REVIEW ARTICLE

The Impact of Stigma on Tuberculosis Management in Sub-Saharan Africa: A Comprehensive Review

Akor Alexander Agada[1,*], Toyin Dare Kayode[2]

[1] Department of Internal Medicine, University of Abuja Teaching Hospital, Nigeria

[2] Department of Internal Medicine, Federal Teaching Hospital Lokoja, Nigeria

***Corresponding Author:** Akor Alexander Agada
Department of Internal Medicine, University of Abuja Teaching Hospital, Nigeria.
Email: alexander.agada@uniabuja.edu.ng

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Abstract

Tuberculosis (TB) remains a critical public health challenge in sub-Saharan Africa (SSA), where stigma emerges as a pervasive barrier that profoundly undermines disease management at every stage of the care cascade. This comprehensive review synthesizes evidence from 30 recent studies conducted across multiple SSA countries to examine how stigma affects TB diagnosis, treatment adherence, and patient outcomes. The evidence reveals that TB-related stigma manifesting as anticipated, internalized, and enacted forms leads to delayed diagnosis, treatment interruption, non-disclosure of TB status, social isolation, and deteriorating mental health. Stigma is deeply intertwined with HIV co-infection, poverty, and inadequate health system responses. The review identifies critical gaps in current TB programs and proposes multi-level interventions including healthcare worker training, community education, integrated mental health support, and person-centered care models. Addressing TB stigma is essential for achieving the WHO's End TB Strategy goals in sub-Saharan Africa.

1. Introduction

Despite tremendous gains in TB diagnosis and treatment technologies, TB remains a devastating infectious disease worldwide, especially in resource-limited settings in sub-Saharan Africa. Much of global efforts aimed at improving TB care have focused on advancing TB treatment paradigms without addressing social determinants and barriers to care. Stigma remains one of the most important underlying barriers facing TB control efforts across all levels of the care continuum in SSA. As the WHO begins implementation of End TB Strategy priorities in high TB burden countries, an increased understanding of the implications of stigma is paramount to improving health seeking behaviour and supporting TB program success in affected communities.

Defined as a social phenomenon driven by judgment and devaluation, stigma toward TB patients presents across several levels. Literature regarding TB stigma across sub-Saharan Africa countries confirms that stigma results in delayed TB diagnosis, poor treatment adherence, disclosure and notification, loss of income, and personal relationships. This paper will review literature from multiple countries across sub-Saharan Africa, publishing within the last 10 years, on the topic of TB stigma. How does stigma affect care seeking and diagnostic delay?. What affects does TB stigma have on treatment adherence?. What implications does stigma have on TB treatment outcomes?. How does the healthcare system and providers feed into TB stigma?. What mental health effects are associated with TB stigma?. What types of stigma interventions exist?. Literature suggests that stigma is multi-faceted and occurs across multiple levels. As such, this review will address these questions through the lens of these various stigma levels and terminologies.

2. Background

2.1 Burden of Tuberculosis Infection in Sub-Saharan Africa

The burden of TB infection and disease across Sub-Saharan Africa countries is high and exacerbated by factors

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such as HIV co-infection, crowded living conditions, poverty, and lack of healthcare resources. TB stigma, like many other health related stigmas, is prevalent across all levels of the patient care continuum.

2.2 TB Stigma

TB stigma across SSA countries is heavily influenced by HIV status, socioeconomic factors, and perceived breech of norms and morals. TB symptoms like marked coughing and weight loss are visible identifiers that elicit stigma responses from others in the community (Bond and Nyblade, 2006). Within many Sub-Saharan African countries, TB stigma had been reported by patients to be "worse than the disease" itself (Adejumo et al., 2025). Literature suggests that TB stigma includes prior understanding of TB and HIV, anticipated stigma, and enacted stigma.

3. Types and Forms of TB stigma

Researchers across various African countries have identified three major types of stigma that TB patients report experiencing.

Anticipated stigma: Afraid of what family members, others in their community, and health care workers might think or say, some TB patients will avoid being diagnosed or seeking care for TB related symptoms.

Internalized stigma: Feeling ashamed because of their TB illness, patients who experience this form of stigma report avoiding others for fear of being judged.

Enacted stigma: Actual reports of being treated poorly because of their TB illness. These types of stigma were reported by TB patients across South Africa, Nigeria, and Uganda.

4. Effects of Stigma

4.1 TB diagnosis and care-seeking delays

TB stigma was shown to cause delayed TB diagnosis in South Africa because patients who perceived that they would be perceived as HIV positive if they were to seek care at their local clinic chose not to go. Feelings of stigma were shown to reduce one's motivation to seek TB diagnosis (Murray et al., 2013). This phenomenon was also shown in Zambia through a mixed methods study. Participants perceived a negative association between TB and HIV which led to stigma, discrimination, and treatment avoidance (Cremers et al., 2016). Participants delayed seeking care at clinics or rejected TB testing because they were afraid of finding out their results were positive. Another study conducted in Ethiopia found that due to lack of awareness about TB and perceived stigma, TB patients presented late to clinics, and overall TB detection was low. The study shows that TB control programs should implement educating rural communities about TB (Abebe et al., 2010).

4.2 Effects on Active Case Finding

Within South Africa, TB stigma contributed to low levels of active case finding at a community level. The study showed that TB stigma, which was fuelled by fear of having TB and an understanding of the TB/HIV dual burden, negatively affects how patients sought care (DeSanto et al., 2023). Participants reported that stigma can be spread verbally through gossip about others who were suspected or confirmed TB patients. Another study done in Eswatini found that there was a positive association between TB knowledge, favourable attitudes, and lower levels of stigma with patients being tested for TB (Chomutare et al., 2025). Participants feared that during active case finding initiatives they would be identified as TB patients.

4.3 Non-Disclosure among TB patients

Fear of being associated with these negative connotations can lead patients to hide their TB status from spouses, family members, and even their communities. A study conducted in Malawi found that TB patients who were diagnosed with TB were unlikely to disclose their status to others unless they felt they would not be stigmatized by that person (Zolowere et al., 2008) . Not disclosing one's TB status can lead to increased transmission and lack of informed decision-making by patients about their treatment plans. In Zambia, similar results were found where TB patients concealed their status due to fear of negative reactions from others (Cremers et al., 2015). Patients went as far as being expelled from their homes because of their TB diagnosis.

5. Effects on Treatment Adherence & Patient Outcomes

Participants reported that some health care workers were rude, hostile, and disrespectful which led participants to conclude their TB treatment (Adejumo et al., 2025). Participants stated that the feeling of being stigmatized by their health care providers was worse than being symptomatic. During interviews, participants even stated "the nurses have killed many patients" due to

their poor behaviour. Researchers in Uganda set out to find out if TB related stigma was associated with adherence to treatment by watching videos directly observed treatment (VDOT). VDOT is when patients take videos of themselves taking medication to then be sent to health care providers for adherence monitoring. Study results showed that there was high overall stigma which led to 1.9 increased odds of participants missing videos. When looking specifically at anticipated stigma, study found that if patients were concerned about being judged for their videos, they had 2 times higher odds of missing videos (Bwambale et al., 2025). This study provides strong evidence that TB stigma, especially anticipated stigma, is a hidden barrier to treatment adherence. Studies have shown that due to poor treatment compliance, TB patients who experience stigma are at higher risk of transmitting the disease to others as well as experiencing serious TB related morbidity. One study conducted in Zambia showed that TB related stigma led to feelings of low self-esteem, insults, ridicule, social exclusion, and withdrawal from friends and families (Cremers et al., 2015). All these feelings contributed to poor adherence to treatment regimens.

In a review study conducted across multiple Sub-Saharan African countries, researchers found that stigma not only causes delays in TB diagnosis but also negatively impacts adherence to treatment plans and creates gaps in care (Izudi et al., 2025). Mental health illnesses like depression and anxiety were shown to decrease TB treatment adherence while alcohol use had been shown to increase TB disease progression, all leading to poor treatment outcomes. Researchers in South Africa wanted to find out what factors at baseline were associated with adherence to TB treatments (Steulet et al., 2026). Major factors included TB stigma, HIV status, and challenges with receiving clinical TB care. This study goes one step further than others by measuring TB stigma and its association with TB treatment and care. A cross-sectional study done in Sierra Leone found that TB stigma was significantly associated with both adherence patterns and patients' quality of life (Lahai et al., 2025). Patients who understood the importance of taking TB medications regularly were more likely to completing taking their medications.

When patients are fearful of being checked for TB at their local health facility, delays in care-seeking occur. If during the diagnostic process patients fear that their status will be leaked to others, they are less likely to return for results and start their treatment regimen. Not only does stigma cause TB patients to not disclose their status, but it also causes them to isolate themselves from others and not seek the care they need. Qualitative research from Kenya uncovered that TB stigma not only influenced treatment outcomes, but also how patients viewed their ability to make decisions to seek treatment (Ondiroet et al., 2024). This study shows that in order to create meaningful interventions we must first understand what the patients needs are.

6. TB/HIV Intersectionality

HIV and TB are commonly co-associated in many Sub-Saharan African countries. Due to various health beliefs about how one could become HIV positive, TB symptoms have been linked to HIV diagnosis. One study conducted in South Africa and Zambia showed that TB patients who were HIV positive experienced a lot of tension due to TB-HIV stigma (Bond and Nyblade, 2006). Visible TB symptoms were enough to trigger stigma because of public beliefs about how HIV is spread and judgments about one's behaviour. Research set out to understand how TB related stigma changed over time by interviewing TB patients every 3 months (Bergman et al., 2025). Study found that not only did stigma change over time, but TB patients went from being enactors of stigma to individuals who feared receiving stigma from others. The study also shows that community attitudes towards HIV and TB are associated with seasonal factors.

TB stigma, HIV stigma, and HIV/TB co- epidemic is associated with decreased use of occupational health services to learn TB status. Researchers in South Africa conducted a study that used structural equation modelling to test their hypothesis (Wouters et al., 2022). They concluded that TB stigma and HIV stigma separately and together through the HIV/TB co- epidemic have negative implications on TB affected individuals. In Zambia, researchers found that TB control efforts are being hindered in high HIV prevalence settings due to an unfolding TB-HIV stigma (Bond and Nyblade, 2006). The stigma is occurring due to visible signs that someone is living with TB and current TB public health programs. Authors go on to suggest that integration of TB-HIV services could help combat some of the root causes of stigma.

One study conducted in Malawi found that TB patients who were on HIV medication through ART

felt as though they were being stigmatized by other TB patients (Zolowere et al., 2008). Patients began to isolate themselves from others and were worried about taking their TB medications. Some participants even went as far to stop taking their medications due to depression caused by stigma from others. Similar results were discovered during research in South Africa (Hayward et al., 2024). Study found that to address TB/HIV intersectional stigma, services would need to be restructured in a way that decreased both anticipated stigma and enacted stigma. Participants came together to co-develop an intervention to address TB/HIV stigma.

7. Barriers to Treatment Adherence and Care Engagement

A prominent theme was fear of stigma leading some patients to refuse or not complete biomedical TB treatment. Research from Zambia documents cases where TB patients refuse biomedical care and opt to seek care from traditional or faith healers instead (Cremers et al., 2015). Other studies have reported patients discontinuing TB treatment against medical advice due to fear of stigma (Adejumo et al., 2025).

8. Psychosocial Impact and Mental Health

8.1 Mental Health Outcomes

TB stigma negatively impacts mental health outcomes. Depression and anxiety due to TB stigma create a negative feedback loop that contributes to poor treatment adherence. One study out of South Africa showed that intersectional stigma had negative influences on mental health outcomes, eventually creating depression and disengagement from care (Foster et al., 2024). Patients across the care cascade faced mental health burdens due to their illness. A review outlined that poor mental health outcomes like depression and anxiety caused by TB stigma create a negative feedback loop that contributes to poor treatment adherence (Foster et al., 2024; Izudi et al., 2025). Current TB care models do not provide support for patients' psychosocial and behavioural health conditions.

8.2 Social Isolation

Patients experience social isolation due to fear of stigma. Interview-based research from Zambia showed that stigma can cause social issues such as low self-esteem, insults from others, ridicule, social exclusion, and overall social isolation from others which affected their quality of life and social position in society (Cremers et al., 2015). Patients experienced problems with their social circles due to their diagnosis. Research out of Nigeria found that when nurses counsel TB patients to remain indoors to prevent spreading the disease provoked feelings of loneliness. Many participants disapproved of this isolation which points to problems with current infection control practices that may increase perceived stigma from others (Adejumo et al., 2025). Social aspects were negatively impacted when patients were told to self-isolate at home.

8.3. Self Esteem

TB stigma negatively affects one's self-identity. In a qualitative study based in Ethiopia, participants reported that stigma can cause self-stigmatization, lower self-esteem due to their diagnosis, and caused concerns over them not being able to find a house or wife in the future (Datiko et al., 2020). Patients felt as though their identities were altered because of their TB status. Highlighting the importance of person-centred approaches to TB care, studies recommend interventions where TB survivors help reduce internal stigma by providing lived experiences (Hayward et al., 2024). Addressing TB stigma in a medical setting should include counselling to address changes to one's identity caused by TB.

9. Differences by Geography and Population

9.1. Urban vs Rural Communities

Urban and rural communities face different challenges with TB stigma. Research out of Equatorial Guinea collected nationwide responses from 55 different communities both in rural and urban settings. They found significant differences in knowledge, attitudes, and stigma across the different communities (Vericat-Ferrer et al., 2022). Rural communities where rural communities were less knowledgeable about TB. Ethiopian studies call for TB control initiatives to focus on rural communities. The study showed that rural communities, females, and participants with no formal education were least likely to know about TB (Abebe et al., 2010). Family members were more likely to tell others about the patient's TB status in rural settings.

9.2. Differences by Country

Sub-Saharan Africa: South Africa

South Africa is significantly overrepresented in the evidence base with 7 studies conducted across Cape Town,

Durban, the Eastern Cape, Gauteng, and the entire country. Common themes across these studies include high levels of TB stigma associated with HIV co-infection (Hayward et al., 2024; DeSanto et al., 2023), intersectional stigma from friends and family (Hayward et al., 2024; Foster, 2024), stigma causes low treatment adherence (Murray et al., 2013), TB stigma negatively affects mental health outcomes (Foster et al., 2024), (Bresenham et al., 2020), health systems and providers contribute to stigma (Bond et al., 2017), and family supports improve treatment adherence (Kipp et al., 2025).

Zambia

Studies from Zambia provide unique insights into the various ways patients are stigmatized. One study documented that the local language term for TB was Zunge which translates to "the white man's disease." This derogatory term made patients more reluctant to seek TB diagnosis and treatment (Cremers et al., 2016). The authors show TB programs need to tackle perceptions like TB is a foreign disease to destigmatize TB. The same study discusses how TB stigma causes patients to seek care from traditional healers and faith-based organizations. The authors recommend collaboration between TB clinics and traditional healers/fake healers to improve patient referral (Cremers et al., 2016). Another Zambian study found that TB patients experienced insults, being avoided, discredited, or laughed at by others (Cremers et al., 2015). Interviews with TB patients revealed stigma negatively impacted their quality of life.

East Africa: Ethiopia, Uganda, Kenya

Stigma was similarly prevalent among tuberculosis patients in studies from Uganda (Bwambale et al., 2025), Ethiopia (Datiko et al., 2020), and Kenya (Ondiroet et al., 2024). Patients were interviewed about their healthcare experiences with TB. Like other regions in Africa, patients reported concerns about confidentiality and healthcare providers' attitudes towards TB patients.

Similar to South Africa, TB patients in these countries also face the additional burden of HIV-associated stigma. Studies from Nigeria reveal that TB patients are also vulnerable to stigma, particularly if they have drug-resistant TB (Adejumo et al, 2025). Although contextual differences exist, the overall findings are generalizable across the African continent.

West Africa: Ghana, Nigeria, Sierra Leone

Inclusion of studies from Ghana (Huq KATME et al, 2022), Nigeria (Adejumo et al, 2025), and Sierra Leone (Lahai et al, 2025) demonstrate the pervasiveness of TB stigma across Africa. Research from Nigeria shows that health care workers recommending self-isolation for TB patients at home made them feel lonely and stigmatized. Patients felt as though the health care workers were accusing them of spreading TB deliberately (Adejumo et al, 2025). Studies from these settings described similar barriers and stigma faced by TB patients.

Central Africa: Equatorial Guinea

Finally, one study from Equatorial Guinea represents research from Central Africa (Vericat-Ferrer et al., 2022). A nationally representative household survey found that knowledge on TB was significantly associated with favourable TB attitudes and less stigma.

9.3. Key Populations

Female sex

Multiple studies from South Africa highlighted that female sex was associated with higher stigma scores (Huq KATME et al., 2022). Women also have less autonomy when it comes to their TB treatment decisions (Huq KATME et al., 2022). Along with low socioeconomic status, female sex was also associated with low treatment adherence.

Children:

Ethiopian studies highlight the importance of targeting children and rural communities (Abebe et al., 2010). One study found that mothers were more likely to disclose TB patient's status to other people in the household than husbands in rural communities.

Persons Who Are HIV-Positive: South Africa

One study out of South Africa found that TB patients who were coinfected with HIV faced higher levels of stigma than those who were only diagnosed with TB (DeSanto et al., 2023). Participants felt scared about disclosing their status to others. An analogous study in South Africa showed that TB patients experienced internalized stigma if they were coinfected with HIV (Murray et al., 2013).

Healthcare Workers

South Africa provides insight on TB stigma from

healthcare workers' perspectives. Interviews with healthcare workers showed that if they felt other healthcare workers would stigmatize them for working with TB patients, they were less likely to seek care for TB (Sommerland et al., 2017).

Drug-Resistant TB Patients

TB patients with drug-resistant TB also face the compounding problem of poor treatment experiences. One study in Nigeria showed patients with drug-resistant TB felt awkward receiving their medications since they weren't in transparent envelopes like other TB patients (Adejumo et al., 2025). Researchers commonly call for further research on MDR-TB stigma.

10. Interventions and Recommendations

10.1. Integrated Model of Care

A study out of sub-Saharan Africa recommends TB programs use an integrated care model to address the needs of TB patients (Foster et al.,2024; Izudi et al., 2025). This model should include mental health screening, alcohol screening with brief intervention and referral to treatment for alcohol use disorders, psychosocial support, and risk reduction counselling. Researchers underline the importance of collaboration between TB care, mental health care workers, and alcohol use counsellors. Implementation would require research, training of health care workers, and community involvement. South African research recommends restructuring service delivery for TB and HIV integration to decrease perceived and experienced stigma (Hayward et al., 2024). Services like TB treatment should be integrated into less obvious settings and task-shifted to community health workers to avoid visibility of diagnosis.

10.2. Training and Addressing Healthcare Worker Stigma

Healthcare workers need proper training to address how to communicate with TB patients and their families (Adejumo et al., 2025). Training should educate health care workers on how to address their internalized stigma about TB. Creating a stigma-free environment requires healthcare workers to change how they approach patients who have TB. South African researchers suggest using stigma reducing interventions to prevent stigma in the workplace TB (Sommerland et al., 2017). Ideas include workshops and campaigns to combat stigma. Having health care workers be champions of change and address stigma towards TB patients can help prevent stigma against patients. Moreover, health care workers need proper infrastructure to feel safe treating tuberculosis patients. Addressing healthcare workers concerns can make them more comfortable with the idea of working with TB patients.

10.3. Community-Level Education

Community interventions should include information dissemination about TB and reducing stigma. Ethiopian researchers propose interventions to reduce TB stigma and increase community awareness about tuberculosis (Datiko et al., 2020). Increased TB awareness could allow household members to better support TB patients who are under their care. Similar to Ethiopia, a study from Ghana suggests we need to increase advocacy, communication, social mobilization, and health education about TB in the general population (Huq KATME et al., 2022). Researchers recommend using mass media to spread awareness about TB. Education and awareness should also happen at the grassroots level. South African studies show the benefits of using TB survivors to speak at school events and include TB information in school curriculums (Hayward et al., 2024). Community-level prevention should include participation in country's TB control activities. Researchers from Equatorial Guinea recommend using the most effective channel of information based on their study, which was health workers (Vericat-Ferrer et al., 2022). Community members should participate in TB screening programs.

10.4. Patient-Centred Care and Peer Counselling

Researchers based in Cape Town provide insights on the importance of co-developing TB interventions with TB affected community members and health workers (Hayward et al., 2024). Patient-centred care that accounts for tuberculosis patient's social experiences with stigma can reduce internal stigma. Peer counselling can help TB patients share knowledge about TB and provide support for family members. TB survivors sharing their story can help other TB patients as mentioned above. Peer counsellors can provide patients with information about TB and address misconceptions about the disease. TB patients should also receive counselling on TB knowledge and perceived social support. Couples and family

counselling can help address stigma at the interpersonal level.

10.5. Policy & Structural Solutions

Policy makers should introduce policies into health systems that address structural barriers to TB care. South African research suggests policy changes like hiding TB programs from general public to other patients and better confidentiality protections (Hayward et al., 2024). Zambia researchers showed the need to reintroduce home-based care programs (Cremers et al., 2016). Collaborations between clinics and local healers can ensure patients seek proper TB diagnosis and treatment. Recommendations from across sub-Saharan Africa include updating HE strategies to address knowledge gaps about TB, tailor made message for key populations about TB, and allotting more resources to TB programs (Vericat-Ferrer et al., 2022). Policies should address food insecurity and poverty which were common themes across multiple studies.

11. Discussion

This literature review looked at 30 studies across tuberculosis affected regions in sub-Saharan Africa. TB stigma is ubiquitous and occurs at multiple levels (individual, healthcare provider, community). Delays in diagnosis and care occur due to patients' anticipated stigma about what others would say if they knew they had TB. Patients will avoid or face challenges actively seeking diagnosis and care due to perceived stigma. TB patients who took their medicine in public experienced discrimination because of their medication bottles, leading to treatment interruption. Enacted stigma from providers and family members causes low treatment adherence. Internalized stigma from patients causes them not to disclose their status to others. Structural factors contribute to stigma like clinics not separating TB patients from others waiting for services. Lack of understanding about TB causes friends and family to stigmatize TB patients. Below are gaps in TB prevention and care that TB stigma contributes to.

Patients' psychosocial needs: Across several studies in sub-Saharan Africa, TB patients are facing mental health challenges like depression because of their TB status (Izudi et al., 2025; Foster et al., 2024). Patients experience anxiety about others finding out they have TB, leading to treatment non-adherence (Foster et al., 2024; Izudi et al., 2025). Integrated care models that address patients' mental health needs are needed to combat TB. Patients' behavioural health conditions: Substance use was only found in one study that showed TB patients are using alcohol as a coping mechanism (Foster et al.,2024; Izudi et al., 2025) . Although only one study mentioned alcohol use, the authors recommend TB programs integrate brief alcohol interventions to address alcohol use as a coping mechanism. TB stigma. Stigma prevents patients from seeking care and patients disclose their TB status to others. It also causes low treatment adherence. Future TB programs should integrate stigma reduction activities throughout the entire TB care continuum. The evidence provided in this review was collected from a wide range of sub-Saharan African countries. These studies used qualitative methods, quantitative methods, and mixed methods to study TB patients. Since these studies are context specific, we can identify which factors cause TB stigma in different settings. Unfortunately, the studies we reviewed were cross-sectional. Cross-sectional studies only allow us to know that two factors are associated with each other but not exactly how one causes the other. For example, we do not know how stigma directly affects TB patients' treatment adherence. Longitudinal studies that follow TB patients over time are necessary to assess how TB stigma changes over time and if patients are able to complete treatment (Bergman et al., 2025). Future studies should conduct intervention research to identify what works at decreasing TB stigma. The studies we reviewed were from different settings but only concentrated on pulmonary TB. Research should examine how stigma differs for drug-resistant TB or extrapulmonary TB. Future studies should interview health care workers, family members, and community members about TB.

Inclusion of stigma reduction into TB programs is critical to ending TB in Africa. Based off of the WHO's End TB Strategy, TB programs should address stigma across the entire care continuum. From community level awareness and active case finding to diagnosis, treatment, and preventive treatment we must address TB stigma. TB care should shift to person-centred models that address patients' mental well-being as part of comprehensive TB treatment (Foster et al.,2024; Izudi et al., 2025). We also need to train and address stigma from health care workers who lack knowledge on how to interact with TB patients. Community members play a crucial role in addressing TB stigma. Peer led interventions where TB survivors share

their stories can allow other TB patients to better cope with their social experiences. TB/HIV co-infection creates a perfect storm that may increase TB stigma. We need to integrate TB and HIV services to decrease the visibility of TB patients who are also HIV positive. Lastly, policy changes need to be implemented to address poverty and food insecurity which were mentioned in multiple studies.

12. Conclusion

TB programs need to integrate programs that address tuberculosis patient's psychosocial well-being. Namely, future TB programs should address TB stigma through community outreach, training healthcare workers on how to interact with TB patients and strengthening privacy at TB clinics. All of these efforts require advocacy at the structural level to policy change. The time to dismantle TB stigma is now. If we can tackle TB stigma head on and integrate person-centred approaches to TB care, we can reach TB targets set by WHO's End TB Strategy.

Declarations

Ethics approval statement

No ethical approval was required for the current study as it did not deal with any human or animal samples.

Consent to participate

Not applicable

Consent to publish

Not applicable

Data Availability Statement

Not applicable

Competing Interests

The authors declare that they have no conflict of interest

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Author contribution

Akor Alexander Agada and Toyin Dare Kayode authors were involved the Conceptualization, Writing review and editing of the Manuscript. All authors have read and agreed to the published version of the manuscript

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