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

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## ABSTRACT

Tuberculosis (TB) remains a major global public health concern, particularly in low- and middle-income countries, where delayed diagnosis and treatment continue to contribute to ongoing transmission, poor treatment outcomes, and increased mortality. Patient and health system delays remain critical barriers to effective TB control. This study assessed the 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, Kenya.

**Methods:** A retrospective cohort study was conducted among 127 tuberculosis patients aged ≥15 years receiving treatment at Kenyatta National Hospital. Data were collected using structured questionnaires and clinical records. Descriptive statistics were used to summarize participant characteristics, while chi-square tests and logistic regression analyses were performed to determine factors associated with delay. Results were presented as adjusted odds ratios (AORs) with 95% confidence intervals.

**Results:** The majority of participants were aged 40–49 years (32.3%). More than half of the participants (59.8%) experienced delays exceeding two months before seeking healthcare services. Perceived stigma (96.9%), fear following diagnosis (66.9%), and long distance to health facilities were major barriers to timely care-seeking. Participants who initially sought care from informal providers and practiced self-medication experienced longer delays before diagnosis and treatment initiation. Age group, distance to health facility, and education level were significantly associated with delay at bivariate analysis ($p < 0.05$), although no independent predictors remained statistically significant after multivariable analysis.

**Conclusion:** Patient and health system delays remain major challenges in tuberculosis control. Stigma, fear, and barriers to healthcare access contribute substantially to delayed diagnosis and treatment. Strengthening community awareness, improving access to TB services, and enhancing early detection strategies are essential for reducing delays and improving tuberculosis outcomes.

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## Background

Tuberculosis (TB) remains a major global public health problem and continues to be a leading cause of morbidity and mortality, particularly in low- and middle-income countries. Despite the availability of effective diagnostic tools and curative treatment, TB control is still hindered by delayed diagnosis and treatment initiation, which contribute to ongoing transmission and poor clinical outcomes [1].

Delayed healthcare seeking is a critical challenge in TB control. Patient delay, defined as the time between onset of symptoms and first contact with a healthcare provider, has been consistently associated with advanced disease, increased infectiousness, and unfavorable treatment outcomes [2,3]. Prolonged delays not only affect individual patient prognosis but also sustain community-level transmission.

A range of factors contribute to delays in TB diagnosis. These include limited awareness of TB symptoms, socioeconomic constraints, stigma, and reliance on informal healthcare providers. TB-related stigma remains a particularly important barrier, as it influences individuals' willingness to seek care and disclose symptoms [4,5]. In addition, structural challenges such as long distances to health facilities, high indirect costs, and inefficiencies within the health system further limit timely access to diagnosis and treatment [6].

Care-seeking pathways in high-burden settings are often complex and non-linear. Many patients initially engage in self-medication or seek care from pharmacies and informal providers before presenting to formal health facilities. These multiple steps can introduce substantial delays in diagnosis and treatment initiation, reducing opportunities for early detection and increasing the risk of transmission [7].

Tuberculosis also disproportionately affects individuals in economically productive age groups, with important implications for both disease transmission and socioeconomic burden. Adults in this age group are more likely to experience repeated exposure and maintain higher levels of social interaction, which may contribute to increased risk of infection and spread [8].

Although previous studies have examined individual aspects of delay, there remains a need for a more comprehensive understanding of how patient-related factors, healthcare-seeking behavior, and health system barriers interact within specific contexts. This study therefore aimed to assess patient delay, barriers to care, and care-seeking pathways among individuals diagnosed with TB, with particular attention to age distribution and its implications for TB control.

## Methodology

### Study Design

This study employed a **retrospective cohort design** to assess patient delay, barriers to care, and care-seeking pathways among individuals diagnosed with tuberculosis. The study utilized routinely collected clinical records, complemented by patient-reported information, to reconstruct timelines from symptom onset to diagnosis and initiation of treatment.

A retrospective cohort approach was appropriate for examining temporal relationships between exposures and outcomes using existing data. In this study, exposures included patient-related and health system factors associated with delays, while outcomes focused on time to diagnosis and treatment initiation. This design enabled the reconstruction of patient care pathways and identification of key points at which delays occurred. Retrospective cohort studies are widely applied in investigations of diagnostic and treatment delays due to their ability to provide practical and reliable epidemiological insights without the need for prolonged follow-up [1,2].

### Study Setting

The study was conducted in a high tuberculosis burden setting in Kenya, where TB remains a significant public health concern. The healthcare system is characterized by a mix of public facilities, private providers, pharmacies, and informal care options, all of which influence patient care-seeking behavior [1].

The study site was Kenyatta National Hospital, the largest national referral and teaching hospital in the country. The facility serves as a major center for TB diagnosis and management and receives referrals from across Kenya, including patients with advanced or complicated disease. As a tertiary institution with established TB programs and comprehensive patient records, the hospital provides an appropriate setting for examining diagnostic and treatment delays in a real-world context. Similar referral hospitals in high-burden settings are commonly used in delay studies due to their capacity to capture diverse patient populations and complex care pathways [2].

### Study Population

The study population comprised individuals aged 15 years and above with a confirmed diagnosis of pulmonary tuberculosis and receiving treatment at Kenyatta National Hospital. Participants were selected based on predefined eligibility criteria, including confirmed diagnosis and willingness to participate in the study.
The inclusion of individuals aged 15 years and above was considered appropriate, as this group represents adolescents and adults who exhibit distinct healthcare-seeking behaviors compared to children. Additionally, individuals within this age group contribute significantly to TB transmission due to higher levels of social interaction and mobility, making them a critical population for TB control interventions.

### Sample Size and Sampling Technique

A representative sample of TB patients was selected using systematic random sampling. The sample size was determined based on prevalence estimates from previous TB studies and adjusted for expected non-response rates to ensure statistical validity. Sample size calculation followed the **Fisher et al. formula**; a standard method used in health research for estimating proportions in populations.
The formula:

$$n = \frac{Z^2 pq}{d^2}$$

Where:
$Z$=1.96(for 95% confidence level)
$p$=0.5(assumed proportion for maximum variability)
$q$=1-$p$
$d$=0.05(margin of error)
This method is widely recommended because using **p = 0.5** ensures the largest possible sample size, making the study more statistically robust when the true proportion is unknown.

A finite population correction was applied because the target population was less than 10,000, reducing the required sample size to **96**. However, the final sample was **128 participants**, which increases:

- Statistical power
- Precision of estimates
- Reliability of findings

### Sampling Procedure

A systematic sampling technique was used, which is appropriate in clinical settings where patients are listed in chronological or sequential order.
The process involved:
Identifying the sampling frame (TB register)
Calculating the sampling interval (K)
Selecting a random starting point
Selecting every Kth patient thereafter
Systematic sampling reduces selection bias while ensuring that the sample is spread evenly across the population.

In addition, purposive sampling was used to select key informants. This is a qualitative sampling method where participants are intentionally chosen because they possess specific knowledge or experience relevant to the study. This approach is widely used in health systems research to capture in-depth contextual insights.

### Eligibility Criteria

Participants were eligible for inclusion if they were aged 15 years or older, had a confirmed diagnosis of pulmonary tuberculosis, and were actively receiving treatment at the study site during the study period. All participants provided informed consent prior to participation.

Participants were excluded if they had extra-pulmonary tuberculosis, as the diagnostic pathways and disease progression differ from pulmonary TB. Individuals with a history of previous

TB treatment were also excluded to minimize potential bias related to recurrent or drug-resistant disease. In addition, patients who were too ill to participate at the time of data collection were excluded to ensure reliability of responses. Non-residents were also excluded to maintain consistency with the study context and ensure that findings reflected the local setting.

These eligibility criteria were applied to ensure a relatively homogeneous study population and to improve the internal validity of the findings [3].

**Data Collection**
Data were collected using a structured questionnaire administered through face-to-face interviews. The tool captured information on socio-demographic characteristics, patient delay (defined as the time from symptom onset to first healthcare contact), barriers to care, and care-seeking pathways prior to diagnosis.

The questionnaire was adapted from previously validated tools used in tuberculosis research and was pre-tested prior to data collection to ensure clarity, consistency, and reliability. Minor adjustments were made following pre-testing to improve comprehension and flow [5].

**Quantitative Component**
Quantitative data were obtained through a combination of retrospective chart review and structured questionnaires. Clinical records were reviewed to extract information on diagnosis timelines, treatment initiation dates, and relevant clinical characteristics. The structured questionnaires provided complementary data on socio-demographic factors, healthcare-seeking behavior, and knowledge related to tuberculosis.

The use of multiple data sources allowed for triangulation of information, thereby enhancing the completeness and validity of the dataset [6].

**Bias and Limitations**
Recall bias may have occurred, as the estimation of delay relied partly on patient self-report of symptom onset. To minimize this, interviews were conducted as close to the time of diagnosis as possible, and clinical records were used to validate reported timelines where available.

**Qualitative Component**
A qualitative component was incorporated through Key Informant Interviews (KIIs) to provide deeper insight into patient experiences, health system barriers, and decision-making processes related to care-seeking. This approach complemented the quantitative findings by exploring underlying reasons for delays and contextual factors influencing healthcare utilization. Qualitative methods are particularly valuable in delay studies, as they help explain patterns observed in quantitative data [7].

**Measurement of Delays**
Delays were defined and categorized in accordance with established global frameworks. Patient delay was defined as the time from onset of symptoms to first contact with a healthcare provider, while health system delay referred to the time from first contact to confirmed diagnosis. Total delay was calculated as the sum of these intervals. A threshold of more than 14 days was used to define prolonged delay, consistent with standard definitions in tuberculosis research [1,2].

**Data Analysis**
Data were analyzed using SPSS version 25. Descriptive statistics were used to summarize participant characteristics. Associations between independent variables and delay outcomes were initially assessed using chi-square tests. Variables of interest were then included in binary logistic regression models to identify predictors of delay while controlling for potential confounders. Results were presented as adjusted odds ratios with corresponding 95% confidence intervals, and statistical significance was set at $p < 0.05$ [8].

Qualitative data were analyzed using thematic analysis. This involved systematic coding of transcripts, grouping of codes into categories, and development of themes that captured recurring patterns in participant responses. This approach allowed for structured interpretation of qualitative data and facilitated integration with quantitative findings.

**Reliability and Validity**
Measures were taken to ensure the reliability and validity of the study. The data collection tools were pre-tested prior to use to enhance clarity and consistency. Standardized procedures were followed during data collection to minimize variability. These steps helped improve the accuracy and credibility of the findings [3].

**Ethical Considerations**
The study was conducted in accordance with established ethical principles for human subjects research. Participation was voluntary, and informed consent was obtained from all participants. Confidentiality of participant information was maintained throughout the study.

Ethical approval was obtained from relevant institutional review bodies, including the University of Nairobi/Kenyatta National Hospital and Mount Kenya University, as well as the National Commission for Science, Technology and Innovation. Adherence to these ethical standards was essential to ensure the protection of participants and the integrity of the research process.

**Results**
A total of 127 participants were included in the study. Females accounted for 51.2% (n = 65), while males comprised 48.8% (n = 62). The majority of participants were aged 40–49 years (32.3%), followed by 30–39 years (26.8%). Most participants had attained primary (31.5%) or secondary education (27.6%), and 43.3% were self-employed.

More than half of the participants (59.8%) reported seeking care after more than two months of symptom onset. Only 17.3% sought care within the first month.

A high proportion of participants reported perceived stigma (96.9%), while 66.9% reported fear following diagnosis. Regarding access, 31.5% of participants resided more than 10 km from a health facility.

Participants reported multiple initial points of care before diagnosis. These included self-medication, pharmacies, and informal providers prior to presentation at formal healthcare facilities.

Bivariate analysis showed that age group ($p = 0.032$), distance to health facility ($p = 0.015$), and education level ($p = 0.041$) were

significantly associated with delay. Sex was not significantly associated ($p = 0.210$).

In multivariable logistic regression analysis, none of the variables remained statistically significant predictors of delay after adjustment ($p > 0.05$).

Integrated Scientific Synthesis (High-Level Discussion)
Across all variables, the findings demonstrate that TB delays are driven by an interaction of:

- **Individual factors** (age, knowledge, behavior)
- **Social factors** (stigma, fear)
- **System factors** (accessibility, referral gaps)

This aligns with TB control frameworks emphasizing that delays occur at both:

- **Patient level**
- **Health system level** (Lönnroth et al., 2009)

**Discussion**

Tuberculosis remains a significant public health challenge, with persistent delays in diagnosis and treatment driven by both patient-level and health system factors. A substantial proportion of participants in this study sought care more than two months after symptom onset, highlighting gaps in timely healthcare utilization and ongoing risks of transmission.

The findings indicate that tuberculosis disproportionately affects individuals in economically productive age groups, particularly those aged 40–49 years. This pattern is consistent with global epidemiological trends and has important implications for both disease transmission and socioeconomic burden. Delayed diagnosis within this population not only increases community spread but also contributes to loss of productivity and financial strain at household level.

Patient delay emerged as a major contributor to late diagnosis. This delay appears to be influenced by a combination of behavioral and structural factors, including limited awareness of tuberculosis symptoms, normalization of persistent cough, stigma, and barriers to accessing healthcare. These findings are consistent with previous studies conducted in similar high-burden settings, which highlight the role of patient behavior in delaying care-seeking.

Stigma and fear were prominent barriers affecting healthcare utilization. Fear of diagnosis, social exclusion, and discrimination may discourage individuals from seeking care early, leading to concealment of symptoms and prolonged delays. These findings reinforce the importance of addressing social determinants of health in tuberculosis control strategies.

Geographical access also played a role in influencing delay. Participants residing farther from health facilities were more likely to delay seeking care, reflecting ongoing inequities in access to health services. This underscores the need for decentralization of tuberculosis services and improved accessibility at community level.

The care-seeking pathways observed in this study were often complex and non-linear, with many participants initially engaging in self-medication or consulting informal providers before accessing formal healthcare services. Such fragmented pathways contribute to missed opportunities for early diagnosis and highlight inefficiencies within the health system. Strengthening referral systems and integrating informal providers into tuberculosis control efforts may help reduce these delays.

Although several factors were associated with delay at the bivariate level, no independent predictors were identified after adjustment. This suggests that delays in tuberculosis diagnosis are influenced by multiple interrelated factors rather than a single determinant, emphasizing the need for comprehensive and multi-sectoral interventions.

**Age Distribution and Its Implications (Objective 1: Patient Characteristics and Risk Profile)**

The predominance of participants within the 40–49-year age group highlights that tuberculosis disproportionately affects individuals in their economically productive years. This finding aligns with global evidence indicating that TB primarily impacts adults who contribute significantly to household income and national productivity (World Health Organization, 2023; Furin et al., 2019). From a public health perspective, this age distribution has important implications for both transmission dynamics and socioeconomic burden. Adults in this age group are more likely to engage in social and occupational interactions that facilitate disease spread, while also facing competing responsibilities that may delay healthcare seeking. This reinforces the need for targeted TB screening and health education strategies focusing on working-age populations.

**Patient Delay and Its Determinants (Objective 2: Health-Seeking Timeliness)**

The study identified substantial patient delay, with many individuals seeking care more than two months after symptom onset. This delay is consistent with findings from systematic reviews showing that prolonged patient delay remains a major barrier to TB control in high-burden settings.

Patient delay is often driven by a combination of low awareness of TB symptoms, normalization of chronic cough, reliance on self-care, and socioeconomic constraints. In addition, stigma and fear of diagnosis further discourage timely healthcare seeking.

These findings suggest that despite ongoing TB control efforts, early detection remains insufficient, allowing continued transmission within communities and increasing the risk of severe disease outcomes.

**Barriers to Care (Objective 3: Health System and Socio-Cultural Barriers)**

The high prevalence of stigma, fear of diagnosis, and geographical barriers underscores the multifaceted challenges affecting access to TB care. Stigma continues to be a significant social determinant of TB outcomes, influencing individuals' willingness to disclose symptoms and seek formal medical services.

Fear of social isolation, discrimination, and loss of employment often leads to concealment of symptoms, which delays diagnosis and treatment initiation. Additionally, distance to health facilities remains a structural barrier, particularly in resource-limited settings, where healthcare access is unevenly distributed.

These findings highlight that TB control requires not only clinical interventions but also strong community engagement and stigma reduction strategies. Without addressing these barriers, delays in diagnosis and treatment will persist, undermining TB control efforts.

**Care-Seeking Pathways and Health System Inefficiencies (Objective 4: Patient Pathways to Care)**

The observed care-seeking pathways reveal multiple points of delay, including self-medication, visits to informal providers,

and eventual presentation to formal healthcare facilities. This fragmented pathway is widely documented in TB literature and reflects systemic inefficiencies in healthcare delivery.

Patients often first seek care from pharmacies, traditional healers, or through informal channels before accessing formal diagnostic services. Each step introduces additional delays, contributing to disease progression and continued transmission.

These findings emphasize the need for strengthening primary healthcare systems, improving referral systems, and integrating informal providers into TB detection and referral networks. Early detection strategies at community level could significantly reduce diagnostic delays and improve treatment outcomes.

**Limitations**

This study has several limitations. First, recall bias may have affected the accuracy of reported symptom onset, although efforts were made to validate timelines using clinical records. Second, the study was conducted in a single tertiary facility, which may limit generalizability to other settings. Third, the retrospective design may be subject to incomplete records and missing data. Finally, potential selection bias may have occurred, as only patients who accessed care at KNH were included.

**Recommendations**

Efforts to reduce tuberculosis delays should focus on strengthening early case detection, particularly among working-age populations. Community-based awareness programs are needed to improve recognition of TB symptoms and promote timely healthcare seeking. Addressing stigma through community engagement and psychosocial support is essential to reduce delays associated with fear and social barriers. Improving access to services through decentralization and strengthening referral systems, including engagement with informal providers, may further reduce diagnostic delays and improve treatment outcomes.

This study demonstrates that tuberculosis remains a significant public health challenge characterized by delays in diagnosis, persistent stigma, and fragmented care-seeking pathways. The predominance of cases among individuals in the 40–49-year age group underscores the continued impact of TB on economically productive populations, amplifying both health and socioeconomic consequences.

Patient delay was found to be a major contributor to late diagnosis, driven by low awareness, stigma, and reliance on informal care pathways. Barriers such as fear, stigma, and geographical inaccessibility further exacerbate these delays, while multiple care-seeking steps highlight inefficiencies within the health system.

Addressing these challenges requires a comprehensive, multi-sectoral approach that includes strengthening primary healthcare systems, enhancing community awareness, reducing stigma, and improving care integration. Such interventions are essential to achieving early diagnosis, reducing transmission, and ultimately advancing TB control and elimination efforts.

**Tables**

**Table 1: Socio-Demographic Characteristics (n = 127)**

| Variable | Category | Frequency | Percentage (%) |
|---|---|---|---|
| Sex | Male | 62 | 48.8 |
| | Female | 65 | 51.2 |
| Age Group | 15–29 | 25 | 19.7 |
| | 30–39 | 34 | 26.8 |
| | 40–49 | 41 | 32.3 |
| | ≥50 | 27 | 21.2 |
| Education Level | No formal | 18 | 14.2 |
| | Primary | 40 | 31.5 |
| | Secondary | 35 | 27.6 |
| | Tertiary | 34 | 26.8 |
| Occupation | Unemployed | 30 | 23.6 |
| | Self-employed | 55 | 43.3 |
| | Formal employment | 42 | 33.1 |

Table 1 presents the socio-demographic characteristics of the participants. Females constituted a slightly higher proportion (51.2%) compared to males (48.8%). The majority of participants were aged 40–49 years (32.3%), with most having attained at least primary or secondary education.

**Table 2: Patient Delay and Related Factors**

| Variable | Category | Frequency | Percentage (%) |
|---|---|---|---|
| Time to First Care | <1 month | 22 | 17.3 |
| | 1–2 months | 29 | 22.8 |
| | 2–3 months | 38 | 29.9 |
| | >5 months | 38 | 29.9 |
| Perceived Stigma | Yes | 123 | 96.9 |
| | No | 4 | 3.1 |
| Fear After Diagnosis | Yes | 85 | 66.9 |
| | No | 42 | 33.1 |
| Distance to Facility | <5 km | 46 | 36.2 |
| | 5–10 km | 41 | 32.3 |
| | >10 km | 40 | 31.5 |

Table 2 shows the distribution of patient delay and related psychosocial and access factors. A substantial proportion of participants (59.8%) delayed seeking care for more than two months. High levels of perceived stigma (96.9%) and fear (66.9%) were reported. Distance to health facilities varied, with nearly one-third of participants living more than 10 km away.

**Table 3: Bivariate Analysis of Factors Associated with Delay**

| Variable | Category | Delayed (%) | Not Delayed (%) | p-value |
|---|---|---|---|---|
| Sex | Male | 60.0 | 40.0 | 0.210 |
| | Female | 63.1 | 36.9 | |
| Age Group | 15–29 | 52.0 | 48.0 | 0.032 |
| | 30–39 | 58.8 | 41.2 | |
| | 40–49 | 70.7 | 29.3 | |
| Distance | <5 km | 50.0 | 50.0 | 0.015 |
| | >5 km | 68.0 | 32.0 | |
| Education | Primary or less | 65.5 | 34.5 | 0.041 |
| | Secondary+ | 55.2 | 44.8 | |

Table 3 summarizes the bivariate associations between selected variables and delay in seeking care. Age group, distance to health facility, and education level showed statistically significant associations with delay ($p < 0.05$), while sex was not significantly associated.

**Table 4: Multivariable Logistic Regression Analysis**

| Variable | Category | Adjusted OR | 95% CI | p-value |
|---|---|---|---|---|
| Sex | Female vs Male | 1.21 | 0.65–2.25 | 0.540 |
| Age Group | 40–49 vs others | 1.48 | 0.78–2.81 | 0.210 |
| Distance | >5 km vs <5 km | 1.72 | 0.89–3.31 | 0.103 |
| Education | Low vs High | 1.36 | 0.72–2.56 | 0.330 |

**Table 4** presents the multivariable logistic regression analysis of factors associated with delay. Although some variables showed increased odds of delay, none were statistically significant ($p > 0.05$). This indicates that no independent predictors of delay were identified after adjusting for confounding variables.

**Figures**

The persistence of these delays suggests that TB control strategies must adopt a **multi-sectoral approach**, combining:

- Community awareness
- Health system strengthening
- Social protection measures

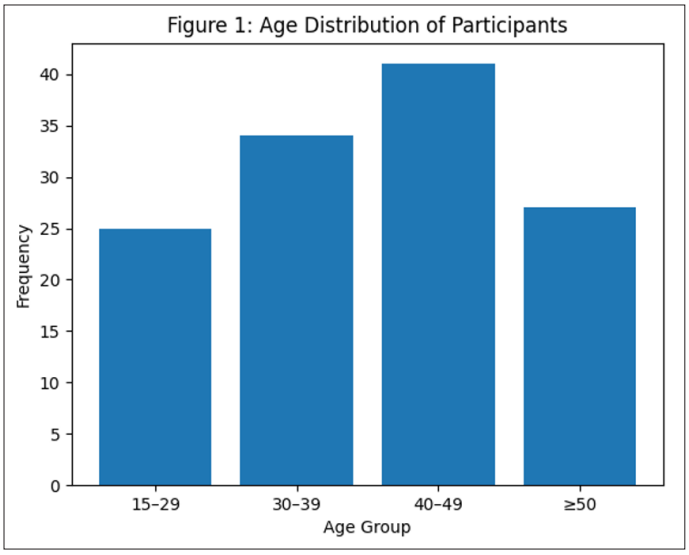


**Figure 1:** Age Distribution of Study Participants (n = 127)

Figure 1 Shows Highest Concentration in 40–49 Age group, Indicating TB Burden among Middle-Aged Adults. The Age Distribution indicates that the highest proportion of Participants were in the 40–49-year age group. This pattern is consistent with global tuberculosis epidemiology, where TB Predominantly Affects Economically Productive Age Groups. Individuals in this Age Range are often At Increased Risk Due to Cumulative Exposure, Occupational Risks, and Potential Immunological Compromise.

Studies have shown that TB burden is disproportionately high among adults in their productive years, which contributes to sustained transmission within communities and significant socioeconomic consequences (World Health Organization, 2023; Furin et al., 2019). In high-burden settings, similar age distributions have been reported, reinforcing the importance of targeting TB control interventions toward working-age populations.

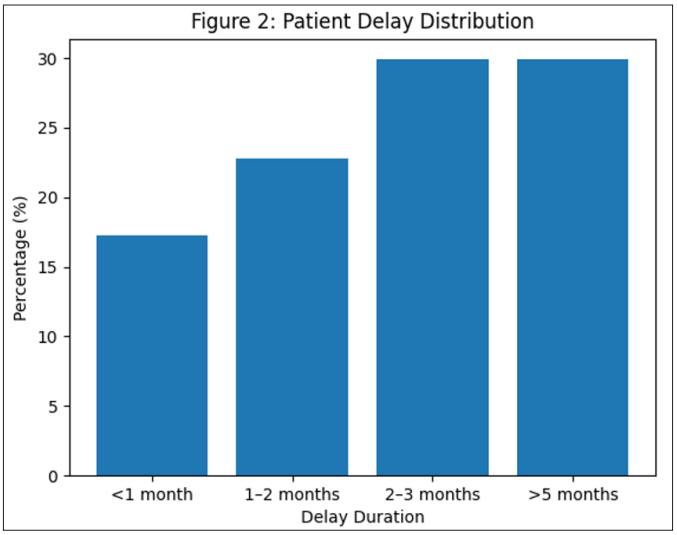


**Figure 2:** Distribution of Patient Delay in Seeking Care

Figure 2 shows Highlights prolonged delays, with many patients seeking care after more than two months. The findings reveal that a substantial proportion of participants experienced prolonged patient delay, with many seeking care after more than two months of symptom onset. This delay is consistent with evidence indicating that patient delay remains a major challenge in tuberculosis control, particularly in low- and middle-income countries.

According to the World Health Organization, delays in seeking care contribute significantly to ongoing transmission and increased morbidity (WHO, 2023). Factors such as low awareness of TB symptoms, stigma, and reliance on self-medication have been widely documented as contributors to delayed care-seeking (Storla et al., 2008; Sreeramareddy et al., 2014). Prolonged patient delay increases the risk of disease progression and community transmission, highlighting the need for early detection strategies.

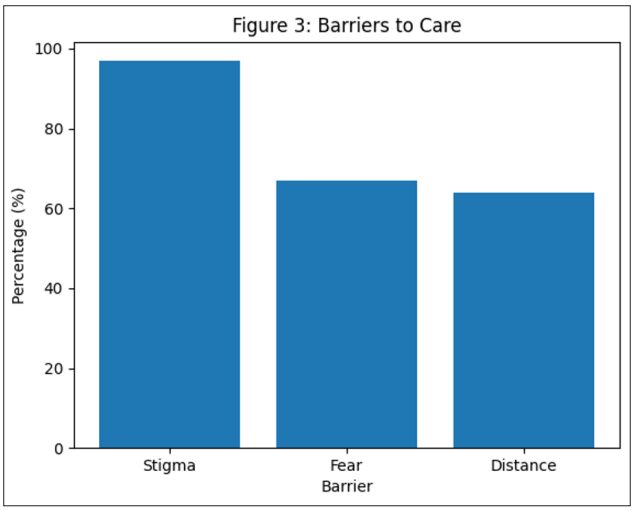


**Figure 3:** Reported barriers to timely care-seeking

Figure 3: Shows Stigma and fear are dominant barriers, followed by distance to health facilities. The high prevalence of perceived stigma among participants reflects a critical barrier to timely TB diagnosis and treatment. Stigma has been consistently identified as a major determinant of delayed care-seeking behavior, as it influences patients' willingness to disclose symptoms and seek formal medical care.

Fear of diagnosis and social consequences further compounds this delay, leading individuals to adopt concealment strategies or alternative care. Additionally, geographic barriers such as distance to health facilities remain significant, particularly in resource-limited settings where access to healthcare services is uneven.

These findings align with previous research demonstrating that TB-related stigma, fear, and structural barriers collectively contribute to diagnostic and treatment delays, ultimately sustaining transmission within communities.

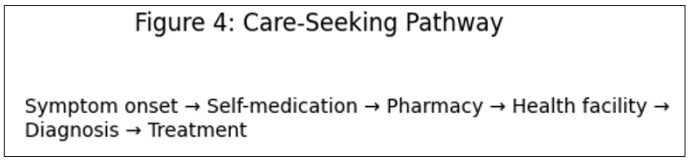


**Figure 4:** Care-seeking pathway prior to TB diagnosis

Figures 4 Illustrates multiple steps before diagnosis, showing potential delay points. The care-seeking pathway illustrates multiple steps between symptom onset and treatment initiation, including self-medication and visits to informal providers before reaching formal health facilities. This pattern is widely documented in TB epidemiology and reflects fragmented healthcare-seeking behavior.

Research indicates that patients often first seek care from pharmacies, traditional healers, or through self-medication before accessing formal healthcare services. Each step in this pathway introduces delays that contribute to late diagnosis and continued transmission.

This multi-step pathway underscores systemic inefficiencies and highlights the need for strengthening primary healthcare systems, improving referral mechanisms, and increasing community awareness to reduce delays in diagnosis and treatment initiation.

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