

Proposed Title Determinants and Consequences of Patient and Health System Delays in Tuberculosis Diagnosis and Treatment Among Individuals Aged 15 Years and Above at Kenyatta National Hospital, Nairobi County, Kenya Abstract Background: Delayed tuberculosis (TB) diagnosis and treatment remain major public health challenges that undermine progress toward the WHO End TB Strategy. In tertiary hospitals, both patient-level and system-level delays can increase morbidity, mortality, and nosocomial transmission—issues that are also critical for perioperative safety and infection control. Objective: To analyze the determinants and consequences of patient and healthcare system delays in TB diagnosis and treatment among individuals aged

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Submitted to JMIR Public Health and Surveillance
on: October 16, 2025
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Table of Contents

Original Manuscript.....	5
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Preprint
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Proposed Title

Determinants and Consequences of Patient and Health System Delays in Tuberculosis Diagnosis and Treatment Among Individuals Aged 15 Years and Above at Kenyatta National Hospital, Nairobi County, Kenya

Abstract

Background:

Delayed tuberculosis (TB) diagnosis and treatment remain major public health challenges that undermine progress toward the WHO End TB Strategy. In tertiary hospitals, both patient-level and system-level delays can increase morbidity, mortality, and nosocomial transmission—issues that are also critical for perioperative safety and infection control.

Objective:

To analyze the determinants and consequences of patient and healthcare system delays in TB diagnosis and treatment among individuals aged

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Abstract

Background: This study investigated the delays experienced by patients and healthcare systems in the diagnosis and treatment of tuberculosis (TB) among adults aged 15 years and above at Kenyatta National Hospital. Tuberculosis remains one of the leading infectious diseases globally, and timely diagnosis and initiation of treatment are crucial to reducing transmission, morbidity, and mortality. The study aimed to quantify the duration and determinants of both patient-related and healthcare system-related delays in accessing TB diagnosis and treatment services.

Objective: The study aimed to quantify the duration and determinants of both patient-related and healthcare system-related delays in accessing TB diagnosis and treatment services.

Methods: A mixed-methods design was employed, integrating quantitative data from patient records and qualitative interviews with healthcare providers. Patients with confirmed TB were recruited between January 2020 and December 2022. The study examined socio-demographic factors, health-seeking behaviors, diagnostic timelines, and healthcare service efficiency indicators. Quantitative data were analyzed using descriptive and inferential statistics, while qualitative data provided contextual insights into systemic challenges and patient experiences.

Results: Findings revealed that the median patient delay—the time from symptom onset to first health-seeking—was significantly longer than the healthcare system delay—the time from first facility visit to diagnosis confirmation. Factors contributing to patient delay included low awareness of TB symptoms, self-medication, stigma, and economic barriers. On the other hand, healthcare system delays were associated with laboratory turnaround times, diagnostic capacity gaps, and referral inefficiencies. Gender, education level, and distance to health facilities were also found to significantly influence delay durations.

Conclusions: The study concluded that both patient and healthcare system factors contribute substantially to overall diagnostic and treatment delays. Addressing these challenges requires integrated interventions that strengthen TB awareness, improve laboratory infrastructure, enhance referral systems, and promote patient-centered care. Policymakers should prioritize targeted health education, community screening, and investment in rapid diagnostic technologies to accelerate TB case detection and treatment initiation. Clinical Trial: Trial Registration:

This study was reviewed and approved by the Mount Kenya University Institutional Review Board (MKU-IRB) under reference MKU/ERC/PH/127/2020, and subsequently authorized by the National Commission for Science, Technology and Innovation (NACOSTI) under permit number NACOSTI/P/21/9874. As this was a retrospective, observational study using existing patient data and facility-level records, it was not registered as a clinical trial.

(JMIR Preprints 16/10/2025:85985)

DOI: <https://doi.org/10.2196/preprints.85985>

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Original Manuscript

THE IMPACT OF PATIENT AND HEALTHCARE SYSTEM-RELATED DELAYS ON TUBERCULOSIS MANAGEMENT AMONG AGED 15 YEARS AND ABOVE AT KENYATTA NATIONAL HOSPITAL

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ARTICLE INFO

Keywords:

Patient delay

Kenya

Healthcare system delay

Tuberculosis

Epidemiology

ABSTRACT

Background: Long diagnosis delay contributes significantly to the failure to eradicate TB. The aim of this study: To identify the root causes that contribute to the delay in treating TB patients at the KNH.

Methods: A descriptive cross-sectional study was conducted among 128 microscopy-positive pulmonary tuberculosis patients in 2022 to address this objective. It concerned the socio-demographic, clinical, microbiological characteristics, and referral location/pathway characteristics of the patients. We then calculated the different delays. The “patient” (time from first symptoms to first consultation), “system” (time from first consultation to first diagnosis) and total (time from first symptoms to diagnosis) median diagnostic delay were estimated.

Results: The response rate for quantitative data was 99.2% (n =127) from a sample size of 128 of the TB patients that presented to the hospital for diagnosis and treatment. For the focus group discussion, the investigator interviewed two (2) groups of seven (14) for both patients and health care workers at the TB clinic at KNH. Bivariate analyses showed significant associations on gender of the respondents that indicated that majority of the respondents were females 51.2% (n= 65) compared to the male counterpart with 48.8% (n = 62). This shows that women are more sensitive to their health issues compared with the male counterparts. This indicate that those with age (40 to 49) were majority 32.3% (n = 41) followed closely by age (30 to 39) 21.3% (n = 27). This is a middle age group thus indicating that they are high-risk group. If intervention is done, then they should be targeted to benefit.

Conclusion: Well laid out TB management (diagnosis and treatment) at KNH is a leeway to efficient healthcare services delivery to the people. KNH has various departments dealing with various ailments and complications. An effective TB diagnosis and treatment team is crucial in preparing for TB management at the facility. Due to the nature of the illness, TB patients and their households can face severe direct and indirect financial and economic costs. These pose barriers that can greatly affect their ability to access diagnosis and treatment, and to complete treatment successfully. Costs included in the TB-specific indicator include not only direct medical payments for diagnosis and treatment, but also direct nonmedical payments (e.g., transportation and lodging) and indirect costs (e.g., lost income). In contrast to SDG Indicator 3.8.2, the TB-specific indicator is restricted to a particular population: people diagnosed with TB who are users of health services that are part of NTP networks (Denholm JT .2021 et al.).

1. Introduction

Tuberculosis (TB) remains a formidable global public health challenge. Recent data paints a concerning picture: in 2018, 7.0 million new TB cases were reported, a notable increase from the 6.4 million cases in 2017, continuing a troubling trend observed between 2009 and 2012. Despite progress in disease prevention, management, and healthcare

access, approximately 10 million people contract TB annually (Gupta RK, 2015, et al.). This high incidence underscores the persistent public health burden and the associated morbidity and mortality of the disease.

TB spreads readily through airborne transmission or close contact with infected individuals. Its presentation is variable; some individuals develop

symptoms soon after infection, while others remain asymptomatic for years, only to succumb to the disease when their immune systems weaken (Hershkovitz I, 2015, et al).

Certain populations are particularly vulnerable. Children under five, individuals over fifty, and those with compromised immune systems face a heightened risk of TB infection. Alarming, the World Health Organization (WHO) estimates that approximately two billion people – one-third of the global population – are infected with the TB-causing bacillus (Negin et al., 2015). The devastating consequences of this widespread infection were starkly illustrated in 2016, when TB claimed 1.7 million lives worldwide. Critically, 95% of these deaths occurred in low-resource countries, solidifying TB's status as the leading infectious cause of death globally.

This essay discusses the complex interplay between the COVID-19 pandemic and tuberculosis (TB), highlighting the impacts on treatment success, transmission, and case detection. While the global TB treatment success rate remained stable at 86% in 2020, suggesting maintained standards of care during the pandemic's initial phase, the broader picture reveals significant challenges. Restrictions like lockdowns and behavioral changes like mask-wearing likely contributed to reduced TB transmission in 2020 and 2021. However, the pandemic exacerbated underlying socioeconomic determinants of TB, such as malnutrition and poverty, ultimately impacting incidence and mortality rates. Critically, a decline in TB case notifications led to decreased detection, resulting in a growing pool of undiagnosed and untreated individuals within communities. Studies suggest stringent lockdown measures correlated with a substantial reduction in transmission (around 50%), and interventions like mask-wearing may have continued to offer some protection even outside of lockdown periods.

The consequences of delayed TB diagnosis and treatment are far-reaching. At the individual level, delays can lead to more advanced disease and poorer treatment outcomes. At the community level, undiagnosed individuals, particularly smear-positive cases, can transmit the infection to numerous contacts annually, perpetuating the cycle of transmission. The complex pathway from symptom onset to diagnosis and treatment often involves multiple delays, ultimately contributing to increased patient morbidity and mortality (Gupta RK, 2015 et al.).

Kenya exemplifies the ongoing struggle with TB. A

survey conducted in 2015-2016 revealed a significantly higher TB burden than previously estimated, with 426 cases per 100,000 individuals. In 2019 alone, it is estimated that 140,000 people contracted TB in Kenya, but only approximately 84,345 cases were diagnosed and reported to national authorities. This significant gap between estimated incidence and reported cases underscores the challenges in TB detection and control within the country.

Kenya's National Tuberculosis Program (NTP) faces significant challenges in combating tuberculosis (TB), as evidenced by substantial gaps in diagnosis and reporting. Data indicates that over 60% of the estimated TB burden remains undetected or unreported. Among those diagnosed and reported, a disproportionate number are male, with children under 15 representing approximately 10% of cases. Drug-resistant TB (DR-TB) poses a particularly concerning threat. In 2019, while an estimated 2,200 DR-TB cases existed in Kenya, the NTP identified and reported only 508.

Despite these challenges, there has been some progress. In 2019, TB incidence decreased by 10.4%. Furthermore, the number of reported TB cases declined by 15.7% from 2019 to 2020, with 72,943 cases reported in 2020. However, even with this progress, projections estimate over 140,000 TB infections in Kenya by 2020, with only 48% of new cases being identified.

Geographic disparities in TB prevalence are also evident. The highest burden of TB cases is concentrated in Nairobi (13%), Meru (5%), Kiambu (5%), Mombasa (4%), and Nakuru (4%) counties. Conversely, Lamu (0.4%), Tana River (0.5%), and Elgeyo Marakwet (0.6%) counties report the lowest numbers. This report includes a detailed county-by-county analysis assessing performance across various relevant indicators, offering targeted insights for localized intervention strategies. This granular data is crucial for the NTP to improve its effectiveness and address the specific challenges faced by different regions in Kenya.

2. Methods and material

2.1. Study area, design and period

Given Nairobi County's disproportionately high tuberculosis (TB) burden compared to the national average in Kenya, this study investigated TB management at Kenyatta National Hospital (KNH). As the country's largest teaching and referral hospital, KNH plays a crucial role in public

healthcare provision and medical education, serving as a training site for both the University Of Nairobi School Of Medicine and the Kenya Medical Training College. This study is significant because KNH operates with a 2000-bed capacity consistently exceeding full occupancy and a workforce exceeding 5,000. Serving approximately 2,000 outpatients and accommodating over 10,000 individuals daily, the hospital diagnoses roughly 200-300 TB cases monthly. Most of these patients are subsequently referred to peripheral health facilities for ongoing care and monitoring after initial diagnosis and treatment initiation. At KNH, anti-tuberculosis treatment protocols follow WHO-recommended regimens: the standard 2HRZE/4HR for new TB patients and 2HRZES/1HRZE/5HRE for retreatment cases, as documented by Mburu (2020). Critically, diagnostic and treatment services are offered free of charge.

To understand factors influencing delays in TB diagnosis and treatment, a retrospective study was conducted at KNH, Nairobi County, from July to August 2022. Utilizing a randomly selected sample of 127 TB patients aged 15 years or older, the study employed a standardized questionnaire administered through face-to-face interviews to collect relevant patient data. This data was then analyzed using SPSS version 20.0. Patient delay was dichotomized using the median value as a cut-off point, allowing for logistic regression analysis. Multivariable logistic regression was then performed to identify factors significantly associated with patient delay in accessing TB care. Statistical significance was determined at a p-value of ≤ 0.05 , with a corresponding 95% confidence interval.

2.2. Target Population

2.3. This study recruited adult participants (aged 15 years and older) newly diagnosed with pulmonary tuberculosis who are undergoing treatment for less than six months. Participants will be recruited from Kenyatta National Hospital (KNH) via systematic enrolments after providing informed consent. Recruitment will continue until the target sample size is reached. Exclusion criteria include a history of previous tuberculosis treatment cases), extrapulmonary tuberculosis, and residency outside of Nairobi.

2.4. Sample size and sampling procedure

This study employed a systematic sampling strategy to recruit 128 newly diagnosed, smear-positive pulmonary tuberculosis (TB) patients from a clinic setting. We utilized patient registration books as our sampling frame, identifying eligible participants during regular clinic hours. Consecutive sampling was initially used to identify potential participants. To ensure a representative sample, we then implemented systematic sampling. First, we calculated a sampling interval (K) by dividing the estimated total patient population by the desired sample size of 128. Following this, a random number was selected between 1 and K to determine the first participant in the sample. Subsequent participants were then chosen at intervals of K, effectively selecting every Kth patient from the registration books. (For example, if the random start was 3 and K was 2, the sample would include patients 3, 5, 7, and so on). This process continued until the target sample size of 128 was reached. Once selected, participants' data was extracted from the registration books, and they were subsequently contacted for follow-up interviews to obtain additional information.

2.5. Data Collection tools

This study employed a questionnaire to collect comprehensive data on tuberculosis (TB) patients. The questionnaire captured socio-economic and demographic factors, including gender, age, education level, marital status, and monthly income.

In addition, it gathered detailed medical background information, specifically focusing on underlying health conditions, presenting symptoms, substance use history, the location of the initial consultation, knowledge about TB, and whether TB-related tests were performed at the first visit. The questionnaire also explored patients' understanding of TB and their healthcare-seeking behaviours. To minimize random sampling errors, a probability sampling method was used to select participants. Data collection involved the researcher attending a chest clinic on weekdays, the clinic's typical operating days. During these visits, newly diagnosed patients and those receiving intensive TB treatment (and collecting their weekly medication supply) were approached. After their consultations, these patients were invited to participate in the study, and the questionnaire was administered in a separate room. Following the provision of informed consent, each participant was given approximately ten to twenty minutes to complete the questionnaire.

2.6. Data Management and analysis

This study investigated factors associated with patient and health system delays in [mention specific context, e.g., TB treatment]. Categorical variables were summarized using frequencies and percentages and compared using the chi-square (χ^2) test. To identify potential predictors of patient and health system delay, univariate logistic regression was performed. A lenient significance level ($P < 0.1$) was used in the chi-square test for variable selection in order to minimize the risk of excluding relevant factors from the univariate analysis. Subsequently, variables exhibiting significance in the univariate analysis were subjected to binary stepwise logistic regression. All statistical tests were two-tailed, with a significance level of $p < 0.05$. Data were initially entered using EPI-info version 7 and then exported to SPSS version 25 for statistical analysis. Binary logistic regression was employed to determine the relationship between each independent variable and the dependent variables (patient and health system delay). Statistically significant relationships were defined as those with P-values below 0.05 and corresponding 95% confidence intervals. The results of the descriptive analysis were presented using tables, figures, and graphs. Specifically, categorical variables were summarized as frequencies and percentages, and column graphs were used to visualize the distribution of TB treatment outcomes stratified by gender, patient type, and age group.

TB patients felt that they should be given free medication 96.1% (n = 122). On how they felt upon being told that they had TB, 66.9% (n = 89) were scared. Distance from health facility and where they got first diagnosis/treatment was statistically significant at $P < 0.005$ ($P = 0.004$), Distance from where they stay, and time taken to seek treatment was significant at $P < 0.05$ ($P = 0.005$). The respondent took between two to three months before seeking medical treatment 29.9% (n = 38). The patient him/herself 40.2% (n = 51) indicated that they are better in term of reducing delay in TB diagnosis and treatment.

These graphs displayed the percentage distribution of treatment outcomes within each of these subgroups.

3.2. Associations and interactions of the key variables

3. Results/Findings

3.1. Socio-demographic and characteristics of the patients

Females were the majority with 51.2% (n = 65). The age with the highest frequency was between (40 – 49) 32.3% (n = 41). On marital status, cohabiting was the highest 43.3% (n = 55). Study indicated that those who reached primary/secondary were majority 59.1% (n = 75). On occupation, those who were independent was high 36.2% (n = 41). Cross tabulation between age and seeking treatment for the first time was significant at $P < 0.05$ ($P = 0.003$). The health care workers were identified as the best in terms of who can reduce TB 44.9% (n = 57). The

Upon receiving a TB diagnosis, a significant proportion of individuals experienced negative emotions. Specifically, 66.9% (n = 85) reported feeling scared, while 21.3% (n = 27) reported experiencing depression. A smaller percentage, 11% (n = 14), expressed disbelief in their diagnosis. These findings underscore the perceived severity of TB and the distress associated with its diagnosis.

Further analysis revealed that a substantial majority, 96.9% (n = 123), of individuals with TB reported experiencing discrimination within their communities, while only 3.1% (n = 4) felt they had not faced such discrimination. This high rate of perceived discrimination highlights the social stigma associated with TB.

The study also examined the time elapsed between the onset of symptoms and the initiation of medical treatment. The largest group of respondents, 29.9% (n = 38), sought medical attention two to three months after experiencing initial symptoms, closely followed by 20.5% (n = 26) who sought treatment within a month. The extended delay of two to three months was attributed to patients seeking diagnoses from multiple hospitals before ultimately receiving care at KNH. A statistically significant association was found between the time taken to seek treatment and the appearance of the first symptoms ($\chi^2 = 151.861$, d.f. = 116, $P = 0.014$).

Regarding awareness, 85.0% (n = 108) of respondents reported being informed about the possibility of having TB, while 15% (n = 19) were either uninformed or unaware. Prior to diagnosis, a large majority, 96.1% (n = 122), had taken some form of treatment, while 3.9% (n = 5) had not taken any medication. This suggests that patients often present with symptoms requiring treatment before a definitive diagnosis is made.

When asked about factors contributing to reduced delays in TB diagnosis and treatment, 44.9% (n = 57) cited the healthcare system, while 40.2% (n = 51) believed their own proactive behavior as a contributing factor. This highlights the importance of both a responsive healthcare system and patient engagement in

timely diagnosis and treatment.

Finally, at the time of the study, 89.4% (n = 125) of TB patients were currently undergoing TB treatment, while only 1.6% (n = 2) were not.

Table 28 presents a statistically significant relationship between the number of children living in a household and a reduction in delays in tuberculosis (TB) diagnosis and treatment ($\chi^2 = 47.848$, d.f. = 18, $P = 0.000$). This finding suggests that the number of children in a household is the sole socioeconomic factor associated with minimizing delays in seeking TB diagnosis and treatment. A possible explanation for this correlation is that households with more children are more motivated to promptly address potential TB infection to prevent its spread within the family.

4. Discussions

Our study's demographic analysis revealed a majority of participants were women, aligning with the 2016 tuberculosis (TB) prevalence survey (Center for Health Solutions, 2017) that indicated a disproportionate TB burden among women. This gender disparity may stem from a combination of factors, including a higher prevalence of comorbidities and potentially compromised immune function in women, or gender-related differences in healthcare-seeking behaviours (Mauvais-Jarvis et al., 2020).

Qualitative data from focus group discussions highlighted concerns regarding the professional conduct of healthcare workers, suggesting that their demeanour significantly influenced the provision of TB care. Participants frequently described healthcare workers as unapproachable, and instances of patient mistreatment, such as verbal reprimands, were reported. One particularly concerning account detailed a patient who received a cursory examination due to their unofficial admission status, resulting in their discharge and subsequent readmission in a critical state. Several factors appeared to contribute to these negative behaviours. A prevalent concern among healthcare workers, particularly those in TB wards, was the fear of contracting the disease from patients. Similarly, lab technicians expressed anxiety regarding the handling and processing of TB samples (WHO, 2016).

Socioeconomic analysis identified the number of children in a household as a significant factor influencing the timely diagnosis and treatment of TB. This association likely reflects heightened

concern among households about potential TB transmission within the family unit. Furthermore, the study identified key reasons for delayed treatment-seeking behaviours. A lack of time and underestimation of symptom severity were the most frequently cited reasons, accounting for 13.4% (n = 17) of cases. Financial constraints hindering access to healthcare facilities were also a significant barrier, representing 7.9% (n = 10) of cases. Less frequently cited, but nevertheless important, contributing factors included a lack of awareness about symptom severity, fear of social stigma or job loss, reliance on private clinics or traditional herbal remedies, challenges related to healthcare access or transportation, and negative past experiences within the healthcare system.

5. Limitations of the study

6. This research encountered several limitations that merit consideration when interpreting the findings. First, the study setting, Kenyatta National Hospital (KNH), presents challenges due to its diverse patient population. This includes individuals facing socioeconomic hardships, incarcerated individuals, and those residing in geographically remote areas, potentially impacting their consistent engagement with TB treatment and follow-up. Second, the reliance on patients accessing care at KNH introduces a selection bias, as individuals opting for private healthcare were excluded from the study, potentially limiting the generalizability of the results. A third limitation lies in the reliance on patient-reported adherence to CPT and ART. This data, while valuable, could not be independently verified and is subject to recall bias or social desirability bias, potentially affecting the accuracy of the assessment. Furthermore, the relatively small sample size restricts the statistical power of the analysis, limiting the ability to definitively establish robust associations between specific factors and TB diagnosis or treatment outcomes. Finally, the COVID-19 pandemic and associated lockdowns imposed significant logistical hurdles, disrupting both healthcare provider workflows and patient access to care, likely influencing study participation and the observed outcomes.

7. Conclusion

The hospital staff reported high rates of TB case notifications, and their treatment outcomes are worse compared to the general population. It is crucial to prioritize the staff in this large hospital as a vulnerable group for TB disease and implement effective infection control measures urgently. A well-functioning team for TB diagnosis and treatment is essential in preparing for TB management within the facility. TB patients and their families often face significant financial and economic burdens due to the illness, which can create barriers in accessing diagnosis and treatment, as well as completing the treatment successfully. Unlike SDG Indicator 3.8.2, the TB-specific indicator focuses on a specific population:

individuals diagnosed with TB who utilize health services within the NTP networks (**Denholm JT .2021 et al.**).

A comprehensive and interconnected strategy that integrates innovative diagnostics, expanded community-based care, and an understanding of local challenges is crucial in eliminating TB. KNH has the potential to be at the forefront of this movement by putting in place the reforms discussed above and serving as a beacon of the comprehensive strategy needed to counter the disease. By embracing a multi-faceted approach, we can significantly reduce the burden of TB and save countless lives.

A multi-pronged approach is essential to enhance tuberculosis (TB) management and control at Kenyatta National Hospital (KNH). This approach should incorporate the use of sophisticated diagnostic tools, the implementation of efficient treatment protocols, and robust preventative strategies.

Strengthening KNH's infrastructure requires the prioritization of multi-channel diagnostic systems and the establishment of distributed networks. This will entail.

- **Integrated Sample Referral:**
 - ✓ **Integrating TB and HIV Testing: Building Efficient and Effective Systems in High-Burden Areas.** (Emphasizes the desired outcome of efficiency)
 - ✓ **Maximizing Impact: Implementing Integrated TB and HIV Testing Services in High-Prevalence Regions.** (Focuses on the positive impact of integration)
 - ✓ **Streamlining Testing: Creating Integrated TB and HIV Testing Programs for High-Prevalence Communities.** (Highlights the simplification aspect)
 - ✓ **Dual Testing:** Implementing two-way testing for TB and COVID-19 in at-risk populations to address co-infection.
- **Advanced Diagnostic Algorithms:** This approach employs a multi-stage strategy for pulmonary tuberculosis (TB) detection, starting with chest radiography (potentially with computer-aided detection, CAD) and molecular rapid diagnostic tests (mWRD) as the initial screening and diagnostic assessments, followed by confirmatory tests.
- **Prioritized Testing:** To effectively combat tuberculosis, prompt mWRD testing and rapid drug

susceptibility testing (DST) must be standard practice for all suspected cases. Focusing these crucial diagnostic efforts on individuals at higher risk will ensure faster identification of drug-resistant strains and facilitate appropriate, targeted treatment plans.

- **Digital Integration:** Modernizing Position Information Processing Through Digital Tools: Streamlining Data Management and Analysis.
- **Child-Focused Diagnostics:** Overcoming diagnostic barriers for tuberculosis in children requires a two-pronged strategy: widespread adoption of innovative, child-friendly tests like mWRD testing on non-sputum specimens, coupled with the establishment of targeted contact tracing initiatives for children and adolescents.
- **Enhanced Collaboration:** Enhancing TB Screening and Management in Day Cares: A Collaborative Approach by IRSU TB.

Recommendations

Prioritizing TB Control at KNH: A Multi-Faceted Approach

To successfully address tuberculosis (TB) at Kenyatta National Hospital (KNH), a comprehensive strategy is essential. This strategy hinges on the interconnected elements of enhanced screening, rapid diagnosis, preventative treatment, and robust infection control:

1. Enhancing Screening and Early Detection:

- **Digital Technology:** To bolster its fight against tuberculosis, KNH should strategically prioritize the implementation of advanced digital chest X-ray systems paired with computer-aided detection (CAD) software. Such technology will greatly improve the accuracy and efficiency of routine TB screening processes.

Decentralized Services: Decentralizing TB screening and diagnostic services is crucial, integrating them seamlessly into the overall care continuum. This necessitates the implementation of outreach initiatives and home care programs to ensure wider access and improved patient management.

Revolutionizing Diagnostic Capabilities:

- **Rapid Molecular Diagnostics:** Adopting the latest World Health Organization recommendations, KNH needs to modernize its approach to TB diagnosis by making rapid molecular diagnostics (mWRD) its primary test, moving away from traditional

sputum examination.

- **Non-Sputum Specimen Analysis:** The diagnostic limitations imposed by the difficulty in obtaining sputum specimens from children necessitate research into and implementation of alternative methods for analyzing non-sputum samples. This is a critical area for advancing pediatric diagnosis.
- **Improved M. Tuberculosis Confirmation:** The accurate identification of *Mycobacterium tuberculosis* infections is paramount, and KNH should focus on strengthening its laboratory infrastructure and optimizing its diagnostic protocols.

Addressing Diagnostic Access and Utilization Gaps:

- **Strengthening Diagnostic Networks:** To ensure equitable access to testing for all, KNH must prioritize strengthening its diagnostic networks through improved service delivery, scalability, and decentralization.
- **Combined Screening:** Integrating tuberculosis (TB) screening with testing for other prevalent diseases, like SARS-CoV-2, in vulnerable populations warrants serious investigation. This approach could improve the efficiency of public health programs and maximize the impact of limited resources by identifying individuals affected by multiple conditions.

Strengthening Tuberculosis Prevention (TPT):

- **Integrated TPT Programs:** To ensure TB prevention reaches its full potential, tuberculosis preventive therapy (TPT) should be integrated into existing services like case identification and contact tracing, strengthening the overall healthcare journey.
- **Improving Access and Compliance:**
 - ✓ KNH focuses on enhancing the accessibility of Tuberculosis Preventive Therapy (TPT), increasing treatment reach, promoting patient adherence, and elevating the precision of TPT documentation and surveillance.
- **Vulnerable Populations Prioritization:**
 - ✓ Targeted interventions are crucial for populations with heightened TB risk, notably individuals living with HIV."
 - ✓ Particular emphasis must be placed on vulnerable populations

disproportionately affected by TB, such as people living with HIV."

Addressing the tuberculosis epidemic requires focused attention on high-risk groups, and individuals living with HIV are a priority.

- **Addressing Patient Reluctance:** To overcome barriers to TPT adoption at KNH, a multi-pronged approach is required. This includes ensuring the consistent and timely availability of new TPT therapies, coupled with proactive efforts to address both staff and patient hesitancy and actively encourage treatment completion.

Infection Prevention and Control:

- **Airborne Transmission Prevention:** KNH facilities must implement comprehensive airborne transmission prevention and control (IPC) measures, guided by a clear IPC policy, throughout all locations.

Ethical approval and consent to participate

Authorization to carry out the research was granted by the Head of the Respiratory and Infectious Diseases Unit, and Ethical approval was obtained from the KNH/UoN Ethics and Research Committee, MKU, and NACOSTI. The confidentiality of all information gathered from the patients' records was guaranteed.

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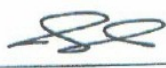
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DECLARATIO

This thesis is my original work and has not been presented for any research leading to the award of a degree in any other institution/university. No part of this thesis may be reproduced without the prior written permission of the author and/or Mount Kenya University.

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PhDPH/2020/65046

Sign Date 5/01/2023.**Declaration by Supervisors:**

This thesis will be submitted to Mount Kenya University with approval as university supervisors.

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ACKNOWLEDGEMENT

I am deeply grateful to my supervisors, Dr. Dominic Mogire, PhD, Senior Lecturer at the School of Public Health, Mount Kenya University, and Dr. Dennis Magu, PhD, Senior Lecturer at the School of Public Health, Jomo Kenyatta University of Agriculture and Technology, for their invaluable assistance and unwavering support throughout this project. I am also immensely thankful to Dr. M. Mudeny, PhD, for providing insightful intellectual and statistical guidance.

My gratitude extends to the management of Mount Kenya University for fostering a supportive and conducive environment for my academic pursuits and research. I also want to acknowledge and thank all the instructors whose inspiration and support were instrumental to both my fellow students and myself.

Finally, I would like to express my heartfelt appreciation to the administration and personnel of Kenyatta National Hospital for their critical clinical assistance during this study program.

To

The Editor-In-Chief

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Dear Editor,

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I am enclosing herewith a manuscript (research article) **“PATIENT AND HEALTHCARE SYSTEM DELAYS IN DIAGNOSTICS AND**

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Detail of each author with his contribution to this paper is as under:

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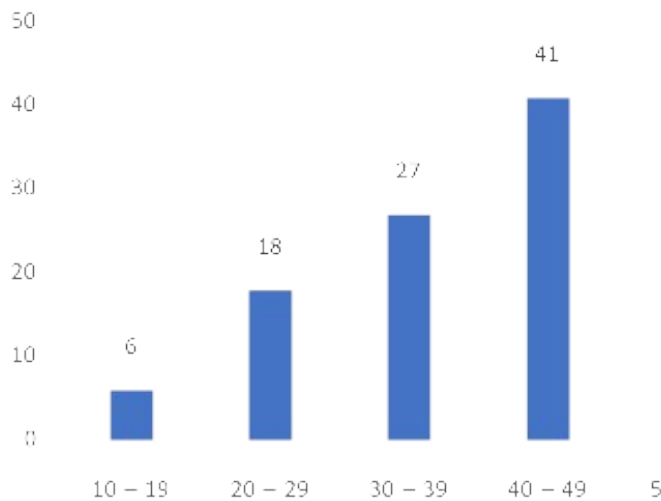
DR. DOMINIC MOGIRE- (drmogere@mku.ac.ke)-MAIN SUPERVISOR

With the submission of this manuscript, I affirm that: all authors participated directly in the planning, execution, or analysis of the study; all authors have read and approved the final version of the manuscript; this work is original and has not been previously copyrighted or published; it is not currently under consideration for publication elsewhere; and we will not submit it elsewhere while under review by this journal. Furthermore, there are no closely related manuscripts or abstracts, published or unpublished, by any of the authors. I have no conflicts of interest to disclose, and Mount Kenya University is aware of this submission.

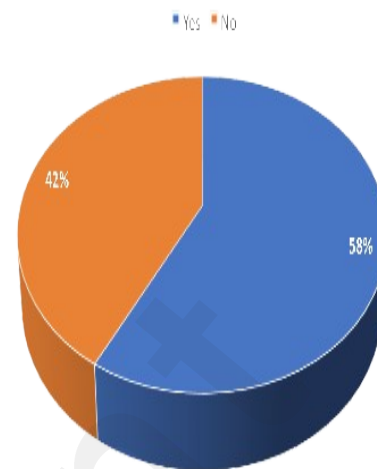
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FIGURES

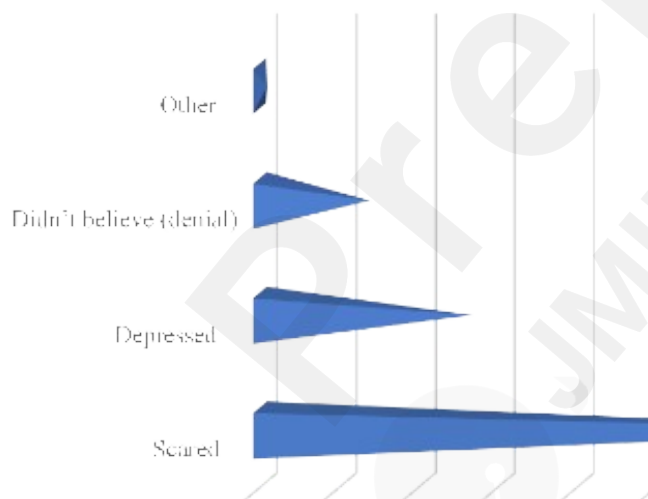
Demographic profile of the r newly Diagnosed TB



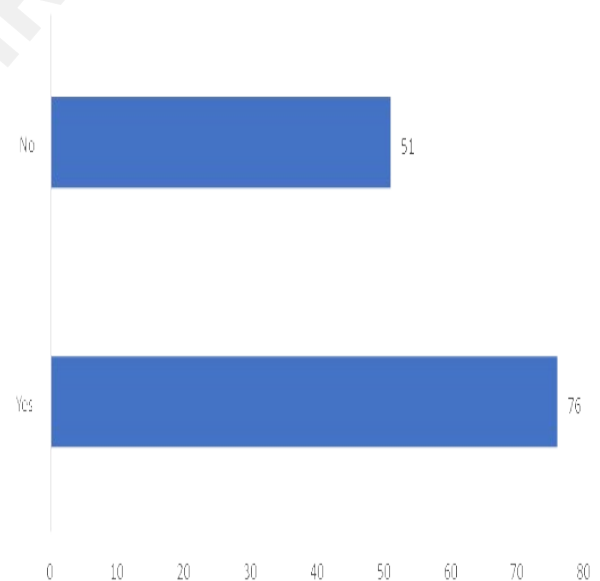
AFRAID OF LOSING JOB UPON TB DIAGNOSIS

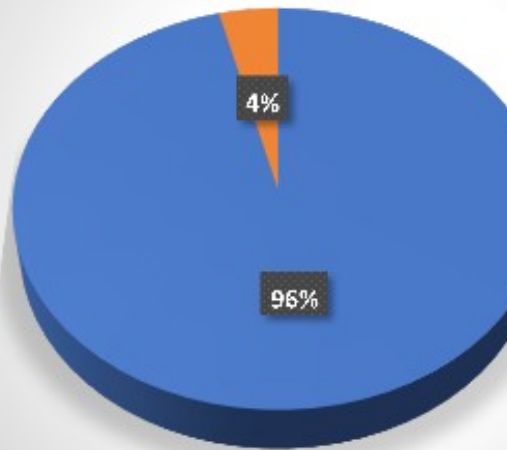
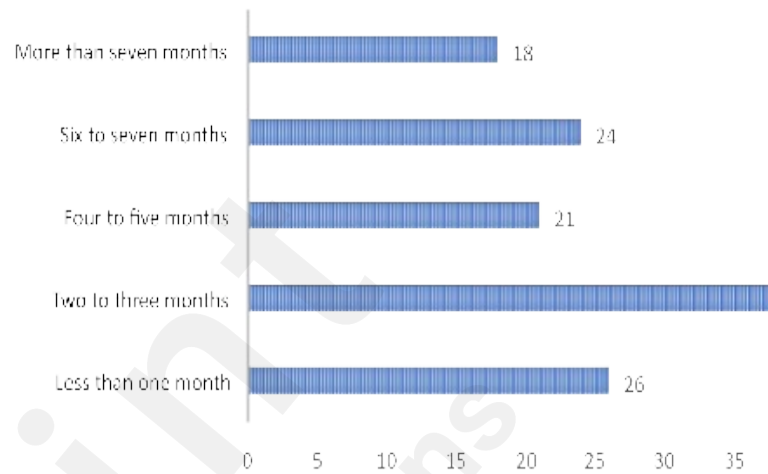
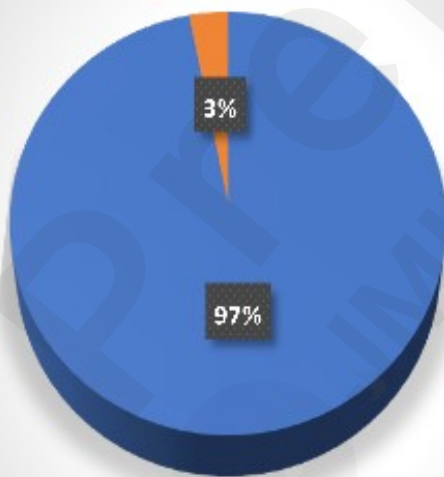
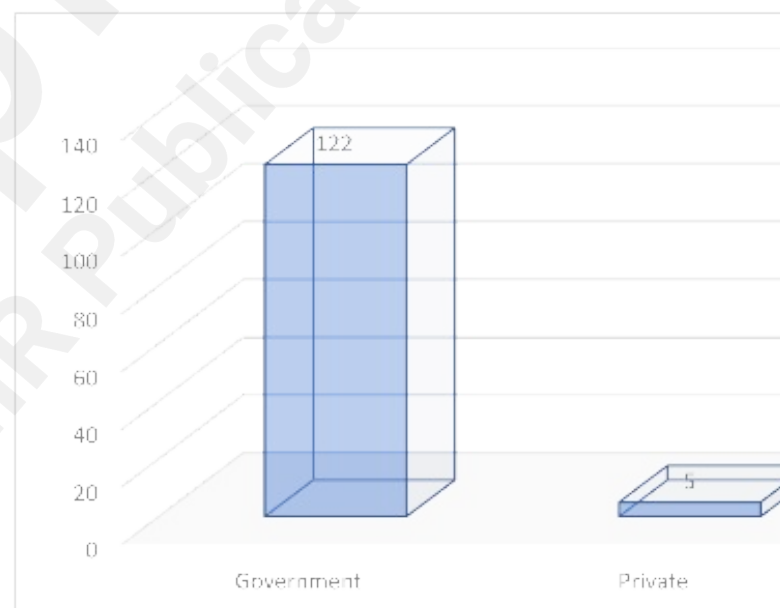


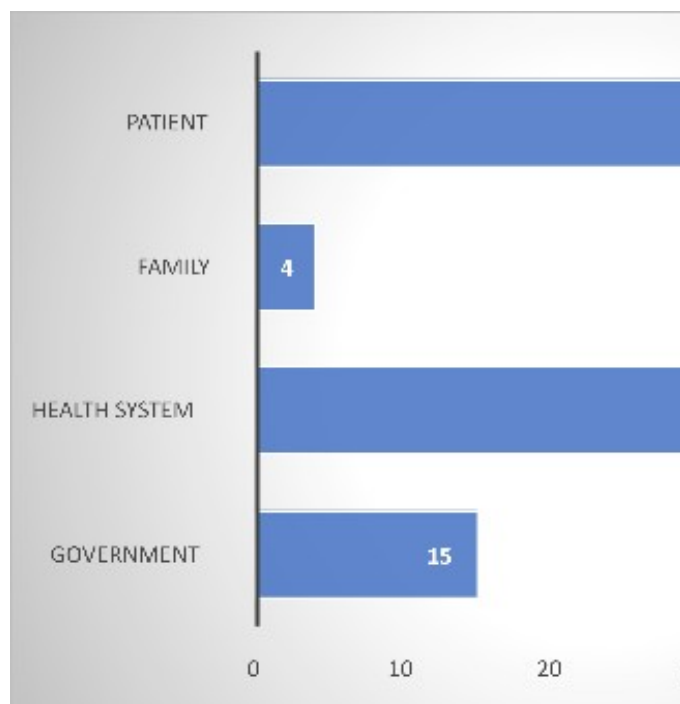
How did you feel when you found out t



Permission to access health care services



Gender TB patient's discrimination**TIME TAKEN BEFORE SEEKING TREATMENT FOR TB****TB discrimination in the community****Preference of TB****Reduction of Delay**



Reduce the delay in diagnosis and treatment for TB

