5: Unit cost of detecting a TB case using IGRA among 600 students

Cost categories	Screening (Tshs)	Diagnosis (Tshs)	Total (Tshs)
Capital cost			
Equipment	1,169,548	2,084,388	3,253,936
Trainings	850,000	850,000	1,700,000
Recurrent cost			
Personnel	97,137,157	84,507,157	181,644,314
Non-medical materials and supplies	677,980	169,495	847,475
Medical materials and supplies	969,000	14,102,700	15,071,700
Utilities	4,529,941	4,529,941	9,059,882
Rental space	1,744,763	2,744,763	4,489,525
Contracted services	23,828,430	23,828,430	47,656,861
Total costs	**130,906,819**	**132,816,874**	**263,723,693**

4.5 Cost drivers associated with TB case detection using IGRA

Figure 2 below presents the cost drivers associated with tuberculosis case detection through IGRA-Based community active case finding. Of all the cost inputs, Personnel and contracted services accounted for a large share of the overall cost of detecting a tuberculosis case, that are, 69% and 18%, respectively.

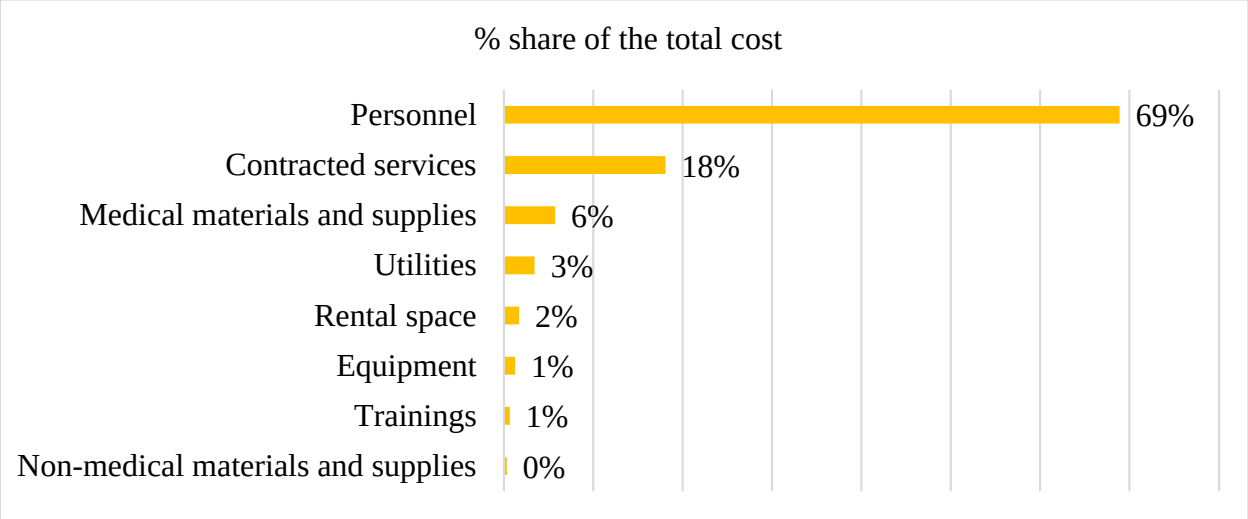


Figure 2: Cost drivers associated with TB case detection using IGRA

4.6 Socio-economic factors associated with TB case detection using IGRA

Table 5 below presents the socio-economic factors of study participants that were associated with IGRA-positive. In a univariate analysis, only sex (cOR=2.22; 95% CI; 1.12-4.40; P<0.023) had a significant association with IGRA-positive. All other remaining variables had no significant association with IGRA positive results. In a multivariate analysis, sex (aOR=3.69; 95% CI; 1.62 – 8.42; P<0.002) and parent status/father not alive (aOR=5.10; 95% CI; 1.28 – 20.30; P<0.021) were the only variable that were significantly associated with positive results (IGRA positive).

Table 6: Socio-economic factors associated with tuberculosis case detection using IGRA

Variable	Description	Univariate analysis		Multivariate analysis	
		cOR (95% CI)	*p*-value	aOR (95% CI)	*p*-value
Grade	I (Ref)	1		1	
	II	1.47 (0.77 – 2.80)	0.241	2.49 (0.93-6.63)	0.068
	III	0.98 (0.12 – 8.04)	0.981	1	
Age category	13 (Ref)	1		1	
	14	0.95 (0.43 – 2.09)	0.897	1.21 (0.43-3.45)	0.719
	15	1.02 (0.40 – 2.61)	0.956	0.62 (0.16-2.44)	0.495
	16	1		1	
Sex	Male (Ref)	1		1	
	Female	2.22 (1.12 – 4.40)	<0.023	3.69 (1.62-8.42)	<0.002
Took RBG vaccine	Yes (Ref)	1		1	
	No	0.76 (0.32 – 1.78)	0.530	1.04 (0.37-2.90)	0.939
Took any vaccine	Yes (Ref)	1		1	
	No	0.99 (0.50 – 1.97)	0.975	1	
	Don’t know	1		0.85 (0.34-2.17)	0.742
Father alive	Yes	1		1	
	No	0.60 (0.23 – 1.53)	0.285	5.10 (1.28-20.30)	<0.021
	Don’t know			1	
Mother alive	No	1		1	
	Yes	0.36 (0.092 – 1.37)	0.134	2.16 (0.61-7.57)	0.230
	Don’t know	1			
Gender of the household head	Male	1 (ref)		1	
	Female	1.90 (0.44 – 1.86)	0.900	1.28 (0.43-3.81)	0.657
Household SES	Poorest (Ref)	1		1	
	2nd quintile	1.12 (0.38 – 3.29)	0.830	1.15 (0.35-3.68)	0.816
	3rd quintile	1.12 (0.38 – 3.29)	0.830	0.49 (0.14-1.64)	0.245
	4th quintile	0.87 (0.28 - 2.75)	0.814	0.78 (0.23-2.73)	0.703
	Least poor	1.50 (0.54 – 4.21)	0.440	0.53 (0.15-1.82)	0.312

CHAPTER FIVE

5.0 DISCUSSION

5.1 Introduction

This chapter discusses the cost analysis and socio-economic factors associated with using Interferon-Gamma Release Assays (IGRA) for tuberculosis case detection. The chapter provides the implication of the findings in relation to the literature for controlling tuberculosis.

5.2 Cost of detecting a TB Case using IGRA-Based Based Community Active case finding

The study estimated the total cost incurred by the project to screen and diagnose students using IGRA to be Tsh. 4,953,936, which is equivalent to US $ 1,883, with personnel accounting for a large share of the total cost. The unit cost of detecting a TB case using IGRA-based community active case finding to be Tshs. 439,539, which is equivalent to US $ 167. These costs highlight the significant investment that is required to effectively identify tuberculosis cases using IGRA-based community active case finding in urban area, where there is high burden of tuberculosis (36). Even though these costs are high, the intervention managed to identify 10.91% (n=43) positive cases out of 600 students that were screened. This outcome underscores the value of screening TB cases using IGRA, especially in high-risk areas. However, further analysis should be conducted to ascertain the cost-effectiveness of IGRA-based community active case finding, that will conclude if it is worthy an investment or not. The findings of this study are comparable to the literature, whereby, other studies estimated the cost of identifying a TB case using IGRA to be Euro 55.21 in Portugal and US $ 33.67 in San Francisco (17,18). Another systematic review in high income countries estimated the cost and cost-effectiveness of IGRA to be CAD 19.0, CAD 45.32, US $ 34.2, US $ 31.18, US $ 171.78, sterling pound 145.98, sterling pound 129, sterling pound 55 and sterling pound 44.83 in Canada (2007), Canada (2008), Japan (2008), USA (2009), Germany (2007), Germany (2009), Switzerland (2007), UK (2010) and France (2010), respectively(19). In another systematic review, it was estimated that an average TST costs of US $ 37.84 and US $ 89.33 for IGRA(20). The evidence suggests a high cost

associated with tuberculosis case detection using IGRA, however, it is effective in identifying tuberculosis cases in a population with high BCG vaccination coverage, demonstrating its value in a diverse epidemiological setting. The high cost in Tanzania could be due to the small number of screened clients that is 600 clients compared with the other studies.

5.3 Cost drivers associated with the use of IGRA-Based Community Active Case finding in detecting a TB case

In this study, personnel and contracted services were the primary cost drivers, accounting for 69% and 18% of the total cost, respectively. This aligns with the literature, which emphasizes the multifaceted nature of cost drivers in TB detection programs. The literature suggests the following cost-drivers that are associated with IGRA-Based Active Case Finding for TB case detection; these are test kits and laboratory expenses, training and capacity building, Human resources, logistic and transportation, community engagement and education, infrastructure and technology, quality assurance and control, monitoring and evaluation, follow-up and treatment costs as well as overhead and administrative costs(21–25). By understanding these cost drivers, could be used in decision to allocate resources optimally and enhance the efficiency in TB control programs. For example, investing in training and capacity building can reduce long-term costs by improving the accuracy and efficiency of TB case detection. Similarly, community engagement and education can enhance the uptake of TB screening services, thereby improving the overall cost-effectiveness of IGRA-based community active case finding.

5.4 Socio-economic factors associated with detecting a TB case using IGRA-Based Community Active Case finding

The findings have showed that, sex (aOR=3.69) and father's status (aOR=5.10) were significantly associated with IGRA-positive results. The association between parental status and TB infection might be linked to socio-economic and psychological factors. Adolescents who have lost a parent, particularly in low-income settings may experience greater stress, poor living conditions and reduced access to health care, of which increase. This was also observed in a study conducted in Addis Ababa - Ethiopia among under-five children which reviled that, orphans and vulnerable children are at higher risk of TB due to malnutrition,

poor living conditions, and reduced access to preventive measures(37). Furthermore, the psychological stress associated with patient loss can weaken the immune system, making them more susceptible to infections, including TB (37). Studies have also showed that, males have higher rates of TB infection compared to female due different factors including biological differences, occupational exposures and health-seeking behaviors(38,39). Difference was observed in this study whereby, for adolescents, females were more likely to test positive when screened for LTBI using IGRA. Tuberculosis continues to disproportionately affect populations worldwide based on different socio-economic factors that influence the effectiveness of IGRA-based Community Active Case Finding in detecting TB cases. In this study, socio-economic status had no significant association with IGRA-positive. This was because, this study was conducted among student in urban settings whose parents are literate with an average wealth compared to those living in rural settings. Several studies have revealed similar strong correlation between socio-economic characteristics and tuberculosis. For example, a study presented that income levels, access to TB services, lower education and health literacy, employment status, health insurance status, stigma and social support, housing and living condition, cultural beliefs and perceptions showed strong collation with IGRA-Based (26–31).

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

This study highlights the value of IGRA-based community active case finding (CACF) in detecting latent tuberculosis infection (LTBI) among adolescents in urban settings. The findings reveal a 10.91% prevalence rate of IGRA-positive cases among adolescents screened, underscoring the effectiveness of this tool in identifying asymptomatic TB infections even in a highly vaccinated population. The study demonstrates that, despite the relatively high costs associated with IGRA, its ability to pinpoint LTBI in vulnerable age groups justifies its continued integration into TB detection protocols, especially in high-burden urban areas such as Dar es Salaam. The comprehensive cost analysis performed shows that IGRA-based screening incurs a unit cost of Tshs 439,539 (USD 167) per TB case detected. Personnel and contracted services emerged as primary cost drivers, representing 69% and 18% of the total costs, respectively. This mirrors findings in other high-resource TB programs, where personnel and operational expenses often dominate costs, diagnostic services are slightly costlier than screening services, a differential likely influenced by the specialized nature of IGRA testing and the labor-intensive requirements for accurate results. The stores the importance of optimizing cost-drivers like personnel, diagnostics, and training to improve the program's efficiency and scalability in similar urban environments. Further, the study identifies significant socio-economic factors influencing TB detection outcomes using IGRA. For instance, female participants and adolescents with a deceased father exhibited a higher likelihood of IGRA positivity (aOR=3.69 for females; aOR=5.10 for adolescents with a deceased father). These associations suggest that specific demographic factors, including parental support and socio-economic stability, may influence susceptibility to TB in adolescent populations. Overall, the results suggest that feasible and impactful tool for TB control among adolescents, though optimizing resources remains critical for sustainable implementation.

6.2 Recommendation

Based on the findings, the following are recommendations.

1. **Cost effectiveness study:** The project team to do the cost effectiveness study at the end of the implementation for better analysis and informed information on the impact and investment of the process of early detection among adolescents.

2. **Community Engagement and Education**: Increasing awareness and education by the leading project team at MUHAS about TB and the importance of screening can enhance the uptake of IGRA-based services in other institutions.

3. **Resource Allocation Optimization**: Understanding and managing primary cost drivers can enhance the cost-effectiveness of TB control programs by Regional and Council Health Management Teams in collaboration with the Ministries.

4. **Ongoing Surveillance**: Continued monitoring and surveillance of TB infections, particularly in high-risk adolescent populations, are essential for early detection and prevention to be done by the project team in collaboration with the health institutions in the communities under the project.

REFERENCES

1. WHO. Use of alternative interferon-gamma release assays for the diagnosis of TB infection - WHO Policy Statement. 2022.
2. Systematic screening for active tuberculosis: an operational guide.
3. for Disease Control C. Tuberculin Skin Testing What is it? How is the TST Administered? How Are TST Reactions Interpreted? Classification of the Tuberculin Skin Test Reaction [Internet]. 2027. Available from: www.cdc.gov/tb/publications/guidelines/infectioncontrol.html
4. WHO. Global tuberculosis report 2023 [Internet]. 2023. Available from: https://iris.who.int/.
5. WHO. Global Tuberculosis report 2022 [Internet]. 2022. Available from: http://apps.who.int/bookorders.
6. Amour MA, Rees CA, Munseri PJ, Said J, Magohe AK, Matee M, et al. Serial T-SPOT.TB responses in Tanzanian adolescents: Transient, persistent and irregular conversions. PLoS One. 2022 Jun 1;17(6 June).
7. Jeremiah K, Lyimo E, Ritz C, PrayGod G, Rutkowski KT, Korsholm KS, et al. Prevalence of Mycobacterium tuberculosis infection as measured by the QuantiFERONTB Gold assay and ESAT-6 free IGRA among adolescents in Mwanza, Tanzania. PLoS One. 2021 Jun 1;16(6 June).
8. Snow KJ, Cruz AT, Seddon JA, Ferrand RA, Chiang SS, Hughes JA, et al. Adolescent tuberculosis. Vol. 4, The Lancet Child and Adolescent Health. Elsevier B.V.; 2020. p. 68–79.
9. UNITED REPUBLIC OF TANZANIA. 2020;
10. Health MOF, Welfare S. The First National Tuberculosis Prevalence Survey in the United Republic of Tanzania Final Report. 2013;(September).
11. Ngadaya ES, Mfinanga GS, Wandwalo ER, Morkve O. Detection of pulmonary tuberculosis among patients with cough attending outpatient departments in Dar Es Salaam, Tanzania: Does duration of cough matter? BMC Health Serv Res. 2009;9:1–5.
12. national center for HIV AIDS viral hepatitis STD C, prevention T. TB Elimination BCG Vaccine [Internet]. Available from: http://www.cdc.gov/tb

13. Hawn TR, Day TA, Scriba TJ, Hatherill M, Hanekom WA, Evans TG, et al. Tuberculosis Vaccines and Prevention of Infection. Microbiology and Molecular Biology Reviews. 2014 Dec;78(4):650–71.
14. Sohn H, Tucker A, Ferguson O, Gomes I, Dowdy D. Costing the implementation of public health interventions in resource-limited settings: A conceptual framework. Vol. 15, Implementation Science. BioMed Central Ltd; 2020.
15. Berrocal-Almanza LC, Harris RJ, Collin SM, Muzyamba MC, Conroy OD, Mirza A, et al. Effectiveness of nationwide programmatic testing and treatment for latent tuberculosis infection in migrants in England: a retrospective, population-based cohort study. Lancet Public Health. 2022 Apr 1;7(4):e305–15.
16. Pareek M, Watson JP, Peter Ormerod L, Min Kon O, Woltmann G, White PJ, et al. Screening of immigrants in the UK for imported latent tuberculosis: a multicentre cohort study and cost-eff ectiveness analysis. Articles Lancet Infect Dis [Internet]. 2011;11:435–79. Available from: www.thelancet.com/infection
17. Sousa S, Rocha D, Silva JC, Ribeiro AI, Gonçalves G, Almeida Á, et al. Comparing the cost-effectiveness of two screening strategies for latent tuberculosis infection in Portugal. Pulmonology. 2021 Nov 1;27(6):493–9.
18. Dewan PK, Grinsdale J, Liska S, Wong E, Fallstad R, Kawamura LM. Feasibility, acceptability, and cost of tuberculosis testing by whole-blood interferon-gamma assay. Vol. 6, BMC Infectious Diseases. 2006.
19. Nienhaus A, Schablon A, Costa J, Diel R. Systematic review of cost and cost-effectiveness of different TB-screening strategies. Vol. 11, BMC Health Services Research. 2011.
20. Goscé L, Parkinson F, Allel K, Surkova E, Kontsevaya I, Wang TT, et al. WHO consolidated guidelines on tuberculosis Module 3: diagnosis. Tests for TB infection Web Annex D Cost-effectiveness of Mycobacterium tuberculosis antigen-based skin tests: a systematic review [Internet]. 2021. Available from: http://apps.who.int/bookorders.
21. Mahon J, Beale S, Holmes H, Arber M, Nikolayevskyy V, Alagna R, et al. A systematic review of cost-utility analyses of screening methods in latent tuberculosis infection in high-risk populations. BMC Pulm Med. 2022 Dec 1;22(1).
22. Tasillo A, Salomon JA, Trikalinos TA, Horsburgh CR, Marks SM, Linas BP. Cost-effectiveness of testing and treatment for latent tuberculosis infection in residents born

outside the United States with and without medical comorbidities in a simulation model. JAMA Intern Med. 2017 Dec 1;177(12):1755–64.

23. Kasvosve I, Ledikwe JH, Phumaphi O, Mpofu M, Nyangah R, Motswaledi MS, et al. Continuing professional development training needs of medical laboratory personnel in Botswana. Hum Resour Health. 2014 Aug 18;12(1).
24. Brumwell A, Tso J, Pingali V, Millones AK, Jimenez J, Calderon RI, et al. A costing framework to compare tuberculosis infection tests. BMJ Glob Health. 2023 Nov 30;8(11).
25. Hang NTL, Ishizuka N, Keicho N, Hong LT, Tam DB, Thu VTX, et al. Quality assessment of an interferon-gamma release assay for tuberculosis infection in a resource-limited setting. BMC Infect Dis. 2009 May 18;9.
26. Hargreaves JR, Boccia D, Evans CA, Adato M, Petticrew M, Porter JDH. The social determinants of tuberculosis: from evidence to action. Am J Public Health. 2011 Apr;101(4):654–62.
27. Krishnan L, Akande T, Shankar A V., McIntire KN, Gounder CR, Gupta A, et al. Gender-Related Barriers and Delays in Accessing Tuberculosis Diagnostic and Treatment Services: A Systematic Review of Qualitative Studies. Tuberc Res Treat. 2014;2014:1–14.
28. Courtwright A, Turner AN. Tuberculosis and Stigmatization: Pathways and Interventions. Vol. 125, Public Health Reports. 2010.
29. Min J, Kim HW, Stagg HR, Rangaka MX, Lipman M, Abubakar I, et al. The cascade of care for latent tuberculosis infection in congregate settings: A national cohort analysis, Korea, 2017–2018. Front Med (Lausanne). 2022 Sep 15;9.
30. Bayati T, Dehghan A, Bonyadi F, Bazrafkan L. Investigating the effect of education on health literacy and its relation to health-promoting behaviors in health center. J Educ Health Promot. 2018;7(1):127.
31. Ogbudebe CL, Adepoju V, Ekerete-Udofia C, Abu E, Egesemba G, Chukwueme N, et al. Childhood Tuberculosis in Nigeria: Disease Presentation and Treatment Outcomes. Health Serv Insights. 2018;11.
32. Cochran_1977_Sampling Techniques.
33. Zheng H, Xiao J, Li F, Chen H, Li D, Wang Y, et al. Interferon-gamma release assay for screening of tuberculosis infection in children. BMC Infect Dis. 2023 Dec 1;23(1).
34. WHO-HTM-TB-2015.19-eng (1).

35. Hutubessy RCW, Baltussen R, Tan Torres-Edejer T, Evans DB. WHO-CHOICE: Guide to Cost-Effectiveness Analyis. Health systems performance assessment: debates, methods and empiricism Geneva: WHO Editions [Internet]. 2003;823–835. Available from: http://books.google.com/books?hl=en&lr=&id=_HloWI6HXbcC&oi=fnd&pg=PR9&dq=edejer+baltussen&ots=hgTnNiuW9x&sig=ffrEjZ6TyLp1EM1y39gYfpVBno8
36. Ministry of Health Tanzania. NTLP annual report 2021. 2021;
37. Sewnet SS, Derseh HA, Desyibelew HD, Fentahun N. Undernutrition and associated factors among under-five orphan children in Addis Ababa, Ethiopia, 2020: A cross-sectional study. J Nutr Metab. 2021;2021.
38. Horton KC, MacPherson P, Houben RMGJ, White RG, Corbett EL. Sex Differences in Tuberculosis Burden and Notifications in Low- and Middle-Income Countries: A Systematic Review and Meta-analysis. Vol. 13, PLoS Medicine. Public Library of Science; 2016.
39. Neyrolles O, Quintana-Murci L. Sexual inequality in tuberculosis. Vol. 6, PLoS Medicine. 2009.

APPENDICES

Appendix I: Consent form – English

A cost analysis of IGRA-Based Community Active Case Finding for Tuberculosis Among

Adolescents in Urban Settings

Introduction

I _____pursuing further education at MUHAS, Muhimbili University of Health and Allied Sciences., I'm conducting a study to determine what factors contribute to employee turnover among health care professionals. The goal is to investigate and obtain the detailed cost of undertaken when doing IGRA- Based Community Active Case Finding. Moreover, the research seeks to capture the nuances and challenges unique to the local healthcare infrastructure and socio-economic characteristics.

Procedures: As one among the stakeholder, you will be asked to share the information with regard to cost and quantity of resources used when undertaking IGRA-Based Community Active Case finding. The interviews will take less than 60 minutes.

Risk associated with participating: There are no anticipated dangers that you could experience as a result of taking part in this study. You won't receive any unique advantages as a participant, either. However, as a stakeholder, you will profit from the steps that policymakers will take to guide policy formulation, resource allocation, and program implementation by providing evidence-based recommendations on the economic viability and sustainability of integrating IGRA-based CACF into routine TB screening for adolescents in this specific urban setting

Confidentiality: Information confidentiality and privacy are ensured during interviews. Since your name is not required, no one can identify you from the information.

Compensation: We sincerely appreciate your participation in this study, but there will be no payment made to you in exchange for your time or any inconvenience.

Voluntary Participation: You are free to cease or withdraw from this study at any moment without incurring any penalties because it is voluntary.

Whom to contact for more questions or queries: You are free to suspend or withdraw from this study at any time because it is voluntary. Dr Helga Mutasingwa, the principal investigator for this project, can be reached at +255 753 930 883 if you have any inquiries

or concerns. Additionally, you are free to contact the Chairman of the MUHAS Institutional Review Board at any time through Muhimbili University of Health and Allied Sciences, P.O. Box 65001, United Nations Road, Dar es Salaam, Tanzania PO Box 9653, Dar es Salaam, Phone: +255 22 2152489, if you have any questions about your rights to participate in this study.

Participant: I am aware of all the aforementioned requirements and have consented to participate in this study.

Name of the participant: _____

Signature: _____

Date: _____

Signature of the interviewer: _____

Date: _____

Appendix II: Consent form – Swahili

Tathmini ya gharama ya kuibui wagojwa wa kifua kikuu kwa kutumia kipimo cha IGRA kwa vijana balehe waishio mijini

Utangulizi

Mimi _____ Ninasoma katika Chuo Kikuu cha Afya na Sayansi Shirikishi Muhimbili (MUHAS). Ninafanya utafiti kutathmini uchambuzi wa gharama katika kufanya uchunguzi wa ugonjwa wa kifua kikuu kwa vijana balehe kwenye jamii zilizo mjini. Lengo ni kutathmini na kufanya uchambuzi wa gharama katika kufanya uchunguzi wa ugonjwa wa kifua kikuu kwa kipimo cha damu. Pia tafiti hii inatafuta kupata picha na changamaoto zilizopo katika utoaji wa huduma hii na jinsi unavyoamubikzana katika kaya za uchumi tofauti.

Taratibu: Kama mmoja wa wadau katika utafiti huu, utaulizwa maswali ili kutoa taarifa za gharama unazotumia kama mtoa huduma kwenye mradi wa kupima kifua kikuu kwa njia ya damu kwenye jamii hii. Mahojiano haya yatachukua takriban chini ya dakika 60.

Athari inayohusishwa na kushiriki: Hakuna athari zinazotarajiwa zenye kuweza kukudhuru kwa sababu ya ushiriki wako katika utafiti huu. Zaidi ya hayo, hakutakuwa na manufaa maalum kwako kama mshiriki. Hata hivyo, kama mmoja wa wadau, utafaidika na hatua zitakazochukuliwa na watunga sera katika uongozaji wa kuboresha sera, mgao wa rasilimali na utendaji wa miradi ukiwa na mapendekezo yenye Ushahidi kulingana na hali ya uchumi katika kupima vinasaba vya ugonjwa wa kifua kikuu kwa njia ya damu kwa vijana balahe mijini.

Usiri: Faragha wakati wa mahojiano na usiri wa habari umehakikishwa. Hutakiwi kutoa jina lako, kwa hivyo maelezo hayawezi kupatikana tena kwako.

Fidia: Hakuna fidia itakayopatikana kwa muda wako na usumbufu wowote, lakini tunakushukuru sana kwa kushiriki katika utafiti huu.

Ushiriki wa Hiari: Ushiriki wako katika utafiti huu ni wa hiari na una haki ya kuusimamisha au kujiondoa wakati wowote bila adhabu.

.

Nani wa kuwasiliana naye kwa maswali au maelezo zaidi: Ikiwa una maswali au maelezo zaidi, unaweza kuwasiliana na mhusika mkuu wa utafiti huu Dr Helga Mutasingwa kupitia nambari yake ya simu: +255 753 930 883. Na pia, kwa swali lolote kuhusu haki zako za kushiriki katika utafiti huu, unaweza kuwasiliana na Mwenyekiti wa Bodi ya Mapitio ya Taasisi ya MUHAS kupitia; Chuo Kikuu cha Afya na Sayansi Shirikishi Muhimbili, P.O. Box 65001, United Nations Road, Dar es Salaam, Tanzania SLP 9653, Dar es Salaam, Simu: +255 22 2152489.

Mshiriki: Ninaelewa masharti yote hapo juu na nimekubali kushiriki katika utafiti huu kwa hiari yangu mwenyewe.

Jina la Mshiriki: _____

Sahihi: _____

Tarehe: _____

Sahihi ya Mhoji _____

Tarehe: _____

Appendix III: Assent form – English

A cost analysis of IGRA-Based Community Active Case Finding for Tuberculosis Among

Adolescents in Urban Settings

Introduction

I _____pursuing further education at MUHAS, Muhimbili University of Health and Allied Sciences., I'm conducting a study to determine what factors contribute to employee turnover among health care professionals. The goal is to investigate and obtain the detailed cost of undertaken when doing IGRA- Based Community Active Case Finding. Moreover, the research seeks to capture the nuances and challenges unique to the local healthcare infrastructure and socio-economic characteristics.

Procedures: As one among the stakeholder, you will be asked to share the information with regard to cost and quantity of resources used when undertaking IGRA-Based Community Active Case finding. The interviews will take less than 60 minutes.

Risk associated with participating: There are no anticipated dangers that you could experience as a result of taking part in this study. You won't receive any unique advantages as a participant, either. However, as a stakeholder, you will profit from the steps that policymakers will take to guide policy formulation, resource allocation, and program implementation by providing evidence-based recommendations on the economic viability and sustainability of integrating IGRA-based CACF into routine TB screening for adolescents in this specific urban setting

Confidentiality: Information confidentiality and privacy are ensured during interviews. Since your name is not required, no one can identify you from the information.

Compensation: We sincerely appreciate your participation in this study, but there will be no payment made to you in exchange for your time or any inconvenience.

Voluntary Participation: You are free to cease or withdraw from this study at any moment without incurring any penalties because it is voluntary.

Whom to contact for more questions or queries: You are free to suspend or withdraw from this study at any time because it is voluntary. Dr Helga Mutasingwa, the principal investigator for this project, can be reached at +255 753 930 883 if you have any inquiries or concerns. Additionally, you are free to contact the Chairman of the MUHAS Institutional Review Board at any time through Muhimbili University of Health and Allied Sciences, P.O.

Box 65001, United Nations Road, Dar es Salaam, Tanzania PO Box 9653, Dar es Salaam, Phone: +255 22 2152489, if you have any questions about your rights to participate in this study.

Participant: I am aware of all the aforementioned requirements and have consented to participate in this study.

Name of the participant: _____

Signature: _____

Date: _____

Name of the parent/guardian: _____

Signature: _____

Date: _____

Signature of the interviewer: _____

Date: _____

Appendix IV: Assent form – Swahili

Tathmini ya gharama ya kuibui wagojwa wa kifua kikuu kwa kutumia kipimo cha IGRA kwa vijana balehe waishio mijini

Utangulizi

Mimi _____ Ninasoma katika Chuo Kikuu cha Afya na Sayansi Shirikishi Muhimbili (MUHAS). Ninafanya utafiti kutathmini uchambuzi wa gharama katika kufanya uchunguzi wa ugonjwa wa kifua kikuu kwa vijana balehe kwenye jamii zilizo mjini. Lengo ni kutathmini na kufanya uchambuzi wa gharama katika kufanya uchunguzi wa ugonjwa wa kifua kikuu kwa kipimo cha damu. Pia tafiti hii inatafuta kupata picha na changamaoto zilizopo katika utoaji wa huduma hii na jinsi unavyoamubikzana katika kaya za uchumi tofauti.

Taratibu: Kama mmoja wa wadau katika utafiti huu, utaulizwa maswali ili kutoa taarifa za gharama unazotumia kama mtoa huduma kwenye mradi wa kupima kifua kikuu kwa njia ya damu kwenye jamii hii. Mahojiano haya yatachukua takriban chini ya dakika 60.

Athari inayohusishwa na kushiriki: Hakuna athari zinazotarajiwa zenye kuweza kukudhuru kwa sababu ya ushiriki wako katika utafiti huu. Zaidi ya hayo, hakutakuwa na manufaa maalum kwako kama mshiriki. Hata hivyo, kama mmoja wa wadau, utafaidika na hatua zitakazochukuliwa na watunga sera katika uongozaji wa kuboresha sera, mgao wa rasilimali na utendaji wa miradi ukiwa na mapendekezo yenye Ushahidi kulingana na hali ya uchumi katika kupima vinasaba vya ugonjwa wa kifua kikuu kwa njia ya damu kwa vijana balahe mijini.

Usiri: Faragha wakati wa mahojiano na usiri wa habari umehakikishwa. Hutakiwi kutoa jina lako, kwa hivyo maelezo hayawezi kupatikana tena kwako.

Fidia: Hakuna fidia itakayopatikana kwa muda wako na usumbufu wowote, lakini tunakushukuru sana kwa kushiriki katika utafiti huu.

Ushiriki wa Hiari: Ushiriki wako katika utafiti huu ni wa hiari na una haki ya kuusimamisha au kujiondoa wakati wowote bila adhabu.

.

Nani wa kuwasiliana naye kwa maswali au maelezo zaidi: Ikiwa una maswali au maelezo zaidi, unaweza kuwasiliana na mhusika mkuu wa utafiti huu Dr Helga Mutasingwa kupitia nambari yake ya simu: +255 753 930 883. Na pia, kwa swali lolote kuhusu haki zako za kushiriki katika utafiti huu, unaweza kuwasiliana na Mwenyekiti wa Bodi ya Mapitio ya Taasisi ya MUHAS kupitia; Chuo Kikuu cha Afya na Sayansi Shirikishi Muhimbili, P.O. Box 65001, United Nations Road, Dar es Salaam, Tanzania SLP 9653, Dar es Salaam, Simu: +255 22 2152489.

Mshiriki: Ninaelewa masharti yote hapo juu na nimekubali kushiriki katika utafiti huu kwa hiari yangu mwenyewe.

Jina la Mshiriki: _____

Sahihi: _____

Tarehe: _____

Jina la Mzazi/mlezi: _____

Sahihi: _____

Tarehe: _____

Sahihi ya Mhoji _____

Tarehe: _____

Appendix V: Data collection tools – Costing questionnaire

A cost analysis of IGRA-Based Community Active Case Finding for Tuberculosis Among

Adolescents in Urban Settings

Part A: Re-current costs

i. Personnel

No.	Type of personnel/cadre ***(e.g.; MD, EN, RN)***	*Salary scale (e.g.; **TGHS A – 1)***	*Salary (**Gross amount**)*	*FTE (**Proportion of time spent per day for TB services**)*	*Monthly allowances & benefits*	Working hours/day	Working days/week
1.							

***ii.* Building and space (rooms + waiting areas)**

No.	*Section (e.g.; waiting area, room 1 etc.)*	*Area (SQM)*	*% of use*	*Additional notes*

iii. Administrative costs/ Overheads

No.	*Type of supply/utilities*	*Quantity/unit used per month*	*Average Cost per months*	*Total cost per year*	*Additional notes*
1.					
2.					
3.					

iv. Contracted services

No.	Type of services	Quantity	Unit cost/month (TZS)	Total cost/year (TZS)	Additional notes
1.					
2.					
3.					

******Note:** Contracted services include all services that are outsourced by the project and are paid on monthly/yearly basis.*

Part B: Capital costs

i. Equipment (Medical; weigh machine, height machine, BP machine, microscope; and non-medical; desktop computer, laptops)

No.	Type of equipment	Quantity	Model number/details	% of use	Unit costs (TZS)	Useful life (in years)
1.						

ii. Furniture (e.g.; examination beds, wooden chairs, office chairs, wooden tables, metal chairs, wooden shelves/cupboard, metal shelves/cupboard)

No.	Type of equipment	Quantity	Model number/details	% of use	Unit costs (TZS)	Useful life (in years)
1.						

v. Training

No.	*Name of the training*	*Duration (days)*	*Number of participants*	*Per-diem per participant*	*Other costs per participant*	*Additional notes*
1.						
1.						
2.						
3.						

Appendix VI: Socio-economic questionaries – English and SwahiliS

I'm going to ask you some background information about your household.

Sasa nitakuliza taarifa za msingi kuhusu kaya

1. Age ____

   Umri _____

2. Sex _____

   Jinsi _____

3. Place of residence/street

   _____

4. What is the gender of the household head?

   Mkuu wa kaya yako ni mwanake au mwanaume?

   a. Male/ Me
   b. Female Ke

5. How many people are living in your household? [By household I mean a person or group of persons who are related or unrelated, who live together, and share meals]

   Ni watu wangapi wanaishi katika kaya yenu? [Kwa kaya ninamaanisha mtu au kikundi cha watu ambao wana uhusiano au wasio na uhusiano, wanaoishi pamoja, na kushiriki mlo]

   _____

6. How many rooms do you have in your household used for sleeping?

   Je, mna vyumba vingapi vya kulala katika kaya yenu? |__|__|

7. Does your household have a separate room which is used as a kitchen?

   Je, kaya yenu ina chumba tofauti ambacho hutumika kama jiko?

   a. Yes/ Ndio
   b. No/ Hapana

8. What is the MAIN source of drinking water for members of your household?

   Nini chanzo KIKUU cha maji ya kunywa kwa wanakaya?

   a. Piped water/ maji ya bomba
   b. Piped in dwelling / Bomba ndani ya nyumba/ makazi
   c. Piped in yard/plot/ Bomba ndani ya uwanja/kiwanja
   d. Public/neighbours /Umma/majirani
   e. Covered well / borehole/ kisima kilichofunikwa / borehole

f. In dwelling/ katika nyumba/makazi
g. In yard/plot / katika uwanja/kiwanja
h. Public/neighbours well/ umma/visima vya majirani
i. Open well/ visima vya wazi
j. Surface water/ maji ya ardhini
k. Spring/ Chemuchemu
l. River/dam/lake/pond/stre am/Canal / Mto/bwawa/ziwa/dimbwi /mkondo/MfereJI
m. Rain water / Maji ya mvua
n. OTHER / MENGINEYO
o. Specify, Ainisha _____
p. CODE

9. What kind of toilet facility does your household usually use?
   Je, kaya yenu hutumia choo cha aina gani?
   a. Flush to piped sewer / Cha kuflashi kwa bomba la maji taka
   b. Flush to piped septic tank / Cha kuflashi kwa tank ya septic ya bomba
   c. Flush to pit latrine / Cha kuflash kwenda shimo la choo
   d. Ventilated improved pit latrine / Choo cha shimo kilichoboreshwa kinachoingiza hewa
   e. Pit latrine /Choo cha shimo na cha kuchuchumaa
   f. No toilet/bush Hakuna choo/kichaka
   g. Other (specify) Nyingine (taja) _____
10. What type of fuel does your household MAINLY use for cooking?
    Je, kaya yenu hutumia HASA nishati ya aina gani kwa kupikia?
    a. Electricity /Umeme
    b. Solar Sola/mionzi ya jua
    c. Gas /Gesi
    d. Paraffin/kerosene Mafuta ya taa
    e. Charcoal/ Mkaa
    f. Firewood /Kuni
    g. Crop residuals/grass/animal
    h. dung Mabaki ya mazao/majani / kinyesi cha wanyama

i. No cooking facilities/ Hakuna vifaa vya kupikia
j. Other (specify) / Nyingine (taja) _____

11. What is the MAIN source of energy for lighting in the household?
Chanzo kikuu cha nishati kwa ajili ya mwanga katika kaya ni kipi?
a. Electricity Umeme
b. Solar Nishati ya jua (Sola)
c. Gas Gesi
d. Paraffin/kerosene Mafuta ya taa
e. Candle/torchi Mshumaa/ tochi
f. Firewood Kuni
g. Other (specify) Nyingine (taja) _____

12. What is the main material of the floor of your house?
Nyumba yenu ina sakafu ya aina gani?
a. Earth/sand Ardhi/mchanga
b. Wood planks Mbao
c. Bamboo/palm
d. Mwanzi/mitende
e. Parquet or polished wood
f. Mbao iliyong'arishwa
g. Ceramic tiles Matofali ya vigae
h. Cement Saruji
i. Carpet Zulia
j. Other (specify) Nyingine (taja) _____

13. What is the main material of your roof?
Nyumba yenu ina paa la aina gani?
a. Grass/leaves/palm/ bamboo/mud
b. Nyasi/majani/Mtende/ mianzi/matope
c. Rustic mat/ Makuti
d. Metal sheets / Mabati
e. Concrete/cement
f. Saruji/ zege
g. Wood / Mbao

h. Ceramic tiles / Matofali ya vigae
i. Other (specify) / Nyingine (taja) _____

14. What is the main material of your walls?

Nyumba yenu ina ukuta wa aina gani?

a. Grass/poles/mud /Nyasi/fito/matope
b. Bamboo with mud / Mwanzi na matope
c. Stones with mud / Mawe yenye matope
d. Wood/timber/ Cardboard / Mbao/Kadibodi
e. Mud or sundried Bricks /Matofali ya udongo au ya mchanga
f. Baked/burnt bricks /. Matofali ya kuchomwa moto
g. Cement blocks / Matofali vya saruji (simenti)
h. Concrete or stone bricks/ Matofali ya zege au mawe
i. Other (specify) /Nyingine (taja)

15. Does your household have electricity?

Je, kaya yenu ina umeme?

a. Yes / ndio
b. No / hapana

16. Does your household own a radio in working order?

Je, kaya yenu inamiliki redio inayofanya kazi?

a. Yes / ndio
b. No / hapana

17. Does your household own a TV in working order?

Je, kaya yenu inamiliki TV inayofanya kazi?

a. Yes / ndio
b. No / hapana

18. Does your household own a DVD player in working order?

Je, kaya yenu inamiliki DVD/ deki ya kupiga mziki inayofanya kazi?

a. Yes / ndio
b. No / hapana

19. Does your household own a land line?

Je, kaya yenu inamiliki simu ya mezani?

a. Yes / ndio

b. No / hapana

20. Does your household own an iron that is in working order?

Je, kaya yenu inamiliki pasi ambayo inafanya kazi?

a. Yes / ndio
b. No / hapana

21. Does your household own a refrigerator that is in working order?

Je, kaya yenu ina friji/ jokofu inayofanya kazi?

a. Yes / ndio
b. No / hapana

22. Does your household own a wall clocks (watch) that is in working order?

Je, kaya yenu inamiliki saa ya ukutani inayofanya kazi?

a. Yes / ndio
b. No / hapana

23. Does your household own a sewing machine that is in working order?

Je, kaya yenu inamiliki cherehani inayofanya kazi?

a. Yes / ndio
b. No / hapana

24. Does your household own a sofa set?

Je, kaya yenu inamiliki seti ya sofa?

a. Yes / ndio
b. No / hapana

25. Does your household own a cupboard?

Je, kaya yenu inamiliki kabati la vyombo?

a. Yes / ndio
b. No / hapana

26. Does your household own a motorcycle in a working condition?

Je, kaya yenu inamiliki pikipiki inayofanya kazi?

a. Yes / ndio
b. No / hapana

27. Does your household own a car in a working condition?

    Je, kaya yenu inamiliki gari inayotembea/ kufanya kazi?

    a. Yes / ndio
    b. No / hapana

28. Does any member of your household have a bank account?

    Je, kuna mwanakaya yeyote aliye na akaunti ya benki?

    a. Yes / ndio
    b. No / hapana

Appendix VII: Ethical Clearance

UNITED REPUBLIC OF TANZANIA

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES

OFFICE OF THE DIRECTOR – RESEARCH, PUBLICATIONS AND INNOVATION

Ref. No.DA.282/298/01.C/2244 Date: 17/05/2024

MUHAS-REC-05-2024-2244
HELGA MUTASINGWA
MUHAS

RE: APPROVAL FOR ETHICAL CLEARANCE FOR A STUDY TITLED: A COST ANALYSIS OF IGRA BASED COMMUNITY ACTIVE CASE FINDING FOR TUBERCULOSIS AMONG ADOLESCENTS IN URBAN SETTINGS

Reference is made to the above heading,

I am pleased to inform you that the Chairperson 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.

APPROVAL DATE: 17/05/2024
EXPIRATION DATE OF APPROVAL: 17/05/2025

STUDY DESCRIPTION:
Purpose:

The purpose of this cross-sectional descriptive study is to determine the unit cost of detecting a TB Case using the IGRA-Based Community Active Case Finding in urban settings.

The approved protocol and procedures for this study is attached and stamped with this letter, and can be found in the link provided: https://irb.muhas.ac.tz/storage/Certificates/Certificate%20-%2015363.pdf and in the MUHAS archives.

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. Apply for and obtain permission to publish the results from National Institute for Medical Research. The application should be before submitting to a publisher and not concurrently through the email publications@nimr.or.tz.
9. 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)
10. The PI is required to ensure that the findings of the study are disseminated to relevant stake holders.
11. 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. Nahya Salim Masoud,

Chairperson, MUHAS Research and Ethics Committee



Appendix VIII: Letter for permit

JAMHURI YA MUUNGANO WA TANZANIA

OFISI YA RAIS, TAWALA ZA MIKOA NA SERIKALI ZA MITAA

HALMASHAURI YA MANISPAA YA TEMEKE

Kumb.Na.TMC/ED/SEC/U....

Date. 14/06/2024

The Headmaster/Mistress
Tandika ss, Relini S.S.
Miburani S.S P/Moyo S.S.
Kibasila S.S Temeke, Lumo S.S.
DAR ES SALAAM.

RE: RESEARCH PROJECT PERMIT FOR. HELGA MUTASINGWA

Please refer to the above.

Kindly allow HELGA MUTASINGWA ..... From MUHIMBILI UNIVERSITY OF HEALTH & ALLIED SCINCE. to conduct research on. A COST ANALYSIS OF I GRA BASED COMMUNITY ACTIVE CASE FINDING FOR TUBERCULOSIS AMONG ADOLESCENTS IN URBAN SETTINGS ..... please give necessary assistance to achie his goal.

Kny: AFISA ELIMU - SEKONDARI
MANISPAA YA TEMEKE

DKT. Janeth Barongo (PHD)
SECONDARY EDUCATION OFFICER
TEMEKE

92 Barabara ya Mandela / Taifa, S.L.P 46343, Dar es Salaam, Simu +255222928132, Nukushi +255222928137, Ba
Pepe: temeke@temekemc.go.tz , Tovuti: www.temekemc.go.tz

THE UNITED REPUBLIC OF TANZANIA

PRESIDENT'S OFFICE, REGIONAL ADMINISTRATION AND LOCAL GOVERNMENT

TEMEKE MUNICIPAL COUNCIL

In reply, please indicate

Date: 14/06/202

REF: .....

MSED

.....

.....

TEMEKE MUNICIPAL COUNCIL

RE: RESEARCH PERMIT: HELGA MUTASIWAWA

Please refer to the heading above.

This is to inform you that, permission is granted to the above mentioned student/researcher from MUHIMBILI UNIVERSITY (MUHAS) to conduct researcher on

A cost Analysis of ICRA Based Community Achve Case finding for Tuberculosis Among Adolescents in Urban Settings in Secondary Schools

The study will be conducted from 17th May 2024 to 17th May 2024.

Please give with necessary assistance.

For: **MUNICIPAL DIRECTOR**

Mkurugenzi Mtendaji
Baraza Ya Temeke

Appendix IX: Permission letter

JAMHURI YA MUUNGANO WA TANZANIA

OFISI YA RAIS

TAWALA ZA MIKOA NA SERIKALI ZA MITAA

HALMASHAURI YA JIJI LA DAR ES SALAAM

Kumb. Na:DCC/ LR.14/II/ **Tarehe: 12/06/2024**

Mkuu wa Shule,
Shule ya Sekondari Azani, Jangwani, Msimbazi, Mnazi Mmoja, Dar es Salaam,
Jamhuri, Gerezani,
DAR ES SALAAM.

Yah: **RUHUSA YA NDUGU HELGA MUTASINGWA KUFANYA UTAFITI (RESEARCH)**

Tafadhali rejea somo tajwa hapo juu.

2. Halmashauri ya Jiji la Dar es Salaam imemruhusu ndugu **Helga Mutasingwa** kutoka Chuo cha **Afya na Sayansi Shirikishi Muhimbili (MUHAS)** kufanya utafiti kuhusu **Upimaji wa Kifua Kiuu kwa Vijana balehe kwenye Shule za Sekondari.** Utafiti huo utafanyika katika Ofisi yako kuanzia tarehe **17 Mei, 2024** hadi tarehe **17 Mei, 2025.**

3. Hivyo mpokee na kumpa ushirikiano kulingana na mahitaji yake.

4. Ninakutakia kazi njema.

Mwl. Mussa S. Ally

Kny: **MKURUGENZI WA JIJI**

Nakala:
- Mkurugenzi,
  Halmashauri ya Jiji la Dar es Salaam (aione kwenye jalada).
- Ndugu **Helga Mutasingwa.**

OFISI YA MKURUGENZI, 1 MTAA WA MISSION, S.L.P. 20950, 11883 - DAR ES SALAAM; SIMU NA. 2128800, 2128805, Fax No. 2121486,website: www.dcc.go.tz, Email: info@ilalamc.go.tz

JAMHURI YA MUUNGANO WA TANZANIA

OFISI YA RAIS

TAWALA ZA MIKOA NA SERIKALI ZA MITAA

MKOA WA DAR ES SALAAM
Anwani ya Simu:
Simu: 2203156/58
Fa: +25522203213
Tovuti: www.dsm.go.tz
Barua Pepe: ras@dsm.go.tz
Unapojibu Tafadhali taja:

OFISI YA MKUU WA MKOA,
3, Barabara ya Rashid Kawawa,
S.L.P 5429,
12880, DAR ES SALAAM.

Kumb. Na.EA.260/307/01B/54 **30 Mei, 2024**

Mkurugenzi wa Jiji,
S. L. P. 20950,
DAR ES SALAAM.

Mkurugenzi wa Manispaa,
Manispaa ya Temeke,
DAR ES SALAAM.

YAH: UTAMBULISHO WA UTAFITI

Tafadhali husika na kichwa cha habari hapo juu.

2. Ofisi ya Mkuu wa Mkoa wa Dar es Salaam inautambulisha utafiti ujulikanao ***"A Cost Analysis of IGRA Based Community Active Case Finding Among Adolescents in Urban Settings"*** ikiwa ni sehemu ya kukamilisha mafunzo ya shahada ya Uzamili ya **Helga Mutasingwa** ambaye ni mwanafunzi katika Chuo Kikuu cha Sayansi na Afya shirikishi Muhimbili.

3. Kibali cha kufanya utafiti huu kimetolewa na Chuo Kikuu cha Muhimbili (MUHAS-REC-05-2024-2244) ambacho kinaanzia tarehe 17 Mei, 2024 hadi 17 Mei, 2025.

4. Utafiti huu umepangwa kufanyika kwenye Halmashauri mbili za Jiji na Temeke ndani ya Mkoa wa Dar es Salaam ambao utahusisha vijana balehe katika shule za Sekondari.

5. Kwa barua hii, namtambulisha kwako **Helga Mutasingwa** ambaye ndio msimamizi mkuu wa utafiti huo ili aweze kufanya utafiti huu muhimu.

Nashukuru kwa ushirikiano.

Dkt. Mohamedi Mang'una
Kny: KATIBU TAWALA WA MKOA
DAR ES SALAAM

Nakala: Katibu Tawala wa Mkoa,
DAR ES SALAAM. - Aione katika jalada

IMEPOKELEWA
10 JUN 2024
MANISPAA YA TEMEKE
S.L.P 46343

14