



Australian Government
Department of Health

COMMUNICABLE DISEASES INTELLIGENCE

2019 Volume 43
<https://doi.org/10.33321/cdi.2019.43.10>

The Strategic Plan for Control of Tuberculosis in Australia, 2016–2020: Towards Disease Elimination

The National Tuberculosis Advisory Committee for the
Communicable Diseases Network Australia

Communicable Diseases Intelligence

ISSN: 2209-6051 Online

This journal is indexed by Index Medicus and Medline.

Creative Commons Licence - Attribution-NonCommercial-NoDerivatives CC BY-NC-ND

© 2019 Commonwealth of Australia as represented by the Department of Health

This publication is licensed under a Creative Commons Attribution-Non-Commercial NoDerivatives 4.0 International Licence from <https://creativecommons.org/licenses/by-nc-nd/4.0/legalcode> (Licence). You must read and understand the Licence before using any material from this publication.

Restrictions

The Licence does not cover, and there is no permission given for, use of any of the following material found in this publication (if any):

- the Commonwealth Coat of Arms (by way of information, the terms under which the Coat of Arms may be used can be found at www.itsanhonour.gov.au);
- any logos (including the Department of Health's logo) and trademarks;
- any photographs and images;
- any signatures; and
- any material belonging to third parties.

Disclaimer

Opinions expressed in Communicable Diseases Intelligence are those of the authors and not necessarily those of the Australian Government Department of Health or the Communicable Diseases Network Australia. Data may be subject to revision.

Enquiries

Enquiries regarding any other use of this publication should be addressed to the Communication Branch, Department of Health, GPO Box 9848, Canberra ACT 2601, or via e-mail to: copyright@health.gov.au

Communicable Diseases Network Australia

Communicable Diseases Intelligence contributes to the work of the Communicable Diseases Network Australia.
<http://www.health.gov.au/cdna>



Communicable Diseases Intelligence (CDI) is a peer-reviewed scientific journal published by the Office of Health Protection, Department of Health. The journal aims to disseminate information on the epidemiology, surveillance, prevention and control of communicable diseases of relevance to Australia.

Editor

Cindy Toms

Deputy Editors

Phil Wright and Simon Petrie

Editorial and Production Staff

Leroy Trapani and Kasra Yousefi

Editorial Advisory Board

David Durrheim,
Mark Ferson, John Kaldor,
Martyn Kirk and Linda Selvey

Website

<http://www.health.gov.au/cdi>

Contacts

Communicable Diseases Intelligence is produced by:
Health Protection Policy Branch
Office of Health Protection
Australian Government
Department of Health
GPO Box 9848, (MDP 6)
CANBERRA ACT 2601

Email:

cdi.editor@health.gov.au

Submit an Article

You are invited to submit your next communicable disease related article to the Communicable Diseases Intelligence (CDI) for consideration. More information regarding CDI can be found at:
<http://health.gov.au/cdi>.

Further enquiries should be directed to:

cdi.editor@health.gov.au

The Strategic Plan for Control of Tuberculosis in Australia, 2016–2020: Towards Disease Elimination

The National Tuberculosis Advisory Committee for the Communicable Diseases Network Australia

1. Executive Summary

The rates of tuberculosis (TB) in Australia remain enviably low in a global context. Together with a relatively small number of other countries where TB incidence is <10 per 100,000, Australia is in a position where TB elimination, defined as <1 case per million population, may be feasible by 2050, noting that there is an ongoing risk of imported cases from countries with high TB incidence. Following successes in pursuing elimination for other infectious diseases globally, the international TB and public health communities have sought to shift focus from control of the TB epidemic towards elimination. International efforts for the post-2015 era focus on an ambitious timeline for the elimination of TB worldwide, with Australia now committed to pre-elimination targets (<1 case per 100,000 population) by 2035, which has already been met in the Australian born population, who represent 72% of the total population.¹

Although Australia has maintained a low and stable TB incidence rate since 1985, indicating effective TB control, there has been little progress in incidence reduction in recent decades, with the absolute number of cases increasing over this period.² The key risk factors found in many parts of the world, including poor TB care practices, poverty, political instability and HIV disease are not major contributors to the epidemiology of TB in Australia. Migration, and to a lesser extent short term residency, often from countries of high TB burden, ensures there is an ongoing potential source of new TB cases, including drug resistant ones, in Australia. In addition, although low in case number, the

incidence of TB remains 6 times higher in the Indigenous Australian population compared with the non-Indigenous Australian born population. Cross border movements between Papua New Guinea (PNG) and the Torres Strait by traditional inhabitants, under the provision of the Torres Strait Treaty, unavoidably pose some risk of TB spread, including drug resistant strains, in the Torres Strait Protected Zone.

In the 5 years addressed by the previous *Strategic Plan for the Control of TB In Australia, 2011-2015*, Australia has made significant achievements towards TB control including: enhancements to off-shore pre-migration screening, which has stabilised onshore TB rates; attaining greater involvement by governmental and non-governmental organisations in TB programs and initiatives; reviewing jurisdictional responsibilities and TB risk groupings; and expanding Australia's support of regional and global workforce training, and research endeavours. Over this 5 year period the National Tuberculosis Advisory Committee (NTAC) has published a number of position papers and policy guidelines that have furthered Australia's efforts in TB control.

The new *Strategic Plan for Control of Tuberculosis in Australia, 2016–2020: Towards Disease Elimination* is a plan for the next 5 years, with particular emphasis on local application of the World Health Organization's (WHO's) Priority Action Areas towards TB elimination. As outlined throughout this document, the continuation of current strategies, including maintenance of an appropriately experienced TB workforce, albeit essential, are however insufficient for

progressing towards TB elimination. Australia's commitment to TB elimination will require expansion of dedicated and appropriately supported programs, working both within and between jurisdictional TB structures and with the Commonwealth. However, to achieve TB elimination will mean that strategic thinking on TB control must extend beyond health portfolios to other agencies.

While the vision remains to eliminate TB in Australia, this Strategic Plan seeks to lay the foundation for an ongoing reduction in overall TB occurrence, with the aim of meeting pre-elimination targets by 2035 in the entire Australian population. While current TB control strategies must be maintained, addressing the risks from migration, prior to and after arrival in Australia, from high TB burden countries and continuing to improve cross border TB control are key challenges which must be met to decrease the low incidence of TB even further. Within the Australian born population, addressing vulnerable and hard to reach groups must be further refined.

The goals of this Strategic Plan are to: (i) reduce TB incidence by an average of 10% per annum by 2020, to ensure Australia is on the right path to meet the 2035 target; and (ii) substantially reduce the disparity in TB rates between Indigenous and Australian born non-Indigenous populations by 2020, with the aim of zero disparity by 2035.

This Strategic Plan outlines 33 actions that are detailed individually within the priority action areas of the Strategic Plan. Areas of particular focus include:

- National and jurisdictional assessments of the regulatory and structural requirements and cost analysis of implementing this Strategic Plan in Australia, in order to inform the implementation of other priority actions.
- Evaluate current migrant screening programs, including pre and post-migration management and outcomes to identify opportunities for further targeting and

strengthening of the programs.

- Through engagement with representative Aboriginal and Torres Strait Islander groups, determine key challenges to TB elimination within their communities.
- Determine the material effects of TB on individuals and families, including financial, educational, employment, accommodation and housing impact.
- Develop a national strategy on latent TB infection (LTBI) diagnosis and treatment.
- Update the Australian standard for care and prevention of drug resistant TB (DR-TB), including the management of contacts.
- Identify and prioritise questions for scientific and operational research that will enable the development of new tools (diagnosis, treatment, prevention) and identification of optimal models of care and service delivery to achieve a reduction of TB incidence in Australia towards elimination.
- Promote regional activities in TB prevention, detection, management and research including contributing to a coordinated advisory role on complex and DR-TB cases.
- Further develop and maintain a dedicated skilled workforce.

This document has been prepared by NTAC as the Strategic Plan for the control of TB in Australia aiming to lay the foundations towards disease elimination, and will be used as a basis for developing a specific NTAC work plan for 2016-2020. In addition to NTAC, it is acknowledged that there are many other stakeholders contributing to TB control and elimination activities in Australia. As such, this Strategic Plan is directed at all those who must take on the responsibility of improving further TB control in this country. It is intended that this Strategic Plan will assist in informing the future activities of all relevant individuals, government agencies

and nongovernment organisations contributing to TB control and with an interest in achieving TB elimination in Australia.

This Strategic Plan should also be seen as a mechanism to inform our regional neighbours, international health agencies and others, of the epidemiology of TB in Australia, the successful achievements to date, the challenges to be met and the strategic direction Australia will take.

2. Introduction: Towards TB Elimination

The incidence of tuberculosis (TB) in Australia (5.3 cases per 100,000 population in 2015) remains amongst the lowest recorded globally.³ As such Australia together with other countries with a TB incidence of 10 per 100,000 population or less are in a position where TB elimination is feasible by 2050. International TB and public health stakeholders have sought to shift focus from control of the TB epidemic towards elimination. In 2014, the World Health Assembly, of which Australia is a Member State, approved with full support the 'End TB Strategy'^{4, 5}. The long-term vision of the strategy is a world free of TB and the strategy goal is to end the global TB epidemic by 2035, defined as a global incidence of fewer than 100 cases per million population. This will require a 95% reduction in the number of deaths due to TB and a 90% reduction in the incidence of TB. Additionally, in view of the progress made in several low-incidence countries, the WHO and the European Respiratory Society, in consultation with representatives from over 30 low-incidence countries, including Australia, adapted the global strategy for these low-incidence countries and developed 'Towards TB Elimination – an Action Framework for Low-incidence Countries'⁶ (WHO Framework). For low-incidence countries (defined as <10 cases per 100,000), the WHO has set a target for the pre-elimination of TB (defined as <10 cases per million population) by 2035, and a further target of TB elimination (defined as <1 case per million population) by 2050. Additionally, 8 priority action areas have been adapted from the WHO global TB strategy for low-incidence countries.⁶ Australia is committed to achieving

the targets specified in these documents which aim to further reduce the incidence, mortality and economic hardship associated with TB (Table 1).

The collective effort of those involved in TB control in Australia since the end of the Second World War should be commended. The incidence of TB in the Australian born population has already reached the specified pre-elimination threshold, a target met by few other countries.⁶ The current challenge for Australia is how to further improve TB control in not only those born in Australia, but also to substantially reduce the incidence of TB in those who have chosen to migrate to or live temporarily in Australia, often from countries with a substantially higher TB burden. The primary determinants of TB rates in Australia are its national migration, education and employment policies, which drive high numbers of migrants that may come from high TB burden countries. Strategic thinking for TB control must now go beyond Departments of Health and encourage broader involvement of other federal, state and territory government departments, non-governmental organisations and community engagement.

Accomplishing elimination targets globally will require new tools such as cost effective advances in diagnosis, antimicrobial therapy and prevention by vaccination, as well as novel and innovative public health action. However substantial progress can still be made to benefit individuals, communities and healthcare systems using currently available tools and approaches. NTAC recognises the need to optimally implement existing programmatic management of TB and maintain an appropriate workforce, while providing an environment supportive of the generation of an evidence base which informs the development and implementation of novel and alternative technologies, approaches and models of service provision.

NTAC has chosen to align this Strategic Plan with the WHO Framework to work towards TB elimination, recognising the importance of global harmonisation of TB management

Table 1: WHO’s post 2015 global TB strategy milestones and targets; and WHO’s Framework towards TB elimination in low-incidence countries^{5,6}

Indicators – compared to 2015	Post 2015 Global TB Strategy				WHO Framework for low-incidence countries	
	Milestone			Target	Target	
	2020	2025	2030	2035	2035	2050
Percentage reduction in number of TB deaths	35%	75%	90%	95%	-	-
Percentage reduction in TB incidence rate	20%	50%	80%	90%	<10 cases per million population	<1 case per million population
Percentage of affected families facing catastrophic costs due to TB	Zero	Zero	Zero	Zero	-	-

efforts. As such the plan sets to outline goals and objectives in the context of the 8 priority action areas as specified in the WHO Framework.⁷

3. Global and Regional Tuberculosis Situation

The annual global TB report published by the WHO (2016) summarised global TB epidemiology for 2015.³ This report estimated that globally in 2015 there were 10.4 million incident cases (range 8.7 million to 12.2 million), of which 6.1 million were formally notified to the WHO. Most of the estimated cases in 2015 occurred in the South-East Asia and the Western Pacific WHO regions (61%) and the WHO African Region (26%). TB is now the biggest killer of any communicable disease, with an estimated 1.8 million TB deaths in 2015, of which 0.4 million were among people living with HIV. Drug resistant TB (DR-TB) remains a major threat to global TB control, with an estimated 480,000 new cases of multidrug resistant (MDR) in 2015. Information from countries with reliable data suggests that about 9.5% of MDR-TB cases worldwide have extensively drug resistant (XDR) TB. However, the true number of these cases remains uncertain as only about a quarter of this MDR TB estimate was notified to the WHO. Nonetheless, the global roll out of rapid molecular technology, such as the Xpert MTB/Rif assay and DNA hybridisation line probe assays to identify important drug resistance, offers substantial opportunities to close this diagnostic gap and enable early commencement

of appropriate therapy. Such therapy has evolved to potentially include new agents (bedaquiline and delamanid) and very recently, a 9-12 month MDR-TB shorter regimen in prescribed circumstances.⁸ Although globally the total number of TB cases remains high, global incidence has been slowly declining with the current annual rate of decline in TB incidence around 1.5%. In addition, mortality has declined 22% between 2000 and 2015, with TB treatment estimated to have averted 49 million deaths over this period. However, TB remains one of the top 5 causes of deaths worldwide. The latest treatment outcome data show a treatment success rate of 83% for TB (2014 cohort), 52% for MDR-TB (2013 cohort) and 28% for extensively drug-resistant XDR-TB (2013 cohort).

A reinvigorated approach to childhood TB globally has turned disease control efforts to an area which had, in some TB programs, become neglected.

The Asia-Pacific Region as a whole accounted for 61% of the world’s TB burden in 2015. Of the 30 high TB burden and high MDR-TB burden countries, 11 and 10 of these countries respectively are located in the WHO South East Asia or Western Pacific Regions, of which many are frequently the country of origin of new migrants to Australia or are linked by tourism or commerce.

PNG shares a sea border with Australia, and in the Torres Strait the distance between

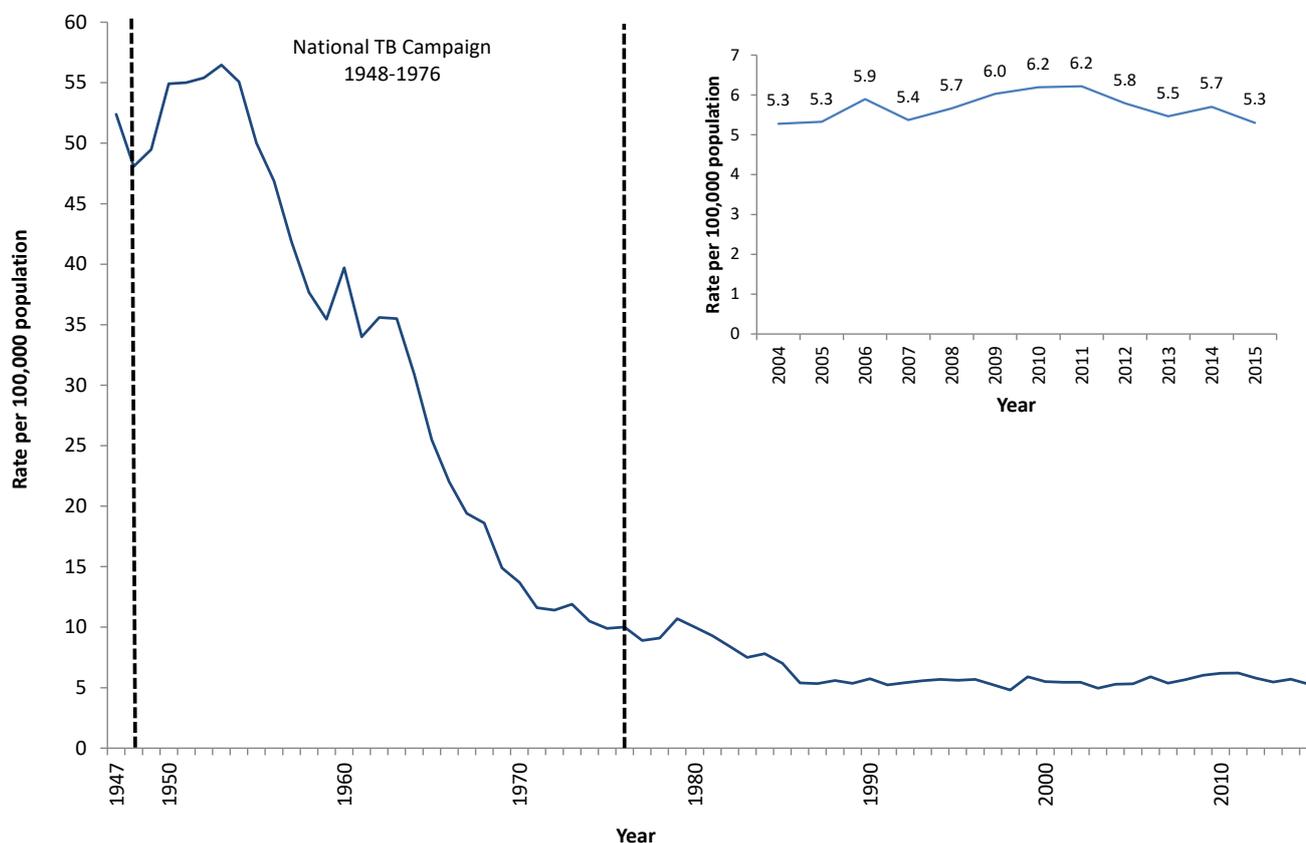
Queensland's Saibai Island and the PNG mainland is 4 kilometres. The Torres Strait Treaty, which entered into force in 1985, allows free movement within the Torres Strait Protected Zone (TSPZ) for traditional inhabitants from certain Australian and Papua New Guinean communities for traditional activities such as fishing, trade and other cultural activities. The incidence of TB in PNG's Western Province, primarily in and around Daru, remains high with a very substantial burden of MDR-TB. Since 2011, the number of PNG nationals seeking care in Queensland has substantially reduced in parallel with improved TB management in the Western Province's South Fly district, which has been supported through significant Australian assistance from the Department of Foreign Affairs and Trade (DFAT). This regional support is an important part of strategic planning to manage the risk of TB transmission in Australia. In addition, in 2016 a new Queensland Health TB control unit based on Thursday Island was established to enable a more locally responsive approach to new TB cases.

4. Tuberculosis Control in Australia

4.1 The second half of the 20th century

The control of TB in Australia has been one of our most important population health achievements. The National TB Campaign (1949-1975) was an effective partnership between the Commonwealth and the jurisdictions which sought to "...reduce as soon and as far as possible the incidence of tuberculosis in Australia, and to provide adequate facilities for the diagnosis, treatment and control of that disease..." from 1948 to 1976.⁹⁻¹⁵ The National TB Campaign strategically employed the evolving best practice of the time through community wide active case finding and ongoing surveillance of rates of disease and death, with legislative and funding support by Government, and the equally strong support of the Australian community. In Australia, TB rates declined significantly between 1954 and 1980 and have remained low (Figure 1). Specific factors which facilitated the success of the National TB campaign were inno-

Figure 1: Notification rates for tuberculosis, Australia, 1947 to 2015, by year



vations in miniature mass radiography, new and effective chemotherapies, the introduction of Bacillus Calmette-Guérin (BCG) vaccination programs and overall improvements to living standards.^{16, 17} The National TB Campaign is an exemplar population health investment, achieving major community gain through reductions in ill-health and death and consequently cost (reduced demand on hospitals, wards and beds and reduction in TB workforce required) to Australia, a tangible benefit for its initial investment.

4.2 TB in Australia at the present time

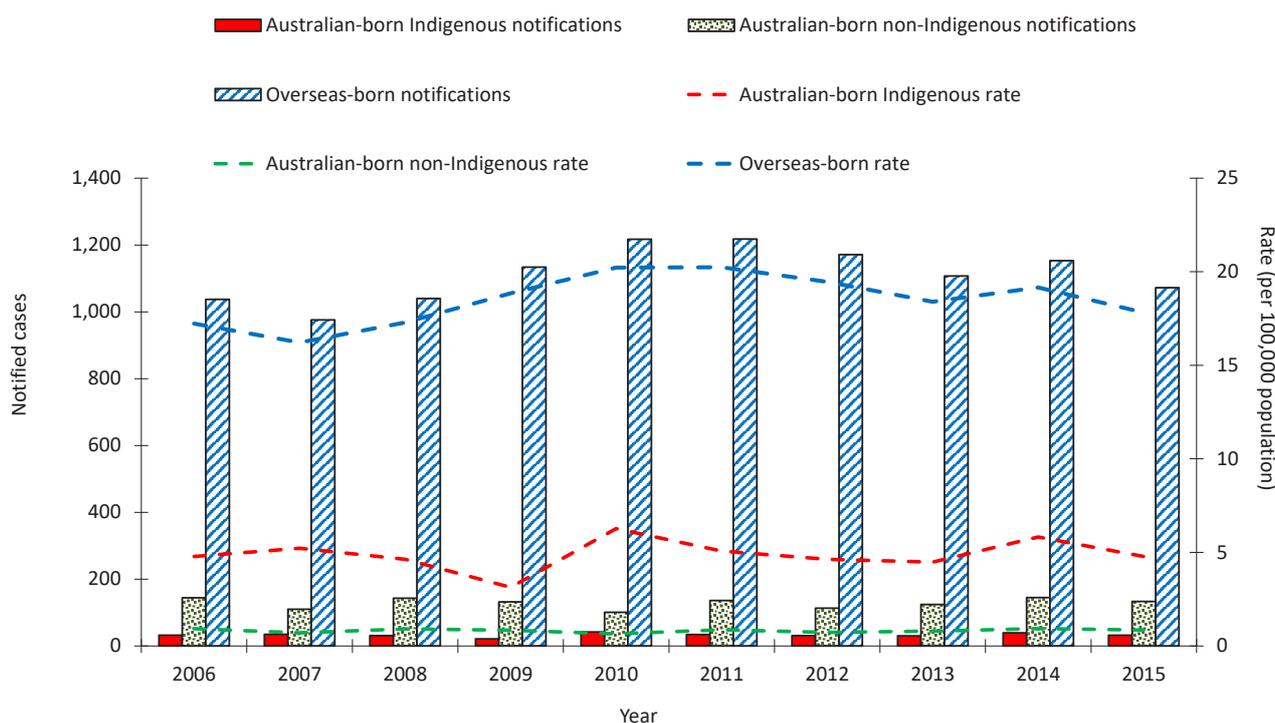
Australia has a population of approximately 24 million people. Aboriginal and Torres Strait Islander people, the Indigenous persons of Australia, represent 3% of the total population. Approximately 28% of Australia's estimated resident population were born overseas.¹

In 2015, there were 1,255 notifications of TB in Australia representing an incidence of 5.3 cases per 100,000 population. The rate amongst non-Indigenous Australian born was 0.8 cases per 100,000 population, below that which the WHO

defines as a state of pre-elimination (<1 case per 100,000 population) and a benchmark which was first achieved in 2003.¹⁸ Whilst the rate in Indigenous Australians (4.8 per 100,000 population) is low by global population standards, it is 6 times that seen in the non-Indigenous Australian born population (Figure 2). Eighty-seven percent of all notifications reported with country of birth were in the overseas born. Treatment outcomes of an annual patient cohort are reported in the following year's annual report. The latest data on treatment outcome is for the 2014 cohort. The overall treatment success for all cases reported in 2014 was 95%.

There were 28 cases of MDR-TB notified in 2015, representing 2.9% of diagnostic isolates subjected to drug susceptibility testing. Seventy-eight per cent of the MDR-TB patients were overseas born. In addition, there were 2 cases of XDR-TB reported in Australia in 2015, both of which were overseas born. The number of PNG Nationals diagnosed with TB in the Torres Strait declined significantly from 47 in 2011 to only 10 in 2015. Such changes were the result of bilaterally agreed changes in cross border patient management.

Figure 2: Notified cases and rate of tuberculosis, Australia, 2006 to 2015, by population subgroup



Migration from high-incidence TB countries is the most significant continuing challenge for TB control and elimination in Australia. The likelihood that a newly arrived migrant will develop TB, including MDR-TB, is dependent not only on the incidence of TB in the country of origin but the local TB epidemiology, the effectiveness of the source country's TB program and the strength of the pre-migration health assessment mandated by the Australian Government.

Although Australia has a reasonably low burden of DR-TB, its close proximity to, and migrant intake from, high DR-TB burden countries means that despite good domestic prevention and management practices, the threat remains. Approximately 12% of Australia's annual bacteriologically confirmed TB notifications are identified as being resistant to at least one of the standard first-line anti-tuberculosis agents, with less than 3% being identified as MDR-TB. The Australian Government's National Antimicrobial Resistance Strategy 2015-2019¹⁹ seeks to minimise the development and spread of antimicrobial resistance and ensure the continued availability of effective antimicrobials through global, regional and domestic efforts. *Mycobacterium tuberculosis* is identified in the National AMR Strategy as a priority organism.

Australia continues to use its well validated programmatic approach to TB control. All patients suspected of TB have access to a fully funded health system to ensure diagnosis, treatment and post treatment monitoring without individual cost to the patient. This is a key element to Australia's successful control of TB to date.

4.3 Laboratory network

There is universal access to laboratory services for the diagnosis and characterisation of tuberculosis. All new isolates have drug susceptibility testing performed. Laboratory diagnosis of TB may occur via both the public and private pathology systems but ultimately all new TB isolates are referred to one of 5 members of the Australian Mycobacterium Reference Laboratories Network (AMRLN), which includes

2 SupraNational Reference Laboratories (SRLs) of which one is also a WHO Collaborating Centre for Tuberculosis Bacteriology.

The scope of services of the reference laboratories covers diagnostic and reference functions including smear microscopy, rapid molecular tests for diagnosis and resistance detection, liquid and solid culture, drug susceptibility testing, molecular typing and genomic sequencing for resistance detection. Whole genomic sequencing has been used in a research setting but more routine use is an application under consideration by at least some reference laboratories. In addition, the AMRLNs perform specialised diagnostic services for investigation of disease due to non-tuberculous mycobacteria as well as coordinate and participate in a national quality assurance program. The SRLs also provide external quality assessment and expert technical assistance to regional national TB reference laboratories in the Pacific, Asia and Africa. Training is provided to clinical, laboratory and public health personnel to ensure understanding of laboratory practice is thorough and contemporary.

4.4 Surveillance

TB is a notifiable disease in all states and territories of Australia. Jurisdictions inform an enhanced data collection protocol which is collated nationally in the National Notifiable Diseases Surveillance System (NNDSS). The TB Data Quality Working Group (TBDQWG) is a working party of NTAC that maintains national consistency and accuracy of TB data and provides guidance on the methodology and interpretation of TB surveillance data in Australia. The Commonwealth funds and maintains the NNDSS and in partnership, through NTAC, monitors and reports surveillance findings. A TB annual report is produced and published in the journal *Communicable Diseases Intelligence* and the Commonwealth Department of Health also ensures annual reporting to the WHO is performed.

5. TB Control Governance in Australia

In Australia's federal system of government, communicable disease control, including TB control is managed through state and territory government based programs, rather than a centralised national program as seen in many other countries. However, the activities of NTAC provide guidance to support a nationally consistent approach to TB control in Australia.

NTAC was established in 1999 as a sub-committee of the Communicable Diseases Network Australia (CDNA) to provide strategic, expert advice to CDNA on a coordinated national and international approach to TB control; and to develop and review nationally agreed strategic and implementation plans for the control of TB within Australia.²⁰ It comprises of state and territory government representatives, the Department of Health, the Department of Immigration and Border Protection, the Public Health Laboratory Network, a paediatric specialist, an HIV-TB specialist, and a regional engagement specialist.

In addition to government based activities, it is acknowledged that there are many non-government stakeholders contributing to TB control and elimination activities in Australia. This collective effort forms Australia's national approach to TB control.

6. The national Strategic Plan for TB control 2011 – 2015

The Strategic Plan for control of Tuberculosis in Australia: 2011-2015²¹ has been previously published. Overall the rates of TB have remained stable, but not reduced, over this time without a significant increase in the small number of MDR-TB cases recorded. Treatment success remains very high.

The significant achievements in the last 5 years have been the strengthening of off-shore screening, which has stabilised onshore TB rates, attaining greater involvement by governmental and non-governmental organisations in TB

programs and initiatives, the reviewing of jurisdictional responsibilities and TB risk groupings, and expanding Australia's support of global and regional workforce training, and research endeavours.

NTAC has also overseen the joint annual publication of laboratory and clinical epidemiological data, which now captures pre-migration screening data, whereas prior to 2014 these data were published separately with data definitions not always exactly aligned.²²

During 2011–2015, NTAC has, in addition to annual reporting, published the following guidelines and position papers:

- Position statement on interferon- γ release assays in the detection of latent tuberculosis infection (2012).^{23, 24}
- The Strategic Plan for Control of Tuberculosis in Australia: 2011–2015 (2012).²¹
- The BCG vaccine: information and recommendations for use in Australia (2013).²⁵
- Essential components of a tuberculosis control program within Australia (2014).²⁶
- Policy recommendation: latent tuberculosis infection screening and treatment in children in immigration detention (2015).²⁷

7. Strategic Plan for Control of Tuberculosis in Australia, 2016-2020: Towards Disease Elimination – Who is it for?

The current Strategic Plan represents the collective view of NTAC on what needs to be undertaken to improve TB control in Australia and, within 5 years, place Australia in a position where pre-elimination targets can be met by 2035 for the entire Australian population. As such, given the stable and low baseline incidence of TB at the current time and that 87% of Australia's notified cases occur in those born overseas, achieving the 6-fold reduction in TB

incidence is ambitious even for a well-resourced country such as Australia. This represents an approximate 10% decline in incidence per annum. The onus for action has traditionally sat with state and territory TB control services and the Commonwealth Department of Health. This is a legacy of the success of the National TB Campaign (1949-1975) where an effective partnership between the Commonwealth and the jurisdictions dramatically reduced the incidence of TB. However, to achieve the pre-elimination targets, action required to address the priority areas lies beyond the traditional Health agencies and must include Immigration and Border Protection, Foreign Affairs and Trade as well as other agencies. Furthermore, a 'Health in All Policies' approach will be required to engage other stakeholders and ensure a horizontal health governance for TB control.²⁸

This Strategic Plan should also be seen as a mechanism to inform our regional neighbours, international health agencies and others of the epidemiology of TB in Australia, the successful achievements to date, the challenges to be met and the strategic direction Australia will take.

Table 2 provides a summary of Australia's vision and goals towards TB elimination that aim to achieve the WHO adapted global TB elimination strategy targets for low-incidence countries. These targets were developed by the WHO and European Respiratory Society, in consultation with representatives from over 30 low-incidence countries, including Australia, in 2014.

8. Priority Action Areas

Eight priority action areas, that align with the WHO's adaptation of the global TB strategy for low-incidence countries⁶, have been identified to guide Australia's approach towards pre-elimination and elimination goals for TB.

Priority 1: Ensure political commitment, funding and stewardship for planning and essential services of high quality

Any reduction in political commitment and funding for TB services can result in substantial impact on public health.²⁹ Previously, well-documented community transmission of TB, including increased drug-resistance and greatly increased healthcare costs, has been linked directly with reduction in TB funding and services, such as in the United States.³⁰ Australian jurisdictional TB programs must be supported appropriately into the future to ensure a skilled workforce is available and high quality programmatic and clinical management is available without individual costs to affected people, particularly in light of increased numbers of drug-resistant TB cases in our region and other challenges to effective TB control globally. The low incidence of TB in Australia, while commendable, may divert human resources away from TB care programs through deficiencies in funding as a result of misperceptions regarding need by health care decision makers, decreased opportunities for education and training, and personal professional disinterest, due to lack of historical involvement in TB, among newly qualified medical practitioners and nurses entering the health system.

Objectives

Beyond TB case management, implementation of this Strategic Plan will require additional broad-based political and financial commitment, both by Australian governments and within our region. Continuation of current strategies is necessary but insufficient for progressing towards elimination. While novel strategies are needed for elimination, it is essential that they be evidence based and cost effective. Scientific, operational and economic research is required to inform the implementation of novel strategies for TB elimination.

A skilled, experienced well trained and supported workforce is essential to maintain TB control and to move towards disease elimination.

Table 2: Australia's milestones* to achieve TB elimination

Goal	2015 Baseline		Milestone		Targets	
			2020		2035	2050
To reduce overall TB incidence rate in Australia	5.3 per 100,000		3.1 per 100,000 (10% reduction per annum)		<1 per 100,000	<1 per million (WHO elimination target)
To reduce the rate of TB in Indigenous Australians	4.8 per 100,000		1.6 per 100,000 (20% reduction per annum)		<1 per million (WHO elimination target)	-
To reduce the rate of TB in Australian born nonIndigenous Australians	0.8 per 100,000		Maintain pre-elimination rates (<1 per 100,000)		<1 per million (WHO elimination target)	-

* The proposed annual reductions have been set to achieve the WHO elimination targets for low-incidence countries.

Australia's success in TB elimination will be reliant on parallel efforts in other countries, particularly in the Asia-Pacific Region. Australia's engagement with partner governments, in bilateral and multilateral forums can promote increased domestic financing and support health system improvements that will lead to better TB management in the Asia Pacific region. Effective political engagement is required to increase regional bilateral and multilateral programs for improved TB management.

Actions required

- National and jurisdictional assessments of the regulatory and structural requirements and cost analysis of implementing this Strategic Plan in Australia, in order to inform the implementation of other priority actions.
- Investigate and identify funding to implement programs towards the elimination of TB in Australia, including clinical and public health programs and operational research efforts.
- Further develop and maintain a dedicated skilled workforce.
- Support for Australian bilateral and multilateral political engagement in relation to TB in the Asia Pacific region.

Priority 2: Address barriers to improved TB care in Australian population groups with higher TB incidence.

TB is a prolonged and often stigmatising condition with economic and relational impacts which must also be addressed.³¹ Given the higher rates of TB in Aboriginal and Torres Strait Islander peoples residing in identified locations, determining barriers to improved TB care and reduction of TB incidence in Indigenous Australians is important and is considered in this section.² The National Strategic Plan must also accommodate the emergence of other groups within the population with higher TB incidence and investigate whether financial costs or other

material effects are barriers to good patient centred TB care or the implementation of targeted public health actions. Such groups may be characterised by shared cultural, medical or socioeconomic factors. Migrants as a risk group for TB are considered principally under Priority Action Area 3.

Objectives

The TB incidence for the Aboriginal and Torres Strait Islander population should match that of the non-Indigenous Australian born population, with the common goal of TB elimination.

Population groups who have increased risk of TB are to be identified to guide investment and resource allocation, and inform public health strategies to reduce TB incidence.

In line with the WHO End TB Strategy to ensure that “no individuals or families suffer catastrophic costs associated with TB”, Australian jurisdictions must remain committed to providing services and support without cost to the individual.³⁴

Actions required

- Through engagement with representative Aboriginal and Torres Strait Islander groups, identify key challenges to TB elimination within their communities and address them, using culturally appropriate approaches.
- Review current collection of TB risk factor data, and determine factors which should be added, in order to better characterise risk groups within the population.
- Investigate the use of new tools for improving collection of information on at-risk groups, such as data linkage and geographic information systems.
- Determine the material effects of TB on individuals and families, including financial, educational, employment, accommodation and housing impact.

Priority 3: Address special needs of migrants, and cross-border issues

The burden of TB in Australia will be heavily dependent on future migration trends and policy, being able to control or prevent TB in new arrivals, and being able to rapidly detect TB in migrants as they age.³⁵ International migrants, primarily those from high burden countries, comprise 85-90% of TB cases occurring in Australia.² Approximately 1,000 migrants living in Australia present annually with active TB predominantly related to an unidentified LTBI acquired outside of Australia. Australia has a requirement for pre-migration screening for active TB but it is not undertaken for all visa applicants, and in some circumstances may not be comprehensive enough.

Post-arrival screening of migrants varies between jurisdictions and systematic guidelines have not been produced. Efforts have been made to raise awareness about TB with migrant students and educational institutions and to mandate health insurance as a pre-requisite for study in Australia, but more effort is needed.

A specific cross-border issue for Australia is the potential for the transmission of TB through the Torres Strait, particularly given traditional visits allowed under the Torres Strait Treaty. Australia undertakes bilateral activity with PNG through DFAT, Queensland Health and other partners to reduce the burden of TB in PNG and therefore the risk of transmission to Australia.

Objectives

Optimally, all migrants from higher incidence TB countries, including longer term visitors, should be screened both pre- and post-migration to detect and prevent active TB with appropriate treatment programs to support this.

Optimal culturally and linguistically appropriate care is provided to enhance access and adherence to treatment.

Non-health agencies engaged with migrants, such as the Department of Immigration and Border Protection, education and housing services and community-based organisations, must be included in policy and decision making to eliminate TB.

TB and LTBI assessment and treatment is provided by state and territory health services without individual cost following migration.

Actions required

- Review the appropriateness and feasibility of pre-migration LTBI screening with the Department of Immigration and Border Protection.
- Evaluate current migrant screening and treatment programs, including pre and post-migration management and outcomes to identify opportunities for further targeting and strengthening of the programs.
- Assess with migrant communities the cultural and linguistic acceptability of TB care.
- Continue support to the Government of PNG for health system strengthening to enable better prevention, detection and treatment of TB, especially support of cross border initiatives for TB control in the TSPZ.

Priority 4: Undertake selective screening for active TB and LTBI in TB contacts and selected high-risk groups, and provide appropriate treatment

Australian policy and practice seeks to ensure that individuals at risk for TB have access to systematic targeted screening and treatment programs.³⁶ Groups at highest risk for active TB within Australia include recent contacts of active cases, migrants from high-incidence settings and individuals at increased risk of progression to active disease due to immunocompromising conditions or therapy. In groups at sufficiently high risk, testing and treatment for

LTBI, accompanied by appropriate active case finding, is effective in prevention of progression to active disease.³⁷

Close contacts of active TB cases are at highest risk for infection.³⁸ Contact tracing, monitoring and evaluation are the responsibility of the respective jurisdictional TB control programs.

Migrants from high-incidence settings have an increased lifetime risk of TB.³⁹ Systematic screening of this cohort for LTBI is currently highly variable because of jurisdictional variations in demand, service capacity and policy, and individual practitioner variation.

Successful strategies for LTBI management require easy access to diagnosis and streamlined treatment, which are not readily available in all geographic areas. Interferon gamma release assays are currently Medicare funded only for immunosuppressed or immunocompromised patients.⁴⁰ A 3 month isoniazid/rifapentine regimen is not readily accessible in Australia as rifapentine is not registered for use in this country.

Objectives

The progression towards elimination of TB in Australia requires the development of a nationally-adopted, sustainable model for targeted LTBI screening and treatment that is universally accessible, culturally appropriate and ethically acceptable.⁴¹

Jurisdictional contact tracing programs need to remain robust, evaluable and nationally consistent.

Actions required

- Develop a national strategy on LTBI screening and treatment.
- Develop a model for engaging primary care providers in the delivery of programmatic targeted LTBI screening and treatment.
- Evaluate timeliness and completeness of con-

tact tracing by jurisdictional implementation of an audit tool that can be used for national collation and analysis of data, and targets, including indicator data for children less than 5 years of age.

- Engage pharmaceutical suppliers, the Therapeutics Goods Administration (TGA) and other agencies to identify mechanisms to enable ready access to new drugs for treatment of LTBI including rifapentine.

Priority 5: Optimise the prevention and care of drug-resistant TB

The National AMR Strategy¹⁹ has identified *M. tuberculosis* as a priority organism for surveillance and notes the serious challenge that DR-TB poses in our region. One of the key objectives of the National AMR Strategy, Objective 6, is to strengthen international partnerships and collaborate on global and regional efforts to respond to antimicrobial resistance issues, including issues relating to the prevention and management of DRTB.

MDR-TB has remained less than 3% of culture-confirmed cases in Australia since 1995 (excluding PNG nationals from the TSPZ). Acquisition of MDR-TB within Australia is uncommon due to the many control measures in place. However, given increasing global MDR-TB and Australia's migration trends, it is likely that the relative burden of drug-resistant TB will increase in Australia.⁴² In 2016, the WHO has given conditional endorsement to a shortened (9-12 month) regimen for the treatment of MDR-TB. New treatment drugs have recently become available (bedaquiline, delamanid) but are not registered for use in Australia. Similarly, combination formulations of first line drugs for children and adults, a measure which helps prevent the emergence of drug resistance by enhancing adherence, are not registered.

Objectives

Ensure the highest standard of clinical care and programmatic management to prevent the transmission and acquisition of DR-TB.

Strengthen and expand efforts to address drug resistance including further research into the outcomes, costs and limitations of MDR-TB treatment and prevention.

Promote national action and regional collaboration on the growing problem of DR-TB in the Asia Pacific region, especially in the context of measures to address regional health security.

Actions required

- Ensure the treatment review process for drug resistant cases detected pre-migration and the follow up of these cases after migration is effective.
- Identify mechanisms to streamline the registration of combination formulations of first line drugs in Australia and to enable easier access to new antimicrobial agents for TB treatment.
- Complete a cohort review of Australian MDR-TB cases, including an assessment of local management and outcomes.
- Update national guidelines on prevention and care of MDR-TB, including the management of contacts. This will include the identification and utilisation of timely molecular resistance testing.
- Identify opportunities at the global, regional and bilateral level to draw attention to, and resourcing for, antimicrobial drug resistance (AMR) including drug resistant strains of TB, consistent with Australia's first National AMR Strategy¹⁹ and the WHO Global Action Plan on Antimicrobial Resistance.⁴³

Priority 6: Ensure continued surveillance, program monitoring and evaluation and casebased data management

Good quality data provide the foundation for understanding TB epidemiology in Australia, which is required to direct appropriate TB control activity and monitor its impact. Commonwealth and jurisdictional health departments are responsible for the management and surveillance of TB in Australia. Data on all diagnosed cases, as defined by a national case definition, are provided by state and territory health departments to the Australian Department of Health and stored on a central database, the NNDSS.^{44,45,46} The data collected through surveillance are disseminated in national annual surveillance reports. While national surveillance for active TB disease is in place, there is no such systematic data collection for LTBI screening and treatment.

Objectives

The quality of surveillance should be continuously improved through regular evaluation and systematic strengthening, utilising advances in technology.

Develop a system for recording and sharing jurisdictional data on LTBI testing activities, including diagnosis and treatment outcomes.

Actions required

- Continue publication of timely national annual TB surveillance reports to monitor TB control in Australia and identify high-risk groups.
- Review the TB data specifications regularly to meet strategic priorities. Identify a mechanism for monitoring LTBI diagnosis and treatment in children at risk who are less than 5 years of age.
- Employ new tools such as data linkage, electronic data extraction, molecular epidemiology techniques, and common collection sys-

tems, where needed to enhance surveillance.

- Investigate the feasibility of developing jurisdictional based systems for recording and sharing data, nationally, on LTBI testing activities.

Priority 7: Invest in research and new tools

Australia is a resource-rich country with a low incidence of TB and substantial capacity for research and development across a wide range of scientific and operational platforms. Australia is therefore ideally placed as a strategic hub for developing and evaluating new strategies and tools that will be essential to achieve TB elimination by 2050. Such research would be immediately relevant for other low-incidence countries, while also addressing a major goal of the WHO End TB Strategy.

Optimising screening and management practices of migrants with TB and LTBI is a critical area for research. Locally, and more broadly within the Asia-Pacific Region, Australian engagement with research should ensure that the use of existing tools and strategies is optimised for maximal reduction in TB burden. However, it is acknowledged that current tools for diagnosis and treatment of TB are inadequate for accomplishing the WHO End TB Strategy targets.⁴⁷ Therefore, greater support for research is also required to develop new tools such as diagnostics, novel therapies and vaccines.

Objectives

Increase Australian investment in basic science, research and the development of novel tools that will improve the diagnosis, treatment and prevention of TB and LTBI.

Australian investment in operational research to inform effective steps to TB elimination nationally and globally should be a strategic priority.

Collaborative research must be part of capacity building efforts to improve TB control in the

Asia-Pacific region, including DR-TB, consistent with Objective 5 of the National AMR Strategy: *Agree a national research agenda and promote investment in the discovery and development of new products and approaches to prevent, detect and contain antimicrobial resistance.*¹⁹

Actions required

- Identify and prioritise questions for scientific and operational research that will enable the development of new tools (diagnosis, treatment, prevention) and identification of optimal models of care and service delivery to achieve a reduction of TB incidence in Australia towards elimination.
- Identify opportunities for government and non-government funding for TB research.
- Facilitate collaborations between Australian researchers in TB control and research partners in the Asia-Pacific region and beyond.

Priority 8: Support global TB prevention, care and control

Countries in the Asia Pacific region account for 58% of the global TB burden and are a key source of DR-TB.² Given that local TB epidemiology is heavily dependent on international migration, programs to reduce TB incidence in high burden countries are also likely to lead to additional public health and cost-benefits for Australia.⁴⁸

Australia contributes to TB control efforts through various aid programs, including contributions to the Global Fund to Fight AIDS, Tuberculosis and Malaria, and the work of bilateral and multilateral partners in the Asia Pacific region. Australia's advocacy for strengthening health systems and health security also addresses many of the underlying weaknesses that lead to drug resistance and increase the spread of TB and other communicable disease in Asia and the Pacific. The pre-migration screening endeavours also assist in capacity building of TB programs in some countries and should continue to be supported. In addition, Australian non-govern-

ment organisations, state based institutions, and individuals are involved in a variety of activities supporting global TB efforts. Two WHO SRLs are based within Australia, which support laboratory networks across the Asia Pacific region. Several Australian organisations are actively involved in education and advocacy to enhance political and community awareness and commitment to the impact of TB in the same regions.

Objectives

Australia commits to and engages in global and regional TB advocacy and control efforts through collaborative involvement in global and regional activities that align with the WHO's End TB Strategy.

Tuberculosis must remain on the political, technical and research agenda in terms of Australia's international and regional role.

Actions required

- Support individuals and organisations in Australia in using local expertise to benefit international programs, including provision of clinical and operational assistance, capacity building and through the application of health economics, mathematical modelling and other available capacities.
- Improve the coordination of partnerships to enhance collaboration between Australian government and non-government organisations and the regional and country partners, and other key stakeholders.
- Promote regional activities in TB prevention, detection, management and research including contributing to a coordinated advisory role on complex and DR-TB cases.
- Identify opportunities to strengthen core health system capabilities (including health financing) in the countries of South East Asia and the Pacific to improve prevention, detection and treatment of communicable diseases in line with *DFAT's Health for Development*

Strategy 2015-2020.

- Provide increased opportunities for reciprocal exchange of TB health workers between Australia and regional partners.

Conclusion

This document has been prepared by NTAC as the Strategic Plan for the next 5 years to improve TB control and provide a push towards the elimination of TB in Australia. It will be used as a basis for developing a specific NTAC work plan for 2016-2020. This Strategic Plan aligns with international priorities, and includes a range of activities which will require further consideration within various jurisdictions, government agencies and other organisations. It is expected, therefore, that relevant organisations, including state and territory TB Programs, will similarly make use of the document to guide and prioritise activities relating to TB over this period.

Australia's efforts to maintain control of TB have been a significant accomplishment, leading to international acknowledgement of the potential for TB elimination in this setting. Elimination, however, will not be accomplished simply through continuation of existing programs, and substantial consideration and investment will be required to develop and implement appropriate additional strategies in Australia. Doing so involves significant challenges, but also brings immense opportunities. Implementation of a strategic approach to elimination of TB in Australia is an opportunity to provide global leadership in establishing policies and practices, and to demonstrate that such approaches can be implemented in efficient and effective ways. Most importantly, though, elimination of TB in Australia would be the culmination of many decades of faithful work towards a vision of a world free of the pain and suffering caused by TB.

References

1. Australian Bureau of Statistics. 3412.0 - Migration, Australia, 2014-15 2016. Accessed

- on 24 October 2016. Available from: <http://www.abs.gov.au/AUSSTATS/abs@.nsf/mf/3412.0>
2. Toms C, Stapledon R, Waring J, Douglas P, National Tuberculosis Advisory Committee for the Communicable Diseases Network Australia, and the Australian Mycobacterium Reference Laboratory Network. Tuberculosis notifications in Australia, 2012 and 2013. *Commun Dis Intell* 2015;39(2).
 3. World Health Organization. Global Tuberculosis Report 2016. 2016. Accessed on 24 October 2016. Available from: <http://apps.who.int/iris/bitstream/10665/250441/1/9789241565394-eng.pdf?ua=1>
 4. World Health Assembly. Sixty-Seventh World Health Assembly, Resolution and Decisions Annexes, WHA67.1 - Global strategy and targets for tuberculosis prevention, care and control after 2015. Geneva, Switzerland: World Health Organization; 2014. Available from: http://apps.who.int/gb/ebwha/pdf_files/WHA67-REC1/A67_2014_REC1-en.pdf#page=25
 5. World Health Organization. The End TB Strategy: Global strategy and targets for tuberculosis prevention, care and control after 2015. 2014. Accessed on 20 October 2016. Available from: http://www.who.int/tb/strategy/End_TB_Strategy.pdf?ua=1
 6. World Health Organization. Towards tuberculosis elimination: an action framework for low-incidence countries. 2014. Accessed on 20 October 2016. Available from: http://apps.who.int/iris/bitstream/10665/132231/1/9789241507707_eng.pdf?ua=1
 7. Lonnroth K, Migliori GB, Abubakar I, D'Ambrosio L, de Vries G, Diel R, et al. Towards tuberculosis elimination: an action framework for low-incidence countries. *Eur Respir J* 2015;45(4):928-952.
 8. World Health Organization. WHO treatment guidelines for drug resistant tuberculosis: 2016 update. 2016. Accessed on 24 October 2016. Available from: www.who.int/tb/areas-of-work/drug-resistant-tb/treatment/resources/
 9. Commonwealth of Australia. *Tuberculosis Act* 1948. In.
 10. State of New South Wales. *Tuberculosis Acts of 1949, 1958, 1965 and 1970*. In.
 11. State of Queensland. *The Tuberculosis Agreement Acts of 1949, 1958, 1964 and 1969*. In.
 12. State of Western Australia. *Tuberculosis (Commonwealth and State Arrangement) Acts of 1949, 1958 and 1965*. In.
 13. State of Tasmania. *Tuberculosis (Campaign Arrangements) Act* 1950. In.
 14. State of Victoria. *Health (Tuberculosis Arrangement) Acts of 1949, 1960, 1965 and 1971*. In.
 15. State of South Australia. *Tuberculosis (Commonwealth Arrangement) Act of 1949*. In.
 16. Condrau F, Worboys M. *Tuberculosis Then and Now: Perspectives on the History of an Infectious Disease*: McGill-Queen's Press - MQUP; 2010.
 17. Proust AJ. *History of Tuberculosis in Australia, New Zealand and Papua New Guinea*. Canberra, A.C.T: Brolga Press; 1991.
 18. Li J, Roche P, Spencer J, Bastian I, Christensen A, Hurwitz M, et al. Tuberculosis notifications in Australia, 2003. *Commun Dis Intell Q Rep* 2004;28(4):464-473.
 19. Australian Government Department of Health. Responding to the threat of antimicrobial resistance: Australia's first national antimicrobial resistance strategy, 2015-2019. Canberra: Commonwealth of Australia;

2015. Available from: <https://www.amr.gov.au/resources/national-amr-strategy>
20. Department of Health. About the National Tuberculosis Advisory Committee (NTAC). 2015. Accessed on October 2015. Available from: <http://www.health.gov.au/ntac>
21. National Tuberculosis Advisory Committee of Communicable D. The strategic plan for control of tuberculosis in Australia: 2011-2015. *Commun Dis Intell Q Rep* 2012;36(3):E286-293.
22. Lumb R. Future reporting of tuberculosis in Australia. *Commun Dis Intell Q Rep* 2014;38(4):E375.
23. National Tuberculosis Advisory C. Position statement on interferon-gamma release assays in the detection of latent tuberculosis infection. *Commun Dis Intell Q Rep* 2012;36(1):125-131.
24. Position statement on interferon-gamma release assays in the detection of latent tuberculosis infection. *Commun Dis Intell Q Rep* 2012;36(1):125-131.
25. The BCG vaccine: information and recommendations for use in Australia. National Tuberculosis Advisory Committee update October 2012. *Commun Dis Intell Q Rep* 2013;37(1):E65-72.
26. Essential components of a tuberculosis control program within Australia. *Commun Dis Intell Q Rep* 2014;38(4):E397-400.
27. Krause V. Policy recommendation: latent tuberculosis infection screening and treatment in children in immigration detention. *Commun Dis Intell Q Rep* 2015;39(4):E597-598.
28. Kickbush I, Bucket K Ed. Implementing Health in All Policies: Adelaide 2010. 2010.
29. Alland D, Kalkut GE, Moss AR, McAdam RA, Hahn JA, Bosworth W, et al. Transmission of tuberculosis in New York City. An analysis by DNA fingerprinting and conventional epidemiologic methods. *N Engl J Med* 1994;330(24):1710-1716.
30. Frieden TR, Fujiwara PI, Washko RM, Hamburg MA. Tuberculosis in New York City--turning the tide. *N Engl J Med* 1995;333(4):229-233.
31. Wingfield T, Boccia D, Tovar M, Gavino A, Zevallos K, Montoya R, et al. Defining catastrophic costs and comparing their importance for adverse tuberculosis outcome with multi-drug resistance: a prospective cohort study, Peru. *PLoS Med* 2014;11(7):e1001675.
32. Doyle JS, Bissessor M, Denholm JT, Ryan N, Fairley CK, Leslie DE. Latent Tuberculosis screening using interferon-gamma release assays in an Australian HIV-infected cohort: is routine testing worthwhile? *J Acquir Immune Defic Syndr* 2014;66(1):48-54.
33. Levy MH, Butler TG, Zhou J. Prevalence of Mantoux positivity and annual risk of infection for tuberculosis in New South Wales prisoners, 1996 and 2001. *N S W Public Health Bull* 2007;18(7-8):119-124.
34. World Health Organization. Global strategy and targets for tuberculosis prevention, care and control after 2015. 2014. Accessed on 05/11/2015. Available from: http://www.who.int/tb/post2015_strategy/en/
35. Denholm JT, McBryde ES. Can Australia eliminate TB? Modelling immigration strategies for reaching MDG targets in a low-transmission setting. *Aust N Z J Public Health* 2014;38(1):78-82.
36. Communicable Disease Network Australia. Tuberculosis: CDNA National Guidelines for the Public Health Management of TB. 2013. Accessed on 4 November 2015. Available from: [http://www.health.gov.au/internet/main/publishing.nsf/Content/D140EDF48C0A0CEACA257BF0001A3537/\\$File/TB-2.0-](http://www.health.gov.au/internet/main/publishing.nsf/Content/D140EDF48C0A0CEACA257BF0001A3537/$File/TB-2.0-)

[april2015.pdf](#)

37. Getahun H, Matteelli A, Abubakar I, Abdel Aziz M, Baddeley A, Barreira D, et al. Management of latent Mycobacterium tuberculosis infection: WHO guidelines for low tuberculosis burden countries. *European Respiratory Journal* 47(6).
38. Marks SM, Taylor Z, Qualls NL, Shrestha-Kuwahara RJ, Wilce MA, Nguyen CH. Outcomes of contact investigations of infectious tuberculosis patients. *Am J Respir Crit Care Med* 2000;162(6):2033-2038.
39. McBryde ES, Denholm JT. Risk of active tuberculosis in immigrants: effects of age, region of origin and time since arrival in a low-exposure setting. *Med J Aust* 2012;197(8):458-461.
40. Australian Government Department of Health. Medicare Benefits Schedule Book: Operating from 01 July 2016. 2016. Accessed on 24 October 2016. Available from: [http://www.health.gov.au/internet/mbsonline/publishing.nsf/Content/1BC94358D4F276D3CA257CCF0000AA73/\\$File/201607-MBS.pdf](http://www.health.gov.au/internet/mbsonline/publishing.nsf/Content/1BC94358D4F276D3CA257CCF0000AA73/$File/201607-MBS.pdf)
41. Denholm JT, Matteelli A, Reis A. Latent tuberculous infection: ethical considerations in formulating public health policy. *Int J Tuberc Lung Dis* 2015;19(2):137-140.
42. World Health Organization. Antimicrobial resistance: global report on surveillance 2014; 2014. Available from: <http://www.who.int/drugresistance/documents/surveillance-report/en/>
43. World Health Organization. Global Action Plan on Antimicrobial Resistance. Geneva: World Health Organization; 2015. Available from: https://apps.who.int/iris/bitstream/handle/10665/193736/9789241509763_eng.pdf?sequence=1&isAllowed=y
44. Communicable Diseases Network Australia. Tuberculosis case definition. 2011. Accessed on October 2015. Available from: http://www.health.gov.au/internet/main/publishing.nsf/Content/cda-surveil-nndss-casedefs-cd_tb.htm
45. Communicable Diseases Network Australia. National Notifiable Diseases Surveillance System. 2015. Accessed on March 2015. Available from: www.health.gov.au/nndss-data
46. Public Health Laboratory Network. Tuberculosis Laboratory Case Definition (LCD). 2006. Accessed on October 2015. Available from: <http://www.health.gov.au/internet/main/publishing.nsf/Content/cda-phlncd-tb.htm>
47. Lonroth K, Migliori GB, Raviglione M. Toward tuberculosis elimination in low-incidence countries: reflections from a global consultation. *Ann Intern Med* 2014;161(9):670-671.
48. Nguyen HT, Hickson RI, Kompas T, Mercer GN, Lokuge KM. Strengthening tuberculosis control overseas: who benefits? *Value Health* 2015;18(2):180-188.