READY NEXT TIME

Beating TB today and preparing for pandemics tomorrow
Acknowledgements

This report was made possible thanks to input from a wide range of experts across pandemic preparedness and tuberculosis. We thank them for their time and invaluable feedback.

Listed by institutional affiliation, in alphabetical order

- Jackline Kiarie, Amref Health Africa
- Dr Bernard Langat, Amref Health Africa
- Dr Bobby John, Æquitas Consulting Pvt Ltd
- Arush Lal, Chatham House Commission on UHC
- Prof Oren Cohen, Duke University & Labcorp
- Dr Emma Hannay, FIND
- Dr Daniel Bausch, FIND
- Anita Suresh, FIND
- Eolann McFadden, Frontline AIDS
- Dr Brenda Waning, Global Drug Facility, Stop TB Partnership
- Dr Grainia Brigden, The Global Fund to Fight AIDS, TB and Malaria
- Melanie Kitongo, The Global Fund to Fight AIDS, TB and Malaria
- Dr Palitha Abeykoon, Global Preparedness Monitoring Board & Sri Lanka Ministry of Health
- Prof Ibrahim Abubakar, Global Preparedness Monitoring Board & University College London
- Marisa Russell, IAVI
- Prof Helen McShane, Jenner Institute, University of Oxford
- Dr Helen Fletcher, Johnson & Johnson Global Public Health
- Prof Madhu Pai, McGill International TB Centre
- Aggrey Aluso, Pandemic Action Network
- Prof Sir Peter Horby, Pandemic Sciences Institute, University of Oxford
- Dame Barbara Stocking, Panel for a Global Public Health Convention
- Sahera Ramzan, RESULTS UK
- Beatrice Coates, RESULTS UK
- Dr Suvanand Sahu, Stop TB Partnership
- Asgar Ismayilov, Stop TB Partnership
- James Malar, Stop TB Partnership
- Mike Frick, Treatment Action Group
- Prof Eric Goosby, University of California San Francisco
- Mike Reid, Center for Pandemic Preparedness and Response, University of California San Francisco
- Janet Ginnard, Unitaid
- Cherise Scott, Unitaid
- Cheri Vincent, USAID
- Amy Bloom, USAID
- Rosemary Mburu, WACI Health
- Fitsum Lakew, WACI Health

We would also like to thank partners who supported the development of case studies featured throughout the report, including Mona Balani (Alliance India), Patrick Kagarusi (Amref Uganda), Vincent Meurrens (EPCON AI), Ivandra Chirrime (Global Fund), Bertha Simwaka (Global Fund), Emilie Rebeyrol Bremeur (Perenco), Ramya Ananthakrishnan (REACH India), Masooda Kaskar (SATVI), Marwou de Kock (SATVI), Professor Rob Warren (Stellenbosch University), Brad Cunningham (SystemOne), Ria–Lee Botha (TASK), Carmen Kleinhaus (TASK), Caryn Upton (TASK), Dr Mubanga Angel (UTH Lusaka), and Dr Mohammad Mputu (UTH Lusaka).
A note on imagery
This report was produced at pace by a research team based in the United Kingdom. The photographs used in this report are largely drawn from stock image libraries unless provided by case study partners. Given the subject matter and density of text, the authors feel the inclusion of these images nonetheless contribute much needed humanity to an otherwise technical discussion. All photo subjects confirmed their consent to be photographed in line with robust requirements set out by the stock image library or case study partners.
# Table of Contents

Acknowledgements.................................................................................................................. 2

Foreword................................................................................................................................... 5

Executive Summary .................................................................................................................. 7

Introduction ................................................................................................................................ 11

Prevent ....................................................................................................................................... 19
  IHR Coordination, Focal Point Functions & Advocacy ................................................................. 21
  Antimicrobial Resistance ........................................................................................................... 23
  Zoonotic Diseases ...................................................................................................................... 26
  Conclusion ................................................................................................................................. 28

Detect ......................................................................................................................................... 30
  Laboratory Systems .................................................................................................................... 32
  Surveillance Systems .................................................................................................................. 37
  Workforce .................................................................................................................................. 42
  Conclusion ................................................................................................................................. 47

Respond ....................................................................................................................................... 49
  Health Emergency Management ................................................................................................. 51
  Health Services Provision ........................................................................................................... 59
  Infection Prevention and Control ............................................................................................... 62
  Risk Communication and Community Engagement ................................................................. 68
  Conclusion ................................................................................................................................. 73

Next Steps for Respiratory Pandemic Prevention, Preparedness and Response ...................... 75

References .................................................................................................................................... 81
Foreword

Nick Herbert (The Rt Hon The Lord Herbert of South Downs CBE PC)
Chairman, Global TB Caucus

Thirty years ago, the World Health Organization (WHO) declared tuberculosis (TB) a global health emergency. Since then, an inadequate global response has seen only incremental progress against the disease. Some 60 million people are estimated to have died from a disease that has been curable for the best part of a century.

Just over three years ago, WHO declared an outbreak of another lethal respiratory pathogen, SARS–COV–2, to be a public health emergency of international concern. In the weeks and months that followed, COVID–19 claimed millions of lives, brought the global economy to a near standstill, and decimated public finances. COVID–19 highlighted weaknesses in public health systems around the world, but it also demonstrated the strengths of some of those same systems. Those strengths now form the foundation of the pandemic preparedness, prevention, and response (PPPR) agenda as the global community looks to recover from this pandemic and prepare for possible future ones.

The time, then, is right to conduct a thorough and comprehensive review of the PPPR agenda and determine how it can best complement and leverage efforts to tackle existing epidemics. Through exploring how systems built for one lethal respiratory pathogen, TB, were deployed to help tackle COVID–19, we can identify areas of strength. It might seem paradoxical to apply learning from the fight against TB when this has been relatively ineffective. But by understanding where the existing response to TB is underpowered, we can identify areas where investments in PPPR can serve a dual purpose: preparing for the next pandemic whilst tackling the world’s leading killer among established epidemics. The High–Level Meetings on PPPR, UHC and TB in September present a powerful opportunity to focus this case.

Underpinning this report is one critical assumption: that the only type of pathogen capable of causing similar damage to COVID–19 will be a respiratory one. We can stop people from doing many things, but they will continue to breathe. As the most widespread existing respiratory pathogen, TB makes a strong proxy for a future pathogen of pandemic potential: it has largely generic respiratory symptoms as a future respiratory pathogen might; its impact is most profound in poor and marginalised populations where a future respiratory pathogen might get a foothold; and the global fight against TB has been set back more than any other disease by COVID–19 — proof enough that services and resources for TB have been consistently among the most powerful tools many countries have had to respond to the pandemic.
Resources for public health are tightly constrained. Governments are being asked to build stronger protections against the next pandemic whilst still dealing with the effects of the last one. By ensuring that money spent on PPPR is put to use today, tackling existing health challenges, we have a chance of securing the necessary investment for tomorrow. I requested this report because of the need to identify exactly what those investments should be. I hope it will prove a valuable resource to policymakers around the world seeking to get maximum impact from their public health spending.

Nick Herbert
March 2023
Executive Summary

Respiratory pathogens pose one of the greatest public health threats globally. Spread by the universal act of breathing, coughing, and close contact, the COVID-19 pandemic has demonstrated just how fast an outbreak of a respiratory disease can become a pandemic, with devastating consequences. The urgent need for better pandemic prevention, preparedness and response (PPPR) capacity has never been clearer.

The COVID-19 response also reflected the fault lines in the fight against already prevalent respiratory diseases like tuberculosis (TB). Decades of investment in the TB programmes built up diagnostic capacity, a health care workforce expert in managing airborne pathogens, resilient community groups and infrastructures that became the foundation of the COVID-19 response. The fact that COVID-19 briefly eclipsed TB as the world’s deadliest infectious disease masks the fact that TB deaths increased for the first time in a decade amidst the pandemic.

The direct and indirect consequences of COVID-19 leave policymakers in a challenging situation. The need to recover lost ground in the fight against endemic infectious diseases is clear. The threat of another respiratory pandemic looms. At the same time, the economic outlook is poor, with many countries struggling to maintain, let alone increase, their investments in public health.

This report seeks to learn the lessons of the last three years and considers where decision makers can channel investments that deliver for citizens today and tomorrow. By mapping World Health Organization (WHO) guidance on PPPR against guidance on TB, it identifies a series of specific policy reforms and investments that have the potential to deliver genuine impact across both agendas. In doing so, the report strengthens the case for investments in public health at a time when doing so is as important as it is challenging.

Methodology

The report maps the WHO’s Joint External Evaluation (JEE) framework against key policy frameworks and technical guidance on TB. The analysis was supplemented by an extensive literature review, as well as interviews with over 30 subject matter experts.
Findings

Governance & Accountability
The comparative rarity of outbreaks with pandemic potential means that accountability mechanisms struggle to predict how on-paper systems will perform in a real crisis. Monitoring progress against an already prevalent respiratory disease will give world leaders a clear indication of the strength of PPPR systems while ensuring governments don’t neglect existing threats. By drawing attention to the intersection between routine and emergency public health functions, we can challenge the notion that investments in PPPR are a zero-sum game.

Prevention
Preventing the emergence of a pathogen with pandemic potential tackles the problem at the source, long before any vast and expensive public health response is mounted. While TB is already prevalent around the world, actions to prevent the emergence and spread of antimicrobial resistance (AMR) and zoonotic spillovers for PPPR can still make a tangible contribution to the TB response.

Detection
Early detection of infection is crucial to stopping the spread of disease. Respiratory infections like TB and COVID-19 share many non-specific symptoms, including cough and fever. With 1 in 3 people with TB unable to access diagnostic evaluation, we have little hope of being able to detect novel respiratory pathogens with the speed necessary to prevent a pandemic. The diagnostic and surveillance systems required to close the diagnostic gap for TB have widespread interoperability for PPPR. Their operation in inter-pandemic years is crucial to outbreak detection and readiness.
Response
TB programme infrastructures provided the foundation for the COVID-19 response, because of the interoperability of staff competencies, infection prevention and control requirements and historic investments in supply chains, treatment support, and community systems. But existing infrastructures were insufficient for their own purpose, let alone to mount a pandemic response. Building surge capacity across primary care and respiratory services will improve pandemic readiness while boosting the current TB response.

Innovation
The development of new medical countermeasures transformed the COVID-19 response, made possible thanks to concerted investments in research and innovation. The development and equitable deployment of a new vaccine, point-of-care diagnostics and novel treatments are equally crucial to the TB response. While innovation was fast-tracked during the pandemic, scientists faced the same barriers that have made TB research slow and access to new tools unequal. Investment in research, clinical trial networks, manufacturing capacity and research enabling policy reform will put us in a much better position moving forward.

Recommendations
Staff, equipment, and systems need to remain permanently active to detect and rapidly respond to outbreaks of international concern. The similarities between TB and other respiratory pathogens with pandemic potential creates a multitude of opportunities to invest in systems that deliver for citizens today, while protecting them tomorrow.

To build sustainable systems for the prevention, preparedness and response to respiratory epidemics and beyond, policymakers should:

1. Ensure strong alignment of governance, funding and accountability for PPPR and TB
   a. Reformed governance and accountability mechanisms should include TB as a tracer indicator, with the amended International Health Regulations ensuring global, regional and national accountability mechanisms can draw on robust data demonstrating countries’ capacity to respond to a major respiratory pathogen in inter-pandemic years.
   b. Include TB within the results frameworks of PPPR funding streams, to ensure funding mechanisms claiming to deliver impact across multiple domains do so in reality. Closer collaboration between global health funders, including the new World Bank Pandemic Fund, should ensure grants enable and encourage interoperability.
c. **Integrate TB into National Health Security Action Plans**, to ensure new investments in national PPPR systems are aligned and integrated with the TB response, leveraging and strengthening existing systems from the outset.

2. **Prevent respiratory pandemics through targeted investments with broad impact**

   a. Expand access to advanced **drug susceptibility testing** and enhance **case-based surveillance** of antimicrobial-resistant pathogens, including DR-TB.

   b. Support action on zoonotic diseases, by building **One Health capacity**.

3. **Strengthen platforms to detect respiratory pathogens with pandemic potential**

   a. Maximise the efficacy of the existing base of diagnostics through **diagnostic networking optimisation**, investing in interoperable diagnostic platforms and strengthened specimen transfer to plug gaps in detection systems.

   b. Build collaborations between funders and Ministries of Health to support **digital surveillance systems** that can provide real-time data across public health priorities including through networked diagnostics.

   c. Strengthen respiratory disease competencies and **increase the size of the healthcare workforce** across tertiary, secondary, primary, and community-based care.

4. **Build the capacity of health systems to respond more effectively to respiratory pandemics**

   a. Prioritise support for **community-led systems** for healthcare delivery that reach marginalised populations and enable effective outbreak response management.

   b. Increase the speed with which quality-assured new tools reach patients by investing in harmonised **medicines regulation and quality assurance** capacity.

   c. Tackle barriers to care and treatment completion by strengthening and expanding **social protection and patient support programmes**.

5. **Support the development and scale-up of innovations to tackle respiratory pathogens**

   a. Target R&D investments for **platform technologies** and other innovations with dual or wider use.

   b. Support the expansion of **trial site capacity** with interoperability in mind, to reduce time delays and costs associated with clinical trials in outbreak and inter-outbreak scenarios.

   c. Reduce time delays associated with clinical trials in outbreak and inter-outbreak scenarios by developing **regulatory capacity and harmonising standards** between regulatory agencies.
6. **Mobilise political momentum for a PPPR agenda that aligns with efforts to end TB, delivering for citizens now and in the future**

a. The political declarations of the forthcoming UN High-Level Meetings on PPPR, TB and UHC should explicitly highlight areas of alignment between these agendas and commit Member States to ensuring national policy and funding priorities target joint areas of opportunity as a matter of urgency.

b. **To ensure high-level political leadership on this agenda**, the pandemic accord and associated accountability mechanisms currently under discussion should, at least, include reference to lessons learned from the response to TB alongside other public health threats.

c. **Health Committees in national parliaments** should hold governments to account for delivering maximum value for money from PPPR and TB investments through at least one hearing or special session focused on the alignment between national PPPR and TB efforts.

d. **Modalities for future UN High-Level Meetings** and summits should explicitly emphasise intersections with other Sustainable Development Goal priorities, in particular TB, to ensure no opportunities for dual impact are missed.
Introduction

Background

The last three years have illustrated that pandemic prevention, preparedness and response (PPPR) systems are both critically important and chronically under prioritised. Failed prevention, slow detection, and inadequate and inequitable public health responses have resulted in over 750 million cases of COVID-19 and almost 7 million deaths at the time of writing, a number that continues to rise and doesn’t begin to consider the total number of excess deaths (WHO, 2023a; The Economist, 2023). Against this backdrop is the clear understanding that the emergence of a new pathogen with pandemic potential is a question of ‘when’ and not ‘if’ (Ballou et al 2022; White House, 2021).

Failure to invest in PPPR has also had a significant impact on other longstanding public health priorities, including much slower moving pandemics. Tuberculosis (TB) is an airborne respiratory disease that, until it was eclipsed by COVID-19, held the title of being the world’s deadliest infectious disease, with nearly 60 million deaths since first being declared a global public health emergency by the World Health Organization (WHO) in 1993 (WHO, 1993). While high-level political summits in 2017 and 2018 marked a step change in the global TB response, the emergence of COVID-19 prompted a large-scale redeployment of core TB infrastructures (WHO, 2022a). In two short years, over a decade of progress in reducing TB deaths has been reversed. In 2021, 1.6 million people lost their lives to disease that has been curable for the best part of a century (WHO, 2022a).

In this context, 2023 will see unprecedented activity and attention to the politics of global health. Negotiations over a new pandemic accord, a review of the International Health Regulations (IHR) and discussions about the sustainable funding of WHO are taking place alongside three UN High-Level Meetings on PPPR, TB and Universal Health Coverage (UHC) respectively. This year will also see a High-Level Political Forum to appraise progress on the Sustainable Development Goals as a whole, alongside a review about the future of the Global Health Initiatives\(^1\) that have formed the basis of global health financing for the last two decades.

---

\(^1\) Global Health Initiatives is a term to describe organisations that mobilise and disburse funds to address global health challenges. This includes the Global Fund to Fight AIDS, TB and Malaria, Gavi the Vaccine Alliance, UNITAID, and the Global Financing Facility.
The same decision makers are also facing a sobering reality at home. The COVID-19 pandemic has wiped trillions off the global economy, as the cost of the immediate public health response has pushed both high- and lower-income countries into unprecedented levels of sovereign debt (Glassman et al., 2023). Some 60% of African countries are already in, or at risk of, debt distress and there are real concerns that many low- and middle-income countries (LMICs) will not be able to sustain, let alone increase, investments in health (ONE, 2023; World Bank, 2022).

The vast majority of the funding gap for pandemic preparedness remains in countries still reliant on donor funding (Eaneff et al 2023), and new health challenges are constantly emerging. The last twelve months have seen global health leaders contend with Ebola outbreaks in Uganda and the Democratic Republic of Congo and there is an ongoing outbreak of Marburg virus disease in Guinea (WHO AFRO, 2023; WHO, 2023b; WHO, 2022c). South Africa has recently reported a cholera outbreak (NICD 2023). High-income countries that might otherwise be expected to step up overseas development assistance (ODA) are facing domestic cost-of-living crises, with healthcare systems buckling after two years of crisis response (IMF, 2022).

The attention of policymakers is being spread dangerously thin. While the need to invest in health has never been greater, the fiscal space for these investments has shrunk markedly, making the case for siloed support of individual health issues increasingly hard to justify. By
identifying opportunities for investment across multiple domains, this report seeks to assist policymakers to prioritise investment with the greatest potential for real impact.

Challenging the notion of PPPR as a zero-sum game compared to other public health priorities will be crucial to incentivising decision makers to support the kind of dual impact interventions covered in this report. TB offers the perfect foundation for this effort.

The case for respiratory prevention, preparedness and response

Emerging infectious diseases can spread through a variety of transmission pathways, including vectors like mosquitoes or direct contact with blood or other bodily fluids (Loh et al., 2015). It is widely accepted, however, that respiratory pathogens represent the greatest risk of a global pandemic because the universal act of breathing, coughing and close contact can spread the pathogen at incredible speed (Adalja et al., 2019). This is especially true in the context of increased urbanisation and crowded living spaces (Neiderud, 2015). Data on influenza, pertussis, measles and rhinoviruses offer further evidence of the prolific spread of respiratory pathogens (Herfst et al., 2017). Respiratory infections caused an estimated 3.7 million or 6.5% of all deaths globally in 2019 (IHME, 2019).

Crucially, the symptoms associated with these respiratory infections are often broad and non-specific. Both influenza and coronaviruses have presented with symptom profiles of cough, fever, fatigue and gastrointestinal complaints. These are symptoms that hundreds of millions of people experience on a daily basis, the vast majority of whom will have nothing more concerning than a seasonal cold and are unlikely to seek immediate medical care. This significantly increases the chances of delayed detection of a novel pathogen, by which point the total number of cases is likely to have reached hundreds if not thousands of people across a significant geographic area.

Strengthening systems to more quickly detect and respond to respiratory infections is therefore crucial to PPPR as a whole. In doing so, governments have the opportunity to simultaneously deliver major gains in the response to existing respiratory illnesses that already represent major causes of death in their countries.

With over 10 million cases annually, a third of the global population exposed, and a 50% death rate without treatment, TB would quickly be classified a pandemic if discovered as a novel pathogen today (WHO, 2022a; Fauci, 2006). People with pulmonary TB develop a persistent cough, often in combination with fever, weight loss, and night sweats. Those that seek care for what they assume to be a stubborn cold or chest infection will often first contact informal and private care providers before being referred for TB testing (Sreeramareddy et al., 2014). The same symptoms also overlap with non-infectious respiratory illnesses that are major causes of death globally, including chronic obstructive pulmonary disease (CDC, 2022).
The ability to rapidly detect and differentiate cases of both existing respiratory pathogens and those caused by novel pathogens relies on improved access to care, rapid diagnostic systems and robust surveillance mechanisms. The ability to then effectively respond to novel respiratory pathogens relies on robust infection prevention and control (IPC) infrastructures, a sufficiently sized health workforce with expertise in managing respiratory conditions, and access to essential medical tools.

The need to respond to a major novel respiratory pandemic during COVID-19 led to a massive redeployment of resources from TB programmes, despite those programmes already lacking sufficient capacity to end TB within globally agreed timelines (Pai et al., 2022). As a result, TB programmes reported enormous declines in case detection, and unlike other public health programmes, struggled to bounce back after periods of lockdown as workforce, laboratory and in-patient capacity remained depleted (WHO, 2022a; Global Fund 2021). The first increase in TB deaths in over a decade demonstrates how the response to a new respiratory pandemic has come at the cost of losing progress made against one of the world’s leading infectious killers.
However, this experience also demonstrates how investments in systems that prevent, detect and respond to TB have the potential to protect against future outbreaks of novel respiratory pathogens. As this report will demonstrate, the response to TB offers fertile ground on which respiratory PPPR can be built, while the careful channelling of these investments can help address some of the most persistent barriers in the fight against TB.

Methodology

To better understand areas of overlap between efforts to strengthen PPPR and respond to TB, the research team undertook a detailed mapping of current guidelines and recommendations across both domains.

The Joint External Evaluation (JEE) tool was developed by the WHO to support countries in assessing IHR core capacities and facilitate their annual reporting duties (WHO, 2022e). It sets out a clear framework of public health capacities required to prevent, detect and respond to public health risks.

To identify areas of overlap with guidance on the TB response, all JEE indicators were mapped against recommendations from the WHO End TB Strategy, Global Plan to End TB 2023–2030, the Political Declaration of the 2018 UN High-Level Meeting on TB, as well as individual pieces of technical guidance issued by WHO (WHO, 2014; Stop TB Partnership, 2022; UNGA, 2018, WHO, 2021a). The mapping was supplemented by a review of both academic and grey literature, to ensure broader recommendations, particularly those made in response to the COVID-19 pandemic, could be drawn on throughout the analysis.

To ensure areas of overlap represented genuine and practicable opportunities for dual impact, the desk research was supplemented by interviews with over 30 subject matter experts and leaders working across PPPR and TB.

Report Outline

The report has been structured to follow the WHO JEE framework, with three chapters focusing on prevention, detection and response. Each chapter explores how the strengthening of key capabilities set out within the JEE might build on and strengthen the TB response.

Instances where JEE capacities related specifically to emerging infectious diseases or where opportunities for impact on TB were not identified through this analysis were excluded from the report. This includes, for example, IHR legislation and immunisation, as well as capacities on chemical and radiation hazards. It also includes points of entry and border health, as these JEE capacities relate specifically to situations in which a Public Health Emergency of International Concern (PHEIC) has been declared by WHO.
This analysis makes reference to cases where opportunities for dual impact cut across multiple JEE capacities, while avoiding unnecessary repetition. For example, the discussion of preventing zoonotic spillovers (P5) also touches on issues of food safety (P6).

The end of each chapter presents a concise list of key policy and investment opportunities with the potential for dual impact, while the final chapter sets out specific actions for policymakers wishing to leverage this dual impact and build a more sustainable system of prevention, preparedness and response for respiratory pandemics and beyond.

Universal Health Coverage

Universal Health Coverage is defined by the WHO as an ideal situation in which “all people have access to the full range of quality health services they need, when and where they need them, without financial hardship” (WHO, 2022d).

UHC has historically focused on minimising the financial burden of healthcare, but the term is increasingly used to describe a wider set of interventions necessary to ensure that all people have access to comprehensive health services (Lal et al 2022b). While this report focuses on the overlap between recommendations to strengthen PPPR and the TB response, it is important to recognise that a number of action areas are deeply interwoven with the UHC agenda, including on workforce, social protection and primary care.

With the UN High-Level Meetings on PPPR, TB and UHC taking place side-by-side this year, ensuring the commitments set out in the final political declarations speak to one another will be crucial to enabling national governments and funders to pursue coherent policy and investment agendas for health.
Dual impact opportunities for TB and PPPR

List of PPPR capacities as defined by the World Health Organization Joint External Evaluation (JEE) framework, with opportunities for dual impact with TB programmes highlighted in BLUE

**PREVENT**
- Legal instruments
- Financing
- Immunisation
- Food safety
- Antimicrobial resistance
- Zoonotic disease
- Biosafety and biosecurity
- IHR coordination, national IHR focal point functions and advocacy

**DETECT**
- National laboratory system
- Surveillance
- Human resources

**RESPOND**
- Health emergency management
- Infection prevention and control
- Health services provision
- Linking public health and security authorities
- Risk communication and community engagement
Prevent

The first pillar of WHO’s pandemic preparedness framework, the Joint External Evaluation tool (JEE), focuses on prevention. Prevention refers to interventions that are designed to reduce the likelihood of a new infectious disease emerging. It also covers efforts that reduce the likelihood of outbreaks becoming epidemics and pandemics. Lastly, some aspects of the broader governance of health systems are considered part of prevention.

Prevention is separated into eight categories of capabilities in the JEE. These are:

- **Legal instruments** – relating to laws, regulations and policies that underpin the national implementation of the International Health Regulations (IHR) – the overarching legal frameworks for countries’ rights and obligations in relation to cross-border health threats.
- **Financing** – relating to the funding, both from domestic and international sources, that support the implementation of IHR capacities. This includes funding that could be accessed in the event of a public health emergency.
- **IHR coordination, national IHR focal point functions and advocacy** – relating to effective multi-sectoral coordination of alert and response systems in-country, their integration with the international IHR system, and supported advocacy measures to ensure political support for implementation of the IHR.
- **Antimicrobial resistance** – relating to efforts to prevent the emergence and spread of antimicrobial resistance.
- **Zoonotic disease** – relating to efforts to minimise the transmission of zoonotic diseases from animals to human populations.
- **Food safety** – relating to systems for the surveillance and response to foodborne diseases and food contamination risks.
- **Biosafety and biosecurity** – relating to efforts to minimise the risk posed by dangerous biological agents.
- **Immunisation** – relating to efforts to protect the population against vaccine-preventable diseases.

Governments may hesitate to spend limited resources on the prevention of potential future health threats when existing public health challenges are already threatening the lives and livelihoods of their citizens (Ricciardi & Lomazzi, 2022). By aligning interventions required to tackle an ongoing public health emergency such as TB with steps necessary to prevent a new pandemic, there is potential to transform how prevention is perceived by decision makers by making the return-on-investment more significant and immediately tangible.
Background: Prevention systems for TB

Prevention of transmission, infection and the development of active TB disease are crucial to stopping the spread of infection. TB prevention systems generally focus on identifying active cases in order to stop onward transmission, through targeted screening, diagnosis and treatment. In this regard, they carry more similarities with pandemic ‘response’ capacities discussed in Chapter 3. However, there are still instances where pandemic prevention activities have the potential to deliver impact across both PPPR and TB, and where infrastructures and capabilities developed as part of the TB response could underpin this work.

One area of overlap relates to governance, accountability and advocacy. In recent years TB has seen unprecedented political attention, having been discussed at the G7 and G20, in a Global Ministerial Conference and in a UN High-Level Meeting. These latter two events helped spur the creation of a WHO-led multi-sectoral accountability framework (MAF) and a global advocacy effort around it (WHO, 2020a). With ongoing discussions regarding the future governance and accountability of PPPR, it is worth considering where these efforts could leverage off these foundations.

Another key area of overlap is drug-resistant TB (DR-TB), which is the single biggest cause of antimicrobial resistance (AMR) globally (Antimicrobial Resistance Collaborators, 2022). AMR has its own dedicated area within the JEE because it “poses a substantial and evolving threat to disease control and global health security” (WHO, 2022e). The comparatively high levels of primary DR-TB transmission mean that one of the most effective preventative approaches is to ensure early diagnosis and effective treatment, which is discussed at greater length in Chapter 3. Nonetheless, many national TB programmes (NTPs) maintain a focus on prevention through universal access to drug-susceptibility testing, surveillance of resistance patterns, and efforts to strengthen stewardship of key drugs more aligned with the AMR capabilities set out in the JEE (WHO, 2022g).

Zoonotic TB, which is caused by the bacterial species Mycobacterium bovis, is most commonly seen in cattle (bovine TB) but can infect people (WHO, 2017a). Because the infection often affects parts of the body other than the lungs and is naturally resistant to pyrazinamide, a key anti-TB drug, resource-constrained NTPs struggle to respond to zoonotic TB effectively (Kock et al., 2021; WHO, 2017a). Exposure to M. bovis occurs principally through close contact with infected animals and the consumption of contaminated animal products, with opportunities to target interventions at these common transmission pathways for zoonotic infections more broadly.

This chapter therefore maps potential synergies in the prevention of respiratory pandemics and TB by focussing on aspects of governance and accountability, AMR and zoonotic disease.
International Health Regulations (IHR) Coordination, Focal Point Functions and Advocacy

The WHO’s JEE framework identifies three indicators of an effective IHR coordination function:

- P3.1 National IHR focal point function
- P3.2 Multisectoral coordination mechanism
- P3.3 Strategic planning for IHR, preparedness or health security

All three of these characteristics are very explicitly tied to the implementation of national IHR obligations, which do not currently reference TB (WHO, 2005). However, IHR is currently under review, and there are parallel negotiations taking place over a pandemic accord. As such, there is value in considering how PPPR governance could overlap with governance of existing public health responses.

Multisectoral coordination and accountability

*JEE indicator overview*

The JEE framework calls for each country to have a national IHR focal point. That position should have adequate levels of authority, administrative support, communication channels, and human, technological, and financial resources to engage with all the duties outlined in the IHR. In addition, each country is required to have a multisectoral coordination mechanism underpinned by appropriate strategic frameworks, guidelines, and operating procedures.

WHO further recommends a national action plan is implemented, with active engagement from decision makers in government and/or legislative bodies at national and intermediate levels. Plans should be monitored, reviewed and updated at least annually, based on risk assessment, simulation exercises and lessons learned from real-world events.

*Opportunities for dual impact*

Current negotiations on a new pandemic accord and review of the IHR were prompted by a failure of the current system to prevent the COVID-19 pandemic (IPPPR, 2021; GPMB, 2021). A core area of focus has been the need for more robust monitoring and accountability (PGPHC, 2023). While the JEE offers an invaluable framework to understand the core tenets of pandemic preparedness, it relies heavily on normative judgements about the appropriateness of policy frameworks and the quality and extent of their implementation (IPPPR, 2021).

While the JEE seeks to determine whether countries have in place the basic systems required to prevent an outbreak reaching pandemic proportions, concrete evidence of these systems’ effectiveness is often generated only when an outbreak occurs. While increasingly likely on a global scale, this is not something that every country is likely to experience.
frequently enough to represent a robust, let alone desirable, monitoring and accountability mechanism. Indeed, many countries scoring highly on the JEE saw their COVID-19 response falter at hurdles that, at least on paper, shouldn’t have existed (IPPR 2021). Moving forward, a ‘tracer’ indicator is required to act as a proxy indicator for pandemic preparedness.

Up until the point of a diagnosis being bacteriologically confirmed, a person affected by TB is likely to have very similar symptoms to a person with an emerging respiratory pathogen, including cough, fever and fatigue. TB, therefore, represents possibly the optimal tracer indicator, demonstrating whether a health system is able to detect and respond appropriately to people developing respiratory symptoms. This is particularly the case because marginalised and vulnerable populations are at greatest risk of TB while also facing the greatest barriers to accessing health systems that can detect respiratory infections, offering an equity-oriented tracer for PPPR.

Ensuring a more holistic understanding of pandemic preparedness and health security capacity will be crucial in this context, and ensure lessons are learned from the failure to sufficiently consider health systems requirements from the outset of the COVID-19 response (Open Consultants, 2022). Existing frameworks, such as Health Systems for Health Security, the Essential Public Health Functions and Service Availability and Readiness Assessments (SARA) offer a helpful foundation for this effort (Brown, 2022; WHO 2018; WHO, 2015a).

Aside from assisting as proxy indicators, the inclusion of existing public health threats within policy and accountability frameworks for PPPR could also contribute to political prioritisation and financing of both agendas in inter-pandemic years. After recent health emergencies with pandemic potential, such as SARS, MERS, and Ebola, political attention and investment in PPPR was fleeting (World Bank, 2017). Even in the aftermath of COVID-19, political focus has waned (PAN, 2022; IPPR 2021). Challenging the notion of PPPR as a zero-sum game compared to other public health priorities will be crucial to incentivising decision makers to support the kind of dual impact interventions covered in this report.
Antimicrobial Resistance

The WHO’s JEE framework identifies five core indicators of effective AMR prevention:

- P4.1 Multisectoral coordination on AMR
- P4.2 Surveillance of AMR
- P4.3 Prevention of multidrug resistant organisms
- P4.4 Optimal use of antimicrobial medicines in human health
- P4.5 Optimal use of antimicrobial medicines in animal health and agriculture

As DR-TB represents a significant proportion of the global burden of AMR, any and all action on TB contributes to the global response to AMR at a fundamental level. However, not all aspects of the TB response overlap with the AMR response. Many AMR pathogens are not spread via a respiratory route, but rather close contact or surface spread. Further, the use of antimicrobials in livestock management and agriculture (P4.5) are not currently thought to be significant drivers of drug-resistance in TB. The prevention of multidrug-resistant organisms as defined by the JEE relates predominantly to hospital-acquired infections (P4.4), the prevention of which will be discussed in detail in Chapter 3.

The following section therefore focuses on the remaining aspects, including multisectoral coordination, surveillance, and stewardship.

Multisectoral coordination on AMR

**JEE indicator overview**

WHO recommends each country develop a national AMR action plan, aligned with the Global AMR Action Plan (WHO, 2015b). A multisectoral coordination mechanism that is led by government should oversee its implementation, on the basis of a costed and fully funded operational plan that is updated and evaluated regularly.

**Opportunities for dual impact**

Given the already high burden of DR-TB globally, the inclusion thereof within national AMR action plans is a priority, particularly in countries with the highest burden. However, many countries with high DR-TB burdens score poorly in terms of their broader AMR policy environment (Patel et al., 2023). The prevalence and established impact of DR-TB is a highly salient example of why AMR should be prioritised – illustrating the urgent need to take action even if other priority AMR pathogens are not thought to be widely prevalent.

Beyond communications, the infrastructure of NTPs is, almost universally, better resourced and more extensive than national AMR programs. By including NTPs and their stakeholders within core AMR coordination mechanisms, countries can avoid reinventing the wheel for AMR, and build on the knowledge, expertise and infrastructure of the NTPs that have been grappling with the world’s leading drug-resistant infection for decades.
**Surveillance of AMR**

**JEE indicator overview**

A robust surveillance system for AMR should have the capacity to generate, collate and report data on the prevalence of drug-resistant pathogens in a given population. Data should be collected from both hospitalised and community patients, with an established network of surveillance sites, a designated national reference laboratory for AMR and a national coordinating centre. The most advanced systems should also be reporting data on antimicrobial consumption and use across human health, animal health and agricultural sectors.

**Opportunities for dual impact**

Most countries have higher rates of DR-TB than they do of any other drug-resistant infection and the pathways for tackling DR-TB are well-established. To address DR-TB, universal access to tests that can determine whether an individual has a strain that is resistant to drugs, and if so which drugs, is critical (Stop TB Partnership, 2022; WHO, 2021b). Drug susceptibility testing (DST) requires the routine use of rapid molecular diagnostics, as well as robust referral pathways to second-line DST and personalised care for each patient (WHO, 2021b; WHO, 2022g). As such, the most efficient way to address AMR is likely to build on these same systems, particularly in LMICs where TB is prevalent and AMR surveillance systems are nascent (Hasan et al., 2018).

Beyond DST, surveillance for TB and AMR currently take contrasting approaches. TB surveillance programmes are amongst the oldest in the world and have historically relied on active sampling methodologies to assess the prevalence of drug resistance within countries. While methodologically robust, prevalence surveys are often too resource intensive to conduct regularly and therefore offer limited insight to policymakers wishing to shape their TB responses in inter-survey years (Hedt et al., 2011; WHO, 2020b). The push towards universal DST has created opportunities for more robust and operationally meaningful case-based surveillance, but country data reveals how far most high TB burden countries are from this ideal (Stop TB Partnership, 2022; WHO, 2022a).

WHO’s Global Antimicrobial Resistance and Use Surveillance system (GLASS), on the other hand, has sought to take a case-based approach from the outset, but largely excluded TB from its remit (Ashley et al., 2018; WHO, 2016a). Global AMR surveillance in low resource settings continues to be hampered, however, by poor diagnostic infrastructure outside the most advanced hospital settings (WHO, 2022h).

While acknowledging the need for some differentiation in sampling and diagnostic methodologies, such as for gram-negative bacteria, there is considerable opportunity to deliver more robust, cost-efficient outcomes for both TB and AMR more broadly through aligned investments (Hasan et al., 2018; WHO, 2016a). As outlined above, the two surveillance approaches contrast in strengths and weaknesses. Alignment between them offers
opportunities for more routine and increasingly decentralised resistance testing of non-
tuberculous infections, and more real-time, case-based surveillance of DR-TB.

**Optimal use of antimicrobial medicines in human health**

*JEE indicator overview*
Guidelines and practices to enable the appropriate use of antimicrobials should be available and implemented in healthcare facilities nationwide, and in relation to all major syndromes. Functioning stewardship programs should be in place within all major health facilities. The WHO ‘Access, Watch and Reserve’ (AWaRe) classification of antibiotics should be adopted within national essential medicines lists, with robust monitoring of antibiotic consumption on this basis. Data on drug resistance and antibiotic consumption should be analysed regularly and shared with prescribers.

**Opportunities for dual impact**
Robust surveillance and stewardship systems are critical to the fight against TB. These systems are particularly essential to protect the very limited arsenal of newer anti-TB drugs from being compromised.

A number of antibiotics required for the treatment of TB are included on the ‘reserve’ or ‘watch’ lists of WHO’s AWaRE classification of antibiotics (WHO, 2021c). Misdiagnosis, inappropriate use and over-the-counter antibiotic sales are major drivers of both DR-TB and AMR more broadly (Daniels et al., 2019). The development and enforcement of robust policy frameworks that ensure responsible use of antibiotics, closer collaboration with the private and informal health sectors, and monitoring of antibiotic consumption are crucial for effective antimicrobial stewardship, including for TB (WHO, 2021d; Satyanarayana et al, 2016). Importantly, such stewardship programmes are for the most part disease-agnostic, so they are likely to deliver impact across the full spectrum of AMR-associated infections.

---

2 Including linezolid, rifampicin, moxifloxacin, kanamycin, levofloxacin, imipenem-cilastatin and meropenem.
Zoonotic Diseases

The WHO’s JEE framework identifies three indicators of an effective system to prevent zoonotic diseases:

- P5.1 Surveillance of zoonotic diseases
- P5.2 Response to zoonotic diseases
- P5.3 Sanitary animal production practices

It is estimated that around 60% of human infections have an animal origin, and 75% of new and emerging human infectious diseases have ‘jumped species’ from other animals to humans (UNEP et al., 2020), with TB among the former and SARS-CoV-2 the latter.

There is a relatively low prevalence of zoonotic TB worldwide, estimated at approximately 147,000 cases and 12,500 deaths in 2016 (WHO, 2017a). Efforts to address zoonotic TB in isolation, therefore, are unlikely to have a significant impact on the prevalence of TB as a whole. Nonetheless, opportunities for intervention with impact on both PPPR and zoonotic TB exist across all three capacities outlined in the JEE, and therefore warrant consideration.

Surveillance of zoonotic diseases

**JEE indicator overview**

A national list of priority zoonotic diseases should be agreed between human health, animal health, and the environment sector. Surveillance efforts should be coordinated between these sectors at both national and intermediate levels to allow surveillance of the whole territory as well as effective information sharing and joint risk assessment between stakeholders across human health, animal health and environment. Surveillance mechanisms should be tested, assessed, reviewed and improved on a regular basis.

**Opportunities for dual impact**

WHO’s roadmap on zoonotic TB emphasises the importance of case-based, electronic recording and reporting systems and efforts to strengthen polymerase chain reaction (PCR) laboratory infrastructure needed to differentiate between *M.tuberculosis* and *M.bovis* infections - exactly the same systems needed for zoonotic disease in general (WHO, 2017a; WHO et al., 2019a). The need for increased surveillance of zoonotic TB has been underscored by the emergence of novel zoonotic TB strains, including *M.orygis* in South Asia and Africa (Kock et al., 2021).

Investments in basic infrastructure for zoonotic surveillance could therefore deliver immediate benefits for TB and provide a framework for wider zoonotic surveillance. Targeted prevalence surveys could offer crucial insights on the prevalence of zoonotic TB and the vulnerability of high-risk populations to zoonotic spillovers more broadly.
Response to zoonotic diseases

JEE indicator overview
A multisectoral national strategy for response to zoonotic events should be in place. A mechanism linking human health, animal health and environmental sectors should be in place to enable a coordinated response to outbreaks of endemic, emerging or re-emerging zoonotic diseases, with clear definition of roles, responsibilities and procedures between sectors.

Opportunities for dual impact
Close collaboration between human health and animal health services relies on each sector having sufficient capacity to engage in substantive collaboration. While high-income countries like the UK boast approximately 0.41 veterinarians per 1,000 population, a country like Kenya reported only 0.01 veterinarians per 1,000 population in its most recent evaluation (FVE 2018; OIE, 2007).

The One Health Joint Plan of Action, released jointly by the WHO and UN food, animal health and environment programmes, identifies core capacity development as the number one ‘action track’ (FAO et al., 2022). In many high-income countries, the management of M.bovis takes place principally in the animal health sector, with close human contacts of infected animals referred for testing as appropriate (PHE, 2014). This is a particularly important strategy as people infected with M.bovis often do not experience typical pulmonary TB symptoms (WHO 2017a). Investments to increase capacity for the response to zoonotic
infections and One Health collaboration could be easily extended to include zoonotic TB, with potentially significant impact.

**Sanitary animal production practices**

**JEE indicator overview**
Countries should mount systematic efforts to improve sanitary practices in the breeding of terrestrial and aquatic animals and the production of animal products to limit the risk of zoonotic disease transmission. National action plans should be based on international standards, with national guidelines on good production practices widely disseminated and adjusted for implementation across different settings. Periodic inspection, assessment and monitoring of practices should be conducted in the main animal production value chains, and compliance with national guidance regularly verified.

There is overlap between these competencies and those set out in relation to food safety (P6). However, as zoonotic TB is most prevalent among subsistence farmers and pastoralist communities that are less likely to be subject to food chain surveillance and emergency responses, we present the discussion of potential overlaps here.

**Opportunities for dual impact**
Transmission of *M.bovis* from animals to humans mostly occurs through the consumption of contaminated dairy and meat products, making efforts to strengthen animal production practises a crucial area for prevention (Devi et al., 2021).

Efforts to reduce the risk of zoonotic transmission among these populations requires sensitive engagement with communities, particularly where livelihoods depend on livestock and strongly held cultural beliefs are integral to farming and food practices. Initiatives that seek to reduce the risk of zoonotic spillovers among these high-risk populations through increased access to veterinary services and sensitisation around sanitary food production are likely to reduce risk across a wide range of zoonotic infections. The relatively high prevalence and chronic underdiagnosis of *M.bovis* make zoonotic TB a potentially promising test case for such activities (Kock et al, 2021; Salyer et al., 2017).

**Conclusion**
To prevent the emergence of pathogens with pandemic potential, countries must have robust governance systems in place, as well as strategies to minimise the risk of unsafe practices in health services and animal production that can lead to the development of new pandemic threats.

By integrating TB into governance processes, policy frameworks and capacity building initiatives, efforts to strengthen pandemic prevention can make a tangible contribution to addressing long-standing barriers in the response to one of the oldest public health threats.
In doing so, efforts to strengthen PPPR would not only build on existing infrastructure built over a century of TB programming, but also clearly demonstrate the tangible impact of these investments in the here and now.

Targeted, sustained investments and policy initiatives in the following areas therefore have the potential to deliver impact across both domains:

**IHR coordination, national IHR focal point functions and advocacy (P3)**

- Strengthen accountability through integration of TB as tracer indicator for respiratory pandemic preparedness.

**Antimicrobial resistance (P4)**

- Expand surveillance infrastructure for antimicrobial-resistant pathogens, including TB.
- Champion stewardship initiatives that target provision of TB medications and other antimicrobials.

**Zoonotic disease (P6)**

- Build surveillance systems for zoonotic disease, including TB.
- Conduct prevalence surveys among high-risk populations.
- Expand One Health capacities.
- Strengthen sanitary animal production practices among high-risk populations.
Detect

The second pillar of the JEE focuses on detection, which refers to the ability of a health system to identify a novel pathogen as early as possible, and subsequently monitor its spread through the population. Detection also refers to systems that monitor existing pathogens, such as malaria or TB, and the development of drug-resistant or variant strains.

Within the WHO’s framework, detection is separated into three categories of capabilities. These are:

- **Laboratory systems** – relating to the physical infrastructure, and accompanying human and financial resources, to identify novel or existing pathogens and other critical information such as drug-resistance profiles and genomic data.

- **Surveillance systems** – relating to the ability of the health system to combine data from laboratories with clinical data relating to the outcomes of patients, as well as wider population-level information, to determine epidemiological trends and identify potential outbreaks.

- **Human resources** – relating to the availability of a large enough number of sufficiently trained personnel to deliver public health functions.
Detection systems are considered a critical element of a pandemic response – where, by definition, public health emergencies occur simultaneously across multiple geographies and interact with one another. Effective surveillance systems mean that information gathered in one health system can directly support and shape the response of another health system, for example, the sharing of the emergence of the Omicron variant by health authorities in Botswana (Freyer, 2021).

Concerns about inadequate detection infrastructure have been raised consistently by global leaders in recent years. At the outset of the COVID-19 pandemic, the Africa Centres for Disease Control and Prevention (CDC) reported that only two countries in Africa had the capability to diagnose the disease (Nkengasong & Mankoula, 2020). Over the last three years there have been considerable efforts to strengthen laboratory systems across the world, but inequities in COVID-19 testing demonstrate the considerable distance still to go to contain the current pandemic, and help protect against future ones (FIND, 2023a; Rahman 2023).

**Background: Detection systems for TB**

A major contributing factor to the continuation of the TB pandemic is the failure to detect more than one third of all incident cases. The 2018 UN High-Level Meeting on TB outlined a series of steps to strengthen detection, similar to those outlined in pandemic preparedness literature.

Of the two-thirds of people affected by TB who are detected by health systems, less than 63% are bacteriologically confirmed using even the most basic of diagnostic technologies (WHO, 2022a). Data on tests conducted, confirmed diagnoses and treatment enrolment are often stored on paper at health clinics, resulting in lengthy delays in that data reaching Ministries of Health and increasing the chances of data loss or errors (van der Heijden et al., 2019).

Given that TB shares many symptoms with other respiratory illnesses, such as a cough and fever, the failure to increase diagnostic rates for TB should be of grave concern to public health authorities preparing for a future respiratory pandemic. If a health system is unable to detect and record cases of one of the most prevalent and well-established pathogens, it is likely to struggle with a new pathogen with a similar symptom profile.

Nonetheless, there is **considerable** infrastructure for TB that could act as a foundation for future PPPR detection systems. This section explores where potential investments to strengthen the detection of pathogens with pandemic potential could leverage these foundations, as well as addressing detection gaps in the TB response to deliver maximum return on investment across both agendas.
Laboratory Systems

The WHO's JEE framework identifies four indicators of an effective laboratory system:

- D1.1 Specimen referral and transport system
- D1.2 Laboratory quality system
- D1.3 Laboratory testing capacity modalities
- D1.4 Effective national diagnostic network

We will consider each of these in turn.

Specimen referral and transport system

**JEE indicator overview**
To ensure specimens can quickly be tested using a range of methods, WHO recommends a country has in place a sustainable referral and transport system for all priority diseases across all levels of the health system. A specimen referral and transport system should be able to reach the full territory and safely handle all specimens.

**Opportunities for dual impact**
It is unrealistic to expect that every site where a patient could give a sample will have the ability to test for all known pathogens as well as identify novel ones. As such, it is necessary to have systems in place to transport samples from the point of origin to advanced laboratories for identification. For pathogens of pandemic potential, these systems need to meet exacting IPC standards (HSE, 2019).

Most countries already have such sample transport systems at least partially in place, including for cultures that require higher IPC standards than for the transport of samples alone (GLI, 2023). Countries can leverage knowledge and procedures from TB sample transfer for their PPPR response.

However, existing TB diagnostic infrastructure is capturing a relatively small proportion of people affected by the disease, insufficiently robust for its own purposes let alone for a PPPR detection system (WHO, 2022a; WHO, 2016b). Patients continue to be asked to travel many miles to seek diagnosis by a health centre able to offer the relevant diagnostic test, delaying detection, treatment enrolment and increasing the number of close contacts exposed (Stop TB Partnership & MSF, 2020; Hanson et al., 2017). Investment is urgently needed to build the systems that can capture samples from a wider proportion of the population for both PPPR and TB, with alignment offering greater impact, reliability and cost-efficiency.

Laboratory quality system

**JEE indicator overview**
To ensure results from laboratory testing can be trusted to inform both clinical care and public health responses, laboratories need to be regularly quality assured. WHO
recommends that national quality standards should be developed and implemented at all levels of the health system, with mandatory licensing in conformity with international quality standards. These frameworks should be regularly exercised, reviewed, evaluated and updated.

**Opportunities for dual impact**
Insufficient quality assurance systems and staff training can lead to a failure to detect a pathogen, leading to potentially fatal delays in initiating clinical care and appropriate public health responses. High TB burden countries usually have systems in place for quality assurance of TB laboratory infrastructure, but limited capacity can undermine their geographic reach, effectiveness and the different diagnostic tests available to patients at any one time (Maurer et al., 2022; Abebaw et al., 2022; Global Laboratory Initiative et al., 2020). Viet Nam, a country with a high burden of both drug sensitive and drug-resistant TB, only has one TB laboratory that has achieved accreditation according to International Organization for Standardization 15189 standards (Gumma et al., 2022). Given that many key diagnostic platforms for TB are also required for emerging infectious diseases, there are key opportunities for interoperable investments in this space.

Furthermore, because of the highly infectious, airborne and potentially drug-resistant nature of TB bacteria, laboratories handling live samples must generally meet Biosafety Level 3 (BSL-3) requirements, the second highest level of containment (GLI, 2019; WHO, 2013). As with most core health systems infrastructure, BSL-3 capacity is significantly lower in low- and middle-income than high-income countries (Schuerger et al., 2022). Expanding national biocontainment laboratory infrastructure, staff training, and policy development therefore has the potential to deliver expanded diagnostic capacity, the quality of testing, and the ability for laboratories to safely handle a wide range of samples, including TB and emerging infectious diseases.
Laboratory testing modalities

**JEE indicator overview**

WHO recommends that national laboratory systems have capacity to conduct rapid antigen and antibody testing, microscopy, serological tests (i.e. antigen and antibody enzyme immunoassays), nucleic acid amplification (i.e. molecular assays), bacterial culture and antimicrobial sensitivity testing. Countries should have some basic gene sequencing capacity, as well as access to whole genome sequencing of unknown and high-consequence pathogens, and viral culture. The laboratory network should have the capacity to test for all endemic and priority diseases with maximum population coverage, and regular review and evaluation.

**Opportunities for dual impact**

To be able to detect an emerging infectious disease, healthcare workers need to be able to quickly rule out potential endemic diseases with similar symptom profiles and have a robust mechanism in place to trigger more advanced testing. As such, there is significant overlap in the diagnostic infrastructure required for the routine testing of endemic respiratory infections like TB and those required for PPPR. Molecular diagnostic technologies such as GeneXpert® and TrueNAT have a vital role to play in rapidly identifying or ruling out endemic infectious diseases such as TB. During COVID-19, the rapid development of pathogen-specific modules and cassettes meant these technologies became the basis of the outbreak response, with many countries reporting massive increases in the number of laboratories undertaking molecular testing (FIND, 2023b; Hannay & Pai 2023).

Significant innovations in multiplex diagnostic platforms offer the potential to test for multiple potential causes of non-specific symptom profiles using just one sample, reducing the time needed to enrol patients on treatment or refer for further testing where known pathogens have been ruled out (Rodriguez, 2022; WHO, 2021e). Similarly, many of the digital technologies utilised to support screening, diagnosis and quality-of-care during the COVID-19 pandemic have widespread applicability to TB, including when combined with the chest X-ray infrastructure that was built up during the pandemic (Bliss 2021).

Some of the tools required for the culture and testing of a bacterial infection like TB will be distinct from those required to identify a novel RNA virus, for example. However, further interoperability exists within the most advanced laboratory tools, such as PCR, mass spectrometry and next-generation sequencing (NGS). These allow for the partial or complete characterisation of new pathogens and strains, as well as enabling the detection of complex drug resistance profiles within a fraction of the time required for culture-based DST. Noting significant investment into these technologies in response to COVID-19 and ever reducing costs per test, expanding access to and improving the quality of these testing modalities offers the potential to have significant clinical and public health impact across both TB and PPPR (WHO, 2022i).
## Case Study – Leveraging Private Sector Capacity

<table>
<thead>
<tr>
<th><strong>Action Area</strong></th>
<th>Laboratory Networks, Multi-Sector Partnership</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Location</strong></td>
<td>Cameroon, Congo, Democratic Republic of Congo &amp; Gabon</td>
</tr>
<tr>
<td><strong>Background</strong></td>
<td>Perenco is an oil and gas company working in rural, isolated areas. During COVID-19, they constructed on-site, state-of-the-art PCR laboratories to enable safe and legal deployment of staff to cramped and restricted workspaces.</td>
</tr>
<tr>
<td><strong>Intervention</strong></td>
<td>Following national accreditation of their laboratories for tropical diseases, Perenco has worked with local health authorities to make unused laboratory capacity available to the public health system. Tests are conducted free of charge, as part of Perenco’s Corporate Social Responsibility policy.</td>
</tr>
<tr>
<td><strong>Impact on PPPR</strong></td>
<td>Limited lab capacity and sample transfer barriers contributed to local people waiting up to 6 months to receive results from PCR tests (for Buruli Ulcer for example). Perenco is able to support local sample transfer and can deliver results within hours in greater quantities. Close partnership with local health authorities mean Perenco laboratories could be leveraged to rapidly identify potential outbreaks in remote areas, to the extent possible. By testing for endemic illnesses, the infrastructure remains active and quality assured in inter-outbreak periods.</td>
</tr>
<tr>
<td><strong>Impact on TB</strong></td>
<td>Local health authorities in the Democratic Republic of Congo have prioritized TB testing in their partnership with Perenco, conducting over 700 PCR tests between April and December 2022. Building on this experience, Perenco is now screening their employees for Latent TB Infection.</td>
</tr>
<tr>
<td><strong>Key Takeaway</strong></td>
<td>PPR guidance recommends leveraging private sector infrastructures during outbreaks. Building partnerships in inter-pandemic periods is mutually beneficial – tackling priority endemic diseases while strengthening preparedness systems.</td>
</tr>
</tbody>
</table>
Effective national diagnostic network

**JEE indicator overview**

Aside from effective specimen referral and transport systems, the smooth operation of a national diagnostic network relies on evidence-based diagnostic testing strategies. These strategies inform where diagnostic infrastructure is placed geographically, and what tests are conducted, in which order. WHO therefore recommends that countries have in place diagnostic strategies across different tiers of the health system, covering primary, secondary and tertiary care, with regular review, evaluation and update as applicable.

**Opportunities for dual impact**

TB guidelines recommend a similar tier-specific diagnostic testing strategy. Low TB case detection rates have often been linked to inefficiencies in this diagnostic network, with existing TB-specific equipment stuck in a catch-22 of low access and low utilisation rates (The Global Fund, 2022; Albert et al., 2020). The initial COVID-19 response relied heavily on laboratory infrastructures built through TB programmes, but this was more of a serendipitous by-product than intentional design (Agarwal et al 2022; GPMB 2019). The longer-term response has meanwhile prompted vast capital expenditure on diagnostic equipment with significant interoperability between PPPR and TB, but concerns are now being raised that many of these machines will be dust-sheeted in the face of reduced pandemic-specific financing (Nyaruhirira et al., 2022; Brigden et al., 2022).
If countries are to build on the sunk costs of pandemic infrastructures, reinforce their capacity to detect pathogens with pandemic potential and increase case detection for existing public health threats, they will need to find a way to maintain this diagnostic equipment, identify gaps and mobilise resources to plug those gaps (Ballou et al 2022). Diagnostic network optimisation (DNO) projects have demonstrated how access to testing can be substantially improved through deploying limited diagnostic capacity according to a more holistic understanding of health priorities and epidemiology (Girdwood et al., 2023; Albert et al., 2020). An integrated review of national diagnostic priorities and post-pandemic capacities can set the foundations for the placement of interoperable diagnostic platforms closer to communities, enabling a move towards molecular tests as first-line TB diagnostics, and making the most advanced diagnostic technologies routinely available to public health programmes.

A resolution calling for integrated national diagnostic strategies at the 2023 World Health Assembly highlights how many countries are already looking to pursue such strategies (WHO, 2023c). While downstream cost savings can likely be delivered, upfront costs associated with such efforts are likely to be significant and require careful management of multiple funding streams. For this effort to succeed, funding streams specific to both PPPR and TB will therefore need to enable these approaches, while ensuring laboratory infrastructures continue to deliver on key public health priorities (GPMB 2019).

**Surveillance Systems**

The WHO's JEE identifies three core indicators of an effective surveillance system. These are:

- D2.1 Early warning surveillance function
- D2.2 Event verification and investigation
- D2.3 Analysis and information sharing

While the verification and response to changes in TB epidemiology are core functions of an effective national TB programme, the JEE indicator refers specifically to incidents with the potential to be public health emergencies of international concern (PHEICs) as set out in the IHR. We will therefore be focusing on opportunities for dual impact within characteristics set out in D2.1 and D2.3.

**Early warning surveillance function**

**JEE indicator overview**

WHO recommends that countries have an early warning surveillance system in place, informed by national guidelines or standard operating procedures that are implemented across national, intermediate and primary public health levels. All components should be integrated into one national system, which should be regularly evaluated and updated as appropriate.
Opportunities for dual impact

There is a wide, and increasing, range of signals that could inform health authorities of a potential outbreak, including clinical indicator data, laboratory data and event data based on media coverage, markets and behavioural insights. The most effective surveillance systems combine these factors to help inform decision-making. For example, an increase in people presenting to health services with a cough and fever alongside data that suggests a recent drought, might prompt an increase in active case finding for TB among subsistence farmers. If the same increase in cough and fever symptoms were to be seen alongside media speculation or increased death rates, public health officials may wish to investigate a potential disease outbreak.

TB data offers a key insight into surveillance capacities in many LMICs. While significant progress has been made in recent years through the roll-out of platforms like Digital Health Information System (DHIS2), many systems are not linked with electronic laboratory data while significant volumes of clinical completions are still stored on paper and transferred onto digital platforms at secondary- or tertiary- care levels, leading to delays and data quality issues (WHO, 2023d; van der Heijden et al., 2019). Despite many diagnostic tools having the capacity to be networked into real-time surveillance systems, only a tiny fraction of this capability is leveraged (Stop TB PSC 2022).

The interoperability of investments in this infrastructure was already demonstrated during COVID-19, when testing and vaccination modules for existing DHIS2 systems became the primary surveillance system in many countries (The Global Fund, 2022). Capital investments in infrastructure to increase decentralised coverage of real-time health information systems,
staff training, networked diagnostics and expanded analytical capacity through the integration of new tools like artificial intelligence all have a high degree of interoperability (Lal et al., 2020). Ensuring digital health information systems have the capacity for longer-term monitoring of patients would offer vital insights for TB programmes and in the event of a pandemic pathogen with a longer period of infectiousness than COVID-19.

Building pandemic surveillance on existing health information systems is crucial not only to cost effectiveness and useability by healthcare workers but can also avert failures in policy coordination (Lal et al., 2022). Doing this well will rely on the creation of incentives, structures and pathways for stakeholders to work together and implement integrated surveillance systems that bring multiple sources of data together for analysis beyond just grant reporting and identify and plug key data gaps (Ballou et al 2022; The Global Fund, 2022).

The COVID-19 pandemic has also seen a massive growth in genome sequencing capacity as countries needed to rapidly identify new variants of concern (FIND 2023). Before the pandemic NGS was often seen as too complex and expensive for routine use in low-resource settings, with limited capacity restricted to academic settings (Hannay and Pai 2023). For countries to maintain and make the most of this expanded infrastructure, they will need to find ways of integrating NGS into routine public health surveillance, including of DR-TB, as well as exploring the increased use of such technologies for patient management (Hannay and Pai 2023: WHO, 2022).
## Case Study – NGS In South Africa

<table>
<thead>
<tr>
<th><strong>Action Area</strong></th>
<th>Laboratory and Surveillance Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Location</strong></td>
<td>South Africa</td>
</tr>
<tr>
<td><strong>Background</strong></td>
<td>To support more robust surveillance of drug-resistant TB, South Africa invested in genome sequencing technologies in the 2010s.</td>
</tr>
<tr>
<td><strong>Intervention</strong></td>
<td>The emergence and spread of COVID-19 saw South Africa utilize and then rapidly build on this capacity to support next generation sequencing (NGS) for the surveillance SARS-CoV-2. With COVID-19 cases reducing, the country is now looking to deploy this expanded capacity across a broader range of public health priorities.</td>
</tr>
<tr>
<td><strong>Impact on PPPR</strong></td>
<td>South Africa has the largest NGS facilities on the African continent (CERI, NICD and SAMRC Genomic Centre) and has sequenced almost 3% of positive COVID-19 cases. This capacity was central to South Africa’s identification of the Omicron variant, enabling countries around the world to prepare for a wave of the more infectious strain.</td>
</tr>
<tr>
<td><strong>Impact on TB</strong></td>
<td>While NGS offers a helpful tool for the surveillance of drug-resistance at population level, the technology can also reduce the time required for patients to receive a comprehensive drug sensitivity result from 6 - 9 weeks to a matter of days. For this reason, South Africa is now looking at how to integrate NGS into routine surveillance and TB diagnosis to improve patient care and prevent the emergence of resistance against newer anti-TB drugs.</td>
</tr>
<tr>
<td><strong>Key Takeaway</strong></td>
<td>Building inter-operable NGS capacity opens the opportunity for more effective surveillance of a range of public health threats. By integrating NGS into routine surveillance and diagnostic services, countries can improve patient care, develop more robust surveillance systems, and maintain vital capacity for outbreak scenarios.</td>
</tr>
</tbody>
</table>
Analysis and information sharing

**JEE indicator overview**
To ensure surveillance data provides valuable insights on public health events of potential concern, countries need to have the capacity to analyse and share information across stakeholders. WHO recommends that analysis of surveillance data is conducted on a regular basis, with epidemiological bulletins shared across sectors and internationally. An electronic platform and dedicated team supporting data management and advanced analysis should be in place.

**Potential for dual impact**
Strengthening core surveillance system infrastructure is likely to generate significantly more data on TB and other endemic public health threats. Increasing epidemiological capacity and collaboration between national institutes of public health and relevant disease programmes will be crucial if governments are to make the most of these insights (IANPHI, 2022).

Making the most of this new intelligence will also rely on mechanisms to meaningfully share findings with decision makers with the authority to act on them. The COVID-19 pandemic marked a significant step change in the high-level surveillance data oversight, with the most senior government officials often briefed on the epidemiological situation on a daily basis. Modelled on similar initiatives for HIV, TB and malaria, live dashboards were installed in some countries to inform decision making across governments (The Global Fund, 2022; Zhao, 2022).

Ensuring decision makers are sufficiently familiar with epidemiological data to confidently respond in the event of an outbreak will rely on sustaining focus in inter-pandemic periods. Establishing live dashboards and mechanisms for regular high-level review of TB surveillance data could prove a crucial means of increasing leadership and accountability for responding to an existing disease threat like TB, while reinforcing senior leaders’ understanding of respiratory pathogen detection and response capacities. Such efforts are especially worthwhile when considering the pivotal role played by political leadership during the COVID-19 response (IPPPR, 2021).
## Case Study – EPCON AI in Nigeria

<table>
<thead>
<tr>
<th>Action Area</th>
<th>Surveillance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Location</strong></td>
<td>Nigeria</td>
</tr>
</tbody>
</table>

### Background
To target interventions efficiently, public health programmes need to understand different communities’ risk of infectious diseases and access to healthcare. In many LMICs, the data required to do this is stored across multiple different databases, including paper-based systems.

### Intervention
By pulling over 70 different environmental, demographic and health systems indicators into the same platform, EPCON AI has been able to develop a system that is more than the sum of its parts. By applying artificial intelligence, their platform can predict vulnerability and healthcare access in communities where data is more limited.

### Impact on PPPR
During COVID-19, in-country partners have been using insights from the system to inform vaccination strategies by identifying communities at heightened risk and with limited access to healthcare. The system has the capacity to process live data from laboratories and health services, using artificial intelligence to make the most of often fragmented and incomplete surveillance systems.

### Impact on TB
The EPCON AI system in Nigeria was built specifically for TB. A key commitment of the UN High-Level Meeting on TB is to increase case detection. By projecting where ‘missing’ TB patients are most likely to live, partners can run much more efficient active case finding initiatives and identify areas requiring urgent investment to improve access to healthcare.

### Key Takeaway
Digital systems that make the most of existing data and leverage novel approaches like artificial intelligence can provide crucial insights for health leaders without access to advanced real-time surveillance. These insights can shape routine services, emergency response and have the potential to identify unusual patterns requiring investigation more quickly.
Workforce

The WHO’s JEE framework identifies four core indicators of a country having the sufficient workforce capacity to prevent, detect and respond to outbreaks of emerging infectious diseases. These are:

- D3.1 Multisectoral workforce strategy
- D3.2 Human resources for implementation of IHR
- D3.3 Workforce training
- D3.4 Workforce surge during a public health event

While characteristic D3.2 is specific to obligations under the IHR, key opportunities for dual impact exist across characteristics D3.1, D3.3, and D3.4.

Multisectoral workforce strategy

**JEE indicator overview**

Countries should conduct an assessment of the workforce implications of implementing key health policies and strategies. A national strategy to develop the health workforce should be established across all relevant sectors and cadres of public health professions, with routine monitoring and review. The strategy should be backed by an adequate and sustainable budget line for workforce development and compensate for workforce attrition.

**Opportunities for dual impact**

Globally, there is an estimated health workforce shortage of around 15 million doctors, dentists, midwifery personnel, nursing personnel and pharmacists, undermining both access to and the quality of care received by millions of people (Boniol et al., 2022). The shortage is already most acute in LMICs, and this inequity is projected to increase in the years leading...
up to 2030, even before considering the impact of COVID-19 on the global economy (Boniol et al., 2022).

Noting the critical role of healthcare workers across routine and emergency public health functions, and the historic neglect of the workforce agenda, any and all action to increase the size and capability of the health workforce is crucial to sustaining progress on PPPR, TB, and UHC more broadly (WHO, 2022j). This includes contact tracers, primary care staff, respiratory specialists, laboratory technicians and epidemiologists. With 70% of all jobs in the health workforce held by women, placing gender equity at the heart of any workforce strategy will be crucial to recruiting and retaining critical staff (WGH, 2022).

The potential role of community health workers is particularly pertinent in relation to both PPPR and the TB response. The non-specific nature of symptoms, the stigma associated with the disease and the increased barriers to healthcare access among those most vulnerable mean that active case finding approaches are crucial to increasing TB case detection (WHO, 2021f). Community health workers who conduct symptom screening, link to services, provide treatment support and tackle misconceptions about the disease offer an important opportunity to improve both access to and quality of care (Stop TB Partnership, 2022).

From a PPPR perspective, a decentralised workforce with the training to identify unusual clusters of symptoms and the ability to report these to health authorities will be key to detecting outbreaks early, particularly among marginalised populations (Bhaumik et al., 2020). The most recent Ebola outbreak in Uganda was first detected by a community health worker, whose quick reporting enabled public health authorities to respond while the number of people exposed remained small.

While many countries are seeking to expand the use of this cadre, many community health workers are still being asked to work as volunteers or in exchange for small stipends, with limited training and insufficient supervision from nurses and doctors (Dam et al., 2022). Ensuring this workforce is sufficiently trained, reimbursed and integrated into the health system will be crucial to them fulfilling their function as key workers in the fight against TB and future respiratory pandemics.
**Case Study – Community Health Workers in Uganda**

<table>
<thead>
<tr>
<th><strong>Action Area</strong></th>
<th>Healthcare Workforce</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Location</strong></td>
<td>Uganda</td>
</tr>
<tr>
<td><strong>Background</strong></td>
<td>Uganda is a low-income country in Sub-Saharan Africa, with a high burden of both TB and TB/HIV. Alongside responding to the COVID-19 pandemic, the country has also faced an outbreak of Ebola Virus Disease from September 2022 to January 2023, with a total of 164 cases and 77 deaths.</td>
</tr>
<tr>
<td><strong>Intervention</strong></td>
<td>Uganda has a long-standing system of ‘Village Health Teams’, made up of community members who volunteer to work with local health authorities and non-governmental organisations to deliver key services to their communities. VHT members are nominated by their villages and receive a stipend per activity.</td>
</tr>
<tr>
<td><strong>Impact on PPPR</strong></td>
<td>The recent Ebola outbreak was first detected after a VHT volunteer raised concerns about a suspicious cluster of deaths in his village. Over 120,000 VHTs were mobilised during both the COVID-19 and Ebola response, to support surveillance, the dissemination of public health information and the continuity of essential services.</td>
</tr>
<tr>
<td><strong>Impact on TB</strong></td>
<td>VHTs have long been involved in linking people with symptoms of TB to appropriate health services, and to support people to complete treatment. During the pandemic, VHTs helped to collect and distribute medication to patients who could not travel to dispensaries. To try to recover lost ground, the Ministry of Health is now mobilising VHTs as part of an active case finding campaign to link people who may not be aware of their TB status to care.</td>
</tr>
<tr>
<td><strong>Key Takeaway</strong></td>
<td>Community-based health workers have intimate knowledge of their communities and established relationships with the people they serve. VHTs have played a crucial role in the prevention, detection and response to outbreaks and in supporting the delivery of patient-centred care more broadly. Building on lessons learned, Uganda is currently conducting a pilot to transition VHTs into fully paid community health workers, to improve training, engagement and retention of this critical workforce.</td>
</tr>
</tbody>
</table>
Workforce training

**JEE indicator overview**
Countries should have in place robust competency-based training programmes for all professions and sectors, with accreditation according to national or internationally recognised competency standards. These systems should be in place across human health as well as animal and environmental services, and be regularly evaluated and updated as needed. Field epidemiology training programmes should be in place in each country, offering basic, intermediate and/or advanced accreditation.

**Opportunities for dual impact**
As previously highlighted in this report, competencies in the diagnosis and management of respiratory infections as a whole are crucial to the management of both TB and novel respiratory pathogens with pandemic potential. Strengthening basic competencies across the full health system therefore has the potential to support TB case finding and improve the overall resilience to respiratory outbreaks, while expanded specialist training can improve quality of TB care and clinical leadership during public health emergencies.

Workforce surge during a public health event

**JEE Indicator overview**
A national multisectoral workforce surge strategic plan in emergencies should be in place and implemented to carry out the functions attributed at the national, intermediate and primary public health response levels. Procedures should be in place to staff, roster, ready
and train the workforce to an adequate capacity to enable task shifting and redeployment of staff as part of the public health response, including through drawing on additional capacity from non-governmental organisations and international partner governments.

**Opportunities for dual impact**

The redeployment of staff was one of the main reasons that TB services were so severely affected during the COVID-19 pandemic. The need for staff with the skills and experience necessary to manage a highly infectious, airborne pathogen with predominantly respiratory symptoms saw TB clinical staff redeployed to the pandemic frontline, in high- and low-income countries alike (Lipman et al., 2022; Zimmer et al., 2022; Adepoju, 2020). Policy experts and epidemiologists were also among those pulled from NTPs to work on COVID-19 (ACTION et al., 2020).

While the redeployment of staff to manage an emerging infectious disease outbreak will always negatively impact the services they previously delivered, part of the problem during COVID-19 was how unprepared the system was for this shift. In a high TB burden country, the NTP will usually represent the largest and most advanced capacity for managing respiratory infections. If countries are to rely on this infrastructure to manage future respiratory outbreaks, bolstering capacity in these services now will be crucial to strengthening PPPR. In doing so, the capacity of NTPs will be expanded in inter-pandemic years, while proactive planning for task shifting during outbreaks can help mitigate some of the indirect harms seen during COVID-19.

**Conclusion**

To detect the emergence of pathogens with pandemic potential, countries require robust laboratory and surveillance infrastructures as well as a sufficiently sized and trained workforce to detect and respond to outbreaks appropriately.

The TB burden in LMICs means laboratory infrastructure, surveillance systems and the health workforce need the capacity to process large volumes of throughput, across the full territory of the country. While the infrastructure and staff directly involved in the early detection of pathogens with pandemic potential will be relatively small, the ability of countries to reliably detect index cases wherever and whenever they first make contact with the health system relies on this widespread, integrated infrastructure.

Importantly, all pillars of pandemic prevention require continuous operation to fulfil their purpose in the event of an outbreak (Wijesinghe et al 2020). Laboratory infrastructure needs to remain quality assured, with staff well-practiced in conducting the full range of diagnostic tests required within a pandemic detection system. Surveillance systems can only offer an early warning signal where there is a robust baseline of data against which changes can be measured. The health workforce who are being asked to detect and then respond to potential outbreaks needs to remain employed, receive regular refresher training and be sufficient in number across the whole territory if it is to fulfil this function.
The nature of *M. tuberculosis* as an airborne pathogen with established drug-resistance, high infection control requirements and non-specific respiratory symptoms means that the strengthening and expansion of infrastructure built as part of the TB response offers the perfect foundation for strengthening pandemic detection capacity globally. Moreover, by acting as a host and maintainer of this national capacity for detecting and responding to respiratory outbreaks, NTPs could be substantially strengthened in inter-pandemic periods. Meanwhile, increased capacity and more robust surge planning for pandemics will help insulate TB programmes from the catastrophic shocks seen during the COVID-19 response.

Targeted, sustained investments and policy initiatives in the following areas therefore have the potential to deliver impact across both domains:

**National Laboratory Systems (D1)**
- Expand specimen referral and transport systems
- Strengthen quality assurance capacity
- Increase BSL-3 laboratory capacity
- Invest in interoperable diagnostic platforms

**Surveillance (D2)**
- Strengthen digital, case-based surveillance systems
- Integrate next generation sequencing into routine surveillance systems
- Prioritise holistic diagnostic networking
- Expand epidemiological capacity
- Establish mechanisms for regular high-level review of surveillance data

**Human Resources (D3)**
- Expand formal community-based health worker capacity
- Strengthen training on respiratory health across the workforce
- Invest in the expansion of dual-impact workforce cadres
- Prioritise existing TB services as ‘hosts’ for pandemic surge capacity
Respond

The third pillar of JEE focuses on response. This refers to the public health response that is initiated on detection of an outbreak with pandemic potential to contain the number of cases and deaths and limit the outbreak’s impact on broader health systems. Outside of pandemics, public health responses seek to achieve very similar objectives, limiting cases and deaths through screening of high-risk populations and ensuring equitable access to quality, person-centred diagnosis and care, though often on a much larger scale.

Within the WHO’s framework, response is separated into five categories of capabilities. These are:

- **Health emergency management** - relating to the processes of emergency management, including whether there are the human, financial, and technical resources available to mount an effective response.

- **Linking public health and security authorities** - relating to the process of responding to an incident of bioterrorism, linking public health and law enforcement and the provision of timely international assistance.
● **Health services provision** – relating to the care and management of patients exposed to an outbreak with pandemic potential, as well as the maintenance of routine health services before, during and after an emergency.

● **Infection prevention and control** – relating to programmes that enable the safe delivery of essential health services, as well as preventing transmission in healthcare settings.

● **Risk communication and community engagement** – relating to the effective exchange of information about an outbreak, the prevention of and response to infodemics, and reaching marginalised and vulnerable populations.

There is a substantial list of recent outbreaks that, while having the potential to become pandemics, were contained thanks to an effective public health response (Resolve to Save Lives, 2022). The 2022 outbreak of Ebola in Uganda, for example, saw the number of deaths limited to a small fraction of previous Ebola outbreaks on the continent (WHO, 2023b). Nonetheless, the COVID-19 pandemic brought to light the often-limited capacity for sustained, large-scale public health responses – not only in LMICs but also in some of the most well-resourced nations globally (IPPPR, 2021).

Particularly considering the substantial gaps in prevention and detection highlighted in previous chapters, response capacities will need to be bolstered significantly if the world is going to be able to contain outbreaks that may have reached hundreds or thousands of cases prior to detection.

**Background: response systems for TB**

NTPs are, for all intents and purposes, the response to an infectious disease outbreak that has reached catastrophic proportions. While having been declared a global public health emergency by WHO 30 years ago, the consistent burden of TB over hundreds of years has led the world to accept these preventable deaths and integrate the response into the routine operations of the health service (Fauci, 2006). In order to deliver on the Sustainable Development Goal commitment to end TB by 2030, however, there has long been an obvious need for a ‘paradigm shift’ of the TB response (Stop TB Partnership, 2018).

As set out in the End TB Strategy, the Global Plan to End TB and the political declaration of the 2018 UN High-Level Meeting on TB, this will rely on universal access to safe, person-centred diagnosis, treatment and care. The development and equitable deployment of new tools to prevent, diagnose and treat TB is also key, with the elimination of the disease only being possible once an effective vaccine has been discovered. Countries will also need to work with a wide range of stakeholders to reach the most vulnerable and marginalised populations, who are often at highest risk of TB, and to tackle the stigma and discrimination that still undermines the TB response.
The prevalence of TB, its presentation as a disease with often nonspecific respiratory symptoms, the particular vulnerability of key populations, the need for long courses of treatment, and persistent research gaps means that there is both considerable TB infrastructure that efforts to bolster outbreak responses could build on, and significant gains to be made in the TB response through strengthening core public health functions.

This section explores where potential investments to strengthen outbreak response capacities could leverage these foundations while also addressing gaps in the TB response to deliver maximum return on investment across both agendas.

**Health Emergency Management**

The WHO’s JEE framework identifies six indicators of an effective health emergency management system:

- R1.1 Emergency risk assessment and readiness
- R1.2 Public health emergency operations centre
- R1.3 Management of health emergency response
- R1.4 Activation and coordination of health personnel and teams in a public health emergency
- R1.5 Emergency logistic and supply chain management
- R1.6 Research, development and innovation

Applying some of the approaches outlined in R1.1 - R1.4 to TB would no doubt be beneficial to ensuring the response was coordinated with the level of urgency and focus warranted by its status as the world’s deadliest infectious disease prior to being eclipsed by COVID-19. Nonetheless, the recommendations set out within the JEE focus very specifically on the mechanisms for responding to potential PHEICs. We will therefore be focusing on R1.5 and R1.6.

**Emergency logistics and supply chain management**

**JEE indicator overview**

To have the capacity to respond to outbreaks with pandemic potential, countries must have in place systems to monitor stock and demand of key health commodities across the health system. Sufficient stockpiles as well as capacity to rapidly procure additional stock are crucial in the event of a surge in demand, alongside robust systems for quality assurance and infrastructure to rapidly distribute and safely store materials across their full territories.

**Opportunities for dual impact**

Health workers responding to an infectious disease rely on a wide range of quality-assured tools to do their jobs, including personal protective equipment (PPE), diagnostic tools, treatments, vaccines and a wide range of consumables. Stockouts of key medical tools can endanger the lives of both patients and healthcare workers, who need access to these
products locally and without delay, regardless of whether they are in an urban centre or a rural community. Most medical products have a limited shelf life, and many require transport and storage at specific temperatures.

Supply chain management infrastructures built with support from health multilaterals like the Global Fund to Fight AIDS, TB and Malaria and Gavi, the Vaccine Alliance, ensured many countries had some systems in place to support the distribution of medical countermeasures during the COVID-19 pandemic (The Global Fund, 2021a). Gaps continue to persist, however, with stockouts and distribution delays leading to inequitable access to both COVID-19 and TB tools (Open Consultants, 2022). Targeted investment in storage facilities, stockpiles, real-time stock monitoring across all facilities, and the systems required to transport goods, including robust last mile logistic capacity, can be fully interoperable, with the potential to increase the efficiency and effectiveness of public health responses in pandemic and inter-pandemic periods.

Mechanisms such as the Global Drug Facility and PAHO Revolving Fund offer a huge value-add both during routine and emergency procurement situations, by pooling procurement to reduce prices, ensuring high standards of quality assurance, offering technical assistance, and supporting more effective market shaping (PAHO 2022; GDF 2019). Increased use of such initiatives and strengthening international supply chain transparency could prove critical in mobilising and distributing medical and non-medical countermeasures equitably and at pace in emergency situations, while reducing stockouts and increasing equitable access for routine public health services (Bollyky et al, 2021).

The inequitable global access to COVID-19 vaccines, diagnostics and treatments has also prompted extensive discussions about the value of increasing manufacturing capacity in LMICs (Africa CDC 2022; Bollyky et al 2021). Considering that maintaining capacity for only pandemic needs, or keeping it “ever warm”, may be neither a technically nor financially
sustainable solution, a certain level of ongoing facility utilisation will be required for effective preparedness. The current focus on vaccine manufacturing capacity is unlikely to deliver direct benefits to the TB response until an effective and safe vaccine is developed, but greater potential overlaps exist in relation to PPE, diagnostics and treatments. Distributed manufacturing, therefore, could help lay the foundations for improved local production, increasing the resilience of global supply chains overall and reducing the reliance of LMICs on external support (Hannay & Pai 2023).

Finally, the importance of regulatory, procurement, pharmacovigilance and quality assurance capacity within Ministries of Health was illustrated clearly during COVID–19, when countries needed to rapidly authorise newly developed tools, establish relationships and quality-assure products from new manufacturers while facing stiff competition from more well-resourced buyers (OECD, 2020). The struggle to deal with these issues for COVID–19 reflects similar challenges that have long prevented people with TB from accessing the most advanced diagnostics and treatments (Rahman 2023; Torreele et al 2023; Masini et al., 2018; Bam et al., 2017). The dangers of substandard and falsified medicines also cuts across a wide range of public health priorities (Akpobolokemi et al 2022; WHO, 2022o).

With a growing number of high TB burden countries transitioning out of donor-supported procurement of key health commodities, investments and initiatives to strengthen regulatory, procurement and quality-assurance capacity and would strengthen public health responses in pandemic and inter-pandemic years (MSF, 2019). More broadly, strengthening and streamlining regional and global regulatory processes represent a real low-hanging fruit in the effort to deliver the products of innovation to people who need them more quickly, with growing political momentum needing financial backing (Pincombe & Guzman, 2022).
### Case Study – Stop TB Partnership’s Global Drug Facility (GDF)

<table>
<thead>
<tr>
<th><strong>Action Area</strong></th>
<th>Supply Chain Management</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Location</strong></td>
<td>Global</td>
</tr>
</tbody>
</table>

#### Background
During the early stages of the COVID-19 pandemic, demand for personal protective equipment (PPE) far outstripped the available supply. Governments needed to quickly procure vast volumes of quality-assured PPE to keep their health workers safe, but bidding wars and a flurry of new suppliers made it difficult for countries to secure a steady, quality-assured supply.

#### Intervention
The GDF was founded in 2003 to facilitate global access to affordable and quality-assured TB diagnostics and treatments. Prior to the pandemic, GDF supported the procurement of PPE for TB programmes, holding close relationships with manufacturers, national procurement agencies and maintaining a rolling stockpile.

#### Impact on PPPR
The GDF was well-positioned to support countries in their COVID-19 response, as IPC requirements for the two airborne pathogens were very similar and GDF already had PPE and Cepheid’s GeneXpert diagnostics instruments in the GDF catalog. GDF was able to add Cepheid’s COVID-19 test to its diagnostic catalogue within 5 days of its approval by US authorities. By leveraging existing relationships with manufacturers, GDF was able to supply Cepheid COVID-19 tests to 33 countries and secure high-quality PPE for 41 low- and middle-income countries who struggled to compete with more established and well-resourced procurement agencies from high-income countries.

#### Impact on TB
The advantages of procuring commodities through the GDF were highlighted in the political declaration of the 2018 UN High-Level Meeting on TB. By working with GDF, countries can secure better prices for quality-assured products, receive technical assistance, and gain access to a rolling stockpile in the event of stockouts. GDF is meanwhile able to forecast demand more effectively, engage in market shaping and support the expedited roll-out of new tools.

#### Key Takeaway
The PPE requirements for managing patients with TB are similar to those required to manage any other infectious, airborne pathogen. Pooled procurement and stockpiling of these essential commodities is more cost efficient and imbues greater resilience in the event of an outbreak or other supply chain changes.
Research, development and innovation

*JEE indicator overview*

Once a newly emerged infectious pathogen has been detected, scientists need to quickly begin work to better understand the nature of the pathogen and develop new vaccines, diagnostics and treatments. This relies on having a cadre of researchers with relevant expertise who have a scientific foundation to fast-track research efforts as well as trial sites in strategic locations to efficiently establish the safety and efficacy of new tools.

It also relies on having a research-enabling environment, through fast and unimpeded access to pathogens (digital surveillance information and actual samples) as well as robust epidemiological data sharing arrangements, flexibility and coordination of funding, and robust mechanisms that are able to quickly evaluate and provide ethical and regulatory approval for trials. All these investments and frameworks help reduce the time between the detection of the pathogen and the development of the effective strategies and tools required to bring the outbreak to an end.
Opportunities for dual impact

The rapid development of vaccines, diagnostics and treatments for COVID-19 was possible because researchers had a solid foundation of knowledge and innovation on which to build (UK CMOs & UK CSAs, 2023). Thanks to decades of basic science in virology, gene therapy, immunology and viral vectors, as well as clinical development programmes across a spectrum of therapeutic areas, COVID-19 vaccines were developed in record time. With TB research having already helped scientists better understand aerosol transmission and determine best approaches for COVID-19 vaccine development, there are significant research areas with the potential to be applied across both domains (Tomlinson, 2020).

These include, but are not limited to, developing a better understanding of mucosal immunity, transmission pathways, co-infection, challenge models, new multiplex diagnostic platforms, reducing cold-chain requirements of new vaccines, new antibiotic discovery, and burden of disease studies.

Meanwhile, basic science has the potential to deliver radical advancements across a wide range of public health priorities. The earliest steps in the development of mRNA vaccines took place in the 1980s following research on eukaryotic gene expression techniques and at a time when the potential medical applications of these scientific advancements were very much unknown to funders (Malone, 1989).

Importantly, this research often relies on sustained public funding, with industry needing to make decisions about funding product development, licensing, regulatory review and manufacturing scale-up with limited certainty of a product’s potential market size, as determined by the number of consumers and their ability to pay (APPG TB, 2014). The world was comparatively well prepared for the emergence of a novel coronavirus, but we could be far less lucky next time. The total list of pathogens with pandemic potential runs into the hundreds, and even among those that have been evaluated by WHO as being the most likely to cause future pandemics, research investment has often remained paltry, with substantial investments only mobilised once an outbreak has grown considerably (Policy Cures Research, 2020).

The same challenges have hampered the development of new tools for TB and many other neglected and poverty-associated diseases, with an estimated funding gap of some USD 1.3 billion for TB in 2022 alone (TAG, 2022). Increased public investment in health research, product development partnerships and market-based incentives to attract private investment will, alongside robust equitable access requirements, ensure the world is in a much better place to respond to pandemics and tackle old foes like TB.

Once scientists have developed a new vaccine, diagnostic or treatment candidate, it needs to be tested for safety and efficacy before being made available to patients. The infrastructure required for clinical trials is extensive, ranging from laboratories and clinics for the monitoring of trial participants through to on-site capacity to handle a safe and consistent candidate product. Understanding the local population’s epidemiology is core to
selecting the right trial site, as is substantive engagement and trust building with communities that will be asked to volunteer as trial participants.

Infrastructure built for TB and HIV vaccine development proved to be crucial to COVID-19 trials because of their suitable epidemiological contexts, high standards of infection control, capacity to handle a wide range of samples and longstanding community engagement mechanisms (NIH, 2022). TB trials have meanwhile been slowed and made more costly because of the need to constantly re-build capacity from scratch due to funding interruptions. Proposals to invest in the maintenance of an international network of clinical trial sites could therefore build on existing infrastructure and enable more efficient and streamlined TB research moving forward, while more agile financing, governance and IT systems would allow for rapid deployment in the event of an outbreak (Pandemic Preparedness Partnership, 2021; Torreele et al 2023).

A further shared barrier for research and innovation across both emerging and endemic infectious diseases relates to the regulatory environment in which research takes place. To generate robust evidence, research needs to take place across multiple contexts and countries. In each case, researchers need to secure regulatory and ethical approval. While the COVID-19 pandemic prompted unprecedented speed and flexibility among regulatory authorities, these processes still caused unnecessary delays, while limited coordination undermined the usefulness of some clinical trials (WHO, 2022k; Harris et al 2022; Sisk et al., 2022; Tikkinenn et al 2020). The inability to initiate trials of Ebola vaccines and therapeutics before the end of the most recent Ebola outbreak is an enormous missed opportunity (Torreele et al, 2023b).

TB researchers in both public and private sectors have long experienced similar challenges, with the regulatory approval often taking longer than the trial itself and sometimes forcing trials to be scaled down. These delays are costly both financially and in terms of the lives that could be saved through earlier utilisation of research outcomes. Efforts to strengthen and harmonise regulatory capacity could thus deliver real impact across a range of health priorities.
Case Study – SATVI and TASK

<table>
<thead>
<tr>
<th>Action Area</th>
<th>Research and Innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>South Africa</td>
</tr>
<tr>
<td>Background</td>
<td>SATVI and TASK are two clinical research facilities founded in the early 2000s to conduct clinical trials for anti-TB compounds, with SATVI focusing on TB vaccines and TASK testing anti-TB drug candidates in development.</td>
</tr>
<tr>
<td>Intervention</td>
<td>Both SATVI and TASK have expanded considerably in the years since, working closely with product development partnerships like IAVI, opening multiple clinical trial sites, investing in core infrastructure, including robust IPC and laboratories, building in-house expertise and establishing close relationships with local communities. Their location in TB/HIV high-burden contexts mean they are able to generate vital data about the safety and efficacy of new tools for these populations.</td>
</tr>
<tr>
<td>Impact on PPPR</td>
<td>Thanks to strong networks with researchers around the world, SATVI and TASK were able to leverage this infrastructure rapidly during the pandemic, becoming the first African sites to begin COVID-19 vaccine trials in early 2020. To date, SATVI has recruited 5,022 trial participants over 3 trials, while TASK recruited 1,899 participants over 20 studies, including on Moderna and Pfizer candidates. Their findings were to play a crucial part in the development and approval of the vaccines that altered the course of the COVID-19 pandemic.</td>
</tr>
<tr>
<td>Impact on TB</td>
<td>SATVI and TASK continue to conduct clinical trials to assess the safety and efficacy of the new tools that are crucial to achieving an end to TB, including vaccines and therapeutics. By quickly starting work on COVID-19 trials, SATVI and TASK were able to sustain vital infrastructure and community trust during a period in which many TB trials needed to be suspended.</td>
</tr>
<tr>
<td>Key Takeaway</td>
<td>Clinical trial infrastructure required for TB is very similar to that required for clinical trials targeting other airborne pathogens. Ensuring this infrastructure is in place and can be quickly leveraged in the event of an outbreak relies on strong networks and sustainable financing to maintain infrastructure, expertise and community trust during gaps in trial-specific funding.</td>
</tr>
</tbody>
</table>
Health Services Provision

The JEE framework identifies three indicators of effective health services provision:

- R3.1 Case management
- R3.2 Utilisation of health services
- R3.3 Continuity of essential health services

The capacity for case management (R3.1) refers specifically to the management of so-called ‘priority health events’, including outbreaks of epidemic prone diseases, trauma, chemical events and radiation emergencies. The potential for investments with impact across PPPR and TB is therefore seen within indicators R3.2 and R3.3.

Utilisation of health services

JEE indicator overview

Resilient health systems are essential for countries to prevent, detect, respond to and recover from public health events. Strong utilisation of health facilities at primary, secondary and tertiary health care facilities and across geographical contexts is considered to be a key indicator of PPPR, with WHO suggesting an average of over 3 outpatient visits per person per
year as reflective of strong levels of health service utilisation. To achieve this, healthcare services must be physically and financially accessible, and offer patient-centred care.

**Opportunities for dual impact**

In 2017, almost one billion people spent more than 10% of their household budget on out-of-pocket health expenditure (WHO, 2022l). A staggering 48% of people with TB continue to face catastrophic costs as a result of their treatment (WHO, 2022a). The prospect of such catastrophic costs can lead to delayed care seeking, preventing early detection of respiratory infections. It can also contribute to treatment interruption or non-compliance with isolation requirements, enabling the further spread of infection and contributing to the development of drug resistance (Patel et al., 2021; Abdoul-Azize & El Gamil, 2021; Fuady et al., 2020; Hore, 2019).

Social protection schemes that reduce the risk of catastrophic costs are therefore a crucial tool in increasing health service utilisation and contributing to improved detection and containment efforts of all infectious diseases. Global coverage of such schemes remains very limited, undermining the effectiveness of schemes built from scratch to respond to the COVID-19 crisis (HRW 2021; OPML 2021). Infectious disease programmes provide a potentially meaningful pathfinder for efforts to develop broader social safety nets (World Bank 2023; Lancet Commission on COVID-19: Task Force on Humanitarian Relief, Social Protection and Vulnerable Groups, 2022).

The need to strengthen primary care services has also been highlighted as a core priority for both PPPR and the TB response (Nachega et al 2022; Sundararaman et al 2021). As was highlighted in the detection chapter, care cascades for patients with respiratory symptoms are often convoluted, with patients bouncing between public, private and informal pharmacies, clinics, specialist services and dispensaries before accessing appropriate care. Ensuring that primary points of care are professionally staffed, properly resourced and integrated into robust referral pathways would give people with respiratory symptoms a safe first point of call, while enabling more patient-centred treatment (Reid et al 2019).

Crucially, these primary points of care can be in both public and private sectors, and cut across community-based services, local clinics and dispensaries or hospital out-patient departments in urban centres. With an increased focus on shorter, all-oral TB regimens, robust primary healthcare services will prove particularly important.

Similarly, regular contact with primary care services would also enable the more widespread detection of non-communicable diseases like diabetes, which are known to increase the risk of infectious diseases and should therefore prompt regular screening and more active management in the case of infection (De Foo et al., 2022). Investments in primary care services and integrated care pathways are therefore crucial if health systems are to find the millions of people with TB who go ‘missing’ each year, identifying those with the greatest vulnerability to infectious diseases and ensuring quick identification of and response to pathogens with pandemic potential (Rangaka et al 2022).
Continuity of essential health services

**JEE indicator overview**

The impact of emerging infectious disease outbreaks is not limited to people directly exposed to pathogens but extends to those whose access to essential health services (EHS) is restricted as a result of the redeployment of resources and the use of non-medical countermeasures such as lockdowns. WHO therefore recommends that countries have a defined package of EHS, with guidelines on the continuity of these services in the event of emergencies. It is recommended that these mechanisms are in place across primary, intermediate and national public health levels, and that they are regularly monitored and exercised.

**Opportunities for dual impact**

The low base of health service provision in many high TB burden countries unfortunately means that mounting a public health response of any size is likely to have a significant impact on EHS. The nature of SARS-CoV-2 as an airborne pathogen with predominantly respiratory symptoms meant that TB programmes were much more significantly impacted by the redeployment of specialist health workers and infrastructure than other disease programmes (The Global Fund, 2021b).

In order to increase the resilience of EHS to shocks of this nature, mapping existing infrastructure most likely to be drawn on in the event of an emerging infectious disease outbreak would offer vital insights into where capacity and continuity planning needs to be bolstered. With future global pandemics likely to be respiratory, it stands to reason that targeted investments in programmes most adept at responding to such pathogens would be well-placed. In many LMICs, it would likely be TB programmes, that, with clear plans on how to minimise the effects of redeployments in the event of an outbreak, would stand to benefit from increased capacity in interpandemic periods.
## Case Study – REACH in India

<table>
<thead>
<tr>
<th>Action Area</th>
<th>Community Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Location</strong></td>
<td>India</td>
</tr>
<tr>
<td><strong>Background</strong></td>
<td>India is home to almost one third of all TB cases globally. People affected by TB often struggle to access diagnosis. The long duration and side-effects of treatment can sometimes prompt people to stop taking their medication early, especially once they start to feel better.</td>
</tr>
<tr>
<td><strong>Intervention</strong></td>
<td>REACH is an NGO that works closely with TB survivors. Their TB champion programme trains TB survivors to support other people with TB in accessing diagnosis and completing treatment. The TB champions have become experts in navigating local health services, built relationships with public health system providers and provide local solutions. In total, REACH has trained over 3,300 TB champions across India.</td>
</tr>
<tr>
<td><strong>Impact on PPPR</strong></td>
<td>In the early stages of the pandemic, TB champions sprung into action. They spotted the urgent need for better public health information and requested training on COVID-19, which they passed on to 34,687 people in their local communities. They identified problems with accessing diagnostic services and medication and worked with local health leaders to resolve them. They played a critical role in linking people for TB diagnosis and treatment, mobilizing additional nutrition support from local leaders within their communities and supporting treatment adherence.</td>
</tr>
<tr>
<td><strong>Impact on TB</strong></td>
<td>The TB champion peer support model plays a crucial role in case finding and supporting treatment completion through person-centred approaches. During the pandemic, the TB champions played a crucial role in maintaining essential services for people with TB. The need to rapidly shift to digital communication has seen TB champions develop new skills that they continue to apply in their day-to-day work.</td>
</tr>
<tr>
<td><strong>Key Takeaway</strong></td>
<td>Community-led peer support mechanisms improve the quality of care received by vulnerable populations in routine and outbreak scenarios. Building capacity to understand the health system and engage with local leaders is crucial to quickly identifying and resolving issues that might emerge during a crisis response.</td>
</tr>
</tbody>
</table>
Infection Prevention and Control

The WHO’s JEE framework identifies three core indicators of effective infection prevention and control (IPC):

- R4.1 IPC Programmes
- R4.2 Surveillance of Healthcare Acquired Infections (HCAI)
- R4.3 Safe environment in health facilities

We will consider each of these in turn.

IPC Programmes

_JEE indicator overview_

IPC programmes should be informed by WHO’s IPC core components framework, with policies and standard operating procedures in place for topics including patient care, patient to staff ratios, sanitising equipment and the environment, PPE for healthcare workers and sanitary waste management (WHO, 2019a). Each healthcare facility should have specific staff responsible for maintaining IPC standards, coordinating staff training and monitoring for and responding to any issues.
Opportunities for dual impact

Effective IPC programmes are crucial to reducing the spread of infection in healthcare settings, containing the size of an outbreak, and limiting the disruption of healthcare worker absences due to sickness. A recent WHO report on the quality of IPC across health systems globally found that only 54% of countries have an active IPC programme in place, and only four countries (3.8%) met all minimum requirements for IPC (WHO, 2022m). Poorer countries have, in general, weaker IPC (Tomczyk et al., 2022).

The danger of this status quo was highlighted all too clearly during the pandemic, when millions of healthcare workers were exposed to COVID-19 at work and sadly lost their lives (Resolve to Save Lives & Community Health Impact Coalition, 2021). This mirrors substandard IPC reported within specialist TB services globally, including insufficient or improper wearing of respirators (Apriani et al., 2019; Chen et al., 2016; Farley et al., 2012).

The newly proposed WHO global strategy on IPC provides a new impetus to direct investments and policy focus towards initiatives that strengthen IPC programmes across primary, secondary and tertiary care settings (WHO, 2022n). These might include improving access to quality-assured respirators for a larger number of healthcare workers, strengthening triage and isolation policies for respiratory symptoms, strengthening IPC leadership and training, and investing in improved ventilation. By focusing on airborne pathogens in particular, such initiatives are likely to have a substantial impact on reducing transmission of TB and emerging respiratory infections in healthcare settings (WHO, 2019b).
Surveillance of HCAIs

**JEE indicator overview**
WHO recommends that countries have in place a national strategic plan for HCAI surveillance, including for pathogens that are antimicrobial resistant and/or prone to outbreaks. The plan should be implemented across all secondary and tertiary healthcare facilities, with data being shared and used continuously to inform prevention efforts.

**Opportunities for dual impact**
The close monitoring of HCAIs among healthcare workers and patients is crucial for the identification and resolution of potential IPC gaps, as well as to ensure that the additional health needs of the infected individuals can be appropriately met. The monitoring of HCAIs is generally poor across LMICs, despite those countries often having a higher burden (Maki & Zervos, 2021).

The comparatively high prevalence of TB makes the surveillance of healthcare acquired TB infection a potentially useful tracer indicator for the effectiveness of IPC programmes as a whole. The close monitoring of TB drug-resistance patterns among in-patients has, for example, offered vital insights for hospital settings with the highest IPC requirements (Crudu et al., 2015). Similarly, the possibility of latent TB infection following exposure (as opposed to active, infectious disease) means systematic screening of all healthcare workers can offer vital insight into the quality of IPC across the health system, while also ensuring the implementation of a core recommendation of the Global Plan to End TB (Apriani et al., 2019; Stop TB Partnership, 2022).

Safe environment in health facilities

**JEE indicator overview**
Robust IPC not only relies on the appropriate use of PPE, but also the safety of the built environment. In this context, WHO highlights the importance of proper water, sanitation and hygiene (WASH) facilities, screening and isolation areas, as well as sterilisation facilities within all health care settings. Standards for the reduction of overcrowding and the optimisation of staffing levels are also critical.

**Opportunities for dual impact**
In many LMICs, the most advanced isolation facilities are those built to care for patients with DR-TB. At the other end of the spectrum, decentralised healthcare facilities often lack access to even the most basic necessities, like running water (Tomczyk et al., 2022; WHO & UNICEF, 2019).

However, most patients will present to these local healthcare services on developing symptoms, regardless of whether these are caused by TB or an emerging infectious disease. Data on TB care cascades highlights the sheer number of opportunities for transmission in primary or secondary healthcare facilities prior to patients reaching these specialist services (Chu-Chang et al., 2020; Oga-Omenka et al., 2020; Chakravarty et al., 2019). Improved
access to basic WASH, screening and triage facilities are key areas of interoperability across infectious diseases. Improving natural or mechanical ventilation and the use of technologies such as ultraviolet irradiation would lead to reduced transmission of all airborne pathogens (WHO, 2019a; WHO, 2019b).

Opportunities for integrated investments for TB and PPPR have grown in recent years, thanks to the development of new, shorter, all-oral DR-TB treatment regimens. With lower reliance on injectable agents and solid evidence of patients quickly becoming non-infectious, these newer regimens enable much earlier discharge from inpatient services and more effective, patient-centred care in the community (WHO, 2022g). Shifting towards these more decentralised models of care requires significant changes in policy and practice, and many high TB burden countries have been slow to transition.

Aside from improving IPC in primary and secondary care facilities, countries should therefore be encouraged to review their capacity for advanced inpatient isolation, with the intention of sustaining and building on existing TB infrastructures for PPPR, while improving the quality of care for patients with DR-TB in both in- and out-patient settings.
## Case Study – UTH Lusaka MDR–TB Ward

<table>
<thead>
<tr>
<th><strong>Action Area</strong></th>
<th>Infection Prevention and Control</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Location</strong></td>
<td>Zambia</td>
</tr>
<tr>
<td><strong>Background</strong></td>
<td>The University Teaching Hospital (UTH) is the biggest public tertiary hospital in Lusaka, Zambia. It hosts the country’s biggest chest and infectious disease departments.</td>
</tr>
<tr>
<td><strong>Intervention</strong></td>
<td>UTH’s MDR–TB ward was converted into a COVID–19 ward following the outbreak of the pandemic. A team of UTH specialists also led on the delivery of a training programme for healthcare workers across TB and COVID–19, and worked with national, regional and local stakeholders to ensure a coordinated response to both diseases.</td>
</tr>
<tr>
<td><strong>Impact on PPPR</strong></td>
<td>The UTH MDR–TB ward was well equipped to manage COVID–19 due to high infection control and prevention standards and specialist staff. Over the last two years, the UTH team has treated hundreds of patients with advanced COVID–19 disease.</td>
</tr>
<tr>
<td><strong>Impact on TB</strong></td>
<td>UTH continued to provide care for people with MDR–TB throughout the pandemic, offering more patient-centred out-patient care using all-oral regimens. By training staff on both COVID–19 and TB, UTH was able to implement bidirectional screening, increasing case detection and identifying a number of patients with COVID–19 and TB co-infection.</td>
</tr>
<tr>
<td><strong>Key Takeaway</strong></td>
<td>Inpatient infrastructure built for the management of patients with MDR–TB is well suited to the management of patients with other respiratory infections. Investments in reinforcing this infrastructure can expand isolation and treatment capacity for outbreaks and sustain high-quality inpatient capacity for patients with MDR–TB that require admission prior to continued out-patient care.</td>
</tr>
</tbody>
</table>
Risk Communication and Community Engagement

The WHO’s JEE framework identifies three core indicators of effective risk communication and community engagement systems (RCCE):

- R5.1 RCCE system for emergencies
- R5.2 Risk communication
- R5.3 Community engagement

We will consider each of these in turn.

RCCE system for emergencies

**JEE indicator overview**

The management of information is crucial to mobilising an effective public health response. This includes having mechanisms to share information, insights and opinions across agencies and key stakeholders, to collate and analyse behavioural and cultural insights and to coordinate public-facing communication messages across stakeholders (WHO, 2017b). These systems need to encompass national, intermediate and local levels, to enable tailored risk communication for communities. WHO recommends having national RCCE systems that are appropriately staffed and funded, with protocols reviewed at least every 24 months and demonstrated capacity to scale up activities in the event (or simulation) of a health emergency.

**Opportunities for dual impact**

Many countries were caught somewhat off-guard by the COVID-19 pandemic, with insufficiently rapid mobilisation and excessively siloed RCCE systems undermining decision making as well as the effectiveness of public health communications (Tambo et al., 2021; GPMB 2021). These lessons are hardly new. The failure of governments in 1918 to prevent misinformation and panic about the Spanish Flu “threatened to break society apart” (Barry 2004), and similar failings in the wake of SARS prompted the inclusion of RCCE systems in the IHR (O’Connor et al 2018).

The involvement of stakeholders leading the response to existing public health threats such as TB has the potential of strengthening the emergency response through insights about airborne transmission prevention, high-risk populations, service usage, cultural practices around respiratory health, and stigma associated with coughing and mask wearing, for example. Private sector entities with experience of managing TB within their workforces held vital insights on the management of airborne pathogens across different industries and workplaces.

Furthermore, the active engagement of these stakeholders can also prevent some of the unintended consequences of the emergency public health responses seen during COVID-19, such as lockdowns without basic information for people requiring sustained access to...
medications (ACTION et al., 2020). Where increased investment in RCCE systems enables the more active engagement of these key stakeholders, efforts will bolster the immediate outbreak response while also more effectively mitigating its secondary impacts on TB programmes.

Relatedly, strengthening community-based monitoring systems has the potential to significantly improve the quality and availability of community-based information to inform decision making in outbreak scenarios (Lal et al 2020; IFRC 2019). The need for robust accountability, including through the active engagement of TB-affected communities, was one of the main conclusions of the 2018 UN High-Level Meeting on TB (UNGA, 2018). Community-based monitoring and accountability platforms such as the Stop TB Partnership’s OneImpact tool have enabled affected communities to report challenges they face in accessing TB health and support services, as well as experiences of human rights violations and stigma (Stop TB Partnership, 2020b). Building on and expanding access to platforms of this nature and strengthening the engagement of community-based organisations in health systems governance will ensure vital data can be shared with health system leaders in a timely manner.

Risk communication

**JEE indicator overview**

Countries need a defined risk communication function, with trained and supported spokespersons in-post and established mechanisms to disseminate information via different channels including government websites, print media, television, radio and social media. Systems for proactive outreach via hotlines, complaint systems and social listening should be in place, as well as routine monitoring of on- and offline media for feedback, insights and data used to adjust and improve communication strategies. The capacity to reach marginalised populations, including through translation, should also be in place.

**Opportunities for dual impact**

During an outbreak of an emerging infectious disease, members of the public need access to evidence-based and trusted information about the level of risk, how to mitigate that risk as individuals, and what steps are being taken by the government to respond. Gaps in risk communication capacity became obvious during recent years, with misinformation and disinformation presenting a major challenge in the response to COVID-19 (IPPPR, 2021). This experience has also highlighted how crucial it is to maintain this capacity in inter-pandemic years, to secure a baseline of key insights, capabilities and public trust upon which outbreak communication efforts can build (Michener et al., 2020; WHO, 2017b).

The lack of accurate and accessible information also represents a major barrier to the response to existing public health threats such as TB. The insidious nature of stigma and discrimination has been identified as a major obstacle to TB care seeking and treatment completion (Chen et al., 2021; Chakrabarty et al., 2018; Craig et al., 2017). There is strong evidence about the power of communication campaigns to target individual and
community-level stigma, both for TB and other infectious diseases like HIV (Stop TB Partnership, 2020a; Theng et al., 2013; Siegel et al., 2015; Kidd et al., 2009). Noting the commitment to tackle TB stigma within the 2018 UN High-Level Meeting on TB political declaration, strengthening communications teams within Ministries of Health would enable the delivery of this key commitment in inter-pandemic years, while increasing capacity for RCCE in the event of an outbreak.

Community Engagement

JEE indicator overview
WHO recommends that communities are active partners, participating in the planning, design and implementation of key interventions. Governments should have a clear mapping of and maintain working relationships with community leaders, faith-based organisations and civil society groups. Emergency responders should be trained and surge capacity mechanisms should be in place for community engagement. To inform engagement strategies, governments should systematically collect and analyse community feedback and socio-behavioural data at national, intermediate and primary public health levels.

Opportunities for dual impact
For emergency responses to be effective, they need to take account of the social and cultural dynamics that shape a population’s susceptibility to infection and the viability of different response strategies (Calone et al., 2020). The social and structural determinants of health transcend both existing and emerging infectious health threats, resulting in significant overlap between populations at heightened risk of emerging infectious diseases and TB.
Importantly, reaching populations most vulnerable to infection, and therefore transmission, relies on trust and a solid understanding of their social, cultural and economic dynamics. This can only be built through sensitive engagement over time (Anoko et al., 2020; Byanyima et al., 2022). This was demonstrated during the COVID-19 pandemic, when community-based organisations focused on responding to TB and HIV played a central role in service delivery, building on decades of experience to increase the active participation of marginalised communities in the public health response.

However, the lack of sustainable funding for community-based organisations, through grants and social contracting for example, undermines the response to existing public health threats and reduces resilience of these systems in outbreak scenarios (UNAIDS Multistakeholder Task Team, 2022). Increased public investment in community-based organisations, particularly those most likely to be drawn on during outbreak responses such as TB-focused organisations, would deliver marked impact across both domains.
### Case Study – Alliance India

<table>
<thead>
<tr>
<th><strong>Action Area</strong></th>
<th>Community Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Location</strong></td>
<td>India</td>
</tr>
<tr>
<td><strong>Background</strong></td>
<td>India has the highest burden of TB globally, and the third highest burden of HIV. Peer support organizations like Touched by TB, the National Coalition of People Living with HIV in India (NCPI+) and Alliance India have been crucial to efforts to expand access to treatment and care, tackle stigma and hold the government to account.</td>
</tr>
<tr>
<td><strong>Intervention</strong></td>
<td>Civil society organizations mobilized to ensure people completing TB treatment and living with HIV continued to receive medication during the lockdown. Building on their existing knowledge of and relationship with local communities, they expanded operations to support the COVID-19 response. In total, the coalition reached over 100,000 people across 10 states.</td>
</tr>
<tr>
<td><strong>Impact on PPPR</strong></td>
<td>By mobilizing existing networks and their knowledge of communities at higher risk of infectious diseases, the coalition was able to secure and distribute PPE and hand hygiene materials to marginalized communities unable to access these during the early stages of the pandemic. Having spent decades building trust, the coalition was able to distribute vital public health information and effectively challenge misinformation and stigma. They continue to engage with policymakers to highlight community concerns and ensure the COVID-19 response delivers for high-risk populations.</td>
</tr>
<tr>
<td><strong>Impact on TB</strong></td>
<td>The coalition ensured patients with TB were able to continue their treatment despite the lockdown, increasing cure rates and reducing the risk of drug-resistance. Working with local health authorities, they were able to address barriers to diagnosis and treatment (e.g. issuing travel permits). Public information materials sought to counteract increasing stigma and educate about the differences between COVID-19 and TB. They continue to engage with policymakers to ensure more people affected by TB can access diagnosis and treatment.</td>
</tr>
<tr>
<td><strong>Key Takeaway</strong></td>
<td>Civil society networks play a crucial role in public health because of their understanding of, access to and influence with marginalized communities. Maintaining robust systems for supporting and engaging with such organizations in inter-pandemic periods is critical to ending TB and delivering a more rapid, impactful and equitable response to outbreaks.</td>
</tr>
</tbody>
</table>
Conclusion

A country's ability to mount an effective response to outbreaks with pandemic potential relies on strong foundations, including robust mechanisms for health emergency management, high-quality health service provision, effective IPC programmes, and streamlined RCCE systems.

Historic investments in the response to TB and other endemic public health threats formed the foundation of the COVID-19 response across many of these domains, particularly in LMICs. However, these foundations remain inadequate both for PPPR and the broader delivery of the Sustainable Development Goals.

Importantly, the continued operation of baseline activities in non-outbreak scenarios is crucial to maintaining the insights, relationships and competencies required for an effective emergency public health response. Targeted, sustained investments and policy initiatives in the following areas therefore have the potential to deliver impact across both domains:

**Health Emergency Management (RI)**

- Strengthen supply chain management infrastructure
- Expand manufacturing capacity mindfully
- Strengthen medicines regulation and quality assurance
- Invest in dual-use research
- Tackle market failure for neglected emerging and poverty-associated diseases
- Build trial site capacity
- Strengthen research regulatory capacity and harmonisation

**Health Services Provision (R3)**

- Expand social protection programmes
- Strengthen primary care
- Embed pandemic surge capacity in priority programmes

**Infection Prevention and Control (R4)**

- Strengthen core IPC programmes, with focus on airborne pathogens
- Implement comprehensive surveillance of TB transmission in healthcare settings
- Improve ventilation in primary and secondary care
- Consolidate and strengthen high-quality in-patient capacity with strong IPC standards

**Risk Communication and Community Engagement (R5)**

- Involve TB stakeholders in RCCE emergency systems
- Invest in community-led monitoring and accountability
- Expand public health communication capacity, with focus on TB stigma in inter-pandemic periods
- Social contracting, grants and funding for community-based organisations
Next Steps for Respiratory Pandemic Prevention, Preparedness and Response

As this report has set out, there is clearly a wealth of areas where targeted investments and smart policy initiatives can drive tangible impact on the prevention, preparedness and response to respiratory pandemics, including TB. With the humanitarian and economic cost of these pandemics now well documented, the case for these dual impact investments is stronger than ever.

In some cases, leveraging these opportunities for dual impact will require the breaking down of historic siloes. NTPs are amongst the oldest public health programmes in the world, with decades of targeted investment reinforcing their vertical nature. While this focus has enabled countries to achieve major progress in their TB response to date, it is increasingly apparent that the most persistent barriers to ending TB cannot be fixed by TB programmes alone.

Increasing access to care and rapid diagnosis, reducing referral delays, strengthening health workforces, reinforcing supply chains and fast tracking the development of new tools are not only crucial to multiple public health priorities, but also far more difficult and expensive to deliver in siloes. The increased focus on cross-cutting investments by initiatives like the Global Fund to Fight AIDS, Tuberculosis and Malaria are to be welcomed in this regard.
Leveraging this potential for cross-cutting impact relies on intentional design from the outset. TB programmes can offer vital insights on how to tackle respiratory infections across different contexts, and how to shape PPPR investments to deliver tangible benefits for TB patients. Indeed, if part of the argument for increasing investments in this space is the capacity to deliver tangible benefits to public health in inter-pandemic years, ensuring progress on TB is included within the monitoring and evaluation of these efforts will be key. At the same time, more robust mechanisms will need to be in place to protect TB services from the kind of damage witnessed during COVID-19.

It is also important for policymakers to remember that TB is a disease that affects the most vulnerable and marginalised populations. As a result, there has been a historic and often justified concern that widening the lens on TB could be a shortcut to further excluding these groups. But for PPPR systems to be truly functional, they need to be able to reach those same vulnerable and marginalised populations who are at greatest risk of emerging infectious disease outbreaks. With TB continuing to kill over 1.5 million people each and every year and TB programmes offering the best foundation for respiratory PPPR, discussions on how to strengthen both systems in an integrated manner must happen on an equal footing.

On a practical level, enabling those conversations and investments will also require much closer collaboration between international leaders and funders. The busy global health calendar in 2023 offers a number of key opportunities to help set the tracks on this agenda.
To build sustainable systems for the prevention, preparedness and response to respiratory epidemics and beyond, policymakers should:

1. **Ensure strong alignment of governance, funding and accountability for PPPR and TB**
   a. **Reformed governance and accountability mechanisms should include TB as a tracer indicator**, with the amended International Health Regulations ensuring global, regional and national accountability mechanisms can draw on robust data demonstrating countries’ capacity to respond to a major respiratory pathogen in inter-pandemic years.
   b. **Include TB within the results frameworks of PPPR funding streams**, to ensure funding mechanisms claiming to deliver impact across multiple domains do so in reality. Closer collaboration between global health funders, including the new World Bank Pandemic Fund, should ensure grants enable and encourage interoperability.
   c. **Integrate TB into National Health Security Action Plans**, to ensure new investments in national PPPR systems are aligned and integrated with the TB response, leveraging and strengthening existing systems from the outset.

2. **Prevent respiratory pandemics through targeted investment with broad impact**
   a. Expand access to advanced **drug susceptibility testing** and **enhance case-based surveillance** of antimicrobial-resistant pathogens, including DR-TB.
   b. Support action on zoonotic diseases, by building **One Health capacity**.

3. **Strengthen platforms to detect respiratory pathogens with pandemic potential**
   a. Maximise the efficacy of the existing base of diagnostics through **diagnostic networking optimisation**, investing in interoperable diagnostic platforms and strengthened specimen transfer to plug gaps in detection systems.
   b. Build collaborations between funders and Ministries of Health to support **digital surveillance systems** that can provide real-time data across public health priorities including through networked diagnostics.
   c. Strengthen respiratory disease competencies and **increase the size of the healthcare workforce** across tertiary, secondary, primary and community-based care.

4. **Build the capacity of health systems to respond more effectively to respiratory pandemics**
   a. Prioritise support for **community-led systems** for healthcare delivery that reach marginalised populations and enable effective outbreak response management.
   b. Increase the speed with which quality-assured new tools reach patients by investing in harmonised **medicines regulation and quality assurance** capacity.
   c. Tackle barriers to care and treatment completion by strengthening and expanding **social protection and patient support programmes**.
5. Support the development and scale-up of innovations to tackle respiratory pathogens
   a. Target R&D investments for **platform technologies** and other innovations with dual or wider use.
   b. Support the expansion of **trial site capacity** with interoperability in mind, to reduce time delays and costs associated with clinical trials in outbreak and inter-outbreak scenarios.
   c. Reduce time delays associated with clinical trials in outbreak and inter-outbreak scenarios by developing **regulatory capacity and harmonising standards** between regulatory agencies.

6. Mobilise political momentum for a PPPR agenda that aligns with efforts to end TB, delivering for citizens now and in the future
   a. The political declarations of the **forthcoming UN High-Level Meetings on PPPR, TB and UHC** should explicitly highlight areas of alignment between these agendas and commit Member States to ensuring national policy and funding priorities target joint areas of opportunity as a matter of urgency.
   b. **To ensure high-level political leadership on this agenda**, the pandemic accord and associated accountability mechanisms currently under discussion should, at least, include reference to lessons learned from the response to TB alongside other public health threats.
   c. **Health Committees in national parliaments** should hold governments to account for delivering maximum value for money in PPPR and TB investments through at least one hearing or special session focused on the alignment between national PPPR and TB efforts.
   d. **Modalities for future UN High-Level Meetings** and summits should explicitly emphasise intersections with other Sustainable Development Goal priorities, in particular TB, to ensure no opportunities for dual-impact are missed.
Full list of opportunities with potential for dual impact across PPPR and TB

PREVENT:

- Surveillance of antimicrobial resistant pathogens, including TB
- Antimicrobial stewardship initiatives
- Zoonotic surveillance among high-risk populations
- Expansion of One Health capacities
- Sanitary animal production practices among high-risk populations

DETECT

- Specimen referral and transport systems
- Laboratory quality assurance systems
- BSL-3 laboratory capacity
- Interoperable diagnostic platforms
- Digital, case-based surveillance systems
- Next generation sequencing for routine surveillance
- Diagnostic networking
- Epidemiological capacity, including among senior government leaders
- Workforce expansion, including primary health and laboratory services
- Community-based formal health workers
- Respiratory health training for all healthcare workers

RESPOND

- Supply chain management infrastructure
- Manufacturing capacity
- Medicines regulation and quality assurance capacity and harmonisation
- Dual-use research
- Addressing market failure for neglected emerging and poverty-associated diseases
- Trial site capacity
- Research regulation and harmonisation
- Social protection programmes
- Primary care capacity and quality
- Respiratory infectious disease service surge capacity
- IPC programs for airborne and respiratory pathogens
- Ventilation systems in healthcare facilities
- Reinforced and consolidated in-patient isolation capacity
- Surveillance of TB transmission in healthcare settings
- Engagement of TB stakeholders in RCCE emergency systems
- Public health communication capacity
- Community-led monitoring and accountability
- Community-led healthcare delivery systems
References


GPMB. (2021). **From world’s apart to a world prepared.** Global Preparedness Monitoring Board. https://www.gpmb.org/annual-reports/annual-report-2021


WHO. (2021c). Access, Watch, Reserve Classification of antibiotics for evaluation and monitoring of use. 2021 AWaRe Classification. https://www.who.int/publications/i/item/2021-aware-classification


