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ARTICLE

A "Just Transition" for Drug-Resistant Tuberculosis

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Abstract

Tuberculosis (TB) remains a serious health threat and strains of TB resistant to first-line therapies account for significant TB-related morbidity and mortality. Widely recognized as a disease of poverty concentrated in low- and middle-income countries, drug-resistant tuberculosis (DR-TB) is a result of deep-seated deprivation and the shortcomings of under-resourced health systems. Traditionally, the response to TB, and particularly DR-TB, has been focused on dealing with the infection and preventing onward transmission, for example, through isolating people with TB in sanatoria or specialized hospital wards. Recently, activists and policy makers have recognized the need to put people affected by the disease at the center of TB programs, but this is just the beginning of the necessary "just" transition from inequitable and unsustainable approaches to addressing TB to ones that are inclusive, community-centered, and resilient. In this article, we examine antimicrobial resistance in TB and highlight the need for a multisectoral, justice-oriented approach that goes beyond biomedical paradigms—we propose a "just" transition that addresses the unequal burden of human suffering and injustices that have become systemic in TB programs. We see a "just transition" as involving long-term structural changes to technologies, policy, infrastructure, scientific knowledge, and practice.

Keywords: antimicrobial resistance; drug resistance; inequity; justice; tuberculosis

1. Framing the need for a "just transition" for drug-resistant tuberculosis

Tuberculosis (TB) remains a serious global health threat, and strains resistant to first-line therapies account for an important share of TB-related illness and death.[1] Already known as a disease of poverty concentrated in low- and middle-income countries (LMICs), drug-resistant tuberculosis (DR-TB) highlights not only deep-seated deprivation but also the shortcomings of under-resourced health systems.[2]

Traditionally, the response to TB, and particularly DR-TB, has been focused on dealing with the infection and preventing onward transmission, for example, through isolating people

[1] Chin et al. 2024; World Health Organization 2024.
[2] Cox et al. 2019.

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with TB in sanatoria or specialized hospital wards. The needs (and preferences) of people with TB disease were hence considered subordinate to the public health imperative of preventing onward transmission.[3] Recently, activists and policy makers have recognized the need to put people at the center of the approach to TB, but this is just the beginning of the necessary "just" transition from inequitable and unsustainable approaches to addressing TB towards ones that are inclusive, community-centered, and resilient.[4]

In this article, we examine antimicrobial resistance (AMR) in TB. We focus on DR-TB because of the particular need for a multisectoral, justice-oriented approach that goes beyond biomedical paradigms—we propose this as a "just" transition that addresses the unequal burden of human suffering in its fullness and seeks to address injustices that have become systemic in TB programs.[5] The injustices include the uneven distribution of diagnostic capacity, the lack of investment in and availability of effective and tolerable treatment, and the exclusion of people affected by TB from shaping program priorities.[6] These programmatic inequities lead to delayed treatment initiation, particularly in rural areas, worse treatment outcomes, and deepened marginalization among already vulnerable populations. In discussing this transition, we draw from scholarship around equity considerations in response to the climate crisis and see a "just transition" as involving long-term structural changes to technologies, policy, infrastructure, scientific knowledge, and practice.[7]

2. Poverty and drug-resistant TB

Globally, the burden of TB is concentrated in LMICs.[8] Furthermore, the poorest in societies are also at greatest risk of developing the disease.[9] Overcrowded housing and malnutrition are key drivers of TB, its transmission and the development of active disease.[10] The risk of TB is also particularly high among people living with HIV, another infection that is entwined with global and local inequities.[11] And with multiple episodes of TB, the risk of DR-TB increases.[12]

Poverty compounds the impacts of an episode of TB, whilst TB also has economic impacts for individuals and families. The poorest in society often struggle to deal with the economic burden of accessing TB care and following the treatment regimens, which—because of direct travel and treatment costs as well as indirect opportunity costs—can exceed 50% of annual household income.[13] Moreover, an episode of TB often leaves long-term sequelae, which are poorly understood and can be life-limiting.[14] Moreover, long-term sequelae of TB often require extended rehabilitation, which entails long-term healthcare expenditures and compounds financial hardship.[15]

[3] Cox et al. 2019; Farhat et al. 2024.
[4] Horter et al. 2021; Odone et al. 2018; Reid et al. 2019.
[5] Bhargava, Bhargava, and Pai 2024.
[6] Chatterjee et al. 2024; Giovenco et al. 2025.
[7] Wang and Lo 2021.
[8] World Health Organization 2024.
[9] Xue et al. 2022.
[10] Lee et al. 2022; Sinha et al. 2019.
[11] Aaron et al. 2004.
[12] Lukoye et al. 2015.
[13] Foster et al. 2015.
[14] Chatterjee et al. 2024; Nightingale et al. 2023.
[15] Nightingale et al. 2023.

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These impacts are particularly pronounced in the case of DR-TB.[16] The treatment regimens are longer (lasting from 6 to 20 months) and their toxicity profiles—although much improved over recent years—can have long-term health impacts.[17] Treatment regimens for DR-TB vary according to the specific resistance profiles (and sometimes limited drug susceptibility testing), but they are often less tolerable and more complex than those for drug-susceptible TB. Treatment can also involve switching between regimens, which prolongs the course. With the higher drug toxicity and increased pill burden, people with DR-TB often face adherence challenges and treatment success rates remain lower than for drug-susceptible TB, often below 60% in high-burden settings.[18] Treatment regimens for DR-TB carry substantial risks of adverse effects, including peripheral neuropathy from linezolid and hepatotoxicity from other agents, further complicating adherence.[19]

For those affected by TB, the consequences are not only health-related; rather they often also face catastrophic health expenditures and loss of livelihood. For example, in Zimbabwe, DR-TB–affected households experienced a median loss of 67% of annual income due to treatment costs, travel expenses, and lost wages.[20] These long-term livelihood impacts can drag families into a spiral of poverty and food insecurity that further increases their risk of TB.[21] There are psycho-social consequences, with people affected by TB unable to fulfill their social (or economic) roles and experiencing social isolation and othering because of TB-related stigma.[22]

3. Inequities in approaches to addressing TB

The challenges of addressing DR-TB mirror those of AMR more broadly. Key issues across LMICs include insufficient laboratory capacity, inadequate drug development supply chains, and under-resourced primary health facilities.[23] These problems contribute to delayed diagnoses, suboptimal treatment, and persistent transmission, which promote the emergence and spread of resistance traits.[24] In DR-TB, this is particularly pronounced because of the difficulties of identifying resistance, the complex treatment regimens, and the interactions with HIV infection.[25]

In LMICs, diagnostic and laboratory infrastructure for DR-TB is often inadequate, particularly in primary care facilities and communities.[26] Identifying resistance in TB still often relies on culture-based laboratory processes, which take weeks. Even though more rapid molecular sequencing approaches have been developed, the lack of resources and infrastructure prevents their implementation in many LMICs.[27] Hence, receiving a diagnosis can involve repeated long-distance travel to reach diagnostic centers and multiple provider consultations. This means prolonged work absenteeism, income loss, direct expenses for

[16] Akalu et al. 2023.
[17] Farhat et al. 2024.
[18] World Health Organization 2024.
[19] Farhat et al. 2024.
[20] Timire et al. 2024.
[21] Balinda, Sugrue, and Ivers 2019.
[22] Adejumo et al. 2025; Redwood et al. 2022.
[23] Cox et al. 2019.
[24] Cipriano et al. 2024.
[25] Oga-Omenka et al. 2020.
[26] Otchere et al. 2024.
[27] Farhat et al. 2024.

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tests not covered by public health programs, and social stigma that exacerbates emotional distress.[28]

The challenges of treating DR-TB are particularly pronounced because—in spite of recent improvements—regimens are often long, toxic, and difficult to access. Positive developments include the recently recommended all-oral regimens that contain bedaquiline, pretomanid, and linezolid (BPaL), although they still require at least 6 months of treatment.[29] However, bedaquiline was the first new drug specifically developed for TB in more than 40 years, and although it represents a major therapeutic advance, it is the result of an antibiotic pipeline with few future candidate compounds.

Global access to bedaquiline also remains uneven—regulatory approval is incomplete in several high-burden countries, and treatment costs can be prohibitive for uninsured patients.[30] Donation programs, such as the Janssen bedaquiline initiative, have provided some relief but have been insufficient to meet demand sustainably.[31] Hence, inadequate health systems mean that even when effective tools exist, they do not reliably reach those who need them most. The poorest often face the double burden of failing health systems and burdensome treatment regimens. Highlighting the moral imperative to accelerate research *and* delivery of shorter and more tolerable (DR-)TB regimens.[32]

4. A necessary "just transition"

Addressing DR-TB as part of broader AMR stewardship requires transformation along the care trajectory, from screening and diagnosis to treatment. Equitable access to rapid, reliable diagnostics and strengthening laboratory systems for early detection and tailored treatment is essential. Integrating AMR management into TB diagnostic platforms, especially at peripheral health facilities, can enhance efficiency and improve patient outcomes.[33] Investment in new treatments is also essential to identify less toxic and shorter regimens for DR-TB. These are approaches that reflect interventions deeply rooted in biomedical models that prioritize pathogen-specific interventions, drug development, and clinical protocols. Although indispensable, they are insufficient when decoupled from broader health system strengthening.[34] Alone, they also neglect the recent shift in TB programming and care toward a more person-centered approach.[35]

Person-centered care is characterized as holistic, individualized, respectful, and empowering, with the person (with TB) central to the process of care through informed, shared decision-making and self-determination.[36] In person-centered care, the person affected by TB and healthcare providers engage in collaborative decision-making, discussing options, treatment risks, and benefits.[37] In this approach, the person affected by TB is an active participant, rather than a passive recipient of care.[38]

[28] Redwood et al. 2022; Yellappa et al. 2017.
[29] Gopalaswamy et al. 2024.
[30] Ravinetto et al. 2024.
[31] Ravinetto et al. 2024.
[32] Giovenco et al. 2025.
[33] Hasan et al. 2018.
[34] Bhargava, Bhargava, and Pai 2024.
[35] Horter et al. 2021.
[36] Reid et al. 2019.
[37] Horter et al. 2021.
[38] Horter et al. 2021; Reid et al. 2019.

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Although the shift to person-centered care is essential, it is only the start of a transition needed to address DR-TB in an effective and fair manner. In considering what is needed, we draw from the concept of a just transition—a socio-technical transition, which involves deep structural changes in systems, and entails long-term and complex changes to technologies, policies, infrastructure, scientific knowledge, and social and cultural practices.[39] This "just" transition requires moving beyond a narrow biomedical approach to one that integrates social, economic, and systemic determinants of health.[40] These investments must be planned and financed as part of broader health system reforms, ensuring they serve multiple health needs.

A "just transition" for TB means confronting the structural forces that seed vulnerability in the first place. Although new drugs, diagnostics, and vaccines are essential, their impact will be compromised unless they are paired with policies that address crowded housing, insecure work, malnutrition, weak labor protections, and the marginalization of affected communities. A truly just transition therefore reframes TB control as a question of distributive justice and democratic accountability: reallocating resources toward social protection schemes, strengthening primary health services, guaranteeing living wages, and empowering communities to shape research priorities and service delivery.[41] In other words, it shifts the center of gravity from laboratories and hospitals to the everyday environments where risk is produced—and where equitable social and economic reforms can dismantle the very conditions that allow drug-resistant strains to flourish.

Reframing the approach to DR-TB through the lens of "just transitions" invites us to imagine a different future: one in which science and solidarity go hand in hand; in which innovation is directed by the concept of health equity; in which communities are empowered and viewed as equal partners, not passive recipients and in which the right to health is realized universally.

5. Engendering the transition

This future will not emerge spontaneously; it requires deliberate choices, courageous leadership, and sustained advocacy. By embracing the principles of justice, inclusivity, and systemic transformation, we can build a shared future that is not only more resistant to the threats of TB and AMR but also more aligned with the values of human dignity and collective well-being. Declarations from recent high-level United Nations meetings on TB have incorporated human rights commitments, including the right to health, to ending stigma and discrimination against people affected by TB, and promoting access to affordable treatments.[42] Countries have, however, often not met these commitments.[43] Furthermore, although the WHO's End TB Strategy and most national AMR action plans recognize equity in principle, they rarely embed enforceable measures that channel resources to the communities carrying the heaviest burden of resistance.

Individuals living in vulnerable situations often lack the opportunity and agency to voice their needs and ideas. Effective TB responses must be grounded in the realities of affected

[39] Wang and Lo 2021.
[40] Bhargava, Bhargava, and Pai 2024.
[41] Engel et al. 2024.
[42] United Nations 2023.
[43] Citro 2024.

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communities.[44] Communities can be key agents in TB elimination when appropriately supported, for example, India's TB Mukt Panchayat initiative and community health worker programs in South Africa, which improved case detection and treatment adherence.[45] Community engagement is not an optional add-on but a foundational element of a just transition.[46] People-centered approaches, including the involvement of TB survivors, grassroots health workers, and civil society organizations, have demonstrated impact in improving case detection, reducing stigma, and supporting treatment adherence.[47] However, in many settings, community-based responses are underfunded, under-researched, and inadequately integrated into national health strategies. A just transition means rebalancing these inequities and investing in the leadership, capacities, and innovations of communities themselves. Communities are key agents in TB elimination efforts, offering culturally grounded, trusted interventions that complement formal health systems.[48]

Research agendas must also reflect the lived realities of patients and the systemic barriers they face. Innovation must not only produce new tools but also address affordability, accessibility, and usability in real-world settings.[49] A just transition envisions research driven by public health needs rather than commercial priorities, supported by financing mechanisms that prioritize equitable access. At the same time, the ethics of innovation must be scrutinized.[50] Who sets the agenda? Who benefits? Who is left behind? These questions are particularly relevant in the context of TB, for which global North–South power imbalances continue to influence funding, policy, and access to tools.

Vijayashree Yellappa is currently a Senior TB consultant at the KNCV Tuberculosis Foundation (KNCV TB+). Trained as a medical doctor and with a PhD in medicine, Dr. Yellappa has over 25 years of professional experience in health policy development and implementation. Dr. Yellappa is an expert in health system and implementation research focusing on infectious diseases (TB, HIV and leishmaniasis), assisting governments in developing and implementing governance and regulatory structures for health systems and private sector service delivery, quantitative and qualitative research methodologies, and health systems strengthening. Previously, Dr. Yellappa worked for the WHO, the World Bank, PATH, FIND, UNICEF, the Institute of Public Health in Bengaluru and the Indian think-tank NITI Aayog.

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Degu Jerene is a medical doctor with over two decades of professional experience working in TB and HIV disease control programs and epidemiology. In addition to his MD from Addis Ababa University and PhD in International Public Health from the University of Bergen, Norway, Dr. Jerene holds a Master of Business Administration from Ashland University, USA. Dr. Jerene is an expert in infectious disease management (including TB and HIV/AIDS), TB epidemiology, capacity building, ministry of health processes, community-based TB services, integrated diabetes/TB/HIV service delivery, TB surveillance and contact screening and health systems strengthening. Although currently at KNCV TB+, Dr. Jerene has previously worked at the World Health Organization, Johns Hopkins University, and Management Sciences for Health.

[44] Ashesh et al. 2025.
[45] Njarekkattuvalappil et al. 2024; Venkatesan et al. 2025.
[46] Topaloglou et al. 2024.
[47] Tiangco et al. 2025; Venkatesan et al. 2025.
[48] Njarekkattuvalappil et al. 2024.
[49] Engel et al. 2024.
[50] Komparic et al. 2019.

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