

Tuberculosis 7



Health-system strengthening and tuberculosis control

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Weak health systems are hindering global efforts for tuberculosis care and control, but little evidence is available on effective interventions to address system bottlenecks. This report examines published evidence, programme reviews, and case studies to identify innovations in system design and tuberculosis control to resolve these bottlenecks. We outline system bottlenecks in relation to governance, financing, supply chain management, human resources, health-information systems, and service delivery; and adverse effects from rapid introduction of suboptimum system designs. This report also documents innovative solutions for disease control and system design. Solutions pursued in individual countries are specific to the nature of the tuberculosis epidemic, the underlying national health system, and the contributors engaged: no one size fits all. Findings from countries, including Bangladesh, Cambodia, India, Tanzania, Thailand, and Vietnam, suggest that advances in disease control and system strengthening are complementary. Tuberculosis care and control are essential elements of health systems, and simultaneous efforts to innovate systems and disease response are mutually reinforcing. Highly varied and context-specific responses to tuberculosis show that solutions need to be documented and compared to develop evidence-based policies and practice.

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Introduction

Since the mid-20th century, national tuberculosis programmes (NTPs) have been instrumental in global efforts to control tuberculosis, but restricted capacity within overburdened health systems has hampered progress. In 1993, WHO declared tuberculosis to be a global emergency,¹ and a five-point tuberculosis control policy was published in 1994 to guide national efforts,² which was later renamed the directly observed therapy, short-course (DOTS) strategy. The strategy focused on commitment to a sustained national effort to fight the epidemic, and outlined performance targets for tuberculosis control to reverse the rising incidence of disease.³

By the end of the 1990s, DOTS was adopted by most countries, with major expansions in China and India. But weak political commitment constrained scale-up of DOTS.⁴ The Stop TB Partnership was formed in 1998, and the first Global Plan to Stop TB, 2001–2005, set objectives to rapidly expand DOTS, meet the emerging challenges

of HIV and multidrug-resistant (MDR) tuberculosis, and improve development of new diagnostics, drugs, and vaccines. WHO built on DOTS with the Stop TB Strategy in 2006,⁵ which served as the basis for a second Global Plan to Stop TB, 2006–2015, with regional benchmarks to achieve 2015 targets.⁶

Between 1994 and 2008, political commitment to improved global health and the UN Millennium Development Goals (MDGs) was bolstered by increased

Key messages

- National tuberculosis programmes have been instrumental in global efforts to control tuberculosis. But bottlenecks in health systems related to financing, the workforce, and supply chain management have hampered progress towards national targets and Millennium Development Goals, despite increases in external funding.
- Rapidly introduced health-system reforms and suboptimum system designs have adversely affected national efforts to control tuberculosis in Africa, Latin America, and eastern Europe. Early and full case detection is a major challenge, and frequency of treatment success is low in many African and eastern European countries.
- Despite intense debate about the benefits of disease-targeted programmes for health systems and system models, and for improved outcomes for communicable diseases, evidence on optimum system designs is weak.
- Findings from countries, including Bangladesh, Cambodia, India, Tanzania, Thailand, and Vietnam, show innovative solutions for disease control and system design to address bottlenecks in health systems. Tuberculosis services have been integrated into primary health care, and are functioning with good outcomes. Participation of non-governmental organisations and the private sector has expanded access.
- Development of solutions is specific to the nature of the country's tuberculosis epidemic, the underlying national health system, and the contributors engaged: no one size fits all. These highly varied responses need to be documented and compared to develop evidence-based policies and practice.
- The findings suggest that advances in disease control and system strengthening are complementary. Tuberculosis care and control are essential elements of health systems, and efforts to innovate systems and disease response are mutually reinforcing.

Search strategy and selection criteria

We searched PubMed, Medline, the Cochrane Library, Popline, ScienceDirect, CAB Direct, and WHO Library Database (WHOLIS) with search terms that included, but were not restricted to, "tuberculosis" and "vertical" or "horizontal" or "integration" or "coordination" or "diagonal" or "delivery of health care, integrated", and "program" or "care" or "service". We also searched the same sources with the terms "tuberculosis" and "health systems" or "health reform". Further publications were identified from references cited in relevant articles and reports. We reviewed only papers published in English. No date restrictions were placed on searches. We included papers that presented evidence of changes in service coverage, and health outcomes of individuals or communities (incidence, prevalence, mortality rate, and case notifications).

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domestic and international financing, including that from the Global Fund to Fight AIDS, Tuberculosis and Malaria. Such dedication has delivered remarkable success for tuberculosis control: incidence has reduced; and through DOTS programmes, 43 million patients were treated, 36 million patients were cured, and more than 6 million deaths were averted between 1995 and 2008.⁷ However, the decline in tuberculosis incidence is slow. In millions of patients disease is undiagnosed or is detected late, and scale-up of interventions to address MDR tuberculosis and HIV-associated tuberculosis is fragile. The world is not yet on track to halve tuberculosis mortality by 2015 because of health-system bottlenecks^{8,9} in the health workforce, financing, drug supply, information systems, and governance.^{10–12}

The Stop TB Strategy guides governments to pursue high-quality DOTS expansion, address HIV-associated tuberculosis and MDR tuberculosis, contribute to health-system strengthening, engage all care providers, empower people with tuberculosis, and promote research to achieve 2015 targets and universal access to care,⁶ with measures to address bottlenecks.¹³ Increases in external funding for efforts to control communicable disease have intensified debates about the benefit of targeted programmes to health systems and the best system models to improve health outcomes.^{14–16} However, these discussions have been limited by a poor evidence base¹⁷ and inadequate consensus on how to address bottlenecks. We aim to address these knowledge gaps by documenting examples of success and failure, and use a coherent framework to inform policies to improve tuberculosis control and other health MDGs.

Data collection

We used a WHO framework to draw attention to the core functions of health systems, specifically governance, finance, the health workforce, technology and supply management, and health-information systems (panel 1). These interlinked functions contribute to delivery of health services.¹⁹ The framework accounts for community participation in strengthening of health systems and the context in which these interactions occur.²⁰ The understanding that disease control and other priority health interventions are intrinsic to health systems is fundamental to this framework.

From examination of studies and reports published between 1995 and 2009, we identified the effects of health-system reforms in the 1990s on the performance of programmes to control tuberculosis. We also reviewed evidence from reports published between 1995 and 2009, NTP reviews undertaken during 2006–09, and case studies on health systems and tuberculosis control during 2009–10. This information was used to identify challenges faced by health systems, within and beyond tuberculosis control, and innovations made to address these challenges, both globally and in individual countries. We present findings from joint government-

partner NTP reviews in Thailand, India, and Vietnam, and case studies of countries with high burdens of tuberculosis—Bangladesh, Cambodia, India, and Tanzania—in which innovations in disease control and system design have been introduced.

Few comprehensive NTP reviews are available in which bottlenecks to programme improvement and scale-up are analysed, thereby restricting our sample size. In Thailand, the most recent NTP review in 2009 followed a full review in 2007.²¹ In Vietnam, the latest review was in 2006.²² In India, more than 50 partners participated in the third in a series of joint monitoring missions in 2009 to review programme functions and results, within the context of the health system and development agenda of the country.²³ The case studies used a validated method²⁴ to explore the interaction of tuberculosis programmes within health systems and the synergy of these programmes with health-system components. This method included interviews of key informants in every country who were purposively selected to represent a sample of several stakeholders.

Effects of health-system reforms on tuberculosis control

In the 1990s, many countries of low and middle income underwent a period of reform in the health sector to improve access, equity, and efficiency.²⁵ In many countries, these reforms led to decentralisation of governance and financing, to disestablishment of national or provincial support from public health programmes for integrated service delivery, and, in some, to introduction of cost-sharing schemes for tuberculosis services. However, political discord, insufficient financing, and low planning capacity meant that these reforms mostly failed to fulfil their mandates and harmed functions that are essential for disease control.²⁶

In some settings, such as some South African provinces in the apartheid era²⁷ and Cambodia,²⁸ these reforms helped integration of service delivery. However, the reforms undermined national tuberculosis control—eg, in Bangladesh,²⁹ China,^{30–32} Kenya,³³ Nepal,³⁴ Zambia,³⁵ Brazil,³⁶ and Peru,³⁷ and in several other Latin American countries with weakened governance,³⁸ such as Colombia³⁹—resulting in reduced programmatic financing, diminished capacity of the health workforce, interrupted drug supplies caused by disrupted supply systems, and impaired case reporting and cohort analysis of treatment, leading to poor epidemic surveillance and monitoring of programme performance. These adverse effects were most striking when poorly conceived system designs, aimed at strict integration, were rapidly introduced, such as in Zambia³⁵ and some Latin American countries.³⁸ The adverse effects of these reforms on tuberculosis outcomes^{40–42} and on other public health programmes, such as childhood immunisation,^{43,44} led to calls for corrective action. WHO guidance proposed methods to build on the strengths of

new health-system structures while protecting core public health functions.⁴⁵

After the dissolution of the Soviet Union in 1991, many former Soviet countries underwent health reforms that focused on financing, and therefore failed to address constraints to delivery of health services.^{46,47} Therefore, despite increased domestic financing for tuberculosis control, the quality of basic tuberculosis care and the response to MDR and HIV-associated tuberculosis are inadequate in most countries.⁴⁸ These failures set the context for innovations that aimed to respond to public health concerns and strengthen systems to improve health outcomes.

Health-system challenges and innovations in tuberculosis control

Governance and stewardship

In the 1990s, progress by DOTS programmes in countries such as Tanzania, China, Vietnam, and Peru showed that well financed NTP units, anchored within a country's ministry of health, could guide substantial improvements in service delivery and treatment outcomes. But many countries struggled with restricted programmatic support, and poor linkage between tuberculosis programmes and health-sector reforms.⁴⁹ Such limitations led to calls for development of effective health-system governance to mount coherent responses to the worsening epidemic.^{4,50}

By 2001, the UN Millennium Declaration⁵¹—which established the MDGs, WHO Commission on Macroeconomics and Health,⁵² and G8 Okinawa conclusions⁵³—recognised tuberculosis as a global health and development priority, providing global stewardship and stimulus to increased international funding for tuberculosis, HIV, malaria, and childhood immunisations. By 2002, most countries with a high burden of tuberculosis had, in collaboration with WHO and other organisations aiming to stop tuberculosis, developed comprehensive plans for DOTS expansion, detailing strategies, financing needs, and gaps in service delivery.⁵⁴

Country responses to the governance challenge have varied. The Bangladeshi Ministry of Health supports stewardship of service delivery through an integrated essential services package, including tuberculosis care, implemented through the public health system in partnership with non-governmental organisations (NGOs). In Cambodia, decentralisation of tuberculosis care to primary care and community structures occurred as part of a national health strategy focused on rebuilding primary health care and a detailed national DOTS expansion plan.²⁸ A coherent support structure at all levels of the Indian Government enabled rapid implementation of the world's largest DOTS programme, the Revised National Tuberculosis Control Programme (RNTCP), through primary health care. The Indian Ministry of Health coordinates activities to control tuberculosis through its central tuberculosis unit, and counterpart tuberculosis

Panel 1: Definitions of key elements of health systems

Health systems

WHO defines as “all organizations, people and actions whose primary intent is to promote, restore or maintain health”, including efforts to address the determinants of health, besides direct activities to improve health.¹⁸ Elements of health systems interact together to form a complex system, and the health system interacts with the wider context within which it is situated. These interactions affect the achievement of goals for health systems.¹⁸

Governance

Policy environment, regulatory environment, stewardship function, and structural arrangements for purchasers, providers, and market regulators. WHO judges that good governance means strategic policy frameworks exist and are combined with effective oversight, coalition building, the provision of appropriate regulations and incentives, attention to system design, and accountability.¹²

Financing

Collection and pooling of finances to remunerate health-care providers and other suppliers to the health system. A good system for health financing raises adequate funds for health in ways that ensure people can use needed services, and are protected from financial catastrophe or impoverishment associated with paying for services.¹²

Health workforce

People operating in the public, private, and non-governmental sectors. A well performing health workforce is responsive, fair, efficient, and achieves the best health outcomes possible with available resources and conditions.¹²

Health-information systems

Produce, analyse, disseminate, and use reliable and timely information on health determinants, performance of health systems, and health status.

Procurement and supply chain management system

Ensure health products and drugs of assured quality, safety, efficacy, and cost-effectiveness are accessible, available, and used on the basis of sound scientific evidence.¹²

Service delivery

Delivery of effective, safe, high-quality personal and non-personal health interventions to people who need them, when and where they are needed, with minimum waste of resources.¹²

Sector-wide approaches

Unify governments, donors, and other stakeholders within the health sector to work under government leadership, to support an agreed set of policies, with a harmonised approach to implementation procedures, such as planning, financial oversight, procurement, monitoring, and reporting.

units in state health ministries oversee provision of tuberculosis services in primary care. Tanzania was among the first countries to achieve nationwide DOTS coverage in 2000, with leadership from the National Tuberculosis and Leprosy Programme (NTLP) within the ministry of health. The Thai Ministry of Health embraced a strong stewardship role to establish a decentralised public health system with integrated tuberculosis services, and to address poor quality programmes in the Bangkok metropolitan area. The Vietnamese NTP is a priority programme within the health-sector plan and is included in the national 5-year development plan. This programme achieved national DOTS coverage by 2001 and has had high rates of treatment success, reaching 93% in new sputum-smear-positive patients. The NTP has adopted an effective stewardship role to expand public-private mix in approaches to control tuberculosis, and to address socioeconomic determinants of disease.

Financing

Tuberculosis control faces four major financing challenges: insufficient funding; low capacity for countries to identify gaps to secure reliable financing; coordination of funding from several sources; and financial barriers to patients' access.⁵⁵⁻⁵⁸ The Global Plan to Stop TB, 2006–2015,⁶ estimated that US\$56 billion would be needed to reach the MDG 6 target for tuberculosis control and the Stop TB Partnership's target to halve the prevalence and mortality of tuberculosis by 2015. For 2010, the unmet financial need for implementation of the Global Plan is \$2 billion.⁷

A coordinated global response has risen to the challenge of insufficient funding. The Global Fund, UNITAID, bilateral agencies, and philanthropic sources have increased financing for the 22 high-burden countries from \$1.84 billion in 2006 to almost \$2.64 billion for 2010, albeit with a growing gap relative to need.⁷ To address weak capacity for financial planning, WHO and technical partners have developed methods to calculate the cost of tuberculosis, and assisted governments to budget for and financially monitor national health plans and DOTS programmes. In 2009, 116 countries provided financing information to WHO.⁷

To improve coordination of funding, new financing mechanisms have been created to channel large funds to countries. The largest of these, the Global Fund, accounts for more than 60% of all external financing for tuberculosis control.⁵⁹ However, the global financing architecture remains complex, and countries struggle to manage this. The Bangladeshi Government developed a sector wide-approach (SWAp) for financing and planning of the Health, Nutrition, and Population Sector Program that includes tuberculosis control. Funding is provided by the government and by a trust fund led by the World Bank that pools financing from eight donors, with five providing financing through separate channels. Cambodia also uses a SWAp to coordinate health financing from more than

20 development agencies and 100 NGOs. External financing, which accounts for around 50% of the funding for tuberculosis control in this country, is ring-fenced and earmarked for NTP management to ensure reliable funding for rapid scale-up of DOTS. In India, most funding for RNTCP is from government, with 10% supplied by international sources to address shortfalls in supply of drugs, diagnostics, technical assistance, civil society partnerships, and advocacy activities. The National Rural Health Mission, a major innovation in the health sector, supplements state financing of tuberculosis control and supports coordinated district management of primary health-care services. In Tanzania, financing from domestic sources and donors is pooled through central budget support at central or district level under a SWAp. Activities to control tuberculosis are funded by on-budget contributions channeled through the NTLP and by direct donor support. The government provides 60% of the tuberculosis budget and donors provide 40%. Use of a regionalisation system, with each region receiving support for tuberculosis activities from an individual donor, avoids duplication of activities from direct donor funding. Thailand, which finances tuberculosis services through a plan for universal health coverage, has strategically used additional domestic financing from external sources to fill gaps in tuberculosis control, for example to support needs of migrant populations. External funding provides more than 50% of financing for tuberculosis control in Vietnam, aligned to the Medium-term Tuberculosis Control Development Plan to ensure coordinated investment, but donors maintain several project coordination units that manage various projects funded by donors.

Patients' access has improved with affordable tuberculosis diagnosis and care. A public-private approach in Bangladesh has enabled NGOs to have a key role in the NTP, and has expanded access through community health workers, cured patients who provide advocacy and peer support, and private providers. In Cambodia, tuberculosis services that centred around hospitals and were difficult to access have successfully been incorporated into primary health care and transitioned to community-based care. Inclusion of tuberculosis services in the free basic health package has improved access, and support from the World Food Programme for patients with tuberculosis has reduced indirect costs of care. Tanzania has expanded access by integration of tuberculosis services (free at the point of delivery) into primary health care. Although Thailand's system for universal health coverage has financed tuberculosis services since 2002, improved access to quality care for MDR tuberculosis and migrant populations has proved challenging in major metropolitan areas.

Human resources

The workforce crisis, driven by low salaries, chronic underinvestment in production and training, out-migration, and HIV infection⁶⁰ has hampered tuberculosis

control.⁶¹ Low-income countries are still affected by deficits in the number, distribution, and capacity of health workers. To support the Stop TB Strategy, WHO has developed guidance for health workforce planning within overall plans for health systems,⁶² and to map roles and responsibilities for key contributors participating in tuberculosis control within the country.⁶³

Two major innovations are alleviating crises in the health workforce: use of community health workers and approaches with a public-private mix, including use of NGOs and the private sector for tuberculosis control and care. Community health workers have been used widely to improve case detection and treatment success in Ethiopia,⁶⁴ and to expand tuberculosis control in Pakistan with the Lady Health Worker Programme.^{65,66} However, in Brazil, few family health teams used community health workers to provide treatment supervision for patients with tuberculosis, thereby missing an opportunity to expand services.⁶⁷ Public-private approaches have frequently been used in high-burden countries to improve care and outcomes, including Kenya,⁶⁸ Indonesia,⁶⁹ Burma,⁷⁰ Nigeria,⁷¹ Pakistan,⁷² the Philippines,⁷³ and South Africa.⁷⁴

An array of innovative system-wide approaches have been used to augment the capacity of the health workforce for tuberculosis control. In Bangladesh, an NGO consortium supports planning, management, and capacity building of the public health workforce, service delivery, and reporting of progress. As part of the essential care package, more than 67 000 staff from the Bangladesh Rural Advancement Committee and 16 000 village doctors from the Damien Foundation provide community outreach for tuberculosis diagnosis and treatment. In Cambodia, transition of tuberculosis services to primary health care has expanded the workforce beyond tuberculosis specialists. Private-sector providers and public-sector physicians who provide after-hours services to augment salaries have been contracted through social franchising models to expand NTP services. Through the RNTCP, the central government in India supports management of tuberculosis programmes by state governments through supply of finances to fill gaps in the health workforce at district and state level, and by training all cadres of health staff and community volunteers on national guidelines for tuberculosis control. Community volunteers receive performance-related incentives of about \$5 on successful completion of treatment for every patient. In Tanzania, since only 35% of government positions are filled with qualified workers, the tuberculosis programme is training health workers, with providers from communities recruited to supervise treatment, and contracting the private sector to expand service delivery.

Procurement and supply chain management

Weak systems for procurement and supply chain management lead to poor quality drugs and treatment

interruptions, thereby retarding tuberculosis control and treatment outcomes, and contributing to the emergence of MDR tuberculosis.⁷⁵ To effectively contain MDR and extensively drug-resistant (XDR) tuberculosis, bottlenecks in drug discovery, registration, quality assurance, and supply systems need to be addressed.⁷⁶

The Global Drug Facility was established in 2001 to address problems related to financing and regular procurement of quality-assured drugs and diagnostics for tuberculosis, and thereby help DOTS expansion.⁷⁷ The Global Drug Facility operates a direct procurement system to achieve competitive prices for antituberculosis drugs that meet WHO's stringent standards, and provides in-country assistance on supply chain management.⁷⁸ Similarly, the Green Light Committee was established to improve access to high-quality second-line anti-tuberculosis drugs for MDR tuberculosis at reduced prices, and to assist countries in programmatic management of MDR tuberculosis.⁷⁹

Several novel approaches have been introduced to procure and supply antituberculosis drugs. In Bangladesh, the system for supply chain management of tuberculosis drugs uses general health-system structures and processes supported by NGOs, to prevent delays in delivery and absence of stock; the Global Drug Facility undertakes procurement. Cambodia has integrated procurement and supply chain management for tuberculosis into the national centralised procurement system. However, the NTP works to address suboptimum capacity for forecasting of treatment needs to ensure timely transportation of drugs from the central drug store to health centres and prevent interruptions in drug supply. In India, antituberculosis drugs are procured centrally through the government system, with a back-up emergency procurement system in which donor finances are used to mitigate national procurement delays. The RNTCP supports logistical management with national stores and uses a dedicated logistics agency to deliver antituberculosis drugs. Tanzania uses the Global Drug Facility to procure antituberculosis drugs, and NTLF uses the existing system for supply chain management, supplemented by additional resources, for distribution to facilities. In Thailand, district and provincial organisations are responsible for planning, procurement, and distribution of tuberculosis drugs to the health facilities that provide tuberculosis care.

Health-information systems

Before DOTS implementation, many countries used ineffective tuberculosis registration and reporting systems with little local benefit. Measurement of the effect of tuberculosis control was restricted to estimates based on a small cohort of surveys of tuberculosis prevalence, and on a range of quite low-cost yearly surveys of the risk of tuberculosis in school-aged children from settings with high prevalence of tuberculosis. Such surveys in children were stymied by high coverage of BCG vaccination which

confounded results of tuberculosis testing. Unavailability of local or global estimates of mortality from tuberculosis led to gross estimation from a small cohort to countries with functioning vital registration systems. During 2000–07, only eight of the 22 high-burden countries had national surveys of disease prevalence, 12 undertook in-depth analysis of routine surveillance data, and four accomplished analysis of vital registration data for mortality.⁸

Growing caseloads of patients with tuberculosis and HIV infection, and larger cohorts of patients needing

retreatment, including for MDR tuberculosis, has led to increasing complexity of tuberculosis monitoring and evaluation. Local capacity to use and benefit from routine data systems remains weak; investment in prevalence surveys and technical support is needed to improve measurement of disease burden and the effect of interventions.⁸⁰

Tuberculosis control programmes are contributing to global efforts to strengthen health-information systems in low-income countries. Nearly all countries worldwide have introduced DOTS as modules within national health-information systems, with standardised and routine quarterly reporting, district-based registers, and patient cards held by facilities providing services. However, some former Soviet countries still retain parallel tuberculosis information systems. WHO is providing support for countries to strengthen routine reporting systems, increase data accuracy, and help rigorous surveys to be undertaken to monitor progress towards 2015 targets for tuberculosis control.⁸¹ All countries that we studied had robust tuberculosis information systems, which were judged to be one of the strongest elements of their national health-information systems, and Bangladesh, India, and Tanzania are working with NGOs to build capacity in data analysis and use.

Panel 2: Integration of tuberculosis services into primary health-care and HIV services

In South Africa, programme outcomes have improved through extraction of tuberculosis services from specialised hospitals and integration of these services into primary health care.⁸³ Use and success of directly observed therapy, short-course (DOTS) has varied, dependent on commitment by provincial authorities. However, integration of key interventions—eg, for HIV and tuberculosis—is now a top priority after a decade of inadequate attention.⁸⁴ In Kwazulu Natal, integration of highly active antiretroviral treatment with the DOTS programme has led to improved health in patients with AIDS, increased CD4 cell counts in patients with HIV and tuberculosis, and higher frequency of cure for drug-sensitive tuberculosis.⁸⁵ In Zambia, implementation of DOTS as part of an existing HIV/AIDS home-care programme has improved cure rates for tuberculosis compared with tuberculosis care delivered in district hospitals.⁸⁶ Similarly, introduction of voluntary counselling and testing with adjunctive co-trimoxazole within a tuberculosis control programme in Malawi has reduced adjusted relative risk and frequency of death in people with AIDS.⁸⁷ Few former Soviet countries have used principles of DOTS to integrate tuberculosis services into primary health care because of weak infrastructure and strong incentives to sustain hospital-based care. In Moldova, an allocated budget was used to integrate vertical services for tuberculosis control into primary health care with funding for tuberculosis provided through a general health-insurance scheme; simultaneously, DOTS guidelines were adopted and led to improved case detection.⁸⁸ In Latvia and Romania, integration of tuberculosis services into strengthened primary health-care infrastructure resulted in improved treatment outcomes.^{89,90} The national tuberculosis programme in Kyrgyzstan was the entry point for scale-up of the Practical Approach to Lung Health for integrated response to adult respiratory illness.⁹¹ Conversely, dedicated tuberculosis-specific institutions exist in a weak health system in Russia, so DOTS scale-up has faltered in many regions,⁹² with gains achieved at quite high cost.⁹³ Discouragingly, in Ukraine, vertical tuberculosis and HIV programmes have hindered effective responses to tuberculosis, multidrug-resistant tuberculosis, and HIV-associated tuberculosis.⁹⁴

Service delivery

Major challenges for tuberculosis control are closely linked with access to health services, especially for the poorest and most vulnerable people.⁸² Poor access impedes early and full case detection, and leads to low treatment success in many African and eastern European countries.⁷⁹ Bottlenecks in the health system interact to create varied delivery challenges in high-burden countries. The form of the health system, the evolution of service integration, and decentralisation policies are specific to countries, so a variety of service delivery models are used to address tuberculosis, MDR tuberculosis, and HIV-associated tuberculosis. In Africa, Latin America, and most of Asia, tuberculosis services are delivered predominantly through primary health care. Many former Soviet countries have dedicated infrastructure for tuberculosis control, but most have failed to integrate tuberculosis services into weak primary health-care services and now face worsening epidemics of tuberculosis and MDR tuberculosis, although examples of successful integration do exist. In particular, integration of tuberculosis and HIV interventions presents a major challenge (panel 2).⁹⁵

WHO began to promote integration of NTPs into primary health care in the 1970s, once the effectiveness of ambulatory tuberculosis treatment had been proven.⁹⁶ By 2007–08, tuberculosis services were being delivered through primary care in 20 of the 22 high-burden countries and 83% of 173 countries reporting progress in tuberculosis control to WHO. In about 64% of these

173 countries, including ten high-burden countries, antituberculosis drugs were supplied to services through integrated supply systems for essential drugs, and in 86%, tuberculosis diagnosis was delivered through general public health laboratory networks.⁸ The Stop TB Strategy and Global Plan to Stop TB, 2006–2015, proposed approaches to expand delivery networks for service delivery, building on system-wide schemes to broaden access and integration by linking tuberculosis and HIV services, and engaging all care providers within public, private, and civil society sectors.^{5,6}

Public-private approaches and primary health care have been used successfully to expand service delivery and patient access, and to improve treatment coverage and health outcomes. In Bangladesh, the ministry of health has worked with two major NGOs to provide tuberculosis services through primary health-care services and community health workers.⁹⁷ In Cambodia, hospital-based DOTS care was the norm until strengthened primary health care enabled delivery of integrated community-based tuberculosis care. The National Rural Health Mission in India has provided a unique opportunity for expanding integrated service delivery, including rapid scale-up of child health, tuberculosis, and combined tuberculosis and HIV services. Bottlenecks have been addressed with laboratory strengthening and outreach to tribal and other high-risk communities. In Thailand, access has been extended through the free primary health-care service package as part of the plan for universal health coverage. However, targeting of metropolitan areas and highly vulnerable populations, including migrants, is now a priority. In Vietnam, tuberculosis control services, which were historically operated through a vertical network, are now embedded in general services. Tuberculosis diagnosis and treatment are free in the public sector and outcomes have been among the best in Asia. But 70% of health expenditure is private, so the national development plan has prioritised countrywide rollout of public-private approaches. To improve early case detection, Tanzania is working to expand access to culture-based methods for tuberculosis diagnosis in primary care, scale up collaborative tuberculosis and HIV activities, and develop public-private models. Appointment of dedicated district officers through the US President's Emergency Plan for AIDS Relief and the Global Fund has aided expansion of integrated tuberculosis and HIV services, but achievement of full coverage remains a challenge.

Interpretation

Despite increased financing for disease control, weak health systems are impeding global efforts to achieve tuberculosis targets and other health MDGs. To target the complex and dynamic nature of the tuberculosis epidemic, the overlapping HIV epidemic, and emerging drug resistance, simultaneous innovations are needed in core functions of systems support and in disease control.

The findings of our study suggest that tuberculosis care and control are essential elements of health systems, and simultaneous efforts to innovate systems and disease control are complementary and mutually reinforcing for improvement of health outcomes.

Major health reforms in the 1990s led to weakened public health efforts, but in the past decade, recommended tuberculosis control strategies have been expanded globally and stewardship of disease control has been strengthened. Such changes have been accompanied by innovations across core system functions in countries that we analysed, including: new financing in global health; SWAps to harmonise and rationalise resource flows; national financing schemes to extend access to essential services; addition of new cadres of health workers to reach poor communities; innovations for quality-assured supplies; and rollout of novel public-private approaches.

Many innovations in components of health systems are proving to be effective. However, their reach is still far from adequate in many low-income settings, and lack of guidance and systematic support is impeding expansion. Recent funding requests to the Global Fund suggest that countries are having great difficulty in identification of optimum solutions to systematically address these bottlenecks.^{98–100} Evidence from our analysis should help targeting of efforts.

Although external financing for tuberculosis control has substantially increased, funding shortfalls remain. Global financing architecture is complex because of several streams of external investments, and countries struggle to manage this complexity with restricted stewardship capacity. Public-private approaches in the countries studied, especially in Bangladesh,⁹⁷ have helped to expand service coverage, improve outcomes, and address gaps in human resources. Public-private mix is a robust model for tuberculosis control and care,¹⁰¹ but such approaches still need to be effectively scaled up in India, since most health care is delivered in the private sector,¹⁰² and public-private approaches remain woefully inadequate in Africa.

Expansion of DOTS programmes has helped to strengthen routine analysis and reporting systems, but major gaps remain in surveillance and measurements of effectiveness. Innovation in supply systems for disease control has been important, but country-level solutions seem to be weakly supported by international sources.

Tuberculosis services have been integrated into primary health care in most regions, and these are functioning with good outcomes. Access has expanded with participation of NGOs and the private sector. However, little evidence is available about how to reach vulnerable populations, and the effect of these steps on other health outcomes has not been examined.¹⁰³

Our analysis is restricted because few reports have been published in peer-review journals on themes related to tuberculosis control and health-system strengthening. Few NTPs have the capacity to adequately document

progress, and, relative to other specialties, few researchers are engaged in tuberculosis control. However, we have tried to address these limitations by use of results from three reviews of NTPs and case studies in four high-burden countries. The NTP reviews might have an inherent positive bias since weak control programmes with few partners and little financing are probably less likely to pursue major reviews. Comprehensive NTP reviews that incorporate analysis of health systems and bottlenecks are urgently needed to expand effective care.

We have shown good examples of success in addressing health-system bottlenecks from the case studies, but these countries might be among the leaders of innovation in health systems and disease control. Therefore, these findings are not generalisable to other high-burden countries with weak systems in which evidence is lacking. Additional case studies are being undertaken in other countries to show examples of restricted success and unsuitable strategies, and to identify context-specific solutions in these settings. Measures to strengthen systems seem to complement advances to control disease, but the success of these measures is specific to the nature of the tuberculosis epidemic, the underlying national health system, and the contributors engaged. Evidence to support which strategies will and will not work in specific contexts remains weak.

Efforts to control disease and other public health priorities, such as maternal and child health, are essential and inseparable elements of health systems. Findings from our analysis suggest that innovations in disease control and system strengthening need to be recorded and compared in different settings to inform policies. As efforts to strengthen health systems are intensified to reach MDGs and address threats to health security, such as tuberculosis and HIV, this evidence will prove crucial.

Contributors

RA conceived the outline of the report with DECW and developed the first draft. RA oversaw the case studies, review of published reports, and analysis of both. DECW reviewed published reports and NTP reviews. RA and DECW developed the final report, with contributions to editing from all authors. All authors read and approved the final version of the report before submission.

Steering committee

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Conflicts of interest

RA is Director of the Strategy, Performance and Evaluation Cluster at the Global Fund to Fight AIDS, Tuberculosis and Malaria, which is the major external funder of tuberculosis programmes worldwide, and he chairs the coordinating board of the Stop TB Partnership. DECW is Coordinator of Policy and Strategy in WHO's Stop TB Department, which provides technical leadership globally on tuberculosis control. MTE is Advisor to the Minister of Health and the Director of the National Centre for Tuberculosis and Leprosy Control; Cambodia is one of the case studies. DM is the Tanzanian Minister of Health and is a member of the board of the Stop TB Partnership; Tanzania is one of the case studies.

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