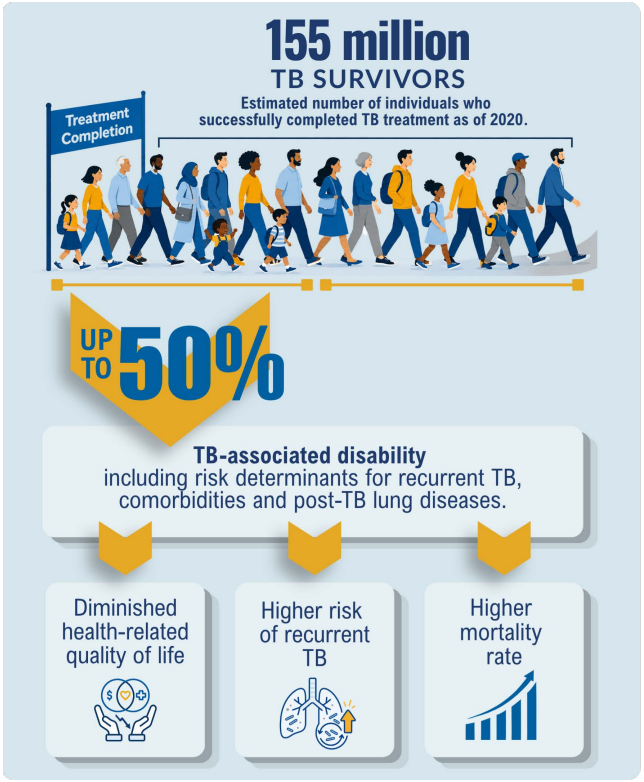
The Union
International Union Against Tuberculosis and Lung Disease
JUNE 2026

BEYOND CURE

The Unfinished Business of Tuberculosis

Long-term problems and disease burden after completion of TB treatment

Modelling estimates suggest globally that by 2020 there were an estimated 155 million tuberculosis (TB) survivors, defined as persons who had successfully completed TB treatment for one or more episodes of TB.[1] A substantial proportion (up to 50% in some studies/settings) of these people affected by TB suffer from TB-associated disability including on-going risk determinants for recurrent TB, comorbidities and TB-associated impairment, including post-TB lung diseases.[2,3,4] These not only diminish health-related quality of life, but also contribute to the higher mortality observed amongst TB survivors as compared with the general population.[5] Additionally, a recent study evaluating the lifetime burden of disease due to incident TB found that nearly 50% of the total disability-adjusted life-years (DALYs) was attributed to post-TB sequelae.[6] Together, these findings highlight that TB can have chronic consequences requiring ongoing, integrated care.



[1] Dodd PJ, et al. Quantifying the global number of tuberculosis survivors: a modelling study. Lancet Infect Dis 2021; 21: 984-992.
[2] Taylor J, et al. Residual respiratory disability after successful treatment of pulmonary tuberculosis: a systematic review and meta-analysis. EClinicalMedicine 2023; 59: 101979.
[3] Maleche-Obimbo E, et al. Magnitude and factors associated with post-tuberculosis lung disease in low- and middle-income countries: a systematic review and meta-analysis. PLoS Glob Public Health 2022; 2: e0000805.
[4] Alene KA, et al. Tuberculosis related disability: a systematic review and meta-analysis. BMC Med 2021; 19: 203.
[5] Romanowski K, et al. Long-term all-cause mortality in people treated for tuberculosis: a systematic review and meta-analysis. Lancet Infect Dis 2019; 19: 1129-1137.
[6] Menzies NA, et al. Lifetime burden of disease due to incident tuberculosis: a global reappraisal including post-tuberculosis sequelae. Lancet Glob Health 2021; 9: e1679-e1687.

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Policies and benefits of addressing multimorbidity and disability during and after TB treatment

World Health Organization (WHO) has published a framework for collaborative action on TB and comorbidities.[7] This framework aims to support countries in the introduction and scale-up of holistic people-centred services to address TB, comorbidities (for example, HIV infection, diabetes mellitus, hypertension, chronic respiratory disease and mental health conditions) and on-going risk determinants of TB (for example, tobacco use, harmful alcohol use, recreational drug use, occupational silica exposure, and undernutrition), both during and after completion of TB treatment. In 2023, WHO issued a policy brief on TB-associated disability, emphasising the need for people-centred, integrated care that includes screening and detection, referral and multidisciplinary approaches including rehabilitation, social protection and stigma reduction within and beyond the health sector.[8] These documents propose a shift of TB care from a disease-focused model to a person-centred, life-course approach. There are a number of potential benefits arising from these policies that are highlighted in **Table 1**.[9]

Table 1: Potential benefits of addressing multimorbidity, risk determinants and disability during and after TB treatment

• Improvement in TB treatment outcomes
• Reduction in risk of recurrent TB
• Provision of pulmonary rehabilitation for those disabled by pulmonary TB
• Provision of supportive care for people with neurological, musculoskeletal, or osteoarticular TB-associated disability
• Improvement in mental health and psychosocial well-being
• Increased longevity and quality of life

Implementing policies addressing multimorbidity and disability during and after TB treatment

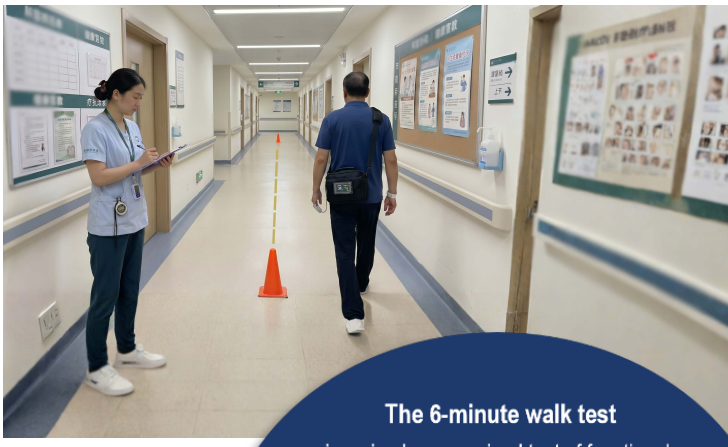
A few countries, such as India, have incorporated 24-month follow-up after TB treatment into their national TB strategic plans. However, most low- and middle-income countries (LMICs), home to the major global burden of TB, have not systematically integrated assessment and referrals into their patient care pathway. Global guidance suggests that national TB programmes (NTPs) can play an important role in assessing comorbidities, risk determinants and TB-associated disability as well as coordinating referrals and linkages to appropriate health and social services during and after TB treatment. In this regard, WHO emphasises the need for operational and implementation research to generate practical knowledge on how to apply holistic people-centred services in real-world programmatic settings and to assess their impact on the health and well-being of people with TB.

Examples of implementation research

Implementation research conducted in China and sub-Saharan African countries (Kenya, Uganda, Zambia and Zimbabwe) suggests that it is feasible and programmatically valuable to undertake additional assessments for comorbidities, risk determinants, and disability in adults at the start and end of TB treatment, within programmatic settings, with referral of those in need for further care.

In two studies in China, NTP staff assessed adults at the end of TB treatment, and at the start and end of TB treatment, respectively.[10,11] The mean (standard deviation) time to complete the assessments was 21 (8) minutes. In the second study,[11] at the end of TB treatment, 18% of adults still had TB-related symptoms, 12% had diabetes, 5% had raised blood pressure, 5% smoked cigarettes, 1% drank excess alcohol and 25% had functional disability as measured by a 6-minute walking test (**Figure 1**).
Referral mechanisms were generally feasible, but referral pathways for pulmonary rehabilitation were weak or limited.

Figure 1. Example of a 6-minute walk test taking place



The 6-minute walk test

is a simple, supervised test of functional exercise capacity. The person walks as far as possible in 6 minutes between marked beacons, slowing or resting, if needed. The main outcome is the total distance walked, recorded in metres. A result of <400m suggests reduced functional capacity and may indicate ongoing disability, including possible post-TB lung disease, undernutrition, frailty or other comorbidities.

[7] World Health Organization. Framework for collaborative action on tuberculosis and comorbidities. Geneva: WHO, 2022.
[8] World Health Organization. Policy brief on tuberculosis-associated disability. Geneva: WHO, 2023.
[9] Harries AD, et al. Why TB programmes should assess for comorbidities, determinants and disability at the start and end of TB treatment. Int J Tuberc Lung Dis 2023; 27: 495-498.
[10] Lin Y, et al. Is it feasible to conduct post-tuberculosis assessments at the end of tuberculosis treatment under routine programmatic conditions in China? Trop Med Infect Dis 2021; 6: 164.
[11] Liu Y, et al. Managing comorbidities, determinants and disability at start and end of TB treatment under routine program conditions in China? Trop Med Infect Dis 2023; 8: 341.

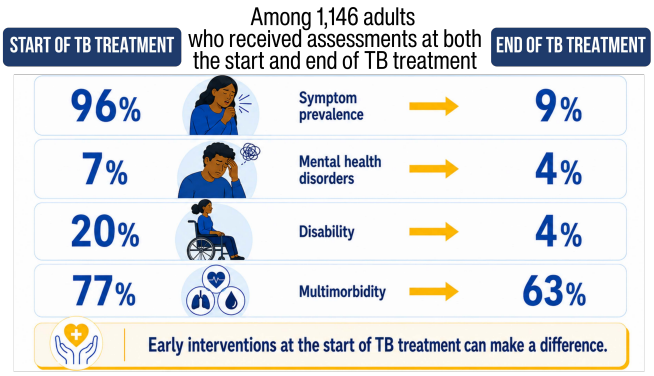
In the first study in sub-Saharan African countries, over 1,000 adults who successfully completed TB treatment were assessed by health care workers in 26 health facilities in a median time of 22 minutes.[12] The proportions of adults with on-going symptoms, comorbidities, risk determinants and disability are shown in **Table 2**. At least two thirds of eligible adults needing further care or support were referred. Most were referred for care within the same health facility, except for those with disability of whom only 20% were referred within the same facility. The study highlights the high burden of multimorbidity and functional limitation after treatment completion.

Table 2: On-going symptoms, comorbidities, risk determinants and disability in adults successfully completing TB treatment in Kenya, Uganda, Zambia and Zimbabwe (n=1,063)

Category	Condition	Percentage of Total
On-going symptoms	Any symptom	26%
	Cough	12%
Comorbidities	HIV infection	44%
	Diabetes or hyperglycaemia	3%
	Raised blood pressure	16%
	Possible depression: PHQ-2 screen positive	4%
Risk determinants	Probable alcohol dependence or possible alcohol use disorder (CAGE score ≥2)	15%
	Malnutrition (Body Mass Index <18.5 kg/m^2)	14%
	Smoked tobacco (any time in last 1 month)	5%
	Occupational exposure to silica	5%
	Recreational drug use (current use)	3%
Disability	6-minute walk test <400 meters	17%
Multimorbidity: comorbidity and/or risk factor and/or disability	None	28%
	One	38%
	Two	21%
	Three or more	13%

Diabetes diagnosis based on fasting blood glucose;
Raised blood pressure defined as systolic blood pressure ≥140mmHg or diastolic blood pressure ≥90mmHg;
PHQ-2= Patient Health Questionnaire 2;
CAGE= cut down, annoyed, guilty, eye-opener questionnaire

In the second study in sub-Saharan African countries, assessments and referrals were conducted in adults at the start and end of TB treatment, with eligible participants referred for further care and support at each time period.[13] In 1,146 adults receiving both assessments, symptom prevalence declined from 96% to 9%, mental health disorders from 7% to 4%, disability from 20% to 4% and multimorbidity from 77% to 63%, suggesting that early assessment and referral may reduce multimorbidity and disability.



Challenges in assessing and referring people affected by TB

There are several key challenges:

1. Despite the publication of policies, there is currently a lack of operational guidelines about how to systematically undertake assessments.
2. There are shortages of trained health care workers to carry out assessments.
3. There are limited resources within programmatic settings for screening for comorbidities, risk determinants and functional limitation/disability (for example, shortages of blood glucose testing for diabetes, lack of space for 6-minute walk tests for disability, and limited access to spirometry or other pulmonary function tests).
4. Despite evidence for effectiveness,[14] there is a lack of pulmonary rehabilitation services, including low-cost community-based models in LMIC.
5. Finally, there are several general health system issues such as a lack of awareness among health care workers and the public about the issue of post-TB multimorbidity and disability, weak referral pathways and limited post-TB treatment follow-up systems.

[12] The Kenya, Uganda, Zambia and Zimbabwe TB Disability Study Group. Disability, comorbidities and risk determinants at end of TB treatment in Kenya, Uganda, Zambia and Zimbabwe. IJTLD Open 2024; 1: 197-205.
[13] Banda FM, et al. Early interventions reduce multimorbidity and TB disability in Kenya, Uganda, Zambia and Zimbabwe. IJTLD Open 2026; 3: 177-184.
[14] Stenberg B, et al. Community-based pulmonary rehabilitation for post-TB lung disease – a programmatic intervention. IJTLD Open 2025; 2: 459-463.

The importance of the long-term follow-up is illustrated by a follow-up study in China where over 500 adults successfully completing TB treatment with appropriate assessments and referrals were followed up 18-24 months later.[15] Compared with the end of TB treatment, there were significant increases in cough (6% to 11%), untreated diabetes (<1% to 3%), high blood pressure (9% to 13%), cigarette smoking (5% to 13%) and excess alcohol consumption (1% to 6%). Risk factors at the end of TB treatment for death or loss to follow-up over the next 18-24 months included on-going symptoms, raised blood pressure and undernutrition. This evidence suggests that health services should integrate long-term care strategies to address these on-going health challenges.

Gaps in knowledge and the need for more implementation research

1. The evidence base should be strengthened and the feasibility and usefulness of assessment and referral in programmatic settings in additional countries and health-system settings should be demonstrated.
2. Despite evidence that children may experience stunted growth and respiratory disorders after successfully completing TB treatment,[16] this vulnerable group remains neglected. Programmatic implementation studies are needed to determine how best to assess and refer children in need.
3. We need to work out context appropriate cut-offs for the 6-minute walk test to ensure that we identify those with disability, and we need simple, validated, scalable tools to assess TB-associated disability.
4. Determining whether assessments and referrals at the start and end of TB treatment are cost-effective and improve both longevity and quality of life must be undertaken.
5. Finally, post-TB assessments must be integrated into national guidelines and national surveillance systems and appropriate indicators incorporated into surveillance systems.

CONCLUSION

Successfully completing TB treatment does not mark the end of illness for many people affected by TB. A substantial proportion continue to experience significant health challenges that affect survival, livelihood, social participation and health-related quality of life. Integrating systematic assessment, referral, and follow-up into national TB care pathways is essential to move from cure to comprehensive care. Without this shift, a large and growing population of people who have completed TB treatment will remain underserved.

[15] Sun Y, et al. Evaluating disability, comorbidities and risk factors after TB treatment: an 18-24 month follow up. IJTLD Open 2025; 2: 299-305.
[16] Martinez L, et al. The long-term impact of early-life tuberculosis disease on child health: a prospective birth cohort study. Am J Respir Crit Care Med 2023; 207: 1080-1088.

The development of this material was supported by Cooperative Agreement number NU2GGH002545 from the U.S. Centers for Disease Control and Prevention. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the U.S. Centers for Disease Control and Prevention, the U.S. Department of Health and Human Services, or the U.S. Government.