# DETERMINANTS OF COVID-19 VACCINE UPTAKE AMONG ADULT TUBERCULOSIS PATIENTS ATTENDING SELECTED CLINICS IN NAIROBI COUNTY, KENYA

**WAQO BORU HUQA**

**MASTER OF SCIENCE IN**
**EPIDEMIOLOGY AND BIOSTATISTICS**

**JOMO KENYATTA UNIVERSITY**
**OF**
**AGRICULTURE AND TECHNOLOGY**

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# Determinants of Covid-19 Vaccine Uptake among Adult Tuberculosis Patients Attending Selected Clinics in Nairobi County, Kenya

**Waqo Boru Huqa**

**A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Science in Epidemiology and Biostatistics of the Jomo Kenyatta University of Agriculture and Technology**

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# DECLARATION

This thesis is my original work and has not been presented for a degree in any other University

Signature ……………………………………Date ……………………………….

**Waqo Boru Huqa**

This thesis has been submitted for examination with our approval as the University Supervisors

Signature ……………………………………Date ……………………………….

**Dr. George Makalliwa**

**JKUAT, Kenya**

Signature ……………………………………Date ……………………………….

**Ms. Caroline Musita**

**JKUAT, Kenya**

# DEDICATION

This work is dedicated to my dear wife, Qabale Kunni, who stood by me, encouraged me, and provided all the support I needed throughout. Also, not forgetting my daughters, Jillo, Biftu, and Chaltu, and, more so, my mother, for prayers and concern. This work is not complete without timely, conclusive, and unlimited support from both supervisors, Dr George Makalliwa and Ms. Caroline Musita. Further dedication goes to the Chief Officer, Department of Health, Marsabit County (2021), and to the entire departmental leadership for granting me this opportunity to study without interruption.

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**TABLE OF CONTENTS**

**DECLARATION** ... ii

**DEDICATION** ... iii

**ACKNOWLEDGEMENT** ... iv

**TABLE OF CONTENTS** ... v

**LIST OF TABLES** ... ix

**LIST OF FIGURES** ... x

**LIST OF APPENDICES** ... xi

**ABBREVIATIONS AND ACRONYMS** ... xii

**DEFINITION OF OPERATIONAL TERMS** ... xiii

**ABSTRACT** ... xiv

**CHAPTER ONE** ... 1

**INTRODUCTION** ... 1

1.1 Background to the Study ... 1

1.2 Statement of Problem ... 2

1.3 Study Justification ... 4

1.4 Study Objectives ... 5

1.4.1 Broad Objective ... 5

1.4.2 Specific Objectives ... 5

1.5 Research Questions ........ 5

1.6 Scope of the Study ........ 6

1.7 Hypotheses ........ 6

1.8 Limitations and Delimitations ........ 7

**CHAPTER TWO ........ 8**

**LITERATURE REVIEW ........ 8**

2.1 Introduction ........ 8

2.1.1 TB, COVID-19 and Vaccination Context ........ 9

2.1.2 Vaccination Importance for TB Patients ........ 9

2.2 Prevalence of COVID-19 Vaccine Uptake among Tuberculosis Patients ........ 10

2.2.1 Global and Regional Context ........ 10

2.2.2 Kenyan Context ........ 12

2.3 Socio-Demographic Factors Influencing COVID-19 Vaccination Uptake among Adult Tuberculosis Patients ........ 13

2.3.1 Evidence Gaps and Implications ........ 14

2.4 Contextual Factors Influencing the Uptake of COVID-19 Vaccine among Adult TB Patients ........ 14

2.4.1 Evidence Gaps and Implications ........ 16

2.5 Facility-Related Factors Influencing COVID-19 Vaccine Uptake among Adult TB Patients ........ 16

2.6 Gaps Analysis ........................................................................................ 18

2.7 Theoretical Framework ......................................................................... 19

2.8 Conceptual Framework ......................................................................... 20

**CHAPTER THREE ............................................................................... 22**

**MATERIALS AND METHODS ............................................................ 22**

3.1 Study Area.......................................................................................... 22

3.3 Study Variables ................................................................................... 23

3.3 Study Population .................................................................................. 24

3.3.1 Participants Eligibility Criteria .......................................................... 24

3.4 Sample Size Determination.................................................................... 25

3.5 Sampling Procedures............................................................................. 26

3.6 Data Collection Tools ........................................................................... 27

3.7 Validity, Reliability, and Pre-Testing of the Tools ........................................ 28

3.8 Data Collection Process ......................................................................... 29

3.9 Data Analysis and Management.............................................................. 30

3.10 Ethical Considerations ......................................................................... 32

**CHAPTER FOUR.................................................................................... 34**

**RESULTS .............................................................................................. 34**

4.1 Results Overview ................................................................................. 34

4.2 Baseline Sociodemographic Characteristics .................................................. 34

4.3 The Prevalence of COVID-19 Vaccinated Adult Tuberculosis Patients ......... 36

4.4 Socio-Demographic Factors Linked to Covid-19 Vaccine Uptake................. 38

4.5 Contextual Factors Associated with Covid-19 Vaccine Uptake ...................... 40

4.6 Health Facility Level Factors Associated with Covid-19 Vaccine Uptake...... 44

**CHAPTER FIVE........................................................................................ 49**

**DISCUSSION CONCLUSIONS AND RECOMMENDATIONS ...................... 49**

5.1 Chapter Overview ........................................................................................ 49

5.2 The Prevalence of COVID-19 Vaccinated Adult Tuberculosis ....................... 49

5.3 Socio-Demographic Factors Linked to Covid-19 Vaccine Uptake................. 50

5.4 Contextual Factors Associated with COVID-19 Vaccine Uptake .................. 52

5.5 Health Facility-Level Factors Associated with COVID-19 Vaccine Uptake .. 54

5.6 Study Strengths and Limitations .................................................................... 56

5.7 Conclusions ................................................................................................... 56

5.8 Recommendations .......................................................................................... 57

**REFERENCES ............................................................................................ 60**

**APPENDICES ............................................................................................. 70**

## LIST OF TABLES

**Table 4.1:** Baseline Sociodemographic Characteristics…………………………...35

**Table 4.2:** Association between Vaccination and Sociodemographic Factors…….40

**Table 4.3:** Association between Vaccination and Contextual Factors…………….42

**Table 4.4:** Association between Vaccination and Health System Factors…………46

**Table 4.5:** Themes and Sub-Themes from the Qualitative Thematic Analysis…….48

## LIST OF FIGURES

**Figure 2.1:** Conceptual Framework……………………………………………………21

**Figure 4.1:** Prevalence of Persons on TB Treatment Vaccinated for COVID-19……36

**Figure 4.2:** COVID-19 Vaccine Uptake among TB Patients……………………..…37

**Figure 4.3:** Vaccine Received by Dosage…………………………………………...37

**Figure 4.4:** Prevalence Based on Sociodemographic Characteristics……………....38

## LIST OF APPENDICES

**Appendix I:** Work plan ........................................................................... 70

**Appendix II:** Budget ........................................................................... 71

**Appendix III:** Respondents' Questionnaire ........................................................ 72

**Appendix IV:** FGDs Guide ........................................................................... 79

**Appendix V:** Key Informant Interview Guide ...................................................... 80

**Appendix VI:** Consent Form for the Key Informants .......................................... 81

**Appendix VII:** Consent Form for the Focus Group Discussion (FGDs) ............. 84

**Appendix VIII:** Sampled Sub-County and Proportionate to Clinics/HF ............. 87

**Appendix IX:** JKUAT Institutional Ethics Review Committee Approval. .......... 88

**Appendix X:** NACOSTI Permit ........................................................................... 89

**Appendix XI:** Nairobi County Department of Health Approval .......................... 90

**Appendix XI:** Publication. ........................................................................... 91

**Appendix XII:** Publication Certificate ................................................................. 92

## ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| **AIDS** | Acquired Immunodeficiency Syndrome |
| **CDC** | Centers for Disease Control |
| **CHAs** | Community Health Assistants |
| **CHVs** | Community Health Volunteers |
| **COVID-19** | Coronavirus Disease 2019 |
| **CUs** | Community units |
| **DHIS** | Demographic Health Information System |
| **DSTB** | Drug Susceptible Tuberculosis |
| **EPI** | Expanded Programme on Immunization |
| **ICPD** | International Conference on Population and Development |
| **ICU** | Intensive Critical Unit |
| **KDHS** | Kenya Demographic and Health Survey |
| **KII** | Key Informant Interview |
| **MOH** | Ministry of Health |
| **NTLDP** | National Tuberculosis, Leprosy and Lung Disease Program |
| **SARS-Cov-2** | Severe Acute Respiratory Syndrome Virus |
| **SDG** | Sustainable Development Goals |
| **SSA** | Sub-Saharan Africa |
| **TIBU** | Tuberculosis Information Basic Unit |
| **TB** | Tuberculosis |
| **VoC** | Variants of Concern |
| **WHO** | World Health Organization |

## DEFINITION OF OPERATIONAL TERMS

| Term | Definition |
| --- | --- |
| **Booster dose** | Is either a 3rd dose for those vaccinated with AstraZeneca, Pfizer, Moderna, or Sinopharm, or a 2nd dose for those vaccinated with Johnson and Johnson. |
| **Complete/Fully vaccinated** | Encompasses two doses of AstraZeneca, Pfizer, Moderna, or Sinopharm, or one dose of Johnson and Johnson vaccine |
| **Health facility level factors** | These refer to aspects of the TB clinic environment that either enable or hinder TB patients from receiving the COVID-19 vaccine. They include vaccine availability, accessibility, service delivery, awareness, demand creation, and health worker support and advice, among others. |
| **Incomplete/Partially vaccinated** | Received one dose of AstraZeneca, Pfizer, Moderna, or Sinopharm, plus being fully vaccinated (Two doses of AstraZeneca, Pfizer, Moderna, or Sinopharm. |
| **Contextual factors** | Refers to factors attributed to a person within a specific community (TB patient) that make them accept or reject a COVID-19 vaccine. Examples include perceived severity and susceptibility to the disease, concerns about side effects or vaccine safety, fear, stigma, and level of trust. |
| **Socio-demographic factors** | Socio-demographics refer to a combination of factors that define people in a specific group or population; they include age, education, religion, employment, marital status, and income levels. |
| **Tuberculosis clinic** | It is a dedicated clinic at the sub-county or county level that administers specific services to TB patients. |
| **Vaccine uptake** | Refer to as the number of people vaccinated with a specific dose of the vaccine in a particular time, which can be expressed as an absolute number or as the proportion of a target population |

## ABSTRACT

Vaccination is a cost-effective public health strategy for controlling infectious diseases, yet low uptake of the coronavirus disease 2019 (COVID-19) vaccine remains a concern, particularly among high-risk groups such as tuberculosis (TB) patients. Coronavirus disease 2019 poses a significant threat to vulnerable populations, with bidirectional interactions between COVID-19 and TB exacerbating disease progression and outcomes due to compromised immunity and sustained community transmission. In Nairobi County, Kenya, nearly 47% of the population remains unvaccinated, with limited data on vaccine uptake among TB patients. This study aimed to investigate the facilitators and barriers to COVID-19 vaccine uptake among adult TB patients attending selected clinics in Nairobi County. To assess the determinants of COVID-19 vaccine uptake among adult TB patients in selected health facilities in Nairobi County, Kenya. A mixed-methods cross-sectional analytical study was conducted in six purposively selected health facilities offering TB services in Nairobi County. A total of 388 adult TB patients were recruited using simple random sampling. Data were collected via a KoBo Collect questionnaire and analyzed using SPSS version 25. Associations were assessed using logistic regression, with $p < 0.05$ as the threshold for statistical significance. All 388 participants responded (response rate: 100%). As of October 2023, the COVID-19 vaccination rate was 46.1%, with 38.1% fully vaccinated. Factors significantly associated with higher vaccine uptake included age >35 years (adjusted odds ratio (aOR) = 1.89, 95% CI: 1.185–3.427, p = 0.030), employment (aOR = 2.8, 95% CI: 1.191–6.705, p = 0.018), perceived susceptibility to COVID-19 (aOR = 2.901, 95% CI: 1.258–6.688, p = 0.012), perceived disease severity (aOR = 3.294, 95% CI: 1.130–9.604, p = 0.029), consistent and accurate messaging (aOR = 3.380, 95% CI: 1.217–9.384, p = 0.019), emphasis on social benefits (aOR = 3.786, 95% CI: 1.204–11.908, p = 0.023), and sufficient public awareness (aOR = 2.86, 95% CI: 1.689–8.254, p = 0.028). Barriers included mandatory registration requirements (aOR = 0.687, 95% CI: 0.270–0.743, p = 0.029) and mistrust in government pandemic management (aOR = 0.076, 95% CI: 0.025–0.229, p < 0.001). COVID-19 vaccine uptake among adult TB patients in Nairobi County was low at 46.1%. Older age, employment, heightened risk perception, effective communication, and adequate awareness facilitated uptake, while registration requirements and mistrust in government acted as significant barriers. Targeted interventions addressing these barriers and leveraging enablers are essential to increase vaccination rates in this high-risk group, thereby reducing severe COVID-19-related morbidity and mortality.

# CHAPTER ONE

# INTRODUCTION

## 1.1 Background to the Study

The emergence of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), causing Coronavirus disease 2019 (COVID-19), has posed profound socio-economic and health challenges globally. COVID-19 remains a significant public health threat, particularly to vulnerable groups, including patients with tuberculosis (TB), due to ongoing viral evolution and transmission (World Health Organization [WHO], 2022a). The bidirectional interaction between COVID-19 and TB exacerbates disease progression and outcomes, as COVID-19 immunosuppression accelerates latent TB reactivation, while TB compromises immunity, increasing susceptibility to severe COVID-19 (Udwadia et al., 2020). This twin pandemic of airborne infections heightens risks of coinfection, severe illness, and mortality, straining health systems worldwide (Udwadia et al., 2020; WHO, 2022a).

Globally, TB affects millions, with approximately one-quarter of the world's population infected with latent TB infection, of which 5–10% progress to active disease over their lifetime (Houben & Dodd, 2016). The COVID-19 pandemic disrupted TB services, reversing progress by several years: notifications dropped sharply in 2020–2021 and deaths increased (Falzon et al., 2023). Although specific data on COVID-19 vaccine uptake among TB patients are limited globally, high-risk groups, such as those with TB, were prioritized for vaccination; however, disruptions in health services and hesitancy likely contributed to suboptimal coverage in TB-endemic regions (WHO, 2022a).

In Africa, which bears a disproportionate TB burden, COVID-19 vaccination rates have lagged, with regional coverage of the primary series around 32–52% by late 2023, far below global averages (Doshi et al., 2024). Sub-Saharan Africa, home to many high-TB-burden countries, faced additional barriers, including supply constraints and access issues (Wariri et al., 2023). Studies indicate low vaccination among people with

comorbidities in several countries, exacerbating risks for TB patients amid prevalent coinfections and high mortality from severe dual disease, as observed in cases like Senegal (Dieye et al., 2024).

In Kenya, a high-TB-burden country with the highest urban prevalence in areas like Nairobi County (558 per 100,000 adults), COVID-19 vaccination in the general population was low (around 20–30% fully vaccinated by 2023) (Kunjok et al., 2025; Trading Economics, n.d.). Data specific to TB patients remains scarce, but vulnerable groups faced similar challenges, compounded by TB service disruptions during the pandemic.

Vaccination is the most cost-effective public health intervention to curb infectious diseases. Yet, low COVID-19 vaccine uptake persists, driven by hesitancy, defined as reluctance or refusal despite availability, safety, and efficacy (a top WHO concern) (MacDonald et al., 2015). Factors influencing uptake included sociodemographic (age, sex, education, income), perceptions (risk, severity, side effects), trust in authorities, and structural barriers (access, awareness) (Roy et al., 2022).

Given the heightened vulnerability of TB patients to severe COVID-19 outcomes and the interplay of multifaceted factors influences the vaccination decisions and there is need to conduct study to inform context-specific strategies for improving acceptance and protection in this high-risk group like tuberculosis patients. The study sought to examine determinants of the COVID-19 vaccine uptake among adult TB patients attending selected clinics in Nairobi County, Kenya.

## 1.2 Statement of Problem

Despite the unprecedented speed of Covid-19 vaccine development and its widespread availability, the low vaccine uptake continues to hinder efforts to achieve herd immunity and remains critical public health challenge, particularly among high risk prioritized sub-population like Tuberculosis patients with pre-existing pulmonary infections (WHO, 2022b). The World Health Organization (WHO) emphasizes prioritizing vulnerable groups, including TB patients, for full vaccination coverage,

while aiming for at least 70% in the general population to curb transmission (WHO, 2021). However, only (53%) of the adult population in Nairobi County were vaccinated according to last situation updates report from ministry of Kenya (MOH 2023). Notably, there is a significant scarcity of covid-19 vaccination coverage data on TB patient sub-population included in this study (Kunjok et al., 2025).

The Covid-19 pandemic disrupted tuberculosis (TB) management especially in high-burden countries, leading to an 18% decline in global TB notifications between 2020 and 2021, 3.6% rise in incidence, where 90% of all TB cases were among adult. This population segment contributes significantly to concurrent pandemic transmission rates, underscoring its role in the broader disease landscapes (Thekkur et al., 2021).

The low uptake in TB patients, compounded by comorbidities such as HIV and malnutrition, weakens immunity and amplifies risks of coinfection, reactivation of TB and severe disease progression. Both infections share intricate bio-social determinants with overlapping clinical characteristics, often causing diagnostic challenges, further heighten the risk of coinfection for this vulnerable population (Udwadia et al., 2020).

The public health burdens are profound, including increased morbidity, mortality, and socioeconomic costs from unvaccinated TB patients contracting COVID-19 (Karami et al., 2025). Co-infected individuals face 2-3 times higher mortality risk (McQuaid et al., 2022), with TB elevating COVID-19 death odds by up to 2.7 times (Migliori et al., 2022), potentially leading to a 20% rise in TB deaths in high-burden countries over 5 years amid pandemic disruptions (Nadity et al., 2021 and Wang et al., 2024).

In Nairobi where intersection of high burden of both infection occurs, and where significant proportion of population resides in informal settlements, vulnerability to both infections is further exacerbated by sustained community transmission and suboptimal vaccination coverage. Therefore, it’s imperative to identify the determinants of uptake in setting and among this high-risk group to mitigate adverse outcomes.

## 1.3 Study Justification

Heightened vaccine uptake will significantly reduce the risk of severe disease, hospitalization, and death, enabling the reopening and recovery of economies and societies. Increased uptake among the TB population will help in achieving the End TB strategy to reduce TB deaths and and to eliminate catastrophic costs for TB-affected households by 2030 (WHO, 2022c).

Scaled-up COVID-19 vaccination coverage among the general population and vulnerable priority groups, such as tuberculosis patients, is a cornerstone for a healthy nation, as it reduces infectivity, opens up economies, and reduces the burden. The study will help realize the Immunization Agenda 2030 (WHO), a global strategy to leave no one behind in any situation or at any stage of life. Additionally, the study will contribute to Kenya's Vision 2030 of achieving a globally competitive and prosperous Kenya with a high quality of life by 2030 (Ministry of Planning and Development, 2008 and the achievement of the Sustainable Development Goals, most immediately affected by the pandemic, such as health (SDG3).

Vaccine uptake is not purely an information and availability factor, but a convolution of factors. Despite the critical importance, there are no prior studies in Kenya or Nairobi County on factors influencing COVID-19 vaccine uptake among TB patients, highlighting a significant knowledge gap that informed this study. Therefore, there is a need to conduct a study that sought to examine the determinants of Covid-19 vaccine uptake among the patients attending TB clinics with a focus on areas with high risks of vulnerable conditions, such as TB, high population, with a significantly high proportion of the population residing in informal settlements, and the highest TB burden. Understanding the factors promoting and limiting vaccine uptake is crucial for planning. The study will be helpful to policymakers, particularly the Ministry of Health and the County government of Nairobi, in tailoring interventions to accelerate vaccine coverage among the general population and especially vulnerable groups, including TB patients.

## 1.4 Study Objectives

### 1.4.1 Broad Objective

To assess the determinants of Covid-19 vaccine uptake among adult tuberculosis patients attending selected clinics in Nairobi County, Kenya.

### 1.4.2 Specific Objectives

1 To determine the prevalence of Covid-19 vaccine uptake among adult tuberculosis patients attending selected clinics in Nairobi County, Kenya.
2 To determine the socio-demographic factors influencing Covid-19 vaccine uptake among adult TB patients in the selected clinics in Nairobi County, Kenya.
3 To determine contextual factors associated with Covid-19 vaccine uptake among adult TB patients attending selected clinics in Nairobi County, Kenya.
4 To determine health facility level factors associated with Covid-19 vaccine uptake among adult tuberculosis patients in the selected clinics in Nairobi County, Kenya.

## 1.5 Research Questions

1. What is the prevalence of Covid-19 vaccine uptake among adult tuberculosis patients attending selected clinics in Nairobi County, Kenya?
2. What are the socio-demographic factors influencing Covid-19 vaccine uptake among adult tuberculosis patients attending selected clinics in Nairobi County, Kenya?
3. What are the contextual factors associated with Covid-19 vaccine uptake among adult tuberculosis patients attending selected clinics in Nairobi County, Kenya?
4. What are the health facility level factors associated with Covid-19 vaccine uptake among adult tuberculosis patients attending selected clinics in Nairobi County, Kenya?

## 1.6 Scope of the Study

The study employed an analytical cross-sectional design, collecting both qualitative and quantitative data at a single point in time to determine the relationship between socio-demographic characteristics, contextual factors, health facility factors, and uptake of COVID-19 vaccine among adult tuberculosis patients in Nairobi County, Kenya. Nairobi County was selected due to its high number of confirmed TB and COVID-19 cases, its role as a major entry point, and its status as the most densely populated county in the country. The study population consisted exclusively of adult TB patients attending selected clinics within Nairobi County.

## 1.7 Hypotheses

### The null hypothesis (H0):

**$H_0$:** There is no significant relationship between socio demographic factors and Covid-19 vaccine uptake among adult tuberculosis patients attending selected clinics in Nairobi County, Kenya.

**$H_0$:** There is no significant relationship between contextual factors and Covid-19 vaccine uptake among adult tuberculosis patients attending selected clinics in Nairobi County, Kenya

**$H_0$:** There is no significant relationship between health facility level factors and Covid-19 vaccine uptake among adult tuberculosis patients attending selected clinics in Nairobi County, Kenya.

### Alternate hypothesis (Ha)

**$H_a$** There is significant relationship between socio demographic factors and Covid-19 vaccine uptake among adult tuberculosis patients attending selected clinics in Nairobi County, Kenya.

$\mathbf{H_a}$: There is significant relationship between contextual factors and Covid-19 vaccination uptake among adult tuberculosis patients attending selected clinics in Nairobi County, Kenya.

$\mathbf{H_a}$: There is significant relationship between health facility level factors and Covid-19 vaccination uptake among adult tuberculosis patients attending selected clinics in Nairobi County, Kenya.

### 1.8 Limitations and Delimitations

The study delimitations included (a) geographic scope where the research was limited to Nairobi County, Kenya, (b) population where it was restricted to adult TB patients over 18 years, (c) cross-sectional study where data was collected at a single time point), and (d) the focus variables were sociodemographic, contextual, and health-related factors linked to COVID-19 vaccine uptake.

The study limitations included the inability to establish causality due to design constraints where cross-sectional designs only show associations and selection bias as only patients from six TB sites were included, affecting findings generalizability. There was potential for temporal ambiguity where all variables were measured simultaneously, which mean it as difficult to determine whether factors such as recent TB diagnosis affected vaccine decision. Lastly, the study also faced measurement and response limitations in terms of self-reported bias and non-response bias.

# CHAPTER TWO

# LITERATURE REVIEW

## 2.1 Introduction

The purpose of this chapter is to review, analyze, and synthesize the existing body of literature relevant to the study objectives and research questions. A comprehensive review of empirical studies, theoretical perspectives, and global, regional, and local evidence is essential to provide a scholarly foundation for the present investigation. This study examined the socio-demographic, contextual, and health facility–related factors influencing the uptake of COVID-19 vaccine among adult tuberculosis (TB) patients attending selected clinics in Nairobi County. This chapter will be structured around the study's key objectives. First, it will examine existing evidence on the prevalence of COVID-19 vaccine uptake, with an emphasis on individuals with TB. Second, the review will discuss socio-demographic factors such as age, gender, education, marital status, and socioeconomic status that have been shown to influence vaccine uptake in various contexts. Third, the chapter will analyze literature on contextual factors including vaccine safety concerns, myths and misconceptions, mistrust, stigma, risk perception, and individual beliefs, all of which have been extensively documented as drivers of vaccine uptake both globally and locally. Lastly, the review will explore health facility-related factors, including accessibility, provider communication, availability of vaccines, quality of services, and health worker recommendations, which are often critical predictors of successful vaccine uptake. By organizing the literature around these four core objectives, the chapter will not only highlight current knowledge and evidence gaps but also demonstrate how the present study builds on, extends, and contextualizes previous research. This synthesis will ultimately provide a strong conceptual and empirical basis for interpreting the study's findings within the broader public health landscape.

### 2.1.1 TB, COVID-19 and Vaccination Context

Tuberculosis (TB) patients are a high-risk group for severe COVID-19 and mortality. The World Health Organization explicitly advises that people with TB should be vaccinated against COVID-19 if they have no symptoms (WHO, 2024). In Africa, TB, HIV, and COVID-19 collide as overlapping epidemics, compounding patient vulnerability (Huerga et al., 2025). For example, Huerga et al. (2025) found that TB/COVID co-infection significantly increased mortality risk compared to either disease alone. Likewise, WHO data indicate that TB deaths rose during the pandemic due to health service disruptions (WHO, 2024), given these risks, COVID-19 vaccination is critically essential for TB patients (WHO, 2024). Yet even in the general population coverage in Africa has been modest, with an Africa CDC report finding ~50% vaccine coverage by 2024, suggesting even greater challenges for vulnerable subgroups (Huerga et al., 2025). In Kenya, national plans targeted 70% adult coverage by mid-2022, but reports show only ~30.7% of adults were fully vaccinated by May 2022 (Ministry of Health, 2022). Similarly, a cohort in Nairobi's informal settlements found that more than 45% of eligible adults remained unvaccinated in early 2022 (Nasimiyu et al., 2022). These overall shortfalls imply that TB patients, often of lower socioeconomic status and with heavy health burdens, may face additional barriers. In fact, a recent Cameroon study found "gaps in COVID-19 KAP among TB patients" (knowledge/attitude/practice) that necessitate targeted interventions (Andoseh et al., 2025). Together, these observations highlight that TB patients in Kenya are both at heightened risk and underserved by current vaccination efforts (WHO, 2024; Huerga et al., 2025).

### 2.1.2 Vaccination Importance for TB Patients

Because TB compromises lung function and immunity, COVID-19 poses a special threat. Studies show co-infection (TB+COVID-19) leads to "poorer outcomes than each [disease] alone" (Huerga et al., 2025). Moreover, TB patients frequently have comorbidities (like HIV or diabetes) that further raise COVID-19 severity. Recognizing this, WHO's technical guidance explicitly recommends COVID-19

vaccination for people with active TB or at risk of TB (WHO, 2024). The rationale is that preventing COVID-19 in TB patients not only saves lives but also helps preserve TB care capacity by avoiding severe cases and isolating COVID-positive patients. However, global evidence suggests that TB patients have not been specifically prioritized or studied for COVID-19 vaccine uptake. A systematic review of pandemic responses noted that pre-existing health inequities often lead to lower vaccine uptake in vulnerable groups (e.g., the elderly or chronically ill) unless explicitly addressed (Huerga et al., 2025; Sibanda et al., 2024). This is echoed in Kenya's own rollout, where early phases targeted the elderly and healthcare workers, but later general rollout had to contend with widespread hesitancy and access gaps (Osur et al., 2022; Rajshekhar et al., 2023). In short, although clinical guidelines label TB patients as "high risk", little published work has examined whether and how these patients get vaccinated, existing health inequities often lead to lower vaccine uptake in vulnerable groups (e.g. the elderly or chronically ill) unless explicitly addressed (Huerga et al., 2025; Sibanda et al., 2024).

## 2.2 Prevalence of COVID-19 Vaccine Uptake among Tuberculosis Patients

Peer-reviewed literature from 2020 onward highlights the vulnerability of tuberculosis (TB) patients to severe COVID-19 outcomes, yet direct data on COVID-19 vaccine uptake prevalence in this group are limited, particularly in low-resource settings. Globally, studies emphasize the need for prioritizing TB patients for vaccination due to heightened mortality risks in co-infected individuals, but few quantify uptake rates. Regionally in sub-Saharan Africa, where TB burdens are high, vaccine acceptance varies widely, often lower among those with comorbidities like TB, though specific prevalence in TB cohorts is rarely disaggregated. In Kenya, including Nairobi County, evidence focuses more on pandemic disruptions to TB services than on vaccine uptake, revealing a critical gap in localized prevalence data for adult TB patients.

### 2.2.1 Global and Regional Context

Globally, specific prevalence data on COVID-19 vaccination among TB patients remain exceedingly scarce. Most early publications (2020–2021) pre-dated

widespread vaccine availability and therefore focused on coinfection risk rather than uptake. Migliori et al. (2022) analyzed a global cohort of 767 TB-COVID coinfected patients from 34 countries, primarily pre-vaccination (up to January 2021), finding a 12.6% mortality rate, with active TB associated with higher fatality (adjusted OR 2.17, 95% CI 1.22–3.86). The study recommended prioritizing TB patients for COVID-19 vaccines but lacked uptake data, as only a fraction of the cohort overlapped with early vaccination phases. A systematic review and meta-analysis by Wang et al. (2022) synthesized data from 82 studies spanning November 2019 to March 2021, estimating a pooled TB-COVID coinfection prevalence of 0.06% (95% CI 0.04–0.09) across diverse regions, but no data on vaccine uptake were widely available during the study period. The review highlighted that TB patients faced a 1.93-fold increased risk of severe COVID-19 (RR 1.93, 95% CI 1.19–3.15), underscoring the potential benefits of vaccination, yet without prevalence metrics for uptake post-rollout. An earlier meta-analysis by Gao et al. (2021) reviewed 36 studies and reported TB as a risk factor for COVID-19 mortality (RR 1.90, 95% CI 1.48–2.44), but again, focused on pre-vaccine eras, concluding that vaccination coverage in TB patients was unknown and urgently needed for future assessments. The scarcity of direct uptake prevalence globally stems from early pandemic priorities on acute management over preventive measures. Where mentioned, barriers like resource diversion and hesitancy are implied to lower uptake, but no pooled estimates exist for TB-specific vaccination rates, with most literature calling for integrated TB-COVID strategies to boost coverage.

In sub-Saharan Africa, where 25% of the world's TB burden is concentrated, the few studies that have measured COVID-19 vaccine uptake in comorbid populations consistently report lower coverage than in the general adult population. A 2023 multi-country analysis of World Bank high-frequency phone surveys across Kenya, Ethiopia, Malawi, Nigeria, and South Africa found overall full-vaccination prevalence ranging from 11% (Nigeria) to 52% (South Africa) by mid-2022, but respondents reporting a chronic lung condition (a proxy that includes TB) were 8–14 percentage points less likely to be fully vaccinated after adjusting for age, education, and rural residence (Wollburg et al., 2023). In a South African cohort of 2,429,927 adults (2020–2022), Kassanjee et al. (2024) documented a COVID-19 full-vaccination prevalence

of only 2.5% among individuals experiencing a TB episode during 2020–2022 compared with 3.8% in age-matched clinic attendees without TB. A meta-analysis by Alemayehu et al. (2022) pooled data from East African countries, including Kenya, Ethiopia, and Uganda, estimating vaccine acceptance at 60.2% among adults, but noted potential drops among comorbid groups due to misinformation and service disruptions.

### 2.2.2 Kenyan Context

Kenya-specific peer-reviewed data on COVID-19 vaccine uptake among TB patients are effectively nonexistent. National surveys and Ministry of Health reports indicate that by December 2022, only 33% of Kenyan adults were fully vaccinated (Ministry of Health, 2023), but none disaggregate by TB status. A 2021–2022 mixed-methods study of TB service delivery across 18 Nairobi County facilities (Mbithi et al., 2021, with follow-up analysis in 2023) documented severe disruptions in TB care during the pandemic but did not collect vaccination status among the 2366 enrolled TB patients during the COVID-19 pandemic between Mar 2020 and Feb 2021. A political-economy analysis of TB care gaps in Kenya highlighted that women with TB, who comprise 38% of Nairobi's notified cases, face additional access barriers that likely depress vaccination rates further, but again provided no prevalence figures (Abdullahi et al., 2024).

The limited available evidence therefore converges on three conclusions: firstly, wherever COVID-19 vaccination prevalence has been measured in TB patients, it is substantially lower than in the general adult population. Secondly no peer-reviewed study has yet reported COVID-19 vaccine uptake prevalence specifically among adult TB patients attending clinics in Kenya, and none at all in Nairobi County despite the county accounting for approximately 20–25% of the national TB burden; and lastly the absence of such data represents a critical evidence gap that impedes targeted catch-up vaccination strategies, risk stratification, and evaluation of integrated TB–COVID service delivery models.

In summary, while TB has been repeatedly demonstrated to increase the risk of severe COVID-19 outcomes, the prevalence of protective vaccination in this vulnerable group remains poorly characterized globally and essentially undocumented in the Kenyan context. Clinic-based prevalence studies in high-burden urban settings such as Nairobi are urgently needed to fill this gap and inform policy.

### 2.3 Socio-Demographic Factors Influencing COVID-19 Vaccination Uptake among Adult Tuberculosis Patients

Studies that focus specifically on TB patients reveal very low COVID-19 vaccine coverage in this group. For example, a recent Indonesian case–control study found only 58.8% of active TB patients had received any COVID‑19 vaccine, and a Cameroon survey reported just 8.3% of TB patients vaccinated against 9.4% of healthy controls (Andoseh et al., 2025; Palupi et al., 2023). Notably, Cameroonian TB patients expressed more positive attitudes toward COVID-19 (55.6% favorable) than healthy peers (48.2%), yet this did not translate into higher uptake (Andoseh et al., 2025). TB cohorts worldwide show suboptimal vaccine coverage, suggesting that general socio-demographic drivers (age, gender, income, etc.) likely influence uptake but have not been directly studied.

In the Cameroon KAP study, socio-demographic patterns among TB patients emerged. TB patients had significantly lower COVID-19 knowledge, with healthy individuals being about twice as likely to demonstrate good knowledge as TB patients (Andoseh et al., 2025). Age also mattered, with younger adults (18–29) being more informed than older groups. Most importantly for COVID-19 vaccine uptake, demographic factors strongly predicted preventive behavior. After adjustment, healthy (non-TB) subjects were approximately three times more likely to report good COVID‑19 prevention practices than TB patients. Males and married participants fared worst, where men were roughly 2–3 times less likely than women to adhere to preventive measures, and married individuals similarly lagged behind singles. These findings imply that among TB patients, being female and young may correlate with better engagement in prevention (and by extension vaccination), whereas older or male

patients may remain vulnerable. Males and married participants fared worst where men were roughly 2–3 times less likely than women to adhere to preventive measures, and married individuals similarly lagged behind singles. These findings imply that among TB patients, being female and young may correlate with better engagement in prevention (and by extension vaccination), whereas older or male patients may remain vulnerable.

In Kenya, virtually no published data dissect TB patient uptake by socio-demographic factors. Kenyan surveys have not assessed vaccination specifically in TB cohorts. In short, there is no published analysis of how factors like age, gender, or education affect COVID-19 vaccine uptake within Kenya's TB patient population.

### 2.3.1 Evidence Gaps and Implications

Overall, socio-demographic drivers of vaccine uptake in TB patients are poorly characterized. Global and African reviews of COVID-19 vaccination almost never stratify by TB status, so key subgroups are hidden. As a result, we lack evidence on whether the usual barriers (e.g., lower education, poverty, female gender, minority status) similarly impede vaccination in TB patients or whether TB-specific issues (stigma, treatment demands, HIV co-infection) create new patterns. In Kenya and elsewhere, this gap means interventions cannot be tailored to TB clients' needs. We therefore highlight an urgent need for TB clinics and registries (especially in Nairobi County) to record demographic data (age, sex, education, income, etc.) alongside vaccination status. Doing so will reveal which TB subgroups are under-vaccinated and allow targeted outreach in this high-risk population.

## 2.4 Contextual Factors Influencing the Uptake of COVID-19 Vaccine among Adult TB Patients

Andoseh et al. (2025) conducted a cross-sectional knowledge–attitude–practice (KAP) survey in a TB clinic setting in Cameroon. They found that many people living with TB had reasonable factual knowledge about COVID-19, but knowledge did not uniformly translate to vaccination behaviour. Respondents commonly cited safety

concerns and mistrust as reasons for hesitancy, and practical worries (for example, whether vaccination might interrupt TB care) appeared in open responses. The study also reported that social-protective motives, for example, wanting to protect household members, were associated with greater stated willingness to accept vaccination. Importantly, the study's cross-sectional design means it can map associations (who reports fear, who is willing) but cannot show whether addressing those beliefs would change uptake. It therefore highlights the need for clinic-based, intervention-oriented research that measures both perceptions and subsequent vaccination behaviour over time.

Jin et al. (2024) conducted a clinical trial that measured humoral responses and short-term safety of two- and three-dose COVID-19 vaccines in people with active pulmonary TB. Their main, behavior-relevant finding is indirect but essential. They reported that the vaccines produced measurable immune responses, and the adverse events were generally mild, mainly as local pain, providing biomedical reassurance that vaccination is tolerated in the TB population. Such biological evidence is directly relevant to the top perceptual barrier often reported by TB patients, including the fear that a COVID-19 vaccine will worsen TB or interact harmfully with TB medicines. However, Jin et al. (2024) did not measure patients' beliefs before or after receiving trial results, nor did they test whether communicating these safety/immunogenicity data changes willingness to vaccinate. The trial answered, "Is the vaccine biologically safe and immunogenic?" but not "does that knowledge change patient perceptions or uptake," leaving a contextual translation gap that justifies research asking TB patients what safety messages they need and whether clinic-level messaging increases COVID-19 vaccine uptake.

Huerga et al. (2025) performed a large prospective study in Kenya, Uganda, and South Africa of ambulatory patients to examine the intersections of SARS-CoV-2 exposure, TB, and HIV in multiple East and Southern African sites. Although primarily epidemiologic and immunologic, the study underscores heterogeneity across settings in prior SARS-CoV-2 exposure and in access to care. For behavioral purposes, the key takeaway is contextual, where attitudes toward vaccination are likely to differ by

locale, HIV status, and clinic-level service models. However, Huerga et al. (2025) do not present a focused behavioral or perceptual analysis of vaccine uptake among TB patients. Therefore, while the paper indicates that context matters, it leaves unanswered which specific perceptual barriers (e.g., safety fears, stigma, mistrust) are most salient in each country or clinic. This lack of granular, clinic-level perceptual data motivates work that specifically probes adult TB patients' beliefs and decision drivers on COVID-19 vaccine uptake in particular urban clinics, such as those in Nairobi, Kenya.

### 2.4.1 Evidence Gaps and Implications

From the synthesis above, concrete gaps supporting further research include a translation gap where safety and immunogenicity evidence exists, but its effect on patient beliefs is unknown. Nairobi patients may have specific concerns about vaccine–TB interactions that are not documented in immunology papers. Also, there is local contextual heterogeneity where multi-country studies show variation by setting (Huerga et al., 2025), so Nairobi may have unique social norms, trust relationships, or clinic workflows that shape uptake differently. A local study would capture Nairobi-specific drivers. Subgroup knowledge gaps where TB cohorts often include people with HIV or drug-resistant TB. Behavioral drivers may differ by comorbidity or treatment phase (Huerga et al., 2025), so Nairobi clinic sampling can intentionally stratify and identify subgroup-specific perceptual barriers.

## 2.5 Facility-Related Factors Influencing COVID-19 Vaccine Uptake among Adult TB Patients

Evidence from Kenya and SSA highlights several health-facility-level determinants of COVID-19 vaccine uptake, which likely apply to TB patients in clinic settings. Key facility factors include accessibility and vaccine availability. For example, studies show that distance to the nearest clinic and transportation costs are significant barriers: one Kenyan qualitative study noted that although vaccines are free, indirect costs such as transportation to health facilities and income loss from taking time off work can be prohibitive (Job et al., 2025). This effect is magnified in rural or informal urban areas

where clinics are sparse (Job et al., 2025). Long travel or waiting times can deter patients who must coordinate with TB treatment schedules. Similarly, stock-outs and supply issues at facilities directly reduce uptake. In South Africa's elderly cohort, 23.4% of those who missed an influenza vaccine cited "vaccine not available at facility" as the reason (Sibanda et al., 2024). The study also found that over half of missed doses were due to stock-outs at health centers (Sibanda et al., 2024). In Kenya, the early COVID rollout was hampered by delayed deliveries and bureaucracy in the central supply chain (Mulupi et al., 2025). Although Kenya leveraged its Expanded Program on Immunization (EPI) cold-chain and public–private partnerships to distribute vaccines (Mulupi et al., 2025), logistical delays still occurred. If TB clinics were not stocked (or if stock routinely prioritized general clinics), TB patients might find vaccines out of stock during their visits.

Other facility dimensions are service organization and staffing. High patient loads or staff shortages can undermine vaccine delivery quality. For instance, one Kenyan analysis found supply-chain issues and high health worker–patient ratios reduced public trust in immunization programs (Job et al., 2025). Healthcare worker strikes (which have occurred in Kenya) also interrupt vaccination campaigns. Clinic hours and integration of services matter, where TB clinics often operate on strict schedules for DOTS therapy. If COVID-19 vaccines are only offered at certain times or in other clinics, TB patients may face scheduling conflicts. There is precedent that integrating vaccination into other services can improve coverage, for example, the WHO and UNICEF recommend co-locating vaccines with antenatal care, but no literature on integration with TB services was found. I note that in some Kenyan HIV/TB clinics (e.g., those funded by PEPFAR), COVID vaccines have been offered alongside routine care, but published data on these are lacking.

A fourth factor is health worker engagement and communication. Trust in providers strongly influences uptake. Job et al. (2025) reported that Kenyan communities' distrust of health messages with rumors and misinformation (spread via media and local leaders) undermines confidence in health workers, often lacking time or training to address concerns (Mulupi et al., 2025). In some cases, patients may lack confidence

in government-run facilities. The Nairobi informal settlement study found higher hesitancy at public clinics (Rajshekhar et al., 2023). For TB patients, who already face stigma and fear of diagnosis, the attitude of clinic staff is crucial. If TB nurses are not well-informed about COVID vaccine benefits or if they neglect to counsel patients on vaccination during TB appointments, vaccine uptake will be low.

In the broader African context, very little is known about TB patient COVID vaccination. No country-level TB programs have published data on how many TB patients are vaccinated, nor on the reasons for uptake or refusal. In Kenya, TB management guidelines urge linking TB patients to HIV services and other care, but do not explicitly integrate COVID vaccination (at least not in publicly available reports). Thus, to our knowledge, no study has systematically explored health-facility-related factors influencing COVID-19 vaccine uptake in TB clinics in Kenya. Existing literature on general population acceptance (e.g., Ilboudo et al., 2025) may hint at issues, but the unique setting of TB clinics has not been studied. Without Kenya-specific research, program planners lack guidance on whether to adapt TB clinics for COVID vaccination (e.g., by co-administration) or focus on community outreach for TB patients.

## 2.6 Gaps Analysis

TB patients in Nairobi County and Kenya in general are an understudied group regarding COVID-19 immunization. On one hand, global and regional studies demonstrate that TB patients are high-risk and have lower COVID-19 prevention uptake (Andoseh et al., 2025; Huerga et al., 2025). On the other hand, Kenyan data show systemic barriers at health facilities (e.g., vaccine stock-outs, access issues that could disproportionately affect TB patients (Job et al., 2025; MOH, 2022). Yet no published literature combines these streams. Our review indicates that health facility–related factors, such as integration of services, supply chain reliability, clinic accessibility, and provider practices, are well-recognized drivers of vaccine uptake in general (Sibanda et al., 2024), but their role among TB patients remains unexplored. This is the evidence gap our fourth objective addresses. Understanding facility factors

is crucial for intervention design. If, for example, transportation costs or stock-outs are the most significant barriers, strategies would differ from those needed if vaccine hesitancy or misinformation are primary.

Furthermore, Kenya’s strategic plan for TB emphasizes patient-centered care and integrated services. The COVID-19 response offers a unique chance to leverage TB clinics as vaccination sites, but this will only work if health facility enablers are identified and weak points fixed. In sum, existing evidence from Kenya and similar settings shows that vaccine uptake among high-risk groups can be suboptimal (Ilboudo et al., 2025; Rajshekhar et al., 2023) and that health system factors (distance, availability, staffing) significantly influence uptake (Sibanda et al., 2024). Yet these have not been explicitly studied for TB patients in Nairobi. Therefore, investigating health facility–related factors in this context is well-justified and timely.

## 2.7 Theoretical Framework

The Health Belief Model (HBM) stands out as a robust theoretical foundation for investigating factors affecting COVID-19 vaccine uptake among adult tuberculosis (TB) patients attending selected clinics in Nairobi County, Kenya, due to its focus on individual perceptions of health risks and preventive actions, which are particularly relevant for immunocompromised populations facing dual threats from TB and COVID-19. Developed in the 1950s by researchers at the U.S. Public Health Service, HBM theorizes that people are more likely to engage in health-promoting behaviors if they perceive a personal threat from a disease (susceptibility and severity), believe the action will reduce that threat (benefits), anticipate manageable obstacles (barriers), receive prompts (cues to action), and feel capable of performing the behavior (self-efficacy).

For adult TB patients in Nairobi, Kenya who face elevated risks of severe COVID-19 due to compromised immune systems HBM's core constructs (perceived susceptibility, severity, benefits, barriers, cues to action, and self-efficacy) provide a structured lens to explore why uptake might be low despite availability. For instance, perceived barriers like fear of vaccine interactions with TB medications or access issues in clinics

can be directly examined. This model has been effectively applied in Kenyan vaccine studies, offering practical guidance for interventions like targeted education to boost perceived benefits. For example, a cross-sectional survey in rural western Kenya used HBM to identify correlates of vaccine acceptance, finding that higher perceived benefits (e.g., protection from severe illness) and cues to action (e.g., recommendations from trusted sources) were linked to greater willingness, while barriers like fear of side effects contributed to 41.7% hesitancy rates.

In practice, applying HBM to this study would involve operationalizing constructs through mixed-methods: quantitative surveys measuring perceptions via validated scales (e.g., from Kenyan adaptations) and qualitative interviews exploring barriers like stigma or economic constraints. Key variables might include socio-demographics (age, employment), as older, employed TB patients showed higher uptake in Nairobi. Potential findings could mirror regional patterns, such as 53.9% unvaccinated TB patients citing myths, necessitating cues like community health worker endorsements

## 2.8 Conceptual Framework

Figure 2.7 below illustrate the conceptual framework which represent the content of the research question. It is the broad picture that provides dynamic structure that depicts the relationship between the dependent and independent variables. The dependent variable is uptake of the COVID-19 vaccine among the adult TB patients attending the TB clinics. The independent variables were categorized into social demographic factors (age, occupation, gender, place of residence, marital status, religion, level of education and income level), Contextual factors (side effects, stigmatization, trust and confidence, rumours and misconception, protection of others and risk perception), and health facility-level factors (accessibility, service delivery, communication and awareness and government control measures).

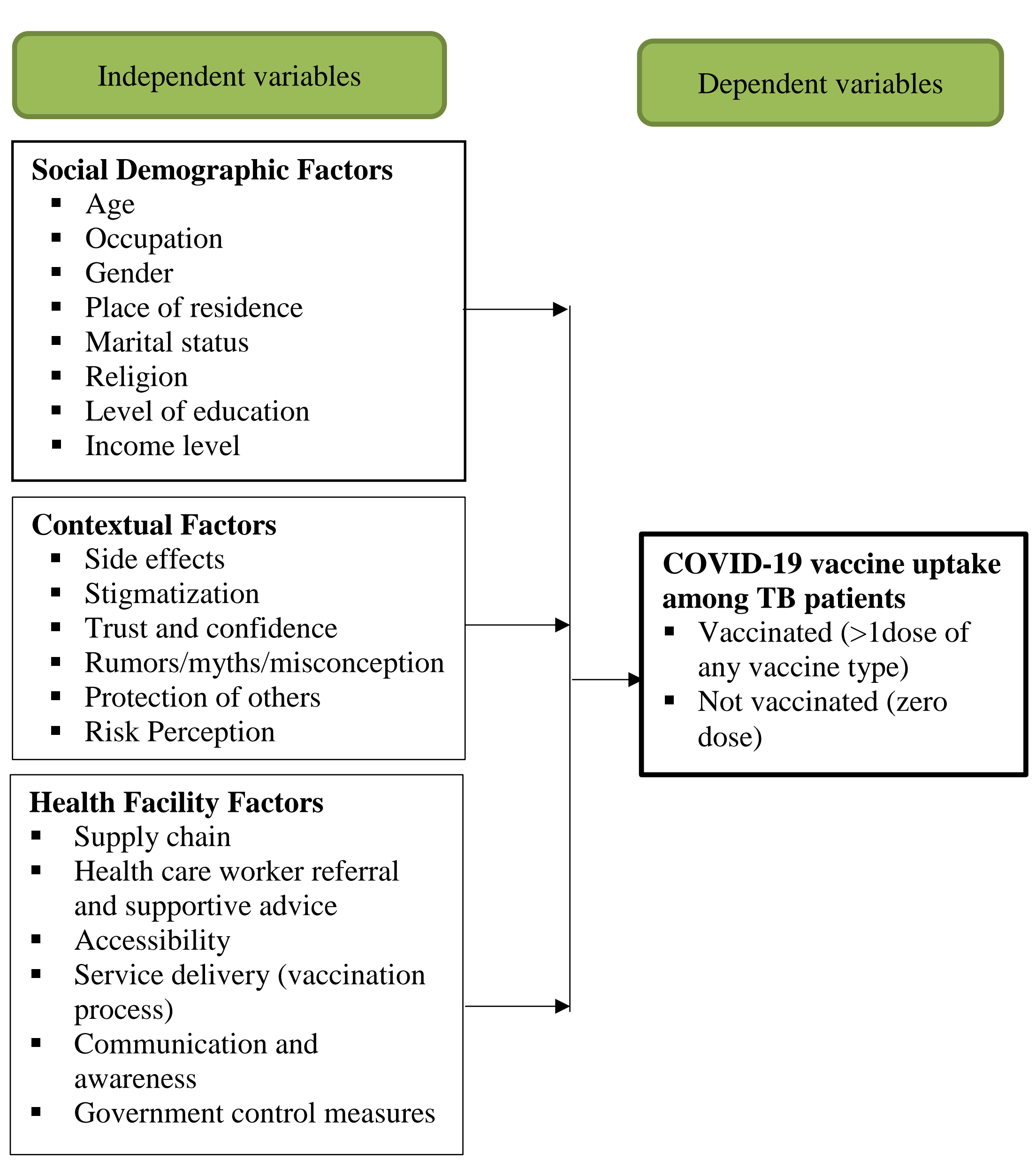


**Figure 2.1 Conceptual Framework**

# CHAPTER THREE

# MATERIALS AND METHODS

## 3.1 Study Area

The study was conducted at a tuberculosis clinic in six sub-counties of Nairobi County, Kenya's capital city, with an estimated population of 4.4 million people, 6,247/km² population density, which is the highest in the country. There was a 3.4% annual population change from the 2009-2019 census and a land area of 703.9 square kilometers.

Nairobi is the capital city and one of the 47 semi-autonomous counties in the country. The current study took place in the County of Nairobi because nearly 80% of COVID-19 cases in Kenya were reported from this area at the onset of the outbreak. The County had over 1000 registered health facilities.

The following TB clinics with high TB population on treatments from the six sub counties across Nairobi County was purposively selected as study sites with their approximate GPS coordinates (latitude and longitude) for reference and navigation:

i. St. Mary's Mission hospital in Langata sub-county, located at approximately -1.3058, 36.8230.
ii. Riruta health Centre in Dagoreti, at approximately -1.2878, 36.7411.
iii. Special treatment clinic (Rhodes chest clinic) in Starehe, at approximately -1.2889, 36.8225.
iv. Mama Lucy Kibaki hospital in Embakasi, at approximately -1.2740, 36.8987.
v. MMM Mukuru health centre in Embakasi West Sub-County, at approximately -1.3253, 36.8854.
vi. Kahawa West Health Centre in Ruaraka Sub-County, at approximately -1.1872, 36.9030. 3.2 Study Design

The facility based cross-sectional design was utilized for the study, complemented by a mixed-method approach to provide a comprehensive understanding of the

determinants of COVID-19 vaccine uptake. The design was adopted as it depicts the prevalence of Covid-19 vaccine uptake at single point in time and collect data on social demographic, contextual and health facility factors influencing the uptake. The trained research assistants facilitated the data collection process at all six study sites concurrently. Pretested semi-structured questionnaires were administered electronically through face-to-face interviews with eligible and consenting tuberculosis patients. The data collection phase spanned a duration of 4 weeks.

### 3.3 Study Variables

The primary outcome, or dependent variable, in this study was the uptake of the COVID-19 vaccine among adult tuberculosis patients attending selected clinics in Nairobi County, Kenya. It was measured through self-reported data collected via a structured questionnaire during face-to-face interviews: The covid-19 vaccine uptake among adult TB patients was measured using the question: "Have you received Covid-19 vaccine?" This close-ended question which indicated the uptake which was answered as either "Yes" or "No".

The independent variables were assessed primarily through the structured questionnaire-based interviews, capturing a mix of socio-demographic factors (age, gender, occupation, marital status, education level, religion, and income) which were measured using direct questions with predefined categories (e.g., age in years or grouped brackets, gender as male/female/other, education as no formal education/primary/secondary/tertiary, income as monthly household earnings in Kenyan shillings or brackets). Contextual factors such as perceived side effects and risk perception related to COVID-19, stigmatization, trust and confidence, protection of others, myths and misconceptions were measured using Likert-scale question (e.g. to large extent, small extent, and not all) responses to statements adapted from health belief models, allowing for quantification of attitudes and perceptions. Facility-Level factors, including availability of supplies (vaccine stocks and variety), accessibility (geographical proximity), communication and awareness, healthcare worker referral and supportive advice, service delivery (vaccination process) and government control

measures were assessed through patient-reported experiences via scaled responses (e.g., availability rated as not at all, to small extent, and to large extent. The 3-likert scale of large extent and small extent was categorized as “Had influence” while not at all was categorized as “No influence”.

The association was measured through bivariate logistic regression to each independent variable separately against the dependent variable. Variables showing an association at a significance level of $p < 0.1$ were subsequently included in a multivariate logistic regression model to control for potential confounders. Final results were expressed as Adjusted Odds Ratios (AORs), with statistical significance maintained at $p < 0.1$.

## 3.3 Study Population

The target population comprised adult tuberculosis patients, both males and females, attending selected TB clinics within Nairobi County. The study specifically concentrated on 4,369 tuberculosis patients undergoing treatment between May and November 2023, as recorded in the Tuberculosis Information Basic Unit (TIBU) database by the County.

### 3.3.1 Participants Eligibility Criteria

#### Inclusion Criteria

i. For quantitative and FGD discussants:
    - All adult (age 18 years and above) and both Male and female TB patients attending selected clinics who provided written consent were eligible in the study

ii. For KII informants, it included the nurses or clinicians at TB clinics/vaccination center.

#### Exclusion Criteria

1. Participants who were newly diagnosed with tuberculosis or had just started treatment on the day the data was collected.

2. Participants who were too ill to take part in the interview.
3. Participants who refuse/didn't state whether he/she had received Covid-19 vaccine. This category (refusal) were replaced immediately at data collection points to achieve determined sample size at that specific TB clinics therefore, such number was not determined.
4. Participants who were unable to communicate.

### 3.4 Sample Size Determination

Sample size was determined using Cochran (1977).

$$n_o = \frac{z^2pq}{e^2}$$

Where no is the sample size, z is the selected critical value of the desired confidence level, p is the estimated proportion of an attribute that is present in the population, q=1-p, and e is the desired level of precision. Assuming the maximum variability, which is equal to 50% (p =0.5), and taking a 95% confidence level with ±5% precision.

From Kenya Covid-19 Vaccination Program- Daily Situation Report as of 19th September, 2022. Covid-19 vaccination coverage in Nairobi County is 53% but no vaccination data among TB patients, thus a 50 % proportion is used to get the maximum number.

p = 0.5 and hence q =1-0.5 = 0.5; e = 0.05; z =1.96 95% confidence level with ±5% precision.

So, $n_o = \frac{(1.96^2)(0.5)(0.5)}{0.05^2}$ =384

The sample size was calculated at a 95% confidence level with a margin of error equal to 0.05. In this case, the representative sample size for the study was 384. Cochran also

proposed a correction formula to calculate the final sample size for population less than 10,000.

$$n = \frac{n_o}{1 + \frac{(n_o - 1)}{N}}$$

Here, no is the sample size derived from the equation above, and N is the population size. To calculate the population, the final sample size for the population in the study was the population size of tuberculosis patients in Nairobi county, N = 4369, and no = 384 is as follows;

n = 384 / 1+ (384 -1 / 4369) =353

This was adjusted upward by 10% (35), covering the case of non-response; therefore, the final sample size for quantitative arm were 388 participants for feasibility considerations and representativeness of the selected sample.

For interviews the participant were selected purposively where 9 health care workers at TB clinics/EPI centers from 5 sites participated in KII while total of 46 TB patients were engaged in focus group discussion. Data saturation was reached after 5KIIs and 4 FDGs and further discussion halted.

### 3.5 Sampling Procedures

Nairobi County was selected due high TB burden in Kenya which ensured representativeness among the study population of TB patients. Then purposive sampling was used to select six high-volume TB clinics across six different sub-counties in Nairobi County, chosen for their substantial patient loads and ability to provide adequate representation of the urban TB patient population. Probability proportional to size (PPS) sampling was then applied to allocate the total sample size (388) across these facilities, with the proportion determined by each clinic's average monthly or annual TB patient attendance (obtained from facility records). This ensured

that larger facilities contributed a proportionally larger number of participants (Appendix VIII).

Once the required sample size for each health facility offering TB services or serving as a TB treatment site was determined, the respondents were selected using a simple random sampling technique. During triage, health talk sessions and on awaiting bay, the present patients who consented to participants were assigned numerical number, each patient's unique number was placed in the lottery-based selection for eligible study participants on the designated clinic day. To reach the predetermined facility-specific quota while accounting for refusals (estimated at 20-30% based on pilot observations), a buffer of additional patients was identified in advance. Eligible adult TB patients (aged ≥18 years) who consented were interviewed after their clinical consultation or during waiting periods.

This simple random approach minimized selection bias, ensured feasibility within the clinic workflow, and allowed the study to achieve the targeted sample distribution across all study TB clinics. The probability proportional to size (PPS) allocation of the sample to each facility and data collection performance per week illustrated the distribution strategy for optimal representation.

For the Focus Group Discussions (FGDs), participants were selected purposefully during clinic days, as they awaited services, ensuring those not already interviewed in the same study were included. Key Informant Interview (KII) participants were purposefully selected to provide expert insights and perspectives relevant to the research objectives.

### 3.6 Data Collection Tools

Quantitative data was collected using a semi-structured questionnaire (Appendix III) while qualitative data collection tools included Focus Group Discussion (Appendix IV) guides and Key Informant Interviews (Appendix V).

### 3.7 Validity, Reliability, and Pre-Testing of the Tools

To ensure the validity and reliability of the data collection tools, several rigorous steps were undertaken in line with established research methodologies, as recommended by Kothari (2004). Validity and reliability of questionnaire was primarily guaranteed through pre-testing of the structured questionnaire and semi-structured guides for Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs). Pre-testing involved administering the instruments to a representative sample of 12 participants (representing 3.1% of the intended study sample), selected from Thika Level 5 Hospital in Kiambu County. This site was chosen due to its demographic and socioeconomic similarities to the study population in Nairobi County, allowing for an accurate assessment of the tools' feasibility, question clarity, adequacy, and alignment with the research objectives without contaminating the main study sample. The Cronbach alpha for the tool was 0.85, which is within the accepted 0.7 reliability (Tavakol & Dennick, 2011).

During the pre-test, feedback focused on the questionnaire's clarity, length, completeness, and logical flow. A subsequent review meeting with the research assistants led to targeted refinements, including rephrasing and re-ordering of questions, replacement of ambiguous terms, addition of explanatory notes, and technical adjustments such as using web links for data entry instead of downloading the KoBoCollect application. These modifications enhanced content validity by ensuring that the tools accurately captured the intended constructs related to COVID-19 vaccine uptake, socio-demographic factors, contextual factors and facility-level influences.

To assess reliability, which refers to the consistency and stability of the instruments over time, a test-retest method was employed. The same questionnaire was administered twice to the same pretest participants before and after covid-19 vaccination exercise. The consistency of responses across these two time points provided an indication of the instrument’s temporal reliability

Reliability was further strengthened through the recruitment and comprehensive training of eight research assistants. A two-day training session covered the study objectives, ethical considerations, effective interview techniques, accurate questionnaire administration, and strategies for handling respondent queries, thereby minimizing interviewer bias and ensuring consistent data collection across all sites. For the quantitative component, daily supervision by the principal investigators involved verifying submitted online responses for completeness, consistency, and accuracy, with immediate corrections applied as needed. Qualitative tools, including audio recordings and semi-structured guides, incorporated built-in consent forms and confidentiality statements to promote trustworthy responses. Overall, these measures pre-testing, iterative refinement, standardized training, and ongoing supervision collectively guaranteed the validity and reliability of the data collection instruments, enhancing the overall quality and credibility of the study findings.

### 3.8 Data Collection Process

A semi-structured electronic questionnaire was administered by the principal investigator with the assistance of research assistants. To enhance standardization and reduce potential bias, clerk was recruited from diploma or degree graduate in health specialties. Each research assistant was taken though two days intensive training on study objectives, ethical procedures, questionnaire administration, consenting and data entry. One research assistants were assigned per facility, except at Mama Lucy Kibaki Hospital and Rhodes Chest Clinic (2 research assistants) due to higher patient volumes and allocated quotas.

For the qualitative component, five key informant interviews (KIIs) were conducted with TB clinic managers and vaccination center heads, they were purposively selected for their oversight roles and in-depth knowledge. Additionally, four focus group discussions (4 FGDs) were held, with an average of 8-12 adult TB patients. Their recruitment was purposefully undertaken to get diverse population strata, gender and those that provided informed consent.

All KII and FGD participants were provided with two-week notification (entailing research objective, questions and consenting) via soft copy and hardcopy to each study site/TB clinics). Verbal and written informed consent explicitly included permission to audio-record the sessions, with participants reminded that recordings would be used solely for transcription and analysis, stored securely, and anonymized. No recordings proceeded without explicit consent, and participants were free to opt out of recording while still participating. Sessions, which were conducted in English and Kiswahili languages, lasted 20-60 minutes, were audio-recorded with consent, transcribed verbatim by hand, and manually analyzed thematically by the investigator. Qualitative findings were triangulated with quantitative results to provide a comprehensive understanding of factors influencing COVID-19 vaccine uptake.

### 3.9 Data Analysis and Management

Quantitative data were cleaned, coded, and initially organized using Microsoft Excel before being imported into IBM SPSS Statistics (Version 26) for comprehensive analysis. Descriptive statistics were used to summarize the socio-demographic and clinical characteristics of the study participants, with categorical variables presented as frequencies and percentages, and continuous variables (e.g., age, income) summarized using means and standard deviations or medians and interquartile ranges where data were non-normally distributed.

Inferential analysis employed logistic regression models to identify factors associated with the primary outcome: COVID-19 vaccine uptake (defined dichotomously as "vaccinated" [received at least one dose] versus "unvaccinated," with a secondary analysis for complete vaccination). The modeling followed a sequential approach to ensure robust identification of independent predictors while controlling for potential confounders.

First, bivariate logistic regression (unadjusted analysis) was conducted for each independent variable separately against the dependent variable. This involved simple logistic regression for each predictor, yielding crude odds ratios (OR) with 95% confidence intervals (CI) and p-values. Variables showing an association at a

significance level of $p < 0.1$, in line with recommendations by Hosmer et al. (2013) to avoid excluding potentially important confounders, were considered candidates for multivariate analysis. This threshold served as the interface between bivariate and multivariate stages, allowing inclusion of variables with suggestive evidence of association while minimizing the risk of overlooking confounders that might become significant after adjustment.

Subsequently, multivariate logistic regression (adjusted analysis) was performed using a hierarchical or stepwise entry approach. All candidate variables from the bivariate stage were initially entered into the model, followed by backward elimination or manual adjustment to retain variables that remained significant ($p < 0.1$) or acted as confounders (causing ≥10% change in the odds ratios of key exposure variables). The final multivariable model included socio-demographic factors (entered first as potential confounders), followed by contextual factors, and then facility-level factors. This hierarchical structure reflected the socio-ecological framework underpinning the study, enabling assessment of the independent contribution of each factor level while adjusting for others. Adjusted odds ratios (aOR) with 95% CI and p-values were reported. Results were presented in tables showing both crude and adjusted associations.

Qualitative data from key informant interviews and focus group discussions were analyzed using a deductive thematic approach guided by a predefined codebook derived from the literature and study objectives (e.g., codes related to perceived risk, stigma, accessibility, and healthcare worker influence). Audio recordings were transcribed verbatim, and transcripts were manually coded line-by-line by the principal investigator. Themes and sub-themes were identified, refined through iterative reading, and illustrated with representative quotes. Triangulation was achieved by integrating qualitative findings with quantitative results—quantitative associations were contextualized and explained using qualitative insights to provide a comprehensive understanding of enablers and barriers to COVID-19 vaccine uptake among TB patients in Nairobi County. Mixed-methods convergence was reported using a joint display approach where applicable.

### 3.10 Ethical Considerations

The study adhered strictly to ethical principles outlined in the Declaration of Helsinki and local guidelines for research involving human participants. Ethical clearance and research permits were obtained from multiple oversight bodies to ensure comprehensive institutional approval. Specifically, the research protocol was reviewed and approved by the Jomo Kenyatta University of Agriculture and Technology Institutional Scientific and Ethics Review Committee (ISREC) under reference JKU/2/4/896B (Appendix IX). Further authorization was granted by the National Commission for Science, Technology, and Innovation (NACOSTI) vide license number NACOSTI/P/23/24637 (Appendix X), which is mandatory for all research conducted in Kenya. At the county level, approval was obtained from the Nairobi City County Government Department of Health Services to permit access to public health facilities within the county (Appendix XI). Finally, institutional permissions were secured individually from the medical superintendents or administrators of each participating facility: St. Mary's Mission Hospital (Langata), Riruta Health Centre (Dagoretti), Rhodes Chest Clinic (Starehe), Mama Lucy Kibaki Hospital (Embakasi), MMM Mukuru Health Centre (Embakasi West), and Kahawa West Health Centre (Ruaraka). These layered approvals ensured that the study complied with national, county, and facility-specific ethical and operational requirements.

Informed consent was obtained from all participants prior to any data collection to uphold the principles of voluntariness, comprehension, and autonomy. The process began with trained research assistants providing potential participants with a clear verbal explanation of the study in their preferred language (English or Kiswahili), covering the purpose, procedures, potential risks (minimal, such as time commitment or emotional discomfort from discussing health issues), benefits (contribution to improved health services), and rights as participants. A printed information sheet detailing this information was then provided for review. Participants were given ample time to ask questions, which were addressed thoroughly. For the quantitative component, eligible adult TB patients who agreed to participate signed (or thumb-printed if illiterate, with a witness) a written informed consent form before the

interview commenced. For qualitative components, including key informant interviews (KIIs) and focus group discussions (FGDs), separate consent forms were used, which explicitly included permission for audio recording. Participants were informed that recordings would be used only for transcription and analysis, stored securely, and destroyed after the study. Verbal consent was also reaffirmed at the start of each recorded session. No data collection proceeded without documented consent, and participants were reminded at multiple points of their right to withdraw at any time without consequences to their medical care.

To avert research malpractices and ensure integrity, several measures were implemented. All research assistants underwent mandatory training on research ethics, including avoidance of coercion, fabrication, falsification, or plagiarism. Daily supervision by the principal investigator involved real-time verification of submitted electronic data for completeness and plausibility, with any discrepancies promptly investigated and corrected. Anonymity was maintained by assigning unique study IDs without linking personal identifiers to responses. In other words, no names or direct identifiers were recorded in questionnaires or transcripts. Confidentiality was protected through secure data handling: electronic data were entered directly into password-protected devices and uploaded to encrypted cloud storage accessible only to the investigator, while hard copies (consent forms) were stored in locked cabinets at the principal investigator's institution. Audio recordings were transcribed without identifiers and deleted after verification. Potential conflicts of interest were declared (none existed), and the study avoided any incentives that could unduly influence participation. Regular debriefings with research assistants monitored adherence to protocols, and any protocol deviations would have been reported to the ethics committees. These safeguards collectively minimized risks of misconduct, protected participant welfare, and upheld the scientific validity of the study.

# CHAPTER FOUR

# RESULTS

## 4.1 Results Overview

The data were successfully collected from all six selected study sites (Mama Lucy Kibaki Hospital, St. Mary's Mission Hospital, Riruta Hospital, Rhodes Chest Clinic, Kahawa West Hospital, and Mukuru Health Center), all from Nairobi County. In total, 388 participants were engaged in the quantitative study, all completing the questionnaires. All 388 participants were included in the data analysis and the findings reported herein.

## 4.2 Baseline Sociodemographic Characteristics

As presented in ***Table 4.2*** below, the mean age of the respondents was 37.35 ± 11.61, most of whom were aged 20 – 35 years (48.7%, N = 189), followed by those aged 36 - 50 years (34.8%, n = 135). The smallest proportion of participants was aged > 65 years (1.5%, n = 6). 63.4% (n = 246) of the participants were male, and (54.6%, n = 212) were married. 47.2% (n = 183) had a secondary level of education. Employment status was 36.6% (n = 142) unemployed, 32.5% (n = 126) formally employed, and 30.9% (n = 120) self-employed. 74.7% (n = 290) earned less than 20000 KES a month. 37.6% (n = 146) lived in Embakasi West, 87.9% (n = 341) were Christians, and 74.5% (n = 289) visited government facilities.

**Table 4.1 Baseline Sociodemographic Characteristics**

| Variable | Frequency (n = 388) | Percentage (100%) |
|---|---|---|
| Age | | |
| < 20 years | 07 | 1.8% |
| 20 – 35 Yrs. | 189 | 48.7% |
| 36 – 50 Yrs. | 135 | 34.8% |
| 51 – 65 Yrs. | 51 | 13.1% |
| > 65 Yrs. | 6 | 1.5% |
| *Mean Age* | *37.35 ± 11.614* | |
| Sex | | |
| Female | 142 | 36.6% |
| Male | 246 | 63.4% |
| Marital Status | | |
| Single | 135 | 34.8% |
| Separated/Widowed | 41 | 10.6% |
| Married | 212 | 54.6% |
| Level of Education | | |
| No Formal | 16 | 4.1% |
| Primary | 102 | 26.3% |
| Secondary | 183 | 47.2% |
| Tertiary | 87 | 22.4% |
| Employment Status | | |
| Unemployed | 142 | 36.6% |
| Self-employed | 120 | 30.9% |
| Formal employment | 126 | 32.5% |
| Monthly Income | | |
| ≤ Ksh. 20000 | 290 | 74.7% |
| Ksh.20001 – 50000 | 70 | 18.0% |
| Ksh. 50001 – 100000 | 28 | 7.2% |
| Residency Sub-County | | |
| Embakasi West | 146 | 37.6% |
| Starehe | 65 | 16.8% |
| Langata | 55 | 14.2% |
| Dagoreti | 52 | 13.4% |
| Embakasi East | 46 | 11.9% |
| Ruaraka/Roysambu | 24 | 6.2% |
| Religion | | |
| Christians | 341 | 87.9% |
| Muslims | 42 | 10.8% |
| Others | 5 | 1.3% |
| TB Centre Type Attendance | | |
| Government Facility | 289 | 74.5% |
| Private Facility | 57 | 14.7% |
| Faith-Based Facility | 42 | 10.8% |

### 4.3 The Prevalence of COVID-19 Vaccinated Adult Tuberculosis Patients

As of November 2023, 46.1% (n = 179) of TB patients attending clinics in Nairobi health facilities had received the COVID-19 vaccination, but only 38.1% (n = 148) had been fully vaccinated. These results are presented in ***Figure 4.3a*** below.

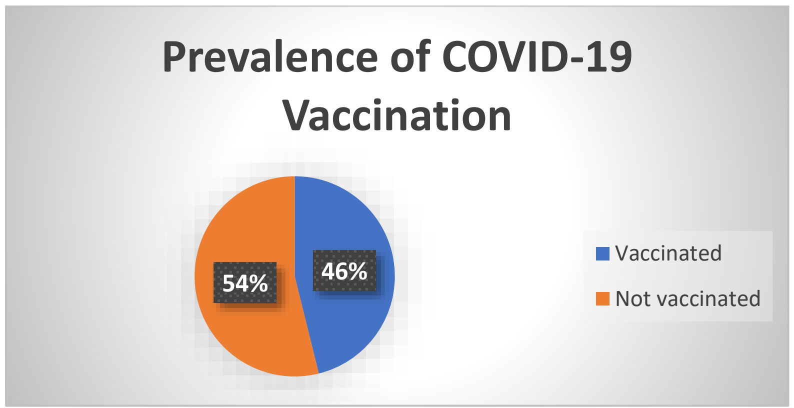


**Figure 4.1 Prevalence of Persons on TB Treatment Vaccinated for COVID-19**

Further analysis on the Covid-19 vaccine uptake, as shown in ***Figure 4.3b*** below, revealed that most of those vaccinated persons received the AstraZeneca vaccine 45.3% (N = 81/179) followed by Johnson& Johnson vaccine 27.4% (N = 49/179), Pfizer vaccine 17.8% (N = 32/179), Moderna vaccine 8.9% (N = 16/179), and only one person had taken Sinopharm vaccine 0.6% (N = 1/179)

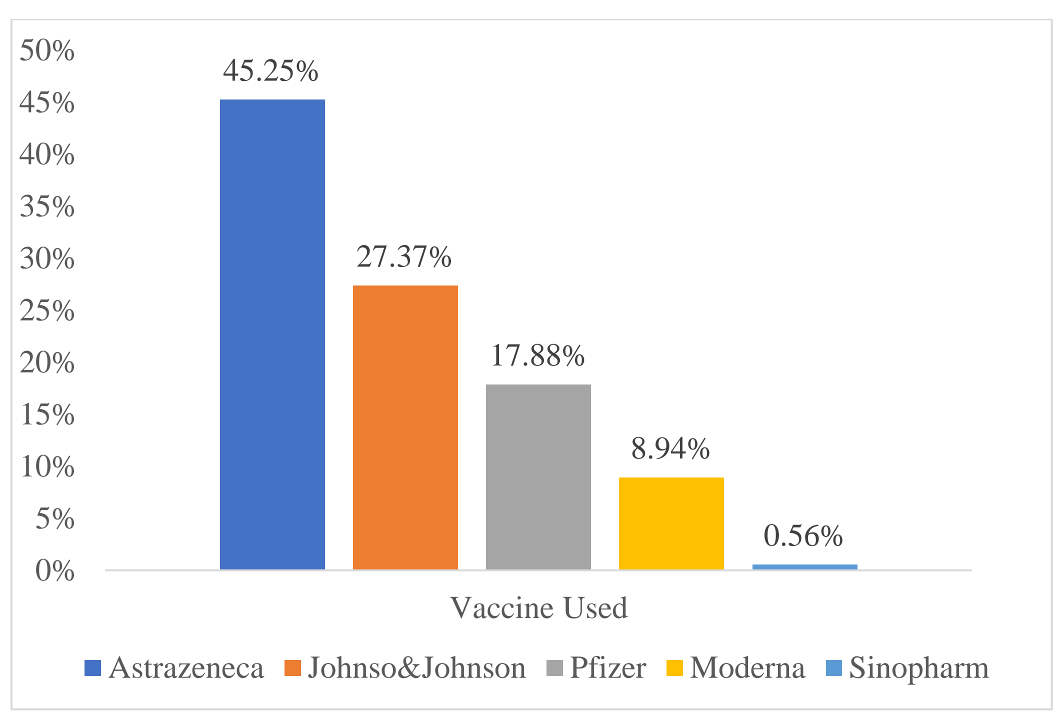


**Figure 4.2 Covid-19 Vaccine Uptake among TB Patients**

The distribution of vaccine received by dosages is as presented in ***Figure 4.3c*** below. The most used single dose was J&J, followed by AstraZeneca.

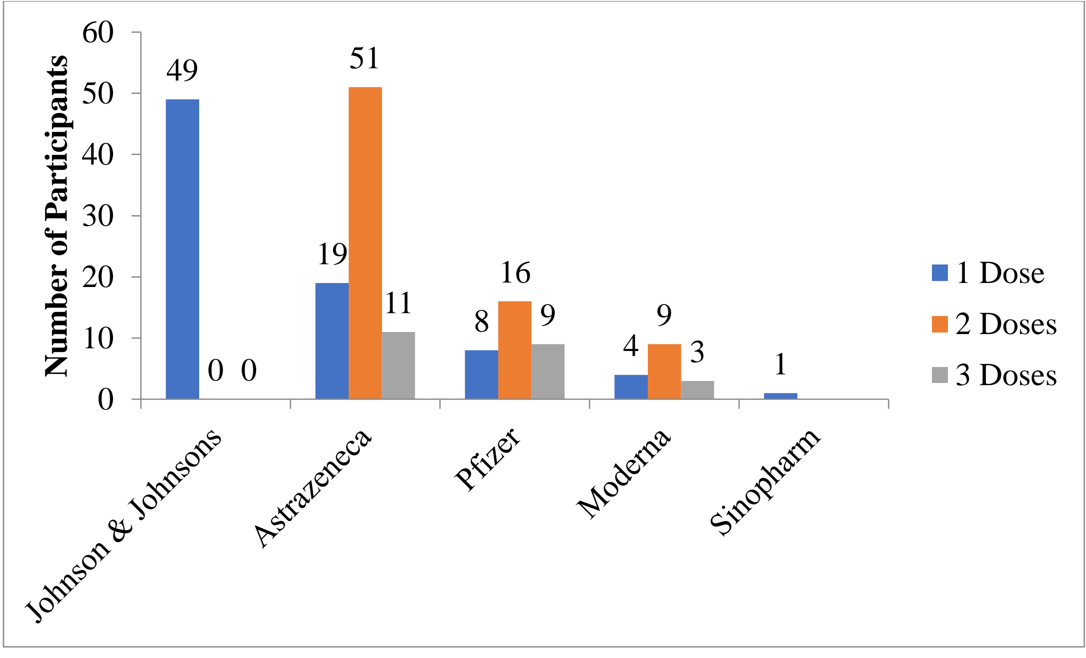


**Figure 4.3 Vaccine Received by Dosage**

The prevalence based on sociodemographic factors is presented in Figure 4.3c below. Each of the participants' sociodemographic characteristics presented uniquely in terms of the proportion of vaccine uptake.

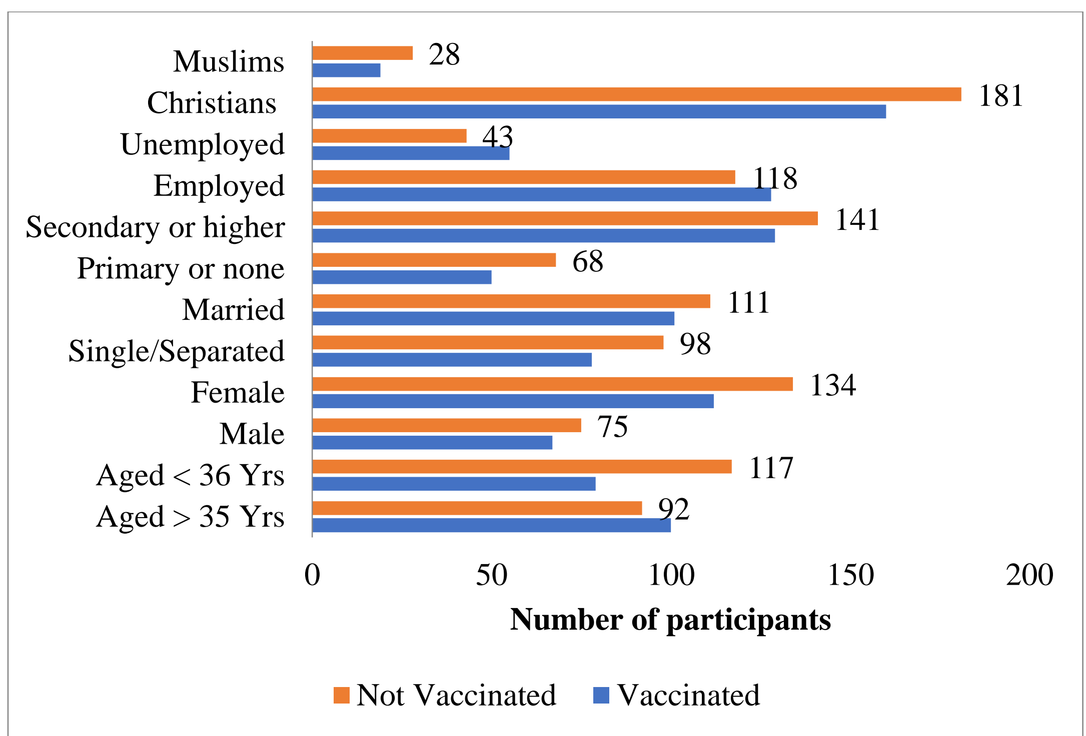


**Figure 4.3 Prevalence Based on Sociodemographic Characteristics**

## 4.4 Socio-Demographic Factors Linked to Covid-19 Vaccine Uptake

After running a simple logistic regression for the bivariate association, the socio-demographic factor variables with statistical significance ($p < 0.05$), including age, occupation, and estimated monthly income, were included in a multivariable logistic regression for the adjusted odds ratio. Age (adjusted odds ratio (aOR) = 1.891; 90% CI: 1.185-3.427; p = 0.03) and occupation (aOR = 2.716; 90%CI: 1.096 – 6.726, p = 0.031) were statistically significantly associated with COVID-19 vaccine uptake. Gender, marital status, highest education level, occupation, estimated monthly income, and religion were insignificantly associated with COVID-19 vaccine uptake at both levels, as shown in Table 4.2.

These findings were strongly corroborated by qualitative evidence, which provides explanatory depth regarding why these socio-demographic factors influenced uptake. Qualitative data consistently showed that older adults and individuals with underlying conditions were widely perceived as being at higher risk of severe COVID-19 outcomes. This perception motivated both self-vaccination and vaccination of household members, particularly among TB patients who recognized compounded vulnerability due to respiratory illness. Participants described vaccination decisions as protective actions directed toward elderly family members, reinforcing the quantitative finding that increasing age was associated with higher vaccine uptake.

"*My mother said we must get vaccinated to protect my father who is seventy.*" (FGD 4)

The quantitative association between occupation and vaccine uptake was robustly triangulated with qualitative themes related to workplace exposure and institutional requirements. Participants in occupations involving frequent public interaction, such as drivers, market vendors, and health workers, reported higher uptake due to both perceived infection risk and employer mandates.

"*I am a driver, I carry many people every day, so the vaccine is necessary.*" (FGD 4)

Additionally, health workers and individuals in formal employment described vaccination as mandatory for continued work or access to services, which directly explains the higher adjusted odds observed quantitatively.

"*In the hospital it was mandatory for us to get vaccinated.*" (FGD 2)

Although estimated monthly income did not remain statistically significant in the multivariable model, qualitative findings provide important contextual insights. Participants from lower socio-economic backgrounds reported barriers related to health system navigation, including difficulties with registration requirements, documentation, and access to digital platforms.

"*Most of our clients live in the slum… some cannot even complete registration.*" (KII 1)

**Table 4.2 Association between Vaccination and Sociodemographic Factors**

| Variable | Vaccinated (N = 179) | Not Vaccinated (N = 209) | Odds Ratio (90% CI) | P Value | Adjusted Odds Ratio (aOR) ( 90% CI) | P Value |
|---|---|---|---|---|---|---|
| Age<br>..> 35 Yrs.<br>..≤ 35 Yrs. | 100 (55.9%)<br>79 (44.1%) | 92 (44.0%)<br>117 (56.0%) | 1.6 (1.077 – 2.406) | 0.025 | 1.891 (1.185 – 3.427) | 0.03* |
| Sex<br>..Female<br>..Male | 67 (37.4%)<br>112 (62.6%) | 75 (35.9%)<br>134 (64.1%) | 1.1 (0.706 – 1.617) | 0.833 | - | - |
| Marital Status<br>..Single/Separated<br>Married | 78 (43.6%)<br>101 (56.4%) | 98 (46.9%)<br>111 (53.1%) | 0.9 (0.588 – 1.307) | 0.540 | - | - |
| Highest Education Level<br>Primary or None<br>Secondary or Higher | 50 (27.9%)<br>129 (72.1%) | 68 (32.5%)<br>141 (67.5%) | 0.8 (0.520 – 1.243) | 0.376 | - | - |
| Occupation<br>..Formal/Self<br>..Employed<br>..Unemployed | 128 (71.5%)<br>51 (28.5%) | 118 (56.5%)<br>91 (43.5%) | 1.9 (1.266 – 2.959) | 0.002 | 2.716 (1.096 – 6.726) | 0.031* |
| Estimated Monthly Income<br>..> Ksh. 20,000<br>..≤ Ksh. 20,000. | 55 (30.7%)<br>124 (69.3%) | 43 (20.6%)<br>166 (79.4%) | 1.7 (1.079 – 2.717) | 0.026 | 0.893 (0.348-2.291) | 0.814 |
| Religion<br>Christians<br>Muslims or Other | 160 (89.4%)<br>19 (10.6%) | 181 (86.6%)<br>28 (13.4%) | 1.3 (0.701 – 2.422) | 0.438 | - | - |

## 4.5 Contextual Factors Associated with Covid-19 Vaccine Uptake

In assessing the association between vaccination and contextual factors, we first evaluated the bivariate association by running a simple logistic regression to identify the odds ratio and p-value. Variables with statistically significant bivariate association were fed into the multivariable logistic regression model to control for confounders and identify the adjusted odds ratio (aOR), and the findings are summarized in Table 4.3 below.

Lack of trust in the government's handling of COVID-19 vaccination emerged as the strongest independent barrier to uptake, with individuals expressing mistrust having a 93.5% reduction in the odds of vaccination (aOR = 0.065; 90% CI: 0.02–0.212; p < 0.001). This quantitative effect was supported by qualitative data, where mistrust was pervasive across all FGDs and KIIs. Participants repeatedly expressed skepticism toward government motives, doubts regarding transparency, and suspicions that political leaders received "different" or "safer" vaccines.

"*People said the leaders got something special, not what we were to get."* (FGD 3)

Quantitatively, perceiving TB as a risk for COVID-19 was associated with lower odds of vaccination (aOR = 0.445; 90% CI: 0.171–1.162; p = 0.098). Qualitative findings provide critical interpretive insight into this counterintuitive direction. While participants acknowledged that TB increases vulnerability, many believed that concurrent illness or TB treatment contraindicated vaccination, leading to postponement or refusal.

"*Most TB patients on treatment decline the vaccine… they think they must finish the drugs first*." (KII 1)

Quantitative results indicated that TB and COVID-19–related stigma nearly tripled vaccine uptake (aOR = 2.973; 90% CI: 0.828–10.68; p = 0.095). This finding was strongly reinforced by qualitative evidence, which showed that stigma operated paradoxically as a motivator for vaccination. Participants described vaccination as a strategy to avoid quarantine, isolation, or community labeling as infectious.

"*People will isolate you… even give you separate cups."* (FGD 4)

Perceiving oneself as vulnerable to COVID-19 was a significant positive predictor of vaccine uptake, with affected individuals being nearly three times more likely to vaccinate (aOR = 2.420; 90% CI: 1.384–8.449; p = 0.008). Qualitative data provided clear convergence, with participants who had experienced COVID-19 illness,

witnessed deaths, or had underlying conditions reporting heightened fear and urgency to vaccinate.

"*I saw someone die… that pushed me to get vaccinated.*" (FGD 3)

Viewing COVID-19 as a serious threat increased the odds of vaccination more than threefold (aOR = 3.294; 90% CI: 0.958–8.624; p = 0.06). Qualitative findings corroborated this pattern. Participants recalled rapid deaths, undignified burials, and overwhelmed health facilities during peak pandemic periods, all of which heightened fear and motivated uptake.

"*Seeing people buried quickly in plastic scared me into taking the vaccine.*" (FGD 4)

**Table 4.3 Association between Vaccination and Contextual Factors**

| Variables | Vaccinated (N = 179) | Not Vaccinated (N = 209) | Odds Ratio (OR) (90% CI) | P Value | Adjusted Odds Ratio (aOR) 90% CI) | P Value |
|---|---|---|---|---|---|---|
| Feared of Side Effects | | | | | | |
| Had Influence | 152 (84.9%) | 177 (84.7%) | 1.02 (0.584 – 1.775) | 1.000 | - | - |
| No Influence | 27 (15.1%) | 32 (15.3%) | | | | |
| Myths/Misconceptions | | | | | | |
| Had Influence | 133 (74.3%) | 182 (87.1%) | 0.43 (0.254 – 0.725) | 0.002 | 0.909 (0.269-3.071) | 0.878 |
| No Influence | 46 (25.7%) | 46 (25.7%) | | | | |
| Stigma on TB and COVID-19 | | | | | | |
| Had Influence | 136 (76.0%) | 176 (84.2%) | 0.59 (0.358 – 0.983) | 0.054 | 2.973 (0.828-10.68) | 0.095* |
| No Influence | 43 (24.0%) | 33 (15.8%) | | | | |
| | | Confidence Level | | | | |
| Mistrust on Vaccine | | | | | | |
| Had Influence | 99 (55.3%) | 181 (86.6%) | 0.19 (0.117 – 0.314) | < 0.001 | 0.820 (0.295-2.285) | 0.705 |
| No Influence | 80 (44.7%) | 28 (13.4%) | | | | |
| Possibility of Future S/Effects | | | | | | |
| Had Influence | 126 (70.4%) | 181 (86.6%) | 0.37 (0.221 – 0.613) | < 0.001 | 1.529 (0.495-4.728) | 0.461 |
| No Influence | 53 (29.6%) | 28 (13.4%) | | | | |
| Thought of Vaccine Profiteers | | | | | | |
| Had Influence | 109 (60.9%) | 168 (80.4%) | 0.38 (0.241 – 0.599) | < 0.001 | 0.682 (0.262-1.776) | 0.433 |
| No Influence | 70 (39.1%) | 41 (19.6%) | | | | |

| Variables | Vaccinated (N = 179) | Not Vaccinated (N = 209) | Odds Ratio (OR) (90% CI) | P Value | Adjusted Odds Ratio (aOR) 90% CI) | P Value |
|---|---|---|---|---|---|---|
| Prefer Natural Immunity<br>Had Influence<br>No Influence | 104 (58.1%)<br>75 (41.9%) | 147 (70.3%)<br>62 (29.7%) | 0.59 (0.384 – 0.890) | 0.014 | 0.918 (0.389- 2.165) | 0.844 |
| Prefer Alternative Medicines<br>Had Influence<br>No Influence | 112 (62.6%)<br>67 937.4%) | 137 (65.6%)<br>72 (34.4%) | 0.88 (0.580 – 1.332) | 0.596 | - | - |
| Mistrust of Government Vaccine Management<br>Had Influence<br>No Influence | 98 (54.7%)<br>81 (45.3%) | 191 (91.4%)<br>18 (8.6%) | 0.11 (0.065 – 0.201) | < 0.001 | 0.065 (0.02- 0.212) | < 0.001* |
| Protection of others | | | | | | |
| The potential to Protect Others<br>Had Influence<br>No Influence | 159 (88.8%)<br>20 (11.2%) | 107 (51.2%)<br>102 (48.8%) | 7.58 (4.424 – 12.983) | < 0.001 | 1.197 (0.453- 3.160) | 0.717 |
| Risk perception | | | | | | |
| Perceived Covid-19 Susceptibility<br>Had Influence<br>No Influence | 153 (85.5%)<br>26 (14.5%) | 88 (42.1%)<br>121 (57.9%) | 8.09 (4.916 – 13.317) | < 0.001 | 3.420 (1.384- 8.449) | 0.008* |
| Perceived Covid-19 Seriousness<br>Had Influence<br>No Influence | 159 (88.8%)<br>20 (11.2%) | 84 (40.2%)<br>125 (59.8%) | 11.83 (6.887 – 20.322) | < 0.001 | 2.874 (0.958- 8.624) | 0.06* |
| Likelihood of more Covid-19 Waves<br>Had Influence<br>No Influence | 154 (86.0%)<br>25 (14.0%) | 71 (34.0%)<br>138 (66.0%) | 11.97 (7.187 – 19.947 | < 0.001 | 0.712 (0.260- 1.953) | 0.510 |
| Tested Positive<br>Had Influence<br>No Influence | 74 (41.3%)<br>105 (58.7%) | 23 (11.0%)<br>186 (89.0%) | 5.70 (3.370 – 9.640) | < 0.001 | 0.843 (0.318- 2.237) | 0.731 |
| Close Person Tested Positive<br>Had Influence<br>No Influence | 105 (58.7%)<br>74 (41.3%) | 50 (23.9%)<br>159 (76.1%) | 4.51 (2.920 – 6.973) | < 0.001 | 0.941 (0.369- 2.402) | 0.900 |
| Consider TB a Risk Factor<br>Had Influence<br>No Influence | 140 (78.2%)<br>39 (21.8%) | 129 (61.7%)<br>80 (38.3%) | 2.23 (1.418 – 3.498) | 0.001 | 0.445 (0.171- 1.162) | 0.098* |

### 4.6 Health Facility Level Factors Associated with Covid-19 Vaccine Uptake

Health facility/system level factors were categorised into four groups (vaccine availability, Covid-19 awareness creation through health education, government directives, and vaccination processes). Each group had specific variables, which were assessed for their association with vaccination status. Firstly, the bivariate association was done by simple logistic regression to identify the odds ratio and associated p-value. Variables with statistical significance bivariate association were fed into the multivariable logistic regression model to control confounders and identify the adjusted odds ratio (aOR) and the findings are summarized in Table 4.4 below.

Quantitatively, availability of a variety of COVID-19 vaccines significantly increased uptake, with patients nearly three times more likely to be vaccinated when preferred options were available (aOR = 2.779; 90% CI: 1.099–7.026; $p = 0.031$). This finding was corroborated by qualitative evidence (Table 4.5), where participants repeatedly emphasized preference for single-dose vaccines, particularly Johnson & Johnson, due to convenience and reduced fear of side effects.

"*Many people preferred Johnson because it was only one shot... when it wasn't there, they opted out.*" (FGD 1)

Consistent positive messaging tripled the odds of vaccine uptake (aOR = 3.380; 90% CI: 1.217–9.384; $p = 0.015$). Qualitative findings strongly supported this association, with participants noting that active sensitization, health talks, and repeated encouragement by health workers increased confidence and acceptance. Conversely, declining sensitization over time corresponded with reduced uptake.

"*We are not sensitizing as much as we used to… and the numbers went down.*" (KII 2)

Perceived social benefits such as avoiding quarantine, maintaining social acceptance, and protecting family members were associated with nearly fourfold higher odds of vaccination (aOR = 3.786; 90% CI: 1.204–11.908; $p = 0.007$). Qualitative data explain

this effect where participants described vaccination as a means to avoid isolation, stigma, and disruption of social roles, particularly during peak pandemic periods.

"*People ran to be vaccinated so that they would not be isolated*." (FGD 4)

Sufficient public awareness more than doubled the likelihood of vaccination (aOR = 2.857; 90% CI: 1.689–8.254; p = 0.004). This association was strongly convergent with qualitative findings highlighting the role of health talks, media messaging, community outreach, and support groups. Declining awareness efforts were consistently linked to falling uptake.

"*When nobody was talking about COVID anymore, the outcome went down*." (KII 3)

Concerns about privacy and confidentiality were associated with approximately twofold higher odds of vaccination (aOR = 2.27; 90% CI: 0.970–5.329; p = 0.059). Qualitative findings provide important interpretive depth. TB patients expressed fear of being seen at vaccination points due to stigma linking TB with HIV and COVID-19 infection. Facilities perceived to offer discreet services encouraged uptake.

"*I'd rather spend fare and go far so that people don't see me*." (FGD 3)

**Table 4.4 Association between Vaccination and Health System Factors**

| Variable | Vaccinated (N = 179) | Not Vaccinated (N = 209) | Odds Ratio (OR) (90% CI) | P Value | Adjusted Odds Ratio (aOR) 90% CI) | P Value |
|---|---|---|---|---|---|---|
| Availability of Vaccines | | | | | | |
| Had Preferred Vaccine | | | | | | |
| Had Influence | 156 (87.2%) | 69 (33.0%) | 13.76 (8.148 – 23.245) | < 0.001 | 2.312 (0.859-6.220) | 0.097* |
| No Influence | 23 (12.8%) | 140 (67.0%) | | | | |
| Had a Variety of Vaccines | | | | | | |
| Had Influence | 142 (79.3%) | 61 (29.2%) | 9.31 (5.826 – 14.881) | < 0.001 | 2.779 (1.099-7.026) | 0.031* |
| No Influence | 37 (20.7%) | 148 (70.8%) | | | | |
| Facility/Centre Opening Hours | | | | | | |
| Had Influence | 144 (80.4%) | 86 (41.1%) | 5.88 (3.712 – 9.329) | < 0.001 | 0.371 (0.132-1.040) | 0.059* |
| No Influence | 35 (19.6%) | 123 (58.9%) | | | | |
| Communication & Awareness | | | | | | |
| Consistent and Accurate Safety Message | | | | | | |
| Had Influence | 165 (92.2%) | 71 (34.0%) | 22.9 (12.371 – 42.42) | < 0.001 | 3.380 (1.217-9.384) | 0.015* |
| No Influence | 14 (7.8%) | 138 (66.0%) | | | | |
| Emphasis on Social Benefits | | | | | | |
| Had Influence | 164 (91.6%) | 81 (38.8%) | 17.28 (9.506 – 31.402) | < 0.001 | 3.786 (1.204-11.908) | 0.007* |
| No Influence | 15 (8.4%) | 128 (61.2%) | | | | |
| Public Awareness on Medication | | | | | | |
| Had Influence | 165 (92.2%) | 80 (38.3%) | 19.00 (10.298 – 35.07) | < 0.001 | 2.857 (1.689-8.254) | 0.004* |
| No Influence | 14 (7.8%) | 129 (61.7%) | | | | |
| Government Directives | | | | | | |
| Mandatory Vaccination Certificate | | | | | | |
| Had Influence | 143 (79.9%) | 90 (43.1%) | 5.25 (3.327 – 8.292) | < 0.001 | 0.875 (0.363-2.105) | 0.765 |
| No Influence | 36 (20.1%) | 119 (56.9%) | | | | |
| Curfew and Lockdowns | | | | | | |
| Had Influence | 148 (82.7%) | 99 (47.4%) | 5.31 (3.306 – 8.512) | < 0.001 | 0.858 (0.302-2.440) | 0.775 |
| No Influence | 31 (17.3%) | 110 (52.6%) | | | | |
| Hotels and Bar Closure | | | | | | |
| Had Influence | 134 (74.9%) | 92 (44.0%) | 3.79 (2.453 – 5.847) | < 0.001 | 1.641 (0.622-4.330) | 0.317 |
| No Influence | 45 (25.1%) | 117 (56.0%) | | | | |

| Variable | Vaccinated (N = 179) | Not Vaccinated (N = 209) | Odds Ratio (OR) (90% CI) | P Value | Adjusted Odds Ratio (aOR) 90% CI) | P Value |
|---|---|---|---|---|---|---|
| Isolation and Quarantine | | | 5.67 (3.303 – 9.731) | < 0.001 | 1.893 (0.505-7.105) | 0.344 |
| Had Influence | 159 (88.8%) | 122 (58.4%) | | | | |
| No Influence | 20 (11.2%) | 87 (41.6%) | | | | |
| Covid-19 Cases Burials Management | | | 2.56 (0.634 – 4.011) | 0.053 | 0.850 (0.248-2.911) | 0.796 |
| Had Influence | 140 (78.2%) | 122 (58.4%) | | | | |
| No Influence | 39 (21.8%) | 87 (41.6%) | | | | |
| | | Vaccination Process | | | | |
| Vaccination Waiting Time | | | 0.69 (0.447 – 1.066) | 0.098 | 1.004 (0.408-2.468) | 0.994 |
| Had Influence | 117 (65.4%) | 153 (73.2%) | | | | |
| No Influence | 62 (34.6%) | 56 (26.8%) | | | | |
| Registration Requirements | | | 0.42 (0.269 – 0.653) | < 0.001 | 0.687 (0.270-0.743) | 0.029* |
| Had Influence | 107(59.8%) | 163 (78.0%) | | | | |
| No Influence | 72 (40.2%) | 46 (22.0%) | | | | |
| Privacy and Confidentiality | | | 0.70 (0.462 – 1.066) | < 0.001 | 2.273 (0.970-5.329) | 0.059* |
| Had Influence | 108 (60.3%) | 143 (68.4%) | | | | |
| No Influence | 71 (39.7%) | 66 (31.6%) | | | | |
| Pre-vaccination Counselling | | | 0.59 (0.395 – 0.905) | < 0.016 | 0.760 (0.312-1.853) | 0.546 |
| Had Influence | 101 (56.4%) | 143 (68.4%) | | | | |
| No Influence | 78 (43.6%) | 66 (31.6%) | | | | |
| Post Vaccination Observation | | | 0.45 (0.295 – 0.692) | < 0.001 | 0.744 (0.311-1.781) | 0.506 |
| Had Influence | 100 (55.9%) | 154 (73.7%) | | | | |
| No Influence | 79 (44.1%) | 55 (26.3%) | | | | |

**Table 4.5 Themes and Sub-themes from the Qualitative Thematic Analysis**

| Main Theme | Subthemes | Related objective |
|---|---|---|
| Age and vulnerability | Older age; Presence of comorbidities | Objective 2 |
| Occupation and workplace exposure | Health workers; Drivers; Market vendors | Objective 2 |
| Socio-economic and educational status | Low literacy; Poverty | Objective 2 |
| Fear of side effects | Pain and swelling; Weakness; Long-term fears | Objective 3 |
| Myths and misinformation | Infertility; Population control; Experimental vaccine | Objective 3 |
| Trust in government and authorities | Leadership skepticism; Safety doubts | Objective 3 |
| Risk perception and severity | Witnessing illness/death; Fear of severe disease | Objective 3 |
| TB and COVID-19 stigma | Fear of isolation; TB–HIV association | Objective 3 |
| Vaccine availability and preference | Single-dose preference; Stock-outs | Objective 4 |
| Registration and documentation barriers | ID and phone requirements; Digital literacy | Objective 4 |
| Health worker communication | Health talks; Consistent messaging | Objective 4 |
| Privacy and confidentiality | Fear of being seen; Discreet services | Objective 4 |

# CHAPTER FIVE

# DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

## 5.1 Chapter Overview

This study aimed to examine the key drivers and obstacles influencing COVID-19 vaccination among adult tuberculosis patients attending specific TB clinics in Nairobi County, Kenya. This chapter provides a discussion of the study results, comparing them with previous literature. The prevalence of adult patients with TB vaccinated for COVID-19 and socio-demographic, contextual factors, and health facility-level factors associated with COVID-19 vaccine uptake are discussed.

## 5.2 The Prevalence of COVID-19 Vaccinated Adult Tuberculosis

The study found that only 38.1% of adult TB patients attending selected clinics in Nairobi County were fully vaccinated against COVID-19, with an overall uptake (at least one dose) of approximately 46%. This low coverage falls substantially below national Kenyan adult full-vaccination rates, which stood at around 33% by late 2022 and were higher in urban areas like Nairobi, where it was up to 51% in some counties by mid-2022 (Ministry of Health, Kenya, 2022). These figures highlight persistently suboptimal protection in this high-risk group despite their vulnerability to severe COVID-19 outcomes.

Comparatively, available evidence from other settings indicates variable but often higher uptake among TB or comorbid patients. For instance, Palupi et al. (2023) reported 58.8% vaccination coverage among adult TB patients in Indonesia, while Wang et al. (2022) observed 68.6% with at least two doses in a cohort of TB-COVID coinfected individuals (though data were from earlier rollout phases). In sub-Saharan Africa, broader studies on chronic conditions (including lung diseases as a proxy for TB) showed lower uptake among comorbid groups. For instance, Wollburg et al. (2023) analyzed multi-country phone surveys (including Kenya) and found individuals with chronic lung conditions 8–14 percentage points less likely to be fully vaccinated

than those without, after adjustments. In South Africa, Kassanjee et al. (2024) reported low full-vaccination prevalence of just 2.5% among TB patients during 2020–2022, compared to 3.8% in non-TB clinic attendees.

The lower uptake observed in this Nairobi-based study aligned with regional patterns in sub-Saharan Africa, where vaccine coverage in comorbid populations lags behind general adult rates due to shared barriers like service disruptions, hesitancy, and access issues (Alemayehu et al., 2022; Wollburg et al., 2023). Globally and regionally, direct prevalence data on COVID-19 vaccination specifically among TB patients remain scarce, particularly post-2022, as most early studies (e.g., Migliori et al., 2022; Gao et al., 2021) predated widespread rollout and focused on coinfection risks rather than uptake. This persistent evidence gap, as noted in the literature review, underscores the value of the current clinic-based findings in an urban high-burden Kenyan setting, where Nairobi accounts for 20–25% of national TB cases.

The suboptimal coverage may be attributable to multifaceted barriers identified in this study and corroborated by broader literature, including individual-level factors (e.g., mistrust, fear of side effects, and myths, amplified in comorbid groups, socio-demographic influences (e.g., younger age and informal occupations reducing perceived urgency), and facility-level challenges (e.g., stockouts, unclear communication, and registration concerns). These align with hesitancy drivers in African chronic disease populations, including misinformation and institutional mistrust (Wollburg et al., 2023). The subsequent sections discuss these associations in detail, highlighting implications for targeted interventions to boost uptake in this vulnerable group and address ongoing gaps in integrated TB-COVID care.

## 5.3 Socio-Demographic Factors Linked to Covid-19 Vaccine Uptake

The study identified age and occupation as the primary socio-demographic factors independently associated with COVID-19 vaccine uptake among adult TB patients. Older patients (aged >35 years) exhibited significantly higher odds of vaccination compared to younger ones, while those in formal or self-employment were more likely to be vaccinated than unemployed individuals.

The age-related finding aligns with widespread patterns in sub-Saharan Africa and other low- and middle-income countries (LMICs), where younger adults consistently report higher vaccine hesitancy and lower uptake, primarily due to diminished perceived personal risk from COVID-19. Multi-country surveys and reviews attribute this to youth perceiving the disease as less threatening, often compounded by misinformation and competing priorities (Wollburg et al., 2023; Alemayehu et al., 2022). In TB-specific cohorts, limited data from Cameroon similarly highlight younger patients' lower engagement with preventive measures, potentially compounded by TB-related vulnerabilities (Andoseh et al., 2025). The qualitative data from this study complement this by revealing lower urgency among younger TB patients, who viewed vaccination as less pressing compared to older adults influenced by government prioritization and media messaging on age-related vulnerability. The finding underscores an equity concern: despite TB patients' heightened comorbidity risks, younger individuals in this high-burden urban Kenyan setting may defer vaccination due to lower perceived susceptibility, mirroring trends in general populations across Africa (Naidoo et al., 2023). The association with occupation reflects structural drivers, including workplace requirements and exposure risks. Employed patients, particularly in public-facing roles, faced incentives such as employer mandates or alternatives to frequent testing, which motivated uptake to maintain livelihoods. This is consistent with global evidence linking employment especially in essential or formal sectors—to higher vaccination rates through policy enforcement and occupational health priorities (Loomba et al., 2023; Wong et al., 2022). In African contexts, where informal employment predominates, unemployed or informally employed individuals often lack such pressures, exacerbating disparities (Smith et al., 2023). Although direct TB-stratified data on occupation are scarce, broader chronic disease studies in the region indicate that employment stability facilitates access and adherence to preventive health measures (Andoseh et al., 2025). Qualitative insights reinforced this, with participants in high-exposure jobs (e.g., drivers, guards) citing employer rules and livelihood protection as key motivators.

Notably, other socio-demographic variables (e.g., gender, education, income) showed no independent association after adjustment, contrasting with some general population

studies where lower education or income predicts hesitancy (Palupi et al., 2023). This may reflect TB patients' shared vulnerabilities overriding typical gradients, or context-specific factors in urban Nairobi clinics. As noted in the literature review, socio-demographic predictors of COVID-19 vaccine uptake remain poorly characterized in TB patients across Africa, with no prior Kenyan studies disaggregating by TB status. The current findings address this gap in a high-burden urban context, suggesting that interventions should prioritize youth-targeted risk communication to counter low perceived susceptibility, alongside leveraging workplace channels for outreach in informal economies. Integrating socio-demographic data into TB registries could further identify under-vaccinated subgroups and support equitable catch-up strategies in comorbid populations

## 5.4 Contextual Factors Associated with COVID-19 Vaccine Uptake

The multivariable analysis revealed that mistrust in the government's handling of the COVID-19 vaccine was the most substantial independent barrier to uptake, profoundly reducing the likelihood of vaccination. In contrast, higher perceived susceptibility to COVID-19 and perceived severity of the disease were significant facilitators, aligning with constructs from the Health Belief Model where perceived threat drives protective behavior. These findings resonate with broader evidence on vaccine decision-making in vulnerable populations. Perceived susceptibility and severity as motivators are well-established predictors of COVID-19 vaccine acceptance in general adult populations across LMICs, where individuals who view themselves at higher personal risk are more likely to vaccinate (Zampetakis & Melas, 2021; Hidayana et al., 2022).

In TB-specific contexts, similar perceptual drivers emerge despite limited direct studies: Andoseh et al. (2025) in Cameroon reported that social-protective motives—such as preventing transmission to family members—were associated with greater willingness to vaccinate among TB patients, complementing the heightened threat perception observed here. The protective role of perceived risk is further supported indirectly by clinical evidence demonstrating that COVID-19 vaccines are immunogenic and generally well-tolerated in active TB patients, with mostly mild

adverse events (Jin et al., 2024). Such biomedical reassurance could, in theory, alleviate safety concerns and reinforce perceived benefits, though translational research is needed to confirm whether communicating these data shifts patient perceptions and uptake.

Mistrust emerged as a dominant barrier, consistent with global and regional patterns where institutional distrust, often fueled by misinformation, historical inequities, and rapid policy changes, significantly undermines COVID-19 vaccine confidence (Jennings et al., 2023). In African settings, mistrust frequently intersects with fears of exploitation or inconsistent messaging, issues particularly salient for comorbid groups like TB patients who already face stigma and service disruptions (Andoseh et al., 2025). Although other contextual factors (e.g., fear of side effects, myths, and stigma) showed associations in bivariate analyses, they lost independent significance after adjustment, likely mediated through mistrust and threat perception variables.

The observed trend that TB and COVID-19 stigma nearly tripled uptake is notable but contrasts with much of the literature showing stigma predominantly hinders care-seeking. COVID-19 stigma has been linked to avoidance of health services due to fear of discrimination and misinformation-driven attitudes (Zhou et al., 2022). The study finding may reflect context-specific coping behaviors where stigma motivates proactive service use, underscoring complex behavioural responses to stigma that merit further investigation.

As highlighted in the literature review, behavioral and perceptual factors influencing COVID-19 vaccine uptake remain underexplored in TB patients, particularly in sub-Saharan Africa and Kenya. Existing studies map associations between knowledge, attitudes, and stated intentions but rarely measure actual uptake alongside beliefs in clinic settings (Andoseh et al., 2025) or provide biological safety data without examining behavioral translation (Jin et al., 2024). Multi-country epidemiologic work underscores contextual heterogeneity (Huerga et al., 2025), yet lacks granular perceptual analysis tailored to urban Kenyan TB clinics. This current study addressed

these gaps by quantifying independent perceptual predictors in a high-burden Nairobi cohort, revealing mistrust as a primary target.

The implications of these findings are clear. Interventions should prioritize trust-building through transparent, consistent communication from trusted sources (e.g., healthcare workers) and leverage perceived threat via targeted risk messaging, especially for TB patients with comorbidities. Integrating brief perceptual assessments into routine TB care could identify hesitant individuals for counseling, while disseminating evidence on vaccine-TB compatibility (Jin et al., 2024) may mitigate residual safety fears. Future research should evaluate whether clinic-based educational interventions addressing mistrust and reinforcing susceptibility/severity cues translate into sustained uptake gains in this high-risk population.

### 5.5 Health Facility-Level Factors Associated with COVID-19 Vaccine Uptake

Multivariable analysis identified several facility-level factors as independent predictors of COVID-19 vaccine uptake among adult TB patients. Consistent and positive messaging on vaccine safety tripled the odds of vaccination, while the availability of a variety of vaccine types doubled them. Emphasis on the social benefits of vaccination and sufficient public awareness efforts also emerged as strong facilitators. Conversely, mandatory registration requirements reduced uptake by approximately 31%.

These findings align with regional evidence emphasizing the critical role of health system factors in vaccine delivery, particularly in sub-Saharan Africa, where logistical and communication challenges persist. Consistent, trustworthy messaging from healthcare providers and government sources has been shown to counter misinformation and build confidence, thereby reducing hesitancy (Rajshekar et al., 2022; WHO, 2020). In Kenyan contexts, clear communication is especially vital amid rumors and rapid protocol changes, with studies noting that distrust in public facilities often amplifies reluctance (Rajshekhar et al., 2023; Mulupi et al., 2025). The positive impact of vaccine variety and availability reflects supply-chain influences where stock-outs and limited options repeatedly hampered rollout in countries like Kenya

and South Africa, directly lowering coverage when patients encounter unavailability during clinic visits (Sibanda et al., 2024; Mulupi et al., 2025). Highlighting social benefits such as collective protection and reduced transmission leverages altruistic motivations, consistent with persuasive messaging strategies that enhance willingness by invoking community responsibility (James et al., 2021). Mandatory registration, however, acted as a barrier, likely due to privacy concerns and bureaucratic friction, echoing broader access issues like transportation costs, waiting times, and scheduling conflicts that disproportionately affect regular clinic attendees such as TB patients (Job et al., 2025). In TB care settings, where patients adhere to strict directly observed therapy schedules, non-integrated services or administrative hurdles can deter opportunistic vaccination.

The finding that concerns about privacy and confidentiality doubled the odds of COVID-19 vaccine uptake appears atypical and inconsistent with broader research. Research suggests privacy fears, like those tied to data sharing or identification requirements, typically act as barriers rather than motivators, though results can vary by context and population (Achore et al., 2024; Zhu et al., 2023). It seems likely that this inverse association might stem from study-specific factors, such as unique demographic dynamics or measurement nuances, but it contrasts with evidence emphasizing trust erosion and hesitancy.

As detailed in the literature review, facility-level determinants of COVID-19 vaccine uptake remain poorly documented specifically for TB patients in Kenya, despite recognition of systemic challenges in general populations, including stock-outs, high patient loads, staff shortages, and inadequate provider counseling (Job et al., 2025; Sibanda et al., 2024). No prior studies have systematically examined these factors in Kenyan TB clinics, representing a key evidence gap. The current results address this by demonstrating that operational reliability (availability and choice), effective communication, and streamlined processes are pivotal enablers in urban high-volume facilities. These findings have programmatic implications, such as integrating COVID-19 vaccination into routine TB services while leveraging existing infrastructure like the Expanded Programme on Immunization cold chain, which could minimize barriers

and capitalize on patient-provider interactions for counseling (Mulupi et al., 2025). Training TB clinic staff to deliver consistent, benefit-focused messaging and ensuring diverse vaccine stocks could further boost coverage. Future interventions should evaluate co-administration models in TB settings to overcome access and integration gaps, ultimately enhancing protection for this high-risk group in Nairobi and similar urban contexts.

## 5.6 Study Strengths and Limitations

One of the strengths of the current study is its adequate sample size. The author calculated the sample size using a well-known formula, ensuring that the study's statistical power is sufficient to answer the research questions and hypotheses. With an adequate sample size, there was less likelihood of making type 2 errors or reporting statistically significant results when in fact they are insignificant (Andrade, 2023). Another strength of the study is that the interpretation of the results is based on an adjusted odds ratio, which means all independent variables are considered when predicting the impact of a variable of interest.

The study limitations included the inability to establish causality due to design constraints where cross-sectional designs only show associations (Levy et al., 2023). It also had selection bias as only patients from six urban TB sites were included, affecting findings generalizability. There was also potential for temporal ambiguity where all variables were measured simultaneously, which mean it as difficult to determine whether factors such as recent TB diagnosis affected vaccine decision. Lastly, the study also faced measurement and response limitations in terms of self-reported bias and non-response bias.

## 5.7 Conclusions

In conclusion, the study revealed that COVID-19 vaccine uptake among TB patients remains low, with various factors either facilitating or obstructing vaccination among adult TB patients attending selected clinics in Nairobi County, Kenya. By objective, the study author concluded that:

1. There is suboptimal COVID-19 vaccine uptake, with approximately 46% of adult TB patients having received at least one dose and only 38.1% fully vaccinated. This coverage remains lower than urban Kenyan averages and highlights persistent gaps in protecting this high-risk group, despite their vulnerability to severe COVID-19 outcomes.
2. Age (>35 years) and occupation (formal or self-employment) were the only socio-demographic factors independently associated with higher uptake. Younger patients showed lower uptake due to reduced perceived urgency, while employed individuals were motivated by workplace mandates and exposure risks, underscoring the need for targeted outreach to youth and informal sectors.
3. Mistrust in government vaccine handling emerged as the most substantial barrier, reducing uptake, while higher perceived susceptibility and severity of COVID-19 significantly facilitated vaccination. Other concerns, such as fear of side effects and stigma, likely operated indirectly through mistrust and threat perception, emphasizing the priority of trust-building and risk communication interventions.
4. Positive health facility-related factors included consistent safety messaging, vaccine variety and availability, emphasis on social benefits, and public awareness efforts, all independently increasing uptake. Mandatory registration requirements acted as a barrier, reflecting administrative and privacy concerns, highlighting opportunities for service integration and streamlined processes in TB clinics to enhance coverage.

## 5.8 Recommendations

Based on objective 1 (prevalence of COVID-19 vaccine uptake), I recommend that health systems and policy makers:

1. Prioritize adult TB patients as a high-risk group for catch-up COVID-19 vaccination campaigns in Nairobi County, given the suboptimal uptake (46% at least one dose; 38.1% fully vaccinated).

2. Routinely integrate COVID-19 vaccination status monitoring into TB registries and national health information systems to track coverage in this vulnerable population and enable timely interventions.
3. Conduct periodic prevalence assessments in urban TB clinics to monitor progress toward higher coverage targets, especially post-pandemic.

Based on objective 2 (socio-demographic factors), recommend that health systems and policy makers:

1. Develop age-specific risk communication strategies targeting younger TB patients (≤35 years) to address lower perceived urgency and enhance motivation through tailored messaging on personal and comorbidity risks.
2. Leverage workplace-based outreach programs, partnering with employers in formal and informal sectors (e.g., transport, security), to promote vaccination via mandates, incentives, or on-site clinics.
3. Address equity gaps by focusing mobile or community-based vaccination services on unemployed and informally employed TB patients, who lack occupational drivers.

Based on objective 3 (contextual factors), I recommend that health systems and policy makers:

1. Implement trust-building initiatives, such as community engagement with trusted local leaders and transparent government communication, to counter institutional mistrust as the primary barrier.
2. Enhance clinic-based counseling using Health Belief Model principles to reinforce perceived susceptibility and severity of COVID-19, incorporating personal testimonies and evidence on vaccine safety in TB patients.
3. Train healthcare workers to proactively address common concerns (e.g., side effects, myths, stigma) during TB visits, integrating brief motivational interviewing to mitigate indirect barriers mediated through mistrust.

Based on objective 4 (health facility-related factors), I recommend that health systems and policy makers:

1. Strengthen vaccine supply chains to ensure consistent availability and variety of vaccine types in TB clinics, minimizing stock-outs and offering patient choice to boost uptake.
2. Promote integration of COVID-19 vaccination services into routine TB care (e.g., co-administration during DOTS visits) to reduce administrative barriers like mandatory registration and improve accessibility.
3. Invest in healthcare worker training for consistent, positive messaging emphasizing vaccine safety and social benefits, alongside public awareness campaigns tailored to TB clinic attendees.

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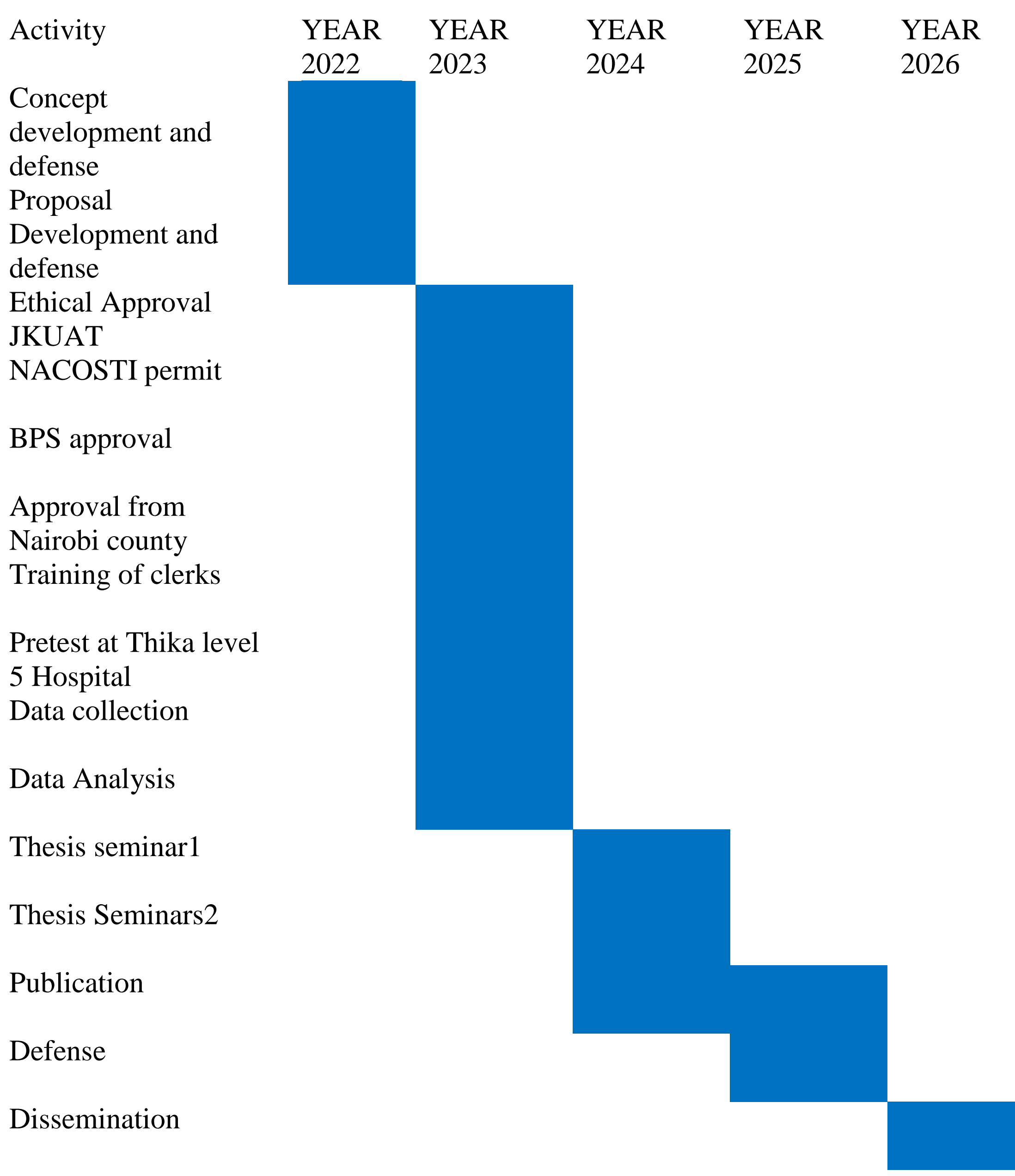
# APPENDICES

## Appendix I: Work plan



**Appendix II: Budget**

| # | Activity | Units | Unit Cost | Total |
|---|---|---|---|---|
| 1 | Ethical Approval-JKUAT | 1 | 5000 | 5000 |
| 2 | NACOSTI | 1 | 15,000 | 15,000 |
| 3 | Data Collection tools printing | 1 | 30,000 | 30,000 |
| 4 | Research assistant training | 2 | 25,000 | 50,000 |
| 5 | Transport | 2 | 20,000 | 40,000 |
| 6 | Research assistant allowance | 8 | 4,000 | 32,000 |
| 7 | Data Analysis | 1 | 10,000 | 10,000 |
| 8 | Seminars &Conferences | 4 | 10,000 | 40,000 |
| 9 | Publications | 1 | 20,000 | 20,000 |
|  | Total |  |  | 200,000 |

**Appendix III: Respondents' Questionnaire**

***Instructions to the respondents***

Indicate by a tick (√) in the box given multiple choices and for others write on space provided. Do not write your name anywhere in this form.

**GENERAL INFORMATION:**

Questionnaire no: ……………… Date of interview: ……........................................

Name of interviewer: ………………………………………………………………………….

Facility name……………………. sub county name……………………..……………

Facility level 1☐ 2☐ 3☐ 4☐ 5☐ 6☐ MFL CODE……………………

Facility type; GOK ☐ Private ☐ FBO☐ Others specify……………

**SECTION A:PART1: SOCIAL DEMOGRAPHIC INFORMATION**

**A1. What is your age in years?** …………………………………………

**A2. Place of residence……………………….**

**A3. What is your gender? (observe)**

Male☐Female☐

**A4. What is your marital status?**

Single☐ Married☒ Widow ☐ Divorced☐ Separated ☐

**A5. What is your highest level of education attained?**

Never been to school ☐

Primary school ☐

Secondary school ☐

Certificate ☐

Diploma ☐

Undergraduate degree ☐

Post graduate ☐

**A6. What is your employment status?**

Unemployed ☐

Formally employed ☐

Self-employed ☐

Retired from employment ☐

**A7 What is your gross monthly income in Kenyan shilling ?………………………………..**

**A8. What is your religious affiliation?**

Christian ☐

Islam ☐

Hindu ☐

Decline ☐

Others: specify: ………………………

**A9: In which TB treatment phase are you in now**

Intensive phase (1st or 2rd months) ☐

Continuation phase (3rd, 4th , 5th and 6th month) ☐

I don't know ☐

Decline ☐

**A10: What do you consider your TB treatment type ? (verify from the patient card)**

New (First time on treatment) ☐ Relapse☐

**SECTION A: PART2: VACCINATION DETAILS**

**A11: Have you heard about Covid-19 Vaccines**

Yes☐ No☐

**A12: if YES in A9 what was your trusted source of information**

Mainstream media (radio, TV) ☐

Social media ☐

Internet ☐

Health care workers ☐

Friends and social groups ☐

Government administrators ☐

Employers ☐

Others specify :…………………………………………………………

**A13: Have you ever been diagnosed (tested positive) of Covid-19 disease ?**

Yes☐ No☐ I don't know☐ Decline☐

**A14: Have you been hospitalized (admitted) because of Covid-19 disease?**

Yes☐ No☐ Decline☐

**A15: Have you received Covid-19 vaccine?**

Yes☐ No ☐

**A16: if yes in A15, How many doses of Covid-19 vaccines did you receive?**

One (1) dose☐ Two (2) doses☐Three (3) doses☐ More than 3 doses☐

**A17: IF yes in A15, which type of vaccine did you receive**

AstraZeneca ☐

Johnson & Johnson ☐

Moderna ☐

Pfizer ☐

Sinopharm ☐

Decline ☐

I don't know/recall ☐

Did not received any ☐

Other: specify:…………………

**A17: What do you consider your COVID-19 Vaccination status?**

Not vaccinated ☐

Partially vaccinated (1dose of AstraZeneca, Moderna, Pfizer or Sinopharm)☐

Fully vaccinated (1 dose of JnJ & 2 doses of AstraZeneca, Moderna, Pfizer or Sinopharm) ☐

## SECTION B:

## CONTEXTUAL FACTORS AND UPTAKE OF COVID-19 VACCINATION

**B1. To what extent are you concerned with side effects/undesirable effect of COVID-19 vaccine?**

Not at all ☐

To small extent ☐

To large extent ☐

**B2. To what extent has myths, misconceptions and rumours on vaccines influenced the decision on COVID-19 vaccine uptake?**

Not at all ☐

To small extent ☐

To large extent ☐

**B3. To what extent has stigma on TB or COVID-19 infections on vaccines influenced the decision on COVID-19 vaccine uptake?**

Not at all ☐

To small extent ☐

To large extent ☐

**B4: To what extent do you think the following statements influenced your confidence level in COVID-19 vaccine?**

| | Not at all | To small extent | To large extent |
|---|---|---|---|
| Mistrust of vaccine benefit | | | |
| Worries over unforeseen future effects | | | |
| Concerns about commercial profiteering of vaccines | | | |
| Positive attitudes toward complementary and alternative medicine | | | |
| Preference for natural immunity | | | |
| Mistrust in Government's management of COVID-19 | | | |

**B5. To what extent do you think it is important to receive COVID-19 vaccine to protect others?**

| | Not at all | To small extent | To large extent |
|---|---|---|---|
| To protect my children and family | | | |
| To protect community members | | | |
| To normalize life (schools and business) | | | |

**B6. To what extent do you think that following statements influenced your decision on COVID-19 vaccine uptake?**

| | Not at all | To small extent | To large extent |
|---|---|---|---|
| Perceived susceptibility to infectious disease | | | |

| | | | |
|---|---|---|---|
| Perceived seriousness of COVID-19 | | | |
| Perceived likelihood of more waves of COVID-19 | | | |
| Tested positive for COVID-19 (self) | | | |
| Tested positive for COVID-19 (someone close) | | | |
| That TB is health risk factor for COVID-19 | | | |

**SECTION C**

**HEALTH FACILITY LEVEL FACTORS AND UPTAKE OF COVID-19 VACCINATION**

**C1. In your own opinion how has the availability of vaccine influenced your decision on COVID-19 vaccine uptake?**

| | Not at all | To small extent | To large extent |
|---|---|---|---|
| Variety of vaccines available | | | |
| Preferred vaccine type | | | |
| Opening hours of vaccination Centre | | | |

**C2. To what degree do you think the health care providers influenced your decision on COVID-19 vaccine?**

Not at all ☐

To small extent ☐

To large extent ☐

**C3. In your own opinion how was distance to the COVID-19 vaccination centers influenced your COVID-19 vaccine decision?**

Not at all ☐

To small extent ☐

To large extent ☐

**C4. To what extent to you agree that the COVID-19 vaccination process influenced your decision on COVID-19 vaccination?**

| | Not at all | To small extent | To large extent |
|---|---|---|---|
| Awaiting time | | | |
| Requirements before registration | | | |
| Privacy and confidentiality observed | | | |
| Health talks before vaccination | | | |
| Post vaccination observation | | | |

**C5: In your own opinion how has communication and awareness on COVID-19 pandemic contributed to COVID-19 vaccine uptake?**

| | Not at all | To small extent | To large extent |
|---|---|---|---|
| Reassurance of vaccine importance | | | |
| Consistent and accurate reporting of vaccine safety and disease | | | |
| Emphasis on social benefits | | | |
| Communicating and education of public on COVID-19 vaccine & disease | | | |

**C6. To what degree do you agree that implementation of control measures and directives by government influenced your decision on COVID-19 vaccine uptake?**

| | Not at all | To small extent | To large extent |
|---|---|---|---|
| Mandatory prove of certificate at work and travels | | | |
| curfews and lockdown | | | |
| Closure of hotels and bars business | | | |
| Isolation and quarantine | | | |
| Burials by government personnel | | | |

**Thank you for participation**

**Appendix IV: FGDs Guide**

**FOCUS GROUP DISCUSSION GUIDE**

**THEME: General Knowledge**

a) What are Covid-19 sign & symptoms, complications and population risk groups.
b) Do you consider TB patient among risk group?
c) Describe generally the importance of Covid-19 vaccination
   (probe) prevention to especially TB patients in particular?

**THEME: Contextual factors**

**Sub themes;**

a) **Side effects**: how has issue of side effects affected your decision to get vaccinated
**b)** What are **conspiracy theories, myths and misconception with regard to COVID-19 vaccine (probe)** how it affected uptake of Covid-19 vaccines?
c) How does **stigmatization a**ffect your decision to get Covid-19 vaccine?
   Probe (stigmatization associated with TB, Covid-19
d) How **does trust and confidence** in MOH vaccine influences how person gets vaccination
e) Is there **stigmatization towards TB** and other patients?
   (probe) how does it influences TB patients to receive COVID-19 vaccines.
f) Perceived susceptibility
g) Perceived severity

## Appendix V: Key Informant Interview Guide

## KEY INFORMANTS GUIDE

### Service delivery sub theme

1) Describe the tuberculosis services offered at your facilities? Schedule for follow up for TB clients? Referral mechanism to vaccine sites?
2) Describe vaccination procedure like records? requirement to get vaccination? any health talk before administration?

### Supply chain sub theme

3) Does the facilities have adequate vaccine all time? Issues of stock out? Cold chain issues?

### Accessibility sub theme

4) Describe average transport cost to vaccination centre? Is there plan for those who work during the day, opportunities for weekends and holidays? How has this effected coverage?

### Demand creation by management sub theme

5) What are communication support available, strategies employed for TB &/or comorbid patients to get vaccination? Means for mobilization? Frequency? Effectiveness or outcome of such if any?

### Human resources management sub theme

6) Describe staff available for Covid-19 vaccination exercise in term of numbers and duration of exercise available

**Thank you for your participation.**

## Appendix VI: Consent Form for the Key Informants

**INFORMED CONSENT FORM (Key Informants)**

**Study Title:** Determinants of Covid-19 Vaccine uptake Among Adult Patients Attending Selected Clinics in Nairobi County, Kenya.

**Principal Investigators:**


WAQO BORU HUQA

Msc Epidemiology & biostatistics: JKUAT

Contacts: +254 727 687 451

E-Mail: boruhuqa@gmail.com


**SUPERVISORS:**


**Dr George Makalliwa**

JKUAT, School of Public Health(SoPH)

Contact: +254 746 844 063

Email: george.makalliwa@jkuat.ac.ke

**Caroline Musita**

JKUAT, School of Public Health(SoPH)

Contact: +254 722 619 557

Email address: cmusita@jkuat.ac.ke


**Introduction:**

I want to thank you for finding time to meet me today. My name is WAQO BORU HUQA. We are carrying out a study titled ***"Determinants of Covid-19 vaccine uptake among adult patients attending selected clinics in Nairobi county, Kenya.***

Before you decide to partake in this study, you need to understand the nature of the study, how it will be conducted, your rights risks and benefits of participating in this study. In this study, you are free to ask questions you may have at any time. Being in this study is on your free will. Once you understand the study, and if you agree to take part, you will be asked to sign on this informed consent form. Before you learn about the study, it is crucial that you know that your participation in this study is entirely voluntary. You may decide not to answer questions or withdraw from the study at any time. Your participation and any information obtained from you will be handled confidentially.

**Purpose of study:**

This study is intended to establish the enablers and barriers for COVID-19 vaccine uptake among patients attending tuberculosis clinics Nairobi County, Kenya. If you agree to take part in this research, you will be asked questions about your Covid-19 vaccination status, the patient related and health facility related enabling and barrier factors. The interview will take about 30-40 minutes.

**Study procedures:**

We shall interview you as key informants been among county, sub county TB and EPI coordinator, clinician, nurses, CHAs and CHVs. We shall interview you as a key informant for this community on Covid-19 vaccine uptake among TB patients. This interview will take about 30 - 40 minutes of your time. You as a key informant are requested to keep the information that will be discussed in this venue secret, and not to discuss the events of this interview. We trust that you will honor your word of keeping this discussion confidential.

**Risks and Benefits of participating**

There are no foreseeable risks in participating in this study. There are no direct benefits for participating in this study. However, the study will generate findings that will benefit you as a participant, the community and the nation.

**Data security and Confidentiality**

All the data collected in this study shall be kept in confidence and shall not be shared with anyone outside the study researchers. All the information gathered by the researcher will be used in confidence for the sole purpose of this research only.

**Costs to Participant**

There is no cost to you for participating in the study. There are no direct benefits for participating in this study.

**Withdrawal from the study:**

You may withdraw from participating in this study at any time without giving the reason. It is only necessary that you inform us in case you make such a decision.

**Participants' statement**

If you have read the informed consent and explained to you, and you understand the information and voluntarily agree to join this study

**CONSENT TO AUDIO-RECORD INTERVIEW**

Consent to audio-record interview given: ……………………………………………

Signature

Consent to audio-record interview denied: ______________________________

Signature

WAQO BORU HUQA ________________________________

Study staff conducting Study staff signature

## Appendix VII: Consent Form for the Focus Group Discussion (FGDs)

INFORMED CONSENT FORM (focus group discussants)

Study Title: Determinants of Covid-19 Vaccine uptake Among Adult Patients Attending Selected Clinics in Nairobi County, Kenya.

Principal Investigators:

WAQO BORU HUQA

Msc Epidemiology & biostatistics: JKUAT

Contacts: +254 727 687 451

E-Mail: boruhuqa@gmail.com

SUPERVISORS:

Dr George Makalliwa

JKUAT, School of Public Health (SoPH)

Contact: +254 746 844 063

Email: george.makalliwa@jkuat.ac.ke

Caroline Musita

JKUAT, School of Public Health (SoPH)

Contact: +254 722 619 557

Email address: cmusita@jkuat.ac.ke

**Introduction:**

I want to thank you for finding time to meet me today. My name is Waqo Boru Huqa. We are carrying out a study titled "Determinants of Covid-19 vaccine uptake among adult patients attending selected clinics in Nairobi County, Kenya.

Before you decide to partake in this study, you need to understand the nature of the study, how it will be conducted, your rights risks and benefits of participating in this study. In this study, you are free to ask questions you may have at any time. Being in this study is on your free will. Once you understand the study, and if you agree to take part, you will be asked to sign on this informed consent form. Before you learn about the study, it is important that you know that your participation in this study is entirely voluntary. You may decide not to answer questions or withdraw from the study at any time. Your participation and any information obtained from you will be handled confidentially.

**Purpose of study:**

This study is intended to establish the enablers and barriers for COVID-19 vaccine uptake among patients attending tuberculosis clinics Nairobi County, Kenya. If you agree to take part in this research, you will be asked questions about your Covid-19 vaccination status, the patient related and health facility related factors. The discussion will take about 30-40 minutes.

**Study procedures:**

We shall conduct focus group discussion you adult TB patients represent youths, women, men, community leaders, persons with disability or any special group category for your sub county. The discussion will be on enablers and barriers for Covid-19 vaccine uptake among TB patients. This discussion will take about 30 - 40 minutes of your time. You as a key discussants are requested to keep the information that will be discussed in this venue secret, and not to discuss the events of this deliberation. We trust that you will honor your word of keeping this discussion confidential.

**Risks and Benefits of participating**

There are no foreseeable risks in participating in this study. There are no direct benefits for participating in this study. However, the study will generate findings that will benefit you as a participant, the community and the nation.

**Data security and Confidentiality**

All the data collected in this study shall be kept in confidence and shall not be shared with anyone outside the study researchers. All the information gathered by the researcher will be used in confidence for the sole purpose of this research only.

**Costs to Participant**

There is no cost to you for participating in the study. There are no direct benefits for participating in this study.

**Withdrawal from the study:**

You may withdraw from participating in this study at any time without giving the reason. It is only necessary that you inform us in case you make such a decision.

**Participants' statement**

If you have read the informed consent and explained to you, and you understand the information and voluntarily agree to join this study

**CONSENT TO AUDIO-RECORD INTERVIEW**

Consent to audio-record interview given:

NAME……………………………SIGN……………………..DATE………………

WAQO BORU HUQA

(Moderato)Study staff conducting Study Signature- ------------- DATE-------- ---

**Appendix VIII: Sampled Sub-County and Proportionate to Clinics/HF**

| Facility Name | Total Tb Pop | Sample Size | Expected # On Clinic Day | Target Per Week | Performance Of Data Collection Per Week | | |
|---|---|---|---|---|---|---|---|
| | | | | | **WK1** | **WK2** | **WK3-4** |
| St. Marys Hosp | 147 | 55 | 23 (Mon & Tues) | 18 | 17 | 19 | 19 |
| Riruta | 139 | 52 | 34(Wed) | 17 | 19 | 17 | 16 |
| Kahawa West | 65 | 24 | 21 (Wed) | 8 | 8 | 10 | 6 |
| Mama Lucy Kibaki | 393 | 147 | 40 (Daily) | 50 | 55 | 53 | 39 |
| Mmm Mukuru | 116 | 43 | 20(Mon &Tue) | 14 | 15 | 15 | 13 |
| Rhodes Clinics | 180 | 67 | 95 (Wed) | 23 | 27 | 23 | 17 |
| **Total** | **1040** | **388** | | | | | |

## Appendix IX: JKUAT Institutional Ethics Review Committee Approval

JOMO KENYATTA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY
P.O BOX 62000(00200) NAIROBI, Tel:(067) 58700001-4
(Office of the Deputy Vice Chancellor, Research Production and Extension Division)

**JKUAT INSTITUTIONAL SCIENTIFIC AND ETHICS REVIEW COMMITTEE**

REF: JKU/2/4/896B

Date: 23rd February 2023

WAQO BORU HUQA
SCHOOL OF PUBLIC HEALTH, JKUAT

Dear Mr. Huqa,

**RE: DETERMINANTS OF COVID-19 VACCINATION UPTAKE AMONG ADULT PATIENTS ATTENDING SELECTED TUBERCULOSIS CLINICS IN NAIROBI COUNTY, KENYA**

This is to inform you that JKUAT Institutional Scientific and Ethical Review Committee has reviewed and approved your above research proposal. Your application approval number is **JKU/ISERC/02316/0823.** The approval period is **23rd February 2023** to **22nd February 2024.**

This approval is subject to compliance with the following requirements;

i. Only approved documents including (informed consents, study instruments, MTA) will be used
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by JKUAT ISERC.
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to JKUAT ISERC within 72 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to JKUAT ISERC within 72 hours
v. Clearance for export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days upon completion of the study to JKUAT ISERC.

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://oris.nacosti.go.ke and also obtain other clearances needed.

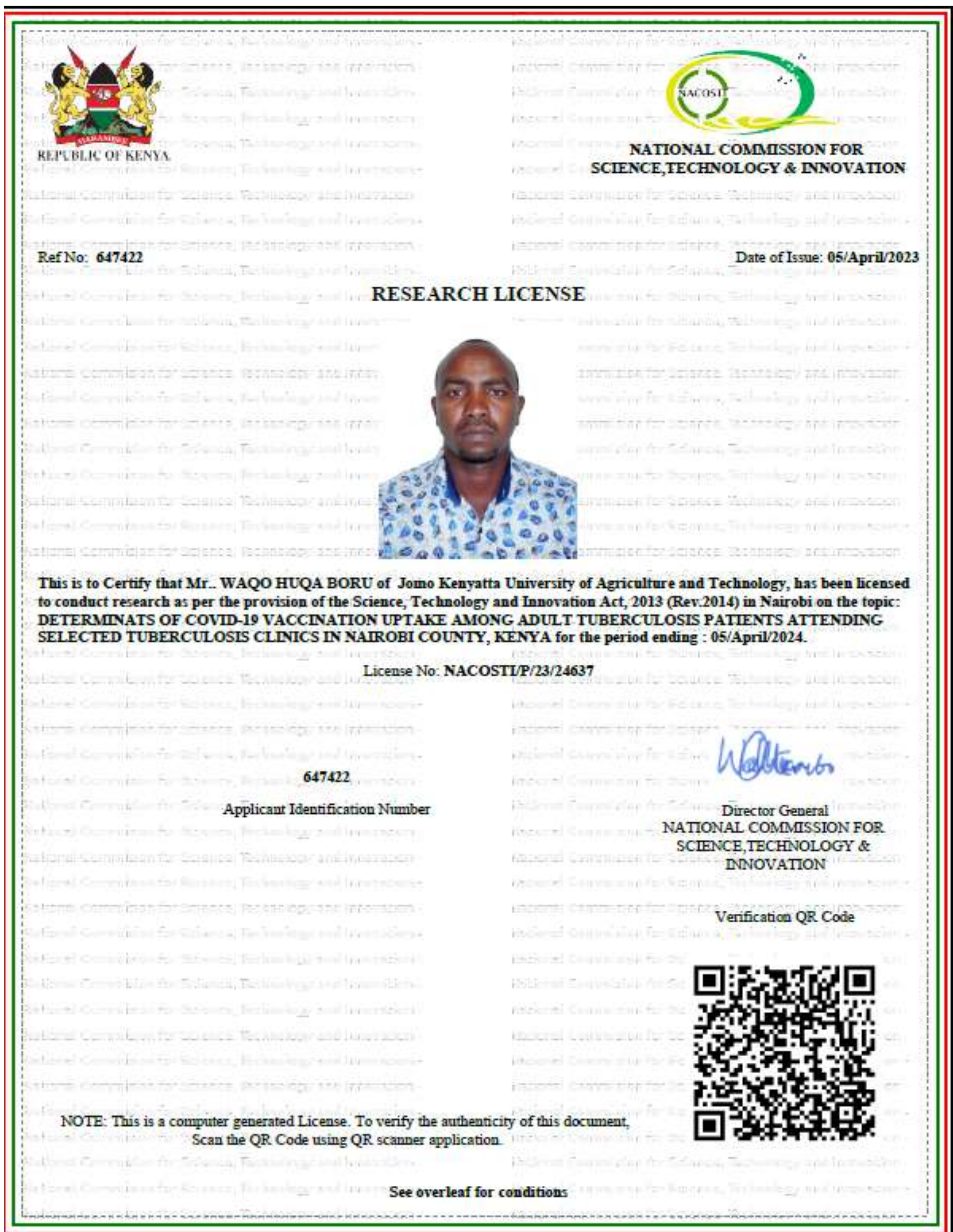
Yours sincerely

Dr Patrick Mburugu
CHAIR, JKUAT ISERC

INSTITUTIONAL ETHICS REVIEW COMMITTEE
23 FEB 2023
APPROVED
J K U A T

*JKUAT is ISO 9001:2015 and ISO 14001:2015 certified*
Setting Trends in Higher Education, Research, Innovation and Entrepreneurship

## Appendix X: NACOSTI Permit



REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **647422**

Date of Issue: **05/April/2023**

**RESEARCH LICENSE**

**This is to Certify that Mr.. WAQO HUQA BORU of Jomo Kenyatta University of Agriculture and Technology, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Nairobi on the topic: DETERMINATS OF COVID-19 VACCINATION UPTAKE AMONG ADULT TUBERCULOSIS PATIENTS ATTENDING SELECTED TUBERCULOSIS CLINICS IN NAIROBI COUNTY, KENYA for the period ending : 05/April/2024.**

License No: **NACOSTI/P/23/24637**

**647422**

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

**See overleaf for conditions**

## Appendix XI: Nairobi County Department of Health Approval

NAIROBI CITY COUNTY

Telephone: Nairobi
020 – 2297000
020 – 8022676
E-mail : medsupnedh@yahoo.com

MAMA LUCY KIBAKI HOSPITAL-EMBAKASI
P.O. Box 1278-00515
BURUBURU-NAIROBI

When replying please quote

HEALTH, WELLNESS & NUTRITION SERVICES

Ref. No. MLKH/ADM/RES/2

Date: 22nd May 2023

Waqo Boru Huqa
Jomo Kenyatta University of Agriculture and Technology
NAIROBI

RE: PERMISSION TO COLLECT DATA

TITLE: 'Determination of Covid- 19 Vaccination uptake among adult tuberculosis patients attending selected tuberculosis clinics in Nairobi County, Kenya)"

Refer to your application to collect data on the above research in this institution.

This is to inform you that the Hospital has given you permission to collect data subject to the following:

1. You are expected to adhere to the rules and regulations pertaining to the data collection.
2. You are expected to submit a copy of the final findings to the research committee.

Francis Githaiga
HUMAN RESOURCE MANAGER

MAMA LUCY KIBAKI HOSPITAL
P.O. Box 1278-00515, BURUBURU

**Appendix XII: Publication.**

Scientific Research Publishing

Journal of Tuberculosis Research, 2025, 13(1), 15-28
https://www.scirp.org/journal/jtr
ISSN Online: 2329-8448
ISSN Print: 2329-843X

# COVID-19 Vaccine Uptake: Prevalence, Health Facility Enablers and Barriers among Adult Tuberculosis Patients across Nairobi County Clinics, Kenya

Waqo Boru*, George Makalliwa, Caroline Musita

Department of Environmental Health and Disease Control, Jomo Kenyatta University of Agriculture and Technology, Nairobi, Kenya
Email: *boruhuqa@gmail.com

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Open Access

**Abstract**

Patients with tuberculosis (TB) are at increased risk of developing severe forms of novel coronavirus 2019 (COVID-19), and COVID-19 coinfection aggravates active TB progression through immunosuppression. Despite the availability of COVID-19 vaccines to prevent and reduce COVID-19 transmission, COVID-19 vaccine uptake levels remain low worldwide. In Kenya, an African country with high TB prevalence and TB-HIV coinfection, 47% of the population had received the COVID-19 vaccine by 2023. This study determined health-system enablers and barriers to the COVID-19 vaccine among adult TB patients across Nairobi County TB clinics in Kenya. An analytical cross-sectional study was used. Three hundred eighty-eight TB patients from six TB clinics across six sub-counties in Nairobi were recruited. The participants completed the study questionnaire. After confounding for age, employment status perceived COVID-19 susceptibility, and perceived COVID-19 seriousness, health system enablers of COVID-19 vaccine uptake were consistent and positive messaging on COVID-19 (adjusted odds ratio (aOR) = 4.498; 95% CI: 1.953 - 10.36, $p < 0.001$), the feeling that the vaccination had significant social benefits was (aOR = 2.632; 95% CI: 1.108 - 6.257, $p = 0.028$), and enough public awareness about the vaccine (aOR = 2.619; 95% CI: 1.099 - 6.239, $p = 0.03$). A significant barrier was vaccine preference (aOR = 0.387, 95% CI: 0.179 - 0.838, $p = 0.016$). This study confirmed health facility factors that enable and hinder COVID-19 vaccine uptake among TB patients. We recommend policy actions to improve TB clinics' infrastructure and resources to support the enablers and address the barriers.

## Appendix XII: Publication Certificate

Scientific Research Publishing
https://www.scirp.org

**Journal of Tuberculosis Research**

**ISSN Print: 2329-843X, ISSN Online:2329-8448**
**https://www.scirp.org/journal/JTR**

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### Publication Certificate

Dear Author(s), February 03, 2026

We extend our sincere gratitude for your contribution to the Journal of Tuberculosis Research (JTR). It is with great pleasure that we inform you that your paper:

**ID:** 1130570
**Title:** COVID-19 Vaccine Uptake: Prevalence, Health Fa-cility Enablers and Barriers Among Adult Tuber-culosis Patients Across Nairobi county clinics, Kenya
**Author(s):** Waqo Boru

has successfully passed the rigorous peer review process, and has been published in Vol. 13 No.1 in March 2025. Congratulations!

Please feel free to contact us if you have any questions.

Best regards
JTR Editorial Office
Email: jtr@scirp.org
https://www.scirp.org/journal/jtr

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