Improving the cascade of global tuberculosis care: moving from the "what" to the "how" of quality improvement

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Tuberculosis is preventable, treatable, and curable, yet it has the highest mortality rate of infectious diseases worldwide. Over the past decade, services to prevent, screen, diagnose, and treat tuberculosis have been developed and scaled up globally, but progress to end the disease as a public health threat has been slow, particularly in low-income and middle-income countries. In these settings, low-quality tuberculosis prevention, diagnostic, and treatment services frustrate efforts to translate use of existing tools, approaches, and treatment regimens into improved individual and public health outcomes. Increasingly sophisticated methods have been used to identify gaps in quality of tuberculosis care, but inadequate work has been done to apply these findings to activities that generate population-level improvements. In this Personal View, we contend that shifting the focus from the "what" to the "how" of quality improvement will require National Tuberculosis Programmes to change the way they organise, use data, implement, and respond to the needs and preferences of people with tuberculosis and at-risk communities.

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Background

Tuberculosis is a global health emergency, affecting more than 10 million people in 2017 and causing 1·6 million deaths.[1] Coverage of tuberculosis screening, diagnostic, and treatment services has rapidly expanded over the past decade; however, yearly reductions in tuberculosis incidence have remained discouragingly modest, averaging less than half the 4–5% annual reductions needed by 2020 to meet WHO End TB Strategy targets.[2] A rapidly growing body of evidence suggests that without focused attention on quality of tuberculosis services, increased coverage alone will not end the tuberculosis epidemic.[3,4] Using data from 2016, estimates from *The Lancet Global Health* Commission on High Quality Health Systems in the Sustainable Development Goal era suggest that as many as 50% of global tuberculosis deaths amenable to health care (about 470 000) could be averted annually by optimising quality of tuberculosis care services that are already provided.[5] These data imply that alongside the continuing need to develop new tools, approaches, and regimens to fight tuberculosis lies the immediate need to optimise coverage and quality of clinical services that are already available. Despite growing recognition of these shortcomings in the quality of tuberculosis care—and the increasing sophistication of approaches to assess their magnitude—intensive work is urgently needed for improvement to occur. To accelerate progress towards achievement of global aims to end tuberculosis by 2035, it is crucial to move from establishing what improvement is required in tuberculosis care to considering how these improvements in quality should be implemented and sustained.

Defining the "what" of quality improvement

Effective tuberculosis care is a complex process, comprising a cascade of essential steps, which in isolation are not entirely sufficient, to achieve recurrence-free survival. Like the HIV care cascade from which it was adapted,[6] the tuberculosis care cascade represents a normative model, delineating steps that are rooted in the International Standards for Tuberculosis Care[7] of what high-quality tuberculosis care should resemble. From analyses of these cascades, programmes visualise their performance in key processes of tuberculosis care and prioritise areas for focused improvement on the basis of identified gaps. Moreover, the model can be applied to specific jurisdictions (eg, district, national, public, and private) and populations (eg, children), and has been adapted to characterise processes specific to care of latent tuberculosis,[8] multidrug-resistant tuberculosis,[9] and tuberculosis-HIV co-infection.[10] Insights from these care cascades, supplemented by studies of standardised patients[11–17] and analyses of patient pathways,[18–22] show gaps in quality of tuberculosis care spanning case detection, diagnosis, and referral, and treatment ini-tiation and completion (table).

Moving from the "what" to the "how" of quality improvement

Challenges to improving care in any setting reflect the adaptive complexity of systems of health-care delivery, in which analyses of individual patients, providers, and clinics in isolation provide an incomplete, frequently myopic, understanding of how inputs and technical innovations are predictably converted into health out-comes.[23,24] In the context of tuberculosis, these challenges are further complicated by unique characteristics of high-burden countries, where health systems are routinely under-resourced, data-rich but information-poor, centrally organised, and weakly responsive to patient preferences and expectations. In these settings, National Tuberculosis Programmes need to bridge the "what" and "how" of quality improvements by using insights from cascades, analyses of patient pathways, standardised patients, and other sources (eg, operational research) to determine improvement interventions that can generate maximum impact at the population level. Doing so, we suggest, will require a shift in how National Tuberculosis Programmes organise, use data, implement, and respond to people with tuberculosis and at-risk communities to improve quality of tuberculosis services.

	Description	Findings
Care cascades	Assess prevalence of achievement in outcomes (eg, screening, diagnosis, notification, and treatment success) across cascade of effective tuberculosis care	Of about 2 700 000 people with tuberculosis in India, 72% reached public-sector tuberculosis diagnostic centres, 60% received tuberculosis diagnosis, 53% registered for treatment, 45% completed treatment, and 39% achieved recurrence-free survival.[9] Of about 532 005 people with tuberculosis in South Africa, 95% accessed tuberculosis screening, 82% received tuberculosis diagnosis, 70% were notified and treated, and 53% had treatment success.[10]
Patient-pathway analyses	Assess alignment of health systems' infrastructure (eg, diagnostic, referral, and treatment capacity) with care-seeking behaviours of patients with tuberculosis	In Indonesia, 19% of people with tuberculosis initiated care at a facility with capacity to do smear microscopy. Although 70% of people with tuberculosis received tuberculosis diagnosis in the public sector, only 54% initiated treatment in the public sector.[18] Of all people with tuberculosis in Pakistan, 87% initiated care in the private sector, whereas 13% initiated care in the public sector. About 5% of people were able to access sputum microscopy at the point of care initiation and 8% initiated care at a facility with capacity for tuberculosis treatment.[22]
Simulated patient studies	Assess content of care delivered to standardised patients with symptoms of presumptive or known tuberculosis during simulated clinical encounters	In China, across three rural provinces, 41% of standardised patients with cough and fever lasting more than 2 weeks were correctly managed (defined as referral to higher-level provider, chest x-ray, or sputum microscopy), and 18% were asked essential questions and examinations recommended by ISTC.[16] In India, among standardised patients in two cities presenting with four case scenarios representing various stages of disease, 35% were correctly managed in the private health sector. This low quality was characterised by underuse of appropriate diagnostics and widespread use of unnecessary medications, including antibiotics and contraindicated quinolones. Private sector providers offered more tuberculosis-focused care in cases with higher diagnostic certainty provided by the patient. Qualified, formal providers offered better quality care than informal or alternative health providers.[14]

ISTC=International Standards for Tuberculosis Care.

Table: Defining the "what" of quality improvement—care cascades, patient-pathway analyses, and simulated patient studies

Changing how National Tuberculosis Programmes respond to people: view patients and communities as partners

Any efforts to improve quality are motivated by the simple truth that health systems are for people.[5] People-centred care has long been recognised as a core domain of quality[25] and represents a central component of WHO's End TB Strategy.[26] Support for delivery of people-centred care has emerged from a growing consensus that failing to meaningfully involve patients, caregivers, and communities in clinical and public health decision making is not only ethically questionable, but might also undermine the effectiveness of interventions to improve outcomes.[27] As coproducers of health alongside providers,[28] patients and communities should be viewed as active partners, rather than passive beneficiaries, in activities of quality improvement that aim to optimise their care.[29]

Despite broad support for people-centred care for tuberculosis, systematic efforts to translate rhetoric into evidence-based practice have been lacking,[30] partly because of a shortage of rigorous evaluations of tuberculosis-specific interventions.[27] Beyond continued commitment to the investigation of new interventions, accelerating adoption of people-centred models of tuberculosis care delivery begins with accepting that not all people with tuberculosis are the same, and that attempts to introduce external perceptions of their condition, care, and social, physical, and emotional wellbeing into an inflexible health system will yield diminishing returns. People with tuberculosis and their families face myriad barriers to optimal care that arise from social determinants of health (ie, poverty, food insecurity, and unstable housing) to which they are inequitably exposed,[31] and opportunity costs that might accompany care seeking and treatment. These barriers are further intensified by the pervasiveness of stigma associated with tuberculosis in communities and health-care institutions, which decreases self-efficacy, normalises social exclusion, and further distances people with tuberculosis from seeking timely care.[32,33]

Listening to the unique needs and preferences of, and barriers faced by, people with tuberculosis, and forging an evidence-based response is the challenge, and task, of a people-centred approach to tuberculosis care. Translating this approach into practice begins with commitment of National Tuberculosis Programmes to seeking routine input from people with tuberculosis about their care experiences and proceeds with meaningful use of this input in quality improvement activities that seek to individualise care. Lessons learned from the global HIV response,[34] and small-scale implementation of tuberculosis-specific models in Belarus,[35] eSwatini,[36] Nicaragua,[37] Peru,[38] South Africa,[39] and Tanzania,[40] can help National Tuberculosis Programmes to navigate adoption of interventions to advance delivery of people-centred care. Community-based treatment programmes, psychosocial support, food and transportation assistance, facilitated linkage to care, directly observed therapy, peer navigation, community sensitisation, facility-based stigma-reduction activities, digital adherence monitoring, and redesigns of clinic flow represent some of the interventions that have been implemented as part of the

HIV response in low-income and middle-income countries and are readily adaptable to the tuberculosis response. Adaptations that aim to improve people-centredness should be driven by continuous input of the people they intend to benefit, making early, active, and collaborative involvement of people with tuberculosis a necessity.

Changing how National Tuberculosis Programmes use data— build local capacity for data use and improvement

Predictable and continuous translation of data into information—and information into action and iterative learning—is a fundamental component of high-quality health systems.[5] To improve quality of tuberculosis care, timely information should be made available to frontline providers and policymakers to diagnose gaps in quality, assess impact of improvement interventions, and establish accountability. Data are abundant in all health systems, but their translation into information for evidence-based, real-time decision making and continuous learning is generally inconsistent. In low-income and middle-income countries, weak health information systems, limited human resources, and a culture of data-for-reporting hinder transformation of data into insights that can drive activities of quality improvement.

Findings from cohort analyses, care cascades, patient pathway analyses, standardised patients, and other surveillance efforts are highly valuable in identification of population-level gaps in quality of tuberculosis care by National Tuberculosis Programmes. But their usefulness, as Sismanidis and colleagues[41] contend, is only realised when they yield insights that can be translated into programmatic action and improved outcomes. For example, data from national and subnational cohort analyses might be helpful in showing that only some patients in a particular catchment are completing treatment, but they provide little insight as to whether, and, crucially, how, clinics and providers should relate these data to their settings in real-time. Not recognising how aggregate trends correspond to a setting, or denying that any such connection exists, is a well documented barrier to applying methods of quality improvement in health-care organisations.[42] Routine collection and feedback of timely, reliable, and contextually meaningful performance data represents a key strategy[43,44] for overcoming this barrier and initiating data-driven responses to identified gaps at the level at which implementation occurs: facilities and the community.

A quasi-experimental study[45] done in Uganda underscores the value, and potential challenges, of using local performance feedback to improve quality of tuberculosis care. Findings revealed that provision of a monthly performance report card to six facilities increased the likelihood of people with tuberculosis receiving care (adherent to International Standards for Tuberculosis Care) by 15%. At the aggregate level, these results are encouraging and contribute to a large body of work showing positive,

albeit modest, effects of data feedback on performance.[46] When combined with other improve-ment interventions, such as training and group problem solving, these effects might be further amplified.[47] However, one of six facilities that participated in the study showed no improvement. This facility, led by a manager who, according to the authors, "was not supportive of quality improvement initiatives",[45] shows that without robust organisational support and shared commitment to quality, performance data carry meaning only as numbers to report, rather than incentive to drive efforts of quality improvement.

Successes from past disease elimination efforts highlight the crucial importance of locally tailored responses driven by timely, relevant data. In the context of tuberculosis, health information systems should first be strengthened to ensure that data are of high quality, feedback of performance data is routine and sufficiently granular to drive action, and data flow bi-directionally to enable system-wide learning and alignment of local quality improvement efforts with national strategies and priorities. Crucially, efforts to strengthen these systems should be paired with intensive training, coaching, and supervision to build local capacity to collect, analyse, and use data for local improvement or advocacy of system-level action on the basis of identified gaps. Programmes to improve data quality and use have been implemented with notable success in low-income and middle-income countries,[48,49] and should be considered in multi-sectoral efforts to foster local empowerment, accountability, and decision-making as part of expansion of universal health coverage and tuberculosis control.

Changing how National Tuberculosis Programmes implement— build programmes instead of projects

Data are integral to improving quality of tuberculosis care; however, data serve no purpose if they are not used to drive change. Too often interventions to improve quality of tuberculosis services are tested only within the confines of rigid study designs, through which their effectiveness might be confirmed but their adaptability goes largely unexplored.[50] Scaling-up silver bullet interventions that work in the laboratory wrongly assumes that implementing facilities and patients they serve are largely homogeneous, evidence supporting best practices is static, and facilities and local health systems have capacity to implement recommended approaches with high fidelity.

Global scale-up of Xpert MTB/RIF offers a cautionary tale on the promises of so-called silver bullets.[51] For example, in its capacity to hasten confirmation of tuberculosis and drug susceptibility in sputum samples from weeks to hours, the diagnostic test was heralded by many as a game changer in efforts to control tuberculosis. After a pragmatic trial in South Africa showed that implementation of Xpert MTB/RIF had little effect on patient outcomes,[52] the tuberculosis field reassessed their assumptions. Like the rollout of Xpert

RTB/RIF, attempts to introduce silver bullets to improve health care ignore the central role of context in shaping the adoption of innovations in health systems,[53] and the complex, interconnected web of processes that tuberculosis programmes need to perfect to successfully treat people with tuberculosis following collection of a sputum sample. Although efficacious in controlled settings, interventions that are taken to scale without improving underlying weak health systems,[51] and without evidence-based adaptation to organisational culture, real and perceived resource constraints, existing policies and practices, or heterogeneity of the epidemic,[54] might not meet expectations. In its distillation of insights from systems thinking, complexity science, organisational psychology, and statistical process control, quality improvement offers a proven approach for accelerating incorporation of complex interventions into routine practice. Importantly, quality improvement is a participatory, team-based, bottom-up approach, harnessing local knowledge to implement interventions that are tailored to unique complexities of local systems.

Quality improvement approaches have improved outcomes of tuberculosis care in select settings.[45,55–62] However, evidence documenting their sustainability remains scarce, especially in the context of National Tuberculosis Programmes. Reliance on external drivers, such as donors, to dictate prioritisation and implementation of quality improvement activities diminishes the likelihood of a sustainable approach to delivering high-quality care.[63] Fundamentally, sustainment of improvement activities requires National Tuberculosis Programmes to develop and support a culture in which continuous monitoring, improvement, and learning are expected and reinforced. To achieve this goal, programmes have to place increasing emphasis on building capacity for local adaptation and evidence-based decision making, rather than time-limited silver bullets, to ensure that gaps in quality are assessed proactively[64] and guarantee that returns on investments in technical innovations, like Xpert MTB/RIF, are maximised by facilitating their incorporation into local practice. This approach also requires commitment to knowledge management in which successful adaptations are effectively curated and rapidly shared to support continuous system-wide learning. Concepts applied during implementation of national HIV quality-management programmes can guide National Tuberculosis Programmes in their identification and promotion of factors that enable quality improvement activities (panel).[65]

Changing how National Tuberculosis Programmes organise— engage all providers in quality

Health-care delivery systems, which are naturally complex and adaptive, resist attempted changes to their prevailing structure and momentum.[23,24,66] As a result, quality improvement efforts that target individual components, levels, or sectors of the health system are rarely effective and sustained on a large scale.[5] In the context of tuberculosis, care delivery can be highly fragmented and unevenly resourced, causing people with tuberculosis to seek care across multiple providers, sectors, and levels of the health system. For example, although the majority of people with tuberculosis first seek care in public and private primary health centres, pharmacies, and community-based programmes, only a minority of these facilities have optimal capacity to appropriately diagnose, treat, or refer those with tuberculosis.[19] This spatial misalignment between where people with tuberculosis first present, and where tuberculosis services are organised, produces a precarious discontinuity in the pathway, resulting in harmful diagnostic delays and suboptimal treatment. These delays, which might span weeks and multiple providers in some settings,[67] hinder timely progression of people with tuberculosis along the tuberculosis care

Figure: **Embedding capacity of quality improvement at all levels of the health system**
To ensure sustainability of improvements in tuberculosis processes and outcomes, efforts should be made to build capacity to implement quality improvements at all levels of the health system (eg, national, subnational [regional, provincial, state, district], and facility) with well-defined activities for each level. Together, these activities should seek to reinforce attributes of high-quality health systems (eg, people-centredness, equity, resilience, and efficiency).[5]

cascade, exposing them to high, often detrimental, economic costs,[68] heightening their risk of suboptimal treatment, drug-resistance, tuberculosis-associated morbidities and mortality, and fuelling onward transmission of disease.

To reduce individual and public health costs of these care discontinuities, National Tuberculosis Programmes should structure quality improvement efforts around locations where people with tuberculosis initially seek care. However, this reorganisation will take more than physical decentralisation of diagnostic and treatment capacity (ie, sputum smear microscopy Xpert MTB/RIF testing for tuberculosis and resistance to rifampicin, and access to tuberculosis medicines) to every primary health centre, pharmacy, and hospital within the health system. These technical innovations are crucial for improving diagnosis and treatment of tuberculosis; nonetheless, effectiveness of these innovations presupposes conti-nuous supply of necessary commodities, providers' ability to adhere to evidence-based guidelines on their use, optimal functioning of care referral systems, and ability of National Tuberculosis Programmes to monitor, support, and hold accountable providers in their delivery of high-quality tuberculosis care. Unfortunately, adherence to guidelines of International Standards for Tuberculosis Care across the tuberculosis care cascade is often poor, with inadequate performance observed in public and private sectors.[3] Moreover, referrals across different levels and sectors in many countries are highly inconsistent,[20] underscoring a need to optimise coordination of care in addition to content of care delivered by individual providers.

To produce lasting improvements, National Tuberculosis Programmes need to engage all tuberculosis providers (primary, secondary, and tertiary) and sectors (public, private, and informal) of the health system in quality improvement efforts by guiding implementation of bold, cross-cutting policies and approaches. As the building blocks of universal health coverage and first points of entry into the health system for many people with tuberculosis, public and private primary health centres comprise the frontline of tuberculosis control efforts, yet routinely possess insufficient capacity to provide high-quality tuberculosis care.[69] Untapped synergies between National Tuberculosis Programmes' mandate to control tuberculosis and broad efforts of public and private sectors to advance universal health coverage offer National Tuberculosis Programmes a way to engage these providers and develop accountability for the quality of tuberculosis care they deliver. Importantly, strong links between HIV,[70] diabetes,[71] undernutrition,[72] tobacco smoking,[73] alcohol use,[74] and corresponding burden of tuberculosis present National Tuberculosis Programmes with the opportunity to collaborate with relevant disease control programmes, social health insurance schemes, and the private sector to ensure that quality improvement activities that address gaps in quality of care for tuberculosis and co-occurring conditions are integrated, jointly monitored, and adequately resourced.[75] Additionally, decentralisation of quality monitoring and decision-making from the national tuberculosis programme to regions, districts, and facilities (figure) heightens feasibility of a system-wide approach amid resource constraints, enables local ownership and accountability over local priorities, and advances quality improvement as a fundamental component of tuberculosis care delivery in an equitable, resilient, efficient, and people-centred health system.[5]

Conclusion

To end tuberculosis, National Tuberculosis Programmes should transition from identification of the problem of quality to implementation of contextually appropriate, evidence-based interventions to ensure that expanded coverage is inextricably linked to expanded access to quality tuberculosis care. Quality of tuberculosis care, in turn, requires vigilance that entails routine measurement of performance, use of data to identify specific areas for improvement, co-ordination of tuberculosis quality activities with health sector-wide improvement initiatives, locally forged solutions to address identified gaps, and partnerships and involvement of people with tuberculosis who might guide providers and public health practitioners to deliver tuberculosis care that is safe, timely, effective, efficient, accessible, equitable, and people-centred.

Contributors
BDA conceived the initial idea for the article. BDA and DJI wrote the first draft of the manuscript. All authors provided critical feedback and approved the final submission.

Declaration of interests
We declare no competing interests.

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