Tuberculosis in Queensland

2017-2019

Queensland Government

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Published by the State of Queensland (Queensland Health), 2021

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Summary

This report summarises the epidemiology of tuberculosis (TB) in Queensland 2017–2019 based on notified cases of which there were 188 cases in 2017, 199 in 2018 and 194 in 2019. Cases in Queensland comprised 13–14 per cent of the total cases of TB notified in Australia each year during 2017–2019. The notification rate of TB was between 3.8 and 4.0 cases per 100,000 population per year and has remained stable since 2015. The overall rate of TB in Queensland remains low by national and global standards.

The majority of TB cases notified in Queensland were born in a high TB incidence country, a small proportion of which are PNG residents who enter via the Torres Strait Protected Zone and account for approximately 5 per cent of TB cases diagnosed in Queensland. Rates of TB in Aboriginal and Torres Strait Islander peoples in Queensland remain high and have increased since 2016. The rate of TB notifications in Aboriginal and Torres Strait Islander peoples during 2017–2019 was 8–15 times greater compared to non-Indigenous Australian born persons. An outbreak of TB was identified during this period that shows ongoing transmission predominantly within the First Nations peoples of Queensland with a unique *Mycobacterium tuberculosis* strain.

During 2017–2019, 88 per cent of Queensland TB cases were laboratory confirmed, with 96 per cent of these confirmed by culture. Drug susceptibility testing (DST) was successfully completed for 99 per cent of culture confirmed cases. Twelve per cent of cases were clinical diagnoses that were not able to be laboratory confirmed. Eighty-three per cent of culture confirmed cases had fully susceptible *M. tuberculosis* complex identified and 20 cases (4%) were identified as multi-drug resistant tuberculosis (MDR-TB). Fifteen MDR-TB cases were born overseas, all in high TB incidence countries; 5 were born in Australia, 4 of whom had spent time in high TB incidence countries, and one was on immunosuppressive therapy at the time of diagnosis.

Treatment outcomes for non MDR-TB cases notified during 2017–2019 indicate 82 per cent completed treatment (including those demonstrating cure), 9 per cent were transferred out of Australia, 1 per cent of cases defaulted from treatment and 4 per cent died prior to the completion of treatment (of which 2% were considered to have died of TB). MDR-TB cases notified during 2016-2018 indicate 68 per cent completed treatment (including cure) and the remaining cases transferred overseas to complete treatment. Overall, 96 per cent of non MDR-TB cases and 100 per cent of MDR-TB cases with a known outcome were considered to have a successful treatment outcome. Treatment outcomes for cases notified in 2019 will be reported in the 2020 report in line with the National Notifiable Diseases Surveillance System reporting.

Acknowledgements

This report was prepared by the Communicable Diseases Branch, with review from the members of the Queensland Tuberculosis Expert Advisory Group and TB nurses' network. We gratefully acknowledge all the nurses and medical officers who manage TB cases in Queensland for the collection of TB surveillance data. In addition, the Queensland Mycobacterial Reference Laboratory and referring laboratories for the continued provision of laboratory services for TB in Queensland.

Introduction

Tuberculosis (TB) is caused by the bacterium *Mycobacterium tuberculosis* complex (*M. tuberculosis* complex). TB transmission usually occurs through the inhalation of infectious droplets when a person with TB disease of the lung coughs, speaks, sings, laughs, or sneezes.[1] The bacteria predominantly infect the lungs (pulmonary disease) but can also cause disease in other parts of the body (extra-pulmonary disease). Only a small proportion of people infected with *M. tuberculosis* complex develop active disease. The lifetime risk of reactivation of TB disease in a person with documented latent TB (LTB) is generally accepted to be between 5–10 per cent,[2,3] although estimates of progression in up to 14.5 per cent of recently infected persons has been modelled in an Australian setting.[4]

According to the World Health Organization Global TB report, there were an estimated 10 million new cases of TB in 2019 worldwide, a decline in the incidence rate of 2 per cent from 2018. Two-thirds of all estimated new cases are in eight countries; India (26%), Indonesia (8.5%), China (8.4%), the Philippines (6%), Pakistan (5.7%), Nigeria (4.4%), Bangladesh (3.6%), and South Africa (3.6%).[5] People living with Human Immunodeficiency Virus (HIV) accounted for 8.2 per cent of all new TB cases.[5] There were an estimated 465,000 new cases of rifampicin resistant TB (RR-TB), 78 percent of these were MDR-TB with 50 per cent of global rifampicin-resistant cases (including MDR-TB) occurring in India, China, and the Russian Federation.[5] There were an estimated 1.4 million TB deaths in 2019. Although the number of TB deaths have fallen in both HIV negative and HIV positive people between 2000 and 2019, TB remained one of the top 10 causes of death worldwide in 2019.[5]

Australia is a low TB incidence country, with 5.8 notified cases per 100,000 population per year in 2017 and 2018.[6] Australia has already achieved pre-elimination targets (<1 case per 100,000 population per year) in the non-Indigenous, Australian-born population, though the rate in First Nations peoples was 4.4 cases per 100,000 population per year in 2018.[6,7] Published evidence of local TB transmission in Australia is limited and the majority of TB cases are born overseas, suggesting that immigration has had a greater influence on the burden of TB in Queensland and Australia than local transmission.[7,8]

TB has been notifiable in Queensland since 1904 for pulmonary TB and 1937 for all forms of disease. It is important to note that the surveillance of notifiable conditions is a passive process which relies on laboratories and diagnosing clinicians to identify and appropriately notify under the Queensland *Public Health Act 2005* and the Public Health Regulation 2018.

Diagnosis and management of LTB is an important part of TB management, with the efficacy of currently available preventative treatments ranging from 60–90 per cent,[9] and consideration of adding LTB as a nationally notifiable condition. This report focuses on diagnoses of active TB in Queensland.

Methods

Tuberculosis (TB) is a pathological diagnosis[1] and provisional diagnosis[2] notifiable condition under Schedule 1 of the Queensland Public Health Regulation 2018. Pathology providers are required to notify the Department of Health of any positive tests for TB as per the Queensland notification criteria guidelines for laboratories.[10] Cases are classified according to the national case definition for TB.[11] Within Queensland, cases are additionally classified as confirmed (laboratory definitive evidence) or probable (clinical evidence only) (Box 1). All cases notified provisionally with TB undergo a review of clinical information by the Medical Advisor, Tuberculosis Queensland Health to ascertain evidence of a clinical course consistent with TB.

Box 1. Australian national notifiable diseases surveillance case definition for Tuberculosis

Tuberculosis surveillance case definition

A confirmed case requires a diagnosis accepted by the Director of Tuberculosis Control (or equivalent) in the relevant jurisdiction, based on either:

1. Laboratory definitive evidence

OR

2. Clinical evidence

Laboratory definitive evidence

- Isolation of *Mycobacterium tuberculosis* complex (*M. tuberculosis*, *M. bovis* or *M. africanum*, excluding *M. bovis* var BCG) by culture

OR

- Detection of *M. tuberculosis* complex by nucleic acid testing EXCEPT where this is likely to be due to previously treated or inactive disease.

Clinical evidence

A clinician experienced in tuberculosis makes a clinical diagnosis of tuberculosis, including clinical follow-up assessment to ensure a consistent clinical course.

Data were extracted from the Queensland Notifiable Conditions System on 10 August 2020 for all confirmed and probable cases of TB notified between 1 January 2015 and 31 December 2019.

[1] Pathological diagnosis notifiable condition refers to a condition where a diagnosis can be made based on a pathology examination of a specimen; When TB has been diagnosed by a pathology service, it is required to be notified to the Notifiable Conditions Register

[2] Provisional diagnosis notifiable condition refers a condition in which a provisional diagnosis can be made based on clinical evidence while awaiting laboratory confirmation if available. When a TB diagnosis is provisionally made It is required to be notified to the Notifiable Conditions Register.

Data are collected from Queensland tuberculosis services and physicians, including demographic details, risk factors, clinical symptoms, treatment, and outcomes. Visa status is also part of the data collection and is provided by self-report.

Papua New Guinea (PNG) residents diagnosed with TB in Queensland (meeting the case definition) who have entered Australia through the Torres Strait Protected Zone (TSPZ) are counted in the number of TB cases in Queensland and are included in the report data unless otherwise stated. These TSPZ residents are also referred to as cross-border cases and are considered as residing in a high incidence country for TB, and any without an arrival date are considered to have newly arrived within the previous year. High TB incidence countries were classified using World Health Organization (WHO) TB burden country estimated incidence data.[12] Countries with an estimated incidence over 40 per 100, 000 population per year were classified as a high TB incidence country. For reporting of risk factor data in this report, such countries are also described as high-risk countries (HRC).

Laboratory confirmatory and drug susceptibility testing were conducted at the Queensland Mycobacterial Reference Laboratory, a WHO designated Supranational Reference Laboratory and Collaborating Centre. All TB cultures, including isolates referred by private pathology providers, were phenotypically tested for first line resistance to isoniazid (H), rifampicin (R), ethambutol (E), pyrazinamide (Z), and streptomycin (S) using the BACTEC™ MGIT™ 960 proportion method, and additional susceptibility testing for amikacin (AK), capreomycin (CAP), cycloserine (CYC), ethionamide (ETD), kanamycin (KAN), and ofloxacin (OFL) where first line resistance was detected. Susceptibility testing for para aminosalicylic acid (PAS) was unable to be performed due to a lack of available testing agents. Moxifloxacin susceptibility testing was introduced in 2018, and ofloxacin testing ceased. All drug concentrations were as recommended by WHO. All cases of phenotypic drug resistance were further assessed by molecular methods.

The GeneXpert™ MTB/RIF assay is a nucleic acid amplification test which detects the presence of both *M. tuberculosis* and rifampicin resistance in a clinical specimen or culture isolate. The Queensland Mycobacterium reference Laboratory routinely performed Xpert MTB/RIF on all new submitted smear positive sputa, and on request for smear negative sputa and extra-pulmonary specimens, or on request from private pathology services. GeneXpert™ and other molecular techniques are used for early identification of resistance. Multi-drug resistant TB (MDR-TB) is defined as resistance to isoniazid and rifampicin, with or without resistance to other first-line drugs.[3] In 2019, conventional Xpert MTB/RIF cartridges were phased out and replaced with the Xpert MTB/RIF Xpert Ultra which is a more sensitive assay for the detection of *M. tuberculosis*.

A successful outcome was defined as a case completing treatment. Unsuccessful outcomes included died of TB, treatment failure, and defaulted from treatment. Treatment default is considered equivalent to the WHO outcome of “lost to follow-up.” Death data were confirmed by a cross-check of records against the Deaths registry unit records by the Queensland Health Statistics Branch. Outcomes excluded from comparison are transferred out of Australia, died of a cause other than TB, still on treatment, and outcome unknown. Where a case transfers from Queensland to other states or territories during treatment, details on outcomes are sought from interstate tuberculosis control services.

Data is presented by notification date which represents the date the laboratory sent the result to the Notifiable Conditions Register in Queensland.

Descriptive analyses were performed using Microsoft Excel™ and Stata/IC^{R} version 14.2. A *p* value of less than 0.05 was considered statistically significant. Cases were assigned to a geographic Hospital and Health Service (HHS) area based on their residential address at the time of diagnosis. Geographic distribution used Queensland HHS boundaries with mapping undertaken in ArcGIS. Overseas residents diagnosed with TB in Queensland are not included in HHS counts or notification rates. Notification rates were calculated using the Queensland Hospital and Health Service and Indigenous/non-Indigenous Estimated Resident Population (ERP).[13] The 2018 ERP was used to calculate 2019 rates as the 2019 ERP was not available at time of report.

Notifications of TB

In Queensland there was an average of 194 notifications of TB each year between 2017 and 2019. Annual totals were 188 notifications in 2017, 199 in 2018 and 194 in 2019. The annual notification rate of TB fluctuated between 3.8 cases per 100,000 population in 2017 and 4.0 cases per 100, 000 population in 2018 (Figure 1). Following a peak in 2011 and subsequent dip in 2012-2013, the notification rate of TB in Queensland has shown a gradual increase during 2013-2019 from 3.3-4.0 cases per 100,000 population per year.

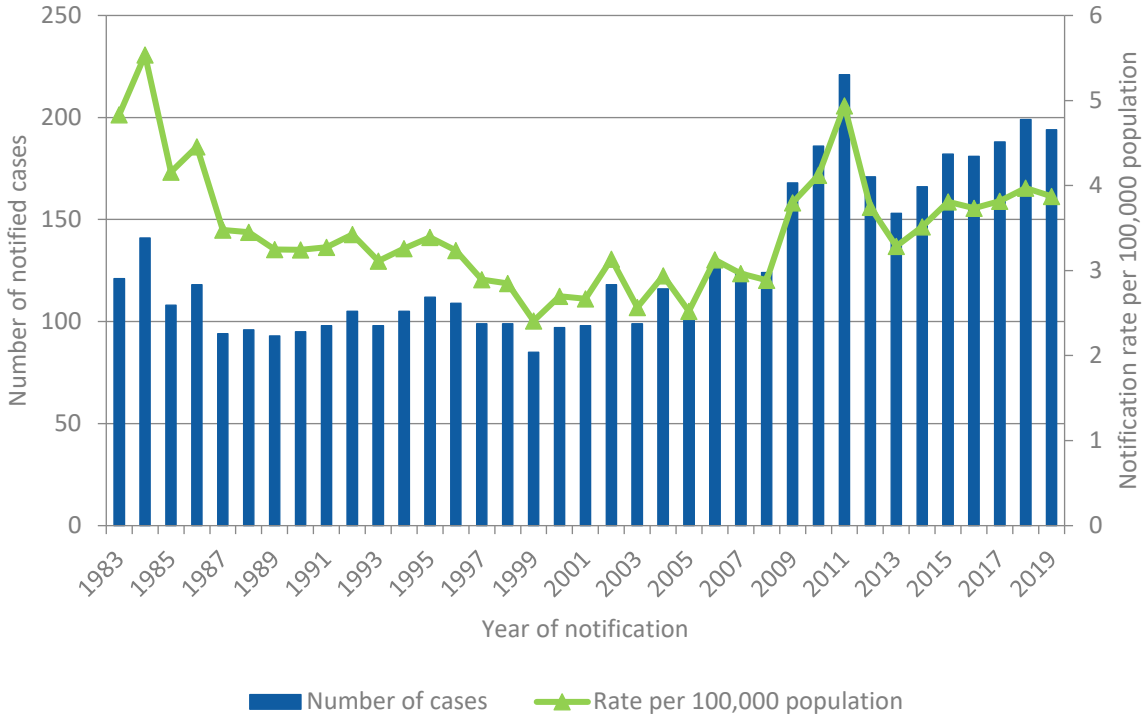

Figure 1. Number and notification rate of TB notifications in Queensland, 1983-2019

Queensland has lower TB incidence in comparison to more populated States. In 2018 NSW and Victoria's rates were 6.5 and 7.1 per 100,000 population.[6] Queensland reported the second lowest notification rate of TB during 2017–2019 amongst all Australian jurisdictions.[6] Queensland notifications represent 13–14 per cent of Australian notifications of TB each year during 2017–2019, while Queensland's population represents 20 per cent of the Australian population.[6, 14]

Demographic characteristics

Age and Sex

During 2017–2019, 51 per cent of cases were female and 49 per cent of cases were male. The ratio of females to males fluctuated between 0.9–1.2 each year with no consistent pattern of a predominant gender during the three-year period.

The age of cases at disease onset during 2017–2019 ranged from 6 months to 97 years with a median age of 39 years. A small number of children are notified with TB in Queensland with 3 per cent of TB notifications occurring in persons aged under 15 years during 2017–2019. Highest numbers and rates of TB notifications were seen in persons aged between 20–39 years of age. The next highest notification rate was seen in persons aged 80–84 years of age (Figure 2).

There was a decrease in notification rates seen in children aged under 15 years and an increase in persons aged 65 years and older during 2017–2019, compared with the age specific notification rates for the previous 3-year period.

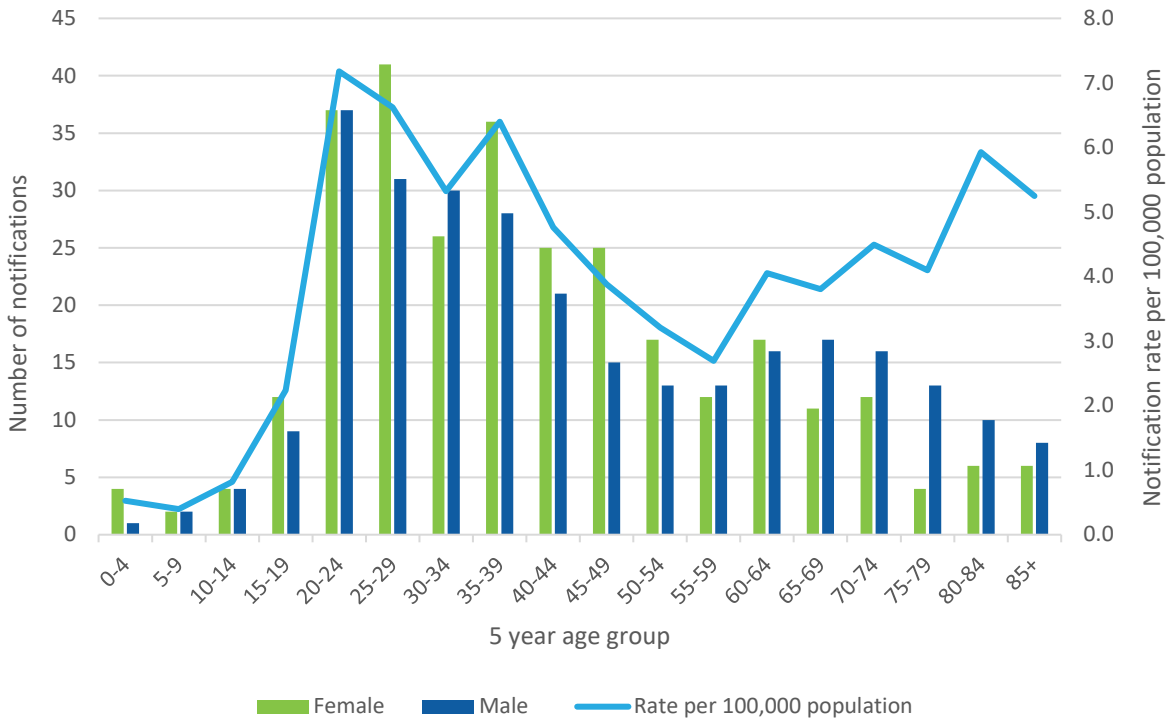

Figure 2. Number of TB cases by sex and age group and age specific notification rate, Queensland 2017 -2019

Place of residence

In 2017–2019 the majority of persons notified with TB in Queensland resided in the South East of the state, with 192 cases (40%) in Metro South Hospital and Health Service (HHS) and 104 cases (22%) in Metro North HHS (Table 1). Over the three-year period, 46 cases (10%) diagnosed with TB in Queensland had an overseas residential address. The majority of these (27 cases, 64%) were residents of PNG at the time of diagnosis. Of the remaining cases 19 resided in other countries, most of which (17) were countries considered to be high TB incidence countries.

Taking into account population size, the highest notification rate in Queensland during 2017–2019 was in the Torres and Cape HHS with 12.4 cases per 100,000 population per year, however rates were lower than the 2014 and 2015 Torres and Cape HHS rates of 35.5 cases and 23.1 cases per 100,000 population per year respectively. Other areas with high notification rates include Cairns and Hinterland HHS (8.5 cases per 100,000 population per year) and North West HHS (9.5 cases per 100,000 population per year) although case numbers are low in this HHS (Table 1, Figure 3). Of the Brisbane metropolitan areas, Metro South HHS (5.6 cases per 100,000 population per year) has the highest rate of TB notifications, followed by Metro North and West Moreton.

The HHS areas that saw their highest number of TB notifications during 2017–2019 compared to the previous 3 years include: Cairns (29 in 2019), Metro South (64 cases in 2017, 2018 and 2019), Metro North (38 cases in 2018), Gold Coast (22 cases in 2017), Sunshine Coast (8 cases in 2018), Wide Bay (6 cases in 2019) and Central West (first case of TB notified within the last 10 years).

Table 1. Number, percentage and rate of TB notifications by HHS of residence, Queensland 2017-2019

Hospital and Health Service[3]	2017	2018	2019	Total	%	Rate per 100,000 population
Torres and Cape	4	4	2	10	1.7	12.1
Cairns and Hinterland	19	21	25	65	11.2	8.4
North West	4	3	1	8	1.4	9.6
Townsville	2	8	9	19	3.3	2.6
Mackay	0	1	6	7	1.2	1.4
Central West	0	1	0	1	0.2	3.2
Central Queensland	2	6	1	9	1.5	1.4
Wide Bay	2	2	6	10	1.7	1.5
Sunshine Coast	5	8	6	19	3.3	1.5
Darling Downs	5	3	4	12	2.1	1.4
South West	0	0	0	0	0.0	0.0
West Moreton	12	7	10	29	5.0	3.3
Metro North	33	38	33	104	17.9	3.4
Metro South	64	64	64	192	33.0	5.5
Gold Coast	22	13	15	50	8.6	2.7
Overseas residents	14	20	12	46	7.9	-
Total row	188	199	194	581	100.0	3.9

[3] Townsville TBCU covers Townsville HHS and North West HHS. Rockhampton TBCU covers Central Queensland HHS and Central West HHS. Toowoomba TBCU covers Darling Downs HHS and South West HHS. Metro South TBCU covers the HHSs of Metro South, Metro North, Gold Coast, Sunshine Coast, West Moreton, and Wide Bay.

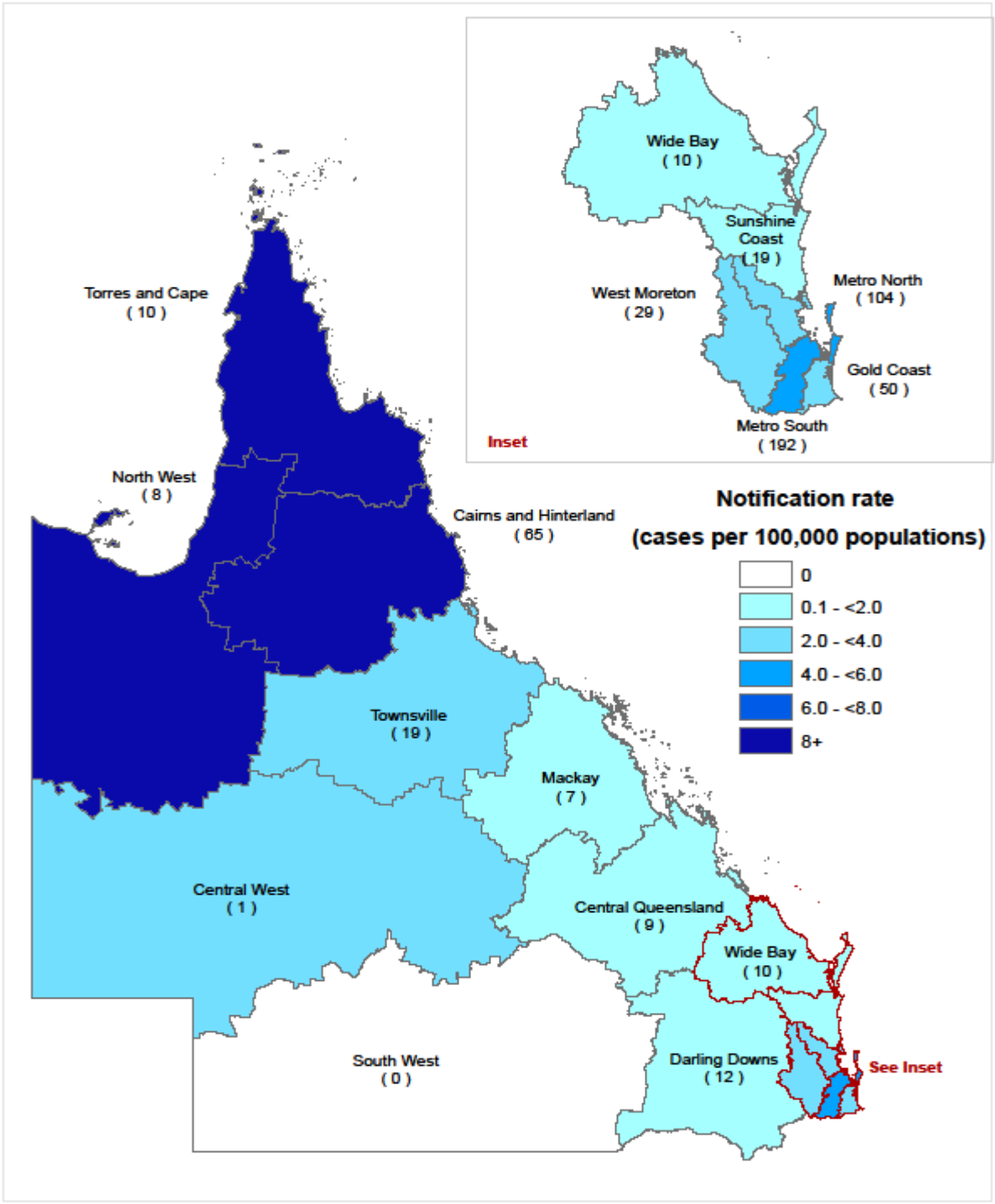

Figure 3. Number and notification rate of TB cases by HHS of residence Queensland 2017-2019

Distribution of cases by TB Control Unit

The management of TB in Queensland is distributed among 1 metropolitan and 6 regional TB Control Units (TBCU). The majority of TB patients in Queensland are managed by Metro South Clinical TB Services (MSCTBS). Cairns TBCU manage the next highest proportion of patients in Queensland, followed by Townsville TBCU. The managing TBCU for each case is nominated by the TB nurse completing the surveillance form. The management of some cases is across multiple TBCUs.

Table 2. Number and proportion of TB cases by managing TB Control Unit, Queensland 2017-2019

TB Control Unit	2017	2018	2019	Total	%
Torres and Cape	6	8	6	20	3.4
Cairns	23	33	26	82	14.1
Townsville	10	11	11	32	5.5
Mackay	0	1	7	8	1.4
Rockhampton	3	7	2	12	2.1
Toowoomba	6	3	6	15	2.6
MSCTBS	140	136	136	412	70.9
Total row	188	199	194	581	100.0

Aboriginal and Torres Strait Islander peoples

There were 36 notifications of TB in Queensland Aboriginal and Torres Strait Islander peoples during 2017–2019, which accounted for 5–8 per cent of all TB notifications each year during the last 5 years (Table 3).

Table 3. TB notifications by Aboriginal and/or Torres Strait Islander origin, Queensland 2015-2019

Aboriginal and Torres Strait Islander status	2015 n (%)	2016 n (%)	2017 n (%)	2018 n (%)	2019 n (%)
Aboriginal but not Torres Strait Islander	9 (5)	5 (3)	6 (3)	6 (3)	6 (3)
Torres Strait Islander but not Aboriginal	6 (3)	3 (2)	3 (2)	8 (4)	5 (3)
Both Aboriginal and Torres Strait Islander	0 (0)	0 (0)	1 (1)	0 (0)	1 (1)
Neither Aboriginal nor Torres Strait Islander	167 (92)	173 (96)	178 (95)	185 (93)	181 (93)
Not Stated / Unknown	0 (0)	0 (0)	0 (0)	0 (0)	1 (1)
Total row	182 (100)	181 (100)	188 (100)	199 (100)	194 (100)

The median age of First Nations cases during 2017–2019 (42 years) was significantly younger than the median age in non-indigenous Australian cases (62 years).

Of Australian born Queenslanders notified with TB, a third are Aboriginal and Torres Strait Islander peoples, with an average of 36 per cent of notifications during 2017–2019. The rate of TB notifications in Aboriginal and Torres Strait Islander peoples in Queensland was 8–15 times the rate of TB notifications in non-Indigenous Australian born persons during 2017–2019 (Figure 4).

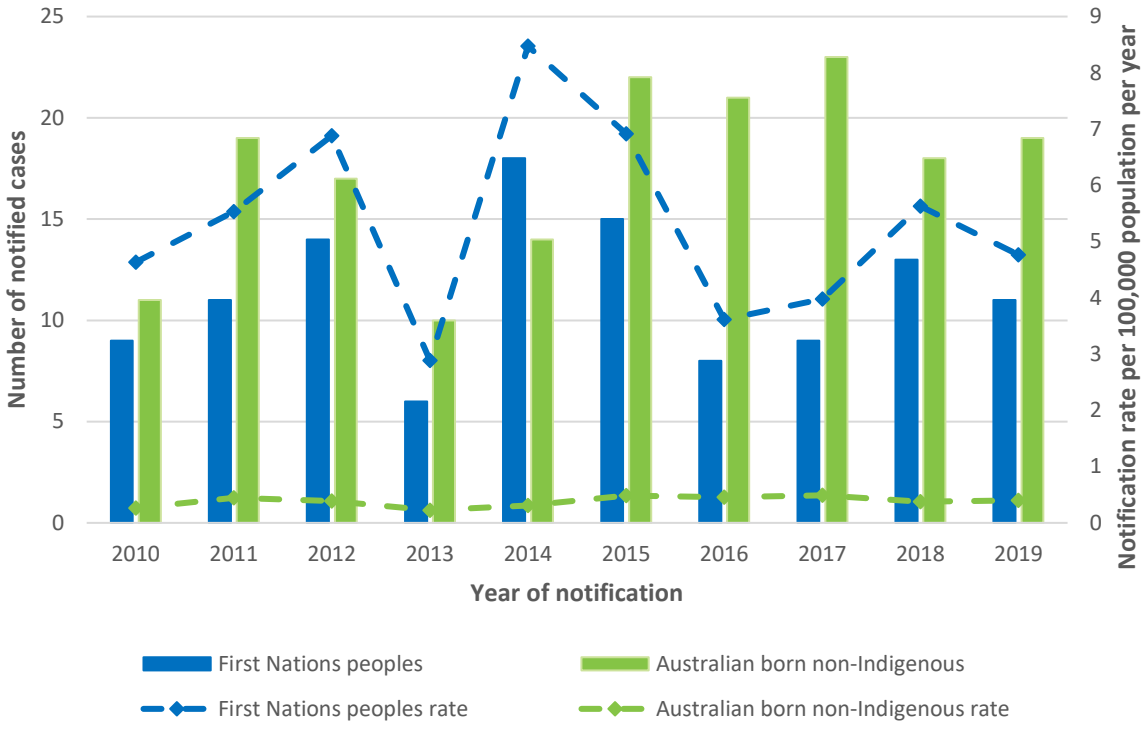

Figure 4. Number and notification rate of TB in Australian born persons in Queensland 2010-2019, First Nations compared to non-Indigenous

Country of birth

During 2017–2019, 488 (84%) of cases were born overseas. By year, there were 156 (83%) in 2017, 168 (84%) in 2018 and 164 (85%) in 2019 overseas born cases. The majority of overseas born cases (444, 91%) were born in a high TB incidence country. The most frequently reported countries of birth include Philippines (18%), India (13%), Papua New Guinea (13%), Vietnam (6%) and China (6%). The number of cases from these countries has fluctuated over the last 5 years (Figure 5). In addition to the most frequently reported countries of birth, there are a number of other high TB incidence countries represented in the TB notifications during 2015–2019 (Table 4).

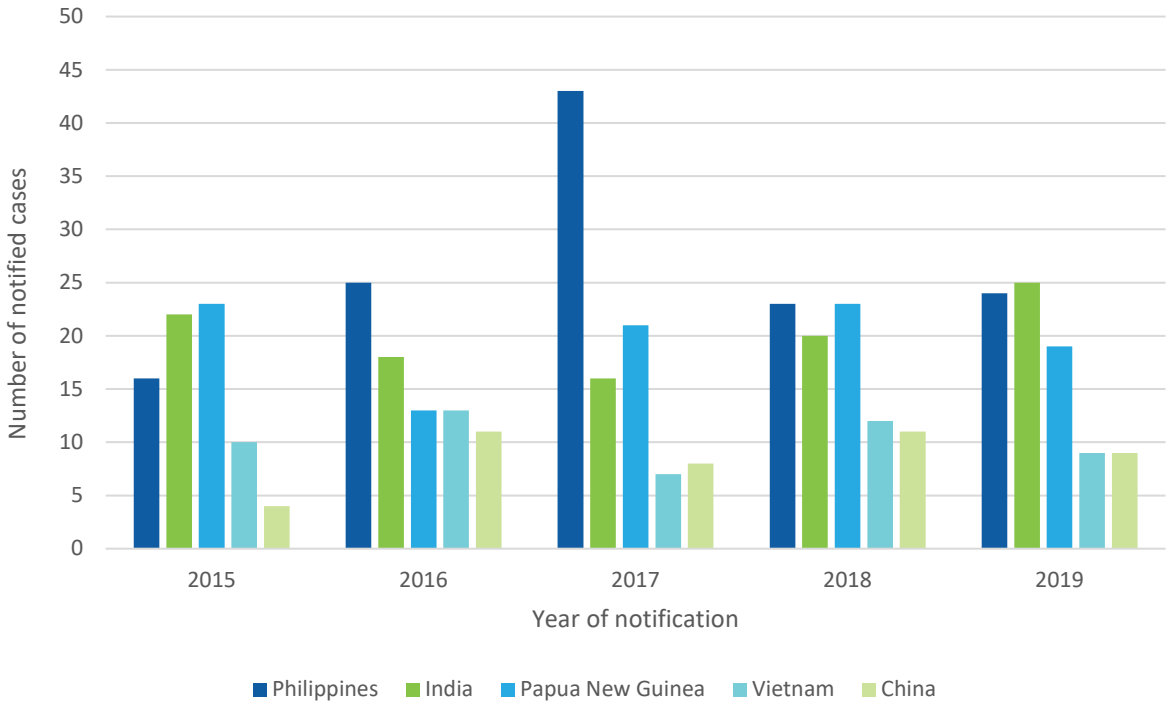

Figure 5. Number of TB cases by top 5 countries of birth notified in Queensland, 2015-2019

Table 4. Number and percentage of overseas born cases by country of birth, Queensland, 2015-2019

Country of birth	2015	2016	2017	2018	2019	Total 2015–2019	% 2015–2019
Philippines	16	25	43	23	24	131	16.7
India	22	18	16	20	25	101	12.9
Papua New Guinea	23	13	21	23	19	99	12.6
Vietnam	10	13	7	12	9	51	6.5
China	4	11	8	11	9	43	5.5
Thailand	2	4	5	9	6	26	3.3
Myanmar	6	5	4	3	7	25	3.2
Indonesia	6	5	4	3	6	24	3.1
Nepal	5	3	3	2	10	23	2.9
Other	51	55	45	62	49	262	33.4
Total overseas born	145	152	156	168	164	785	100.0

The population pyramid highlights the differences in overseas and Australian born cases (Figure 6). Overseas born TB cases are significantly younger than Australian born cases with an average age of 41 years (95%CI 39–42) compared to 54 years (95%CI 50–58). More than half of overseas born cases are aged under 40 years compared to a third of Australian born cases.

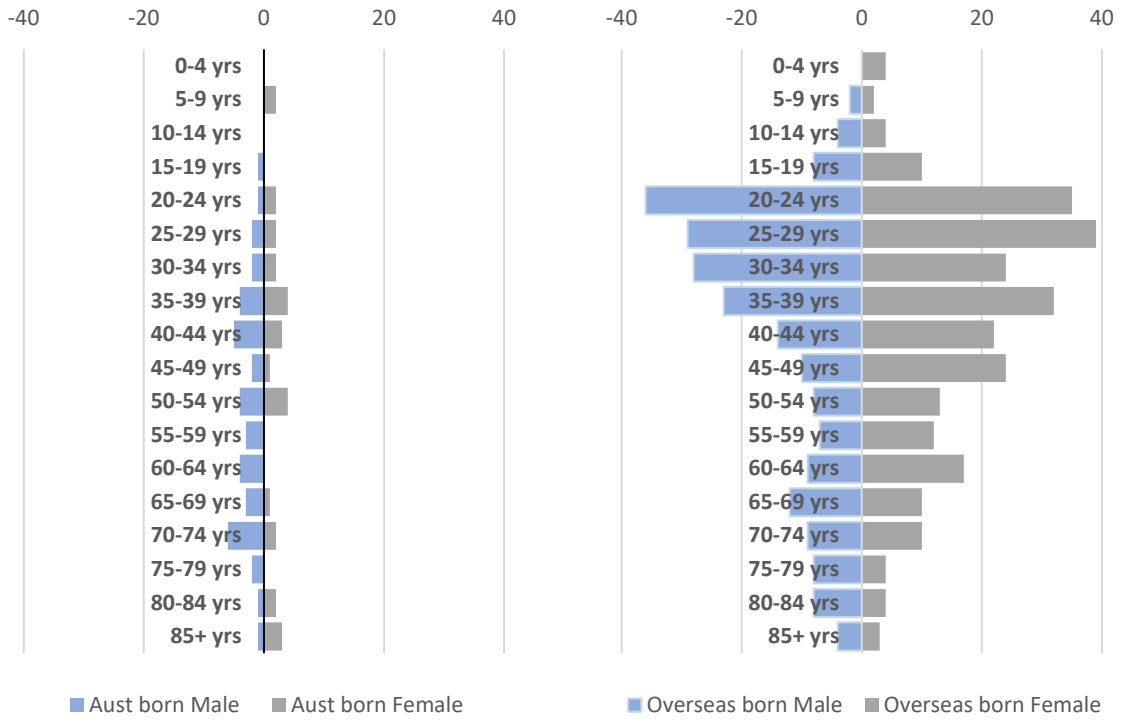

Figure 6. Number of Australian born and Overseas born TB cases by age group and sex, Queensland 2017-2019

Of the 488 cases who were born overseas in 2017–2019, half of them (n=247) were notified with TB within 5 years of arriving in Australia, with nearly a quarter of these (n=119) newly arrived or notified within the first year of arriving in Australia (Figure 7).

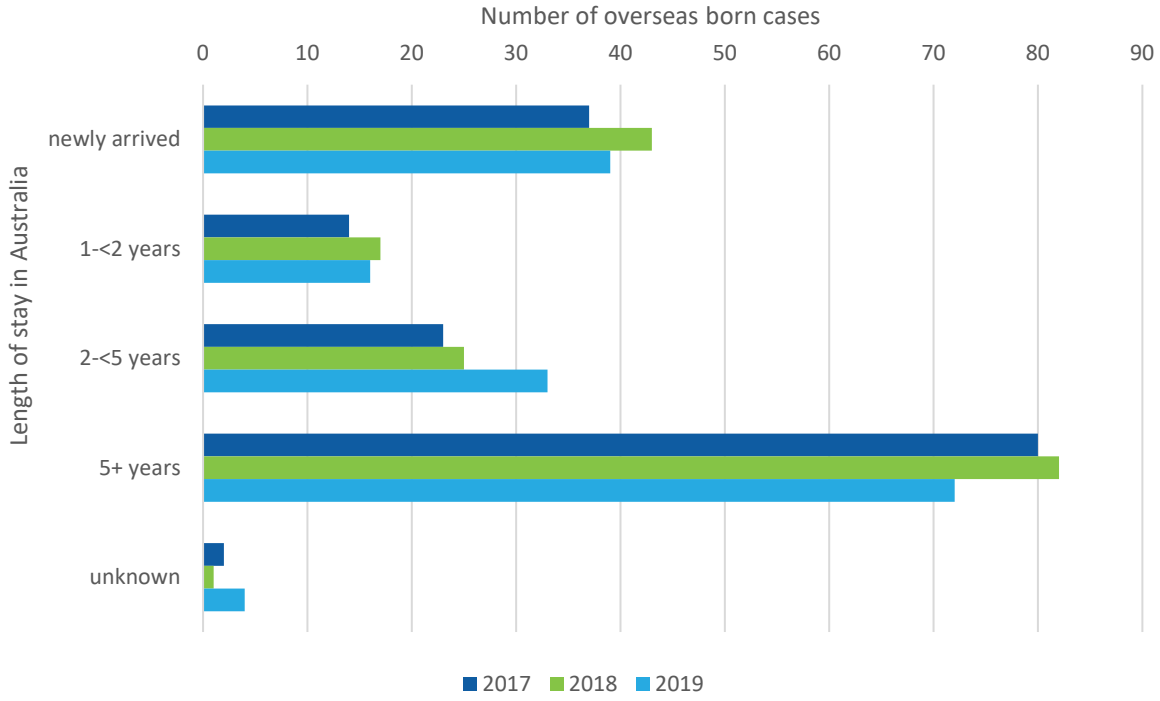

Figure 7. Length of stay in Australia (prior to diagnosis) for overseas born TB cases, Queensland 2017-2019

A person applying for a visa to reside in Australia is required to undergo a health examination. If that assessment identifies a potential risk for active TB post-migration, the person is put on a TB health undertaking. This is an agreement with the Australian Government to attend and follow up with a TB service in Australia. During 2017–2019, an average of 16 per cent (13–18%) of overseas born cases each year were on a health undertaking at the time of their TB diagnosis. Although this proportion fluctuates over time, it has remained stable since 2015.

Half of the overseas born cases during 2017–2019 were permanent residents of Australia at the time of their diagnosis (Table 5). Five per cent of overseas born cases during 2017–2019 were PNG residents diagnosed with TB on the Australian islands of the Torres Strait Protected Zone (Treaty Visitation rights).

Table 5. Residency status of overseas born TB cases at diagnosis, Queensland 2017-2019

Residency status	2017	2018	2019	Total	%
Permanent resident	81	81	78	240	49.2
Overseas student	20	18	25	63	12.9
Refugee/humanitarian	9	17	14	40	8.2
Overseas visitor	12	11	14	37	7.6
Treaty visitation rights	6	13	5	24	4.9
Unauthorised person	1	1	1	3	0.6
Other	27	27	27	81	16.6
Total overseas born	156	168	164	488	100.0

Risk Factors

Common risk factors

Information on risk factors for TB was available for all cases during 2017–2019. The most frequently reported risk factors were migration from a high-risk TB country (HRC), and spending time, travel or residence in a HRC that was not the cases country of birth (Table 6). Both factors were more common in overseas born than Australian born cases. Similar proportions of Australian born and overseas born cases reported close contact with a person with TB. However, Australian born cases were more likely than overseas born cases to report diabetes, alcohol and non-IV drug use, steroids/immunosuppressive therapy, renal failure, and homelessness. Current or previous employment in the healthcare industry was more commonly reported in overseas born cases than Australian born cases.

Table 6. Risk factors for TB by place of birth, Queensland 2017-2019

Common risk factors	All cases		Australian born cases		Overseas born cases	
	n	%	n	%	n	%
Total	581	100	93	100	488	100
Migrant from HRC	380	65	0	0	380	78
Past travel to or residence in HRC	377	65	31	33	346	71
Close contact with TB	147	25	23	25	124	25
Refugee	74	13	0	0	74	15
Diabetes	59	10	17	18	42	9
Currently or previously employed in health industry	53	9	2	2	51	10
Alcohol or non-IV drug abuse	34	6	20	22	14	3
Steroids/immunosuppressive therapy	34	6	9	10	25	5
Renal failure	11	2	6	6	5	1
HIV coinfection	12	2	1	1	11	2
Homelessness	10	2	8	9	2	0
Immunosuppression due to cancer (other than skin cancer)	7	1	4	4	3	1
IV drug use	3	1	2	2	1	0
Institutional living	1	0	1	1	0	0
Major abdominal surgery	1	0	0	0	1	0
Silicosis	0	0	0	0	0	0
Other	25	4	12	13	13	3
No known risk factors	22	4	15	16	7	1
Risk factors not assessed	0	0	0	0	0	0

TB-HIV coinfection

It is recommended that all new TB cases in Queensland are tested for HIV.[2] The proportion of TB cases tested for HIV has improved over the last 5 years, with an increase from 79 per cent in 2015 to 92 per cent in 2018 (Table 7).

Table 7. HIV testing of TB cases, Queensland 2015-2019

HIV testing status	2015	2016	2017	2018	2019
HIV tested	144	160	168	184	171
Not tested	30	21	20	15	21
Refused testing	1	0	0	0	0
Testing history unknown	7	0	0	0	2
Total	182	181	188	199	194
Percentage tested	79%	88%	89%	92%	88%

Of the TB cases tested for HIV during 2017–2019 there were 12 (2%) co-infected with HIV. Over the last 5 years the number of co-infections has ranged from 3–5 cases per year (2–3% of tested cases).

TB in health care workers

During 2017–2019, 65 cases (11%) reported having worked in a healthcare facility prior to their diagnosis with TB and of these, 50 cases (77%) were healthcare workers (HCW), 14 in 2017, 19 in 2018 and 17 in 2019.

Of the 50 cases who reported being HCWs, 4 (8%) were born in Australia and 46 (92%) were born overseas, all in high TB incidence countries. Thirty-four (68%) reported currently working or working within the last 12 months as a HCW in Australia, of whom 4 were likely to have been infectious while in their workplace as diagnostic respiratory samples were smear positive. Contact tracing is undertaken by TBCUs in collaboration with facility-based infection control services where a HCW or patient is considered infectious in a health care setting. From these 4 cases, there have been no secondary cases of TB disease identified.

Clinical presentation

Site of disease

Pulmonary and extra-pulmonary disease

Similar proportions of notified cases of TB presented with pulmonary disease in 2017 and 2018 with presentations for pulmonary disease slightly less in 2019 (Table 8). In general, two-thirds of TB cases in Queensland have pulmonary disease involvement (60–67%) and one-third have extrapulmonary disease only (34–40%).

Table 8. Site of TB disease, Queensland 2017-2019

Site of disease	2017 n (%)	2018 n (%)	2019 n (%)
Pulmonary	111 (59)	113 (57)	101 (52)
Pulmonary plus other sites	13 (7)	19 (10)	15 (8)
Extrapulmonary disease only	64 (34)	67 (34)	78 (40)
Total	188 (100)	199 (100)	194 (100)

The most common extrapulmonary sites of disease presentation were involvement of the lymph nodes (19%) followed by pleura (7%), abdomen (4%), bone or joint (4%) and meninges/central nervous system (3%) (Table 9). Lymph node disease was more likely to occur in overseas born cases than Australian born cases.

Table 9. Sites of disease for cases with extrapulmonary involvement, Queensland 2017-2019

Extrapulmonary site of disease	Number	%
Lymph node	110	19
Pleura	39	7
Abdominal	23	4
Bone or joint	22	4
Meninges/Central Nervous System	19	3
Disseminated TB	14	2
Eye	14	2
Genitourinary	12	2
Miliary	9	2
Pericardial	3	<1
Other site	24	4

Disease classification

New and relapse cases

The majority of cases notified in Queensland were new cases of TB (Table 10), with 5–7 per cent of cases per year that were identified in previously treated patients. These included cases whose previous treatment was overseas (19 cases, 3%) or in Australia (13 cases, 2%) and their relapse may have been due to recrudescence of disease with the same strain or acquisition of a new strain of *M. tuberculosis*.

Table 10. Disease classification of TB cases, Queensland 2017-2019

Case Type	2017 n (%)	2018 n (%)	2019 n (%)
New case	180 (96)	189 (95)	180 (93)
Relapse following full or partial treatment overseas	7 (4)	5 (3)	7 (4)
Relapse following full treatment in Australia	1 (1)	4 (2)	7 (4)
Relapse following partial treatment in Australia	0 (0)	1 (1)	0 (0)
Total	188 (100)	199 (100)	194 (100)

Presentation and treatment

Approximately half of the TB cases notified during 2017–2019 initially presented because of symptoms consistent with TB (279, 48%), with a further 119 (20%) initially identified through TB screening. Reasons for screening were health undertakings (62%), contact screening of household and other close contacts (14%), high risk migrant screening (12%), HCW screening (5%) and other reasons (7%). The remaining one third of cases notified during 2017–2019 initially presented for an unrelated illness and TB was made as an incidental diagnosis.

Most TB cases notified during 2017–2019 (559, 96%) began treatment in Queensland. Eighty percent of cases who began treatment, did so within a week of diagnosis and 92 per cent had begun within 2 weeks of diagnosis (Figure 8). For sputum smear positive cases, 92 per cent began treatment within a week of diagnosis and 96 per cent had begun within 2 weeks of diagnosis.

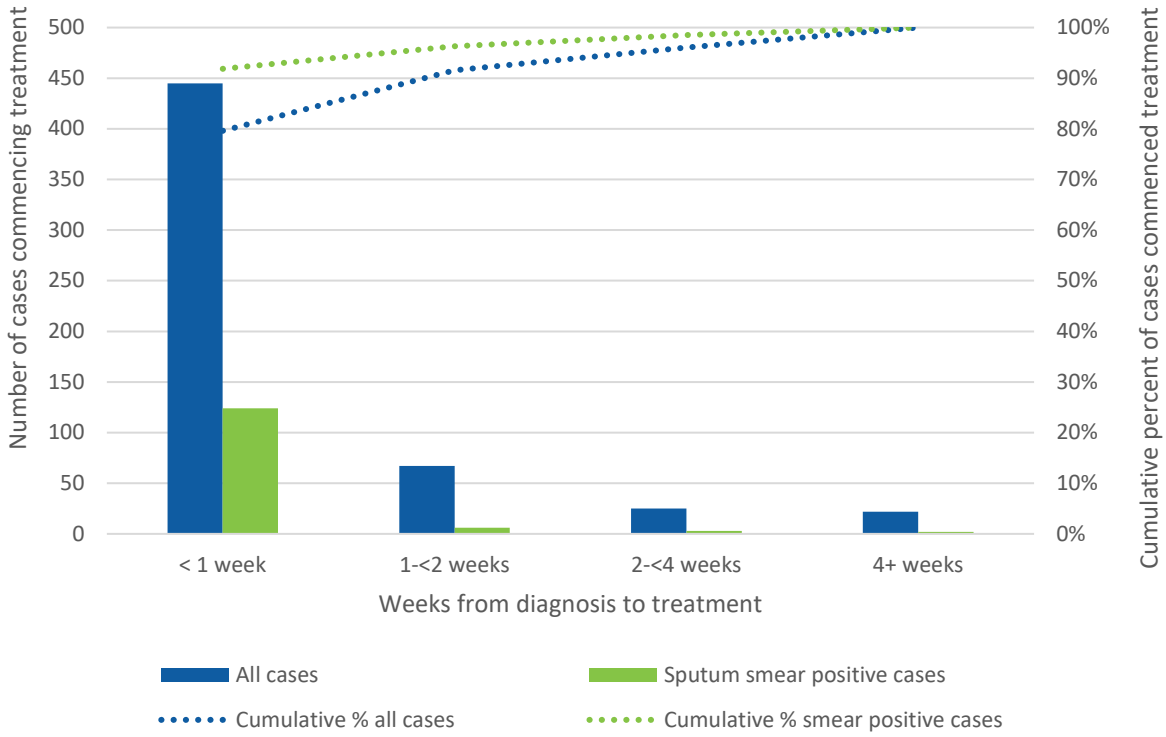

Figure 8. Time from diagnosis to treatment (number, cumulative percent) for all cases and sputum smear positive cases in Qld, 2017-2019

Clinically diagnosed cases

All clinically diagnosed cases in Queensland require evidence of a follow up assessment that confirms their clinical path is consistent with TB to meet the national surveillance case definition.[11] During 2016–2018 there was an increase in the number of clinically diagnosed TB cases in Queensland particularly in PNG residents diagnosed in the Torres Strait Protected Zone (TSPZ). PNG residents diagnosed clinically with TB in the TSPZ who are referred to PNG health services before a complete diagnostic work up is feasible, generally do not have evidence of their clinical pathway. Therefore, these cases were removed from Queensland surveillance numbers but would be expected to appear in PNG surveillance data if TB was confirmed. Excluded clinical diagnoses in PNG treaty residents numbered 7 in 2016, 12 in 2017, 10 in 2018 and 4 in 2019.

Laboratory testing

Of the 581 TB cases in 2017–2019, 512 (88%) of diagnoses were laboratory confirmed either by isolation of *Mycobacterium tuberculosis* complex [*M. tuberculosis*, *M. bovis*, or *M. africanum*, excluding *M. bovis* var BCG] by culture or detection of *Mycobacterium tuberculosis* complex by nucleic acid testing, except where this was likely to be due to previously treated or inactive disease.[11]

In 2017–2019, 489 (84%) cases were confirmed by culture including 2 cases of *M. africanum*, 3 cases of *M. bovis* (excluding BCG variant) and 484 cases of *M. tuberculosis*. A further 23 (4%)

cases were confirmed by nucleic acid testing only and the remaining 69 (12%) cases were made by clinical diagnoses.

Laboratory confirmation was more common in cases with pulmonary involvement (97%) than cases who had extrapulmonary disease only (73%).

Drug susceptibility testing

Of the 489 culture confirmed cases in 2017–2019, 486 (99%) had drug susceptibility testing (DST) information available. Of these 486 cases, 402 (83%) were fully susceptible to first line drugs, 64 (13%) were resistant to one or more of the first line drugs and 20 (4%) were classified as MDR-TB (Table 11).

Table 11. Phenotypic drug susceptibility testing of culture positive TB cases by site of disease, Queensland 2017-2019

2017 Drug susceptibility testing	Pulmonary cases (including those with other sites) n (%)	Extrapulmonary cases n (%)	Total n (%)
Fully susceptible	98 (83)	38 (79)	136 (82)
Isoniazid resistant but susceptible to rifampicin	8 (7)	3 (6)	11 (7)
Rifampicin resistant but susceptible to isoniazid	0 (0)	0 (0)	0 (0)
Other resistance but susceptible to isoniazid and rifampicin	7 (6)	5 (10)	12 (7)
Multi-drug resistant (resistant to isoniazid and rifampicin)	5 (4)	1 (2)	6 (4)
Total	118 (100)	48 (100)	166 (100)

2018 Drug susceptibility testing	Pulmonary cases (including those with other sites) n (%)	Extrapulmonary cases n (%)	Total n (%)
Fully susceptible	100 (79)	41 (85)	141 (81)
Isoniazid resistant but susceptible to rifampicin	6 (5)	4 (8)	10 (6)
Rifampicin resistant but susceptible to isoniazid	0 (0)	0 (0)	0 (0)
Other resistance but susceptible to isoniazid and rifampicin	10 (8)	3 (6)	13 (7)
Multi-drug resistant (resistant to isoniazid and rifampicin)	11 (9)	0 (0)	11 (6)
Total	127 (100)	48 (0)	175 (100)

2019 Drug susceptibility testing	Pulmonary cases (including those with other sites) n (%)	Extrapulmonary cases n (%)	Total n (%)
Fully susceptible	90 (87)	34 (83)	124 (86)
Isoniazid resistant but susceptible to rifampicin	9 (9)	3 (7)	12 (8)
Rifampicin resistant but susceptible to isoniazid	0 (0)	1 (2)	1 (1)
Other resistance but susceptible to isoniazid and rifampicin	3 (3)	2 (5)	5 (3)
Multi-drug resistant (resistant to isoniazid and rifampicin)	2 (2)	1 (2)	3 (2)
Total	104 (100)	41 (100)	145 (100)

The majority of cases found to be resistant to drugs other than isoniazid and rifampicin were resistant to streptomycin only (63%) followed by pyrazinamide only (20%) (Table 12).

Table 12. Phenotypic drug resistance patterns for culture positive TB cases susceptible to both isoniazid and rifampicin, Queensland 2017-2019

Other resistance drug susceptibility profiles	Total cases (pulmonary and extrapulmonary) n (%)
Streptomycin resistant only	19 (63)
Pyrazinamide resistant only	6 (20)
Ethionamide resistant only	3 (10)
Ofloxacin resistant only	1 (3)
Streptomycin and Ethionamide resistant	1 (3)
Total	30 (100)

There were three culture confirmed cases where phenotypic drug susceptibility was not possible. One culture was overgrown with non-acid fast microorganisms and two others grew *Mycobacterium tuberculosis* complex and a nontuberculous mycobacterium.

The pattern of drug resistance since 2010 shows that the proportion of fully susceptible culture confirmed cases has ranged between 77–87 per cent over time (Figure 9).

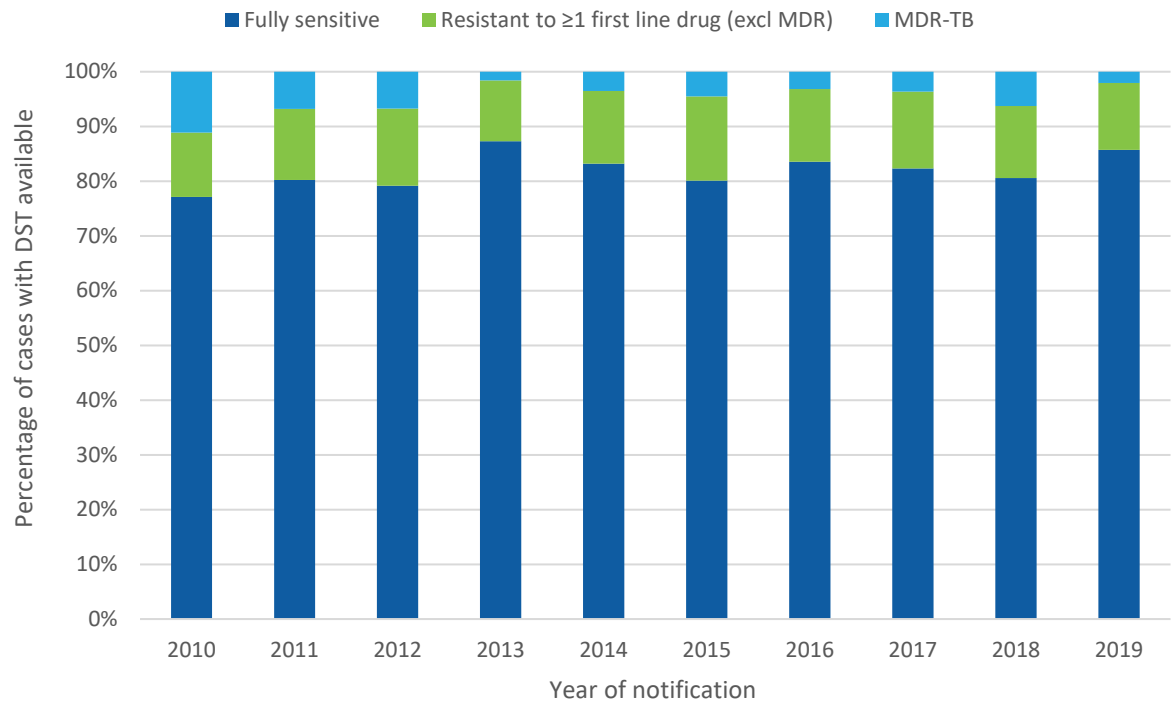

Figure 9. Drug susceptibility of culture confirmed TB cases, Queensland 2010-2019

There were 19 TB cases where drug susceptibility results were only available through molecular methods and all of these were rifampicin susceptible (Table 14). Drug susceptibility testing (either through phenotypic or molecular techniques was not available for 4 cases whose TB was found using an in-house PCR on tissue specimens (2 lymph node, 1 aorta tissue and 1 lung tissue).

Table 13. Molecular drug susceptibility testing of NAT positive cases, Queensland 2017-2019

Molecular drug susceptibility testing	Pulmonary cases (including those with other sites)	Extrapulmonary cases	Total
Rifampicin susceptible	8	11	19
Unable to be performed	1	3	4
Total	9	14	23

There were 20 (4%) MDR-TB cases identified during 2017–2019. There were no cases of extensively drug resistant TB (XDR-TB), an MDR-TB strain also resistant to any fluoroquinolone and one of the second line injectable agents. There were 2 cases of MDR-TB also resistant to any fluoroquinolone (Table 13). Revised WHO definitions of XDR-TB and pre XDR-TB recommended in February 2021 have not been applied retrospectively to this dataset.

Eighteen (90%) of the MDR-TB cases had pulmonary disease (including 4 with other sites involved) and 2 (10%) had extrapulmonary disease. Of those with pulmonary involvement, 5 (28%) cases were sputum smear positive at diagnosis. Seven (35%) of the MDR-TB cases were born in PNG with 6 being cross border cases. Five (25%) of the MDR-TB cases were born in Australia, 3 of whom had spent time in high TB incidence countries. The remaining 8 (40%) MDR-TB cases were born overseas, all in high TB incidence countries.

Table 14. Antibiotic resistance profiles of MDR-TB cases, Queensland 2017-2019.

YEAR	AK	CAP	CYC	ETD	ETH	ISO	ISZ	KAN	OFL	PYR	RIF	STR	MOX
2017	S	S	S	R	R	R	R	S	S	S	R	S	
	S	S	S	S	S	R	R	S	S	S	R	R	
	S	S	S	R	S	R	R	S	S	S	R	R	
	S	S	S	S	S	R	R	S	S	R	R	R	
	S	S	S	R	S	R	R	S	S	S	R	R	
	R	R	S	R	S	R	R	R	S	R	R	R	
2018	S	S	S	R	S	R	S	S	S	S	R	R	
	S	S	S	S	R	R	R	S	R	S	R	S	
	S	S	S	R	S	R	R	S	S	R	R	R	
	S	S	S	R	S	R	R	S		R	R	R	S
	S	S	S	R	R	R	R	S		S	R	R	S
	S	S	S	R	S	R	R	S		S	R	R	S
	S	S	S	R	R	R	S	S		S	R	R	S
	S	S	S	R	S	R	R	S		S	R	R	S
	S	S	S	R	S	R	R	S		S	R	R	S
	S	S	S	R	S	R	R	S		S	R	R	S
	S	S	S	R	S	R	R	S		R	R	R	S
2019	S	S	S	S	S	R	R	S		R	R	R	S
	S	S	S	R	S	R	R	S		R	R	R	S
	S	S	S	S	S	R	R	S		S	R	R	R

Notes and Abbreviations used in table:

Each row represents the antibiogram for an individual MDR-TB case.

AK-Amikacin, CAP-Capreomycin, CYC-Cycloserine, ETD-Ethionamide, ETH-Ethambutol, ISO- Isoniazid 0.1, ISZ-Isoniazid 0.4, KAN-Kanamycin, OFL- Ofloxacin, PYR-Pyrazinamide, RIF-Rifampicin, STR-Streptomycin, MOX-Moxifloxacin.

Treatment regimens

Of the 581 cases notified during 2017–2019, treatment was commenced in Queensland for 559 (96%). Twenty cases did not commence treatment as their care was transferred out of Australia. Another 2 cases died of causes other than TB before commencing treatment. A further 34 cases commenced treatment in Queensland before their care was transferred out of Australia.

Eighty-nine percent of non-rifampicin resistant cases that commenced treatment were commenced on a standard four drug regimen of isoniazid (H), rifampicin (R), ethambutol (E) and pyrazinamide (Z) (Table 15). A small number of cases (5%) with fully susceptible disease were commenced on 3 drug regimens (either HRE or HRZ) and a further 2 per cent commenced or were changed to non-standard regimens.

Table 15. Chemotherapy regimens of non-rifampicin resistant TB cases by antibiotic susceptibility results, Queensland 2017-2019

Antibiotic susceptibility	HREZ	HRE	HRZ	Other	Total
	n (%)	n (%)	n (%)	n (%)	n (%)
Fully susceptible	362 (94)	2 (1)	14 (4)	9 (2)	387 (100)
Rifampicin susceptible (GeneXpert only)	17 (85)	2 (10)	0 (0)	1 (5)	20 (100)
Isoniazid resistance (but susceptible to rifampicin)	30 (91)	0 (0)	0 (0)	3 (9)	33 (100)
Other resistance (but susceptible to isoniazid and rifampicin)	24 (83)	2 (7)	2 (7)	1 (3)	29 (100)
Rifampicin resistance indeterminate	1 (100)	0 (0)	0 (0)	0 (0)	1 (100)
No susceptibility results	66 (94)	2 (3)	0 (0)	2 (3)	70 (100)
Total	500 (89)	8 (1)	16 (3)	16 (6)	540 (100)

Abbreviations used in table:

HREZ – treatment regimen of Isoniazid, Rifampicin, Ethambutol and Pyrazinamide; HRE - treatment regimen of Isoniazid, Rifampicin and Ethambutol; HRZ - treatment regimen of Isoniazid, Rifampicin and Pyrazinamide; Other – treatment regimen other than listed above.

WHO recommended the preferred regimen for isoniazid resistant (but rifampicin susceptible) TB to be a regimen using levofloxacin throughout the treatment course.[15] Three of the isoniazid resistant cases during 2017–2019 received a regimen including levofloxacin, consistent with WHO guidance. One-third of MDR-TB cases and a single RR-TB case during 2017–2019 were commenced or changed to the all-oral longer duration Bedaquiline containing regimen, as recommended by WHO guidelines at the end of 2019.[16]

Table 16. Chemotherapy regimens of rifampicin resistant TB cases by antibiotic susceptibility results, Queensland 2017-2019

Antibiotic susceptibility	BDQ containing regimen	Other MDR regimen	Total
Rifampicin resistant	1	0	1
Multi-drug resistance (resistant to isoniazid and rifampicin)	6	12	18
Total	7	12	19

Abbreviations used in table:

BDQ containing regimen – treatment regimen that contains Bedaquiline; Other MDR regimen – a treatment regimen without Bedaquiline.

MPT64 negative TB outbreak

In December 2017, a case of drug susceptible TB in North Queensland was detected in a close household contact of 2 persons diagnosed with TB earlier the same year. Subsequent investigations demonstrated a distinct bacterial phenotype and shared molecular typing patterns using VNTR-MIRU methodology. Identification of this initial cluster of TB cases triggered subsequent laboratory and epidemiological investigations.

Whole genome sequencing (WGS) was performed on historically stored isolates (where able to be retrieved) and prospectively collected strains of *Mycobacterium tuberculosis*. Inability to express the diagnostic protein, MPT64 antigen, was common to all laboratory confirmed cases available for testing and which were clustered as per WGS analysis. The laboratory results of the investigation provide evidence of serial transmission between cases which meets the national definition of a TB outbreak.[17]

As at 1 March 2021, there have been 44 cases (43 QLD cases and 1 NSW case) identified within the outbreak including 39 confirmed cases linked by WGS and 5 probable cases who are epidemiologically linked where no isolate was available for WGS.

Outbreak cases were all adults, ranging in age from 18 to 68 years, 60 per cent were male. Queensland outbreak cases were geographically centred around Cairns and Hinterlands, Townsville, and Central Queensland. Cases were predominantly Aboriginal and Torres Strait Islander peoples (86%) and the number of cases over time is presented in Figure 10.

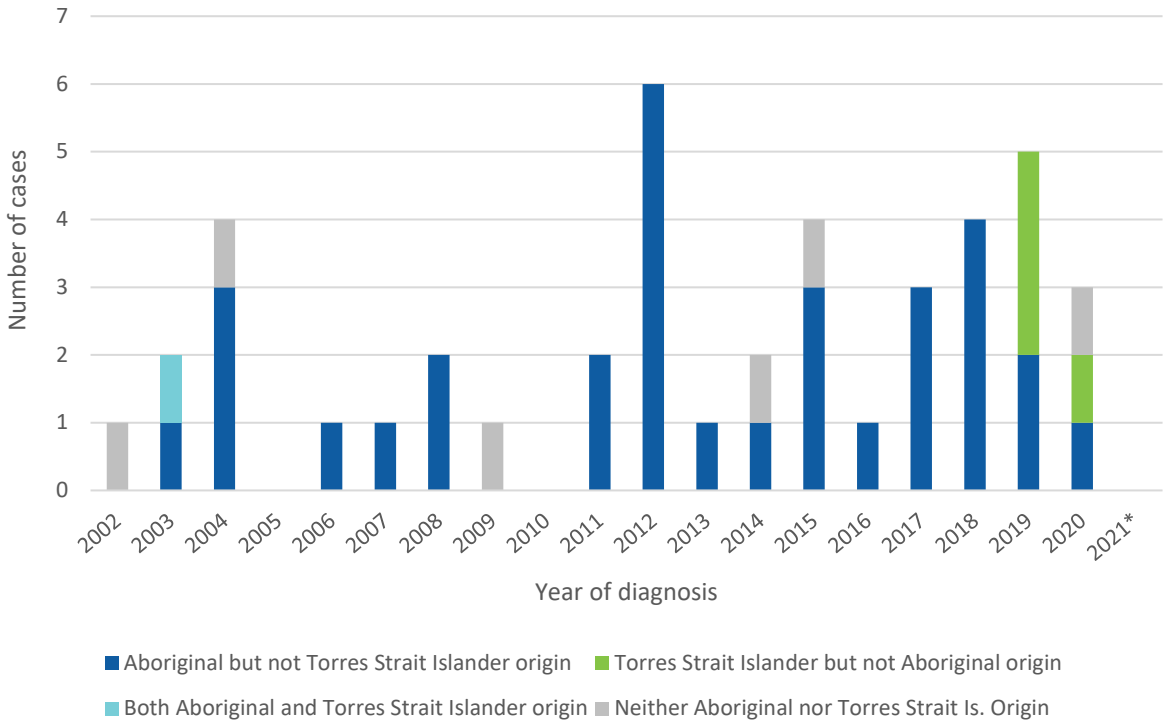

*Figure 10. Epidemic curve of Queensland confirmed and probable outbreak cases by Aboriginal and Torres Strait Islander peoples, 2002-2021 (*as at 1 March 2021)*

The outbreak investigation has identified ongoing transmission predominantly within the First Nations peoples of Queensland with a unique *Mycobacterium tuberculosis* strain. The public health response to the outbreak is ongoing.

Treatment outcomes

The treatment outcomes of an annual cohort of TB cases are reported in the following year's report for drug susceptible cases (and clinically diagnosed cases) and 2 years following their notification year for MDR-TB cases. This allows adequate time for all cases to begin treatment and for the opportunity for a treatment outcome to be recorded for most cases. This report includes outcomes for non MDR-TB cases notified 2017–2019 (Table 17) and outcomes for MDR-TB cases notified 2016–2018 (Table 18). Treatment outcomes are defined by the National Notifiable Diseases Surveillance System dataset (Appendix 1).

Successful outcomes were achieved in 96 per cent of non-MDR cases notified during 2017–2019 (Table 17). A successfully treated case is considered cured if a clinical sample at the end of treatment is culture negative for TB. In practice this only applies to pulmonary cases where the sample is expectorated sputum. A small number of cases defaulted and did not complete treatment, approximately 1–2 per cent each year. Between 1–4 per cent of cases died of TB and a further 1–4 per cent of cases died of another cause prior to completing treatment each year.

The treatment outcomes for the 22 MDR-TB cases notified during 2016–2018 (Table 18), 15 (68%) completed treatment (including those demonstrating cure) and 7 (32%) transferred overseas while completing treatment.

Table 17. Treatment outcomes for drug susceptible/non MDR-TB and clinically diagnosed TB cases, Queensland 2017 – 2019

Treatment outcome	2017 n (%)	2018 n (%)	2019 n (%)
Cured (bacteriologically confirmed)	30 (16)	38 (20)	47 (25)
Completed treatment	126 (69)	124 (66)	91 (48)
Defaulted from treatment	2 (1)	4 (2)	2 (1)
Died of TB	7 (4)	1 (<1)	4 (2)
Died of other cause	2 (1)	2 (1)	8 (4)
Not followed up, outcome unknown	0 (0)	0 (0)	0 (0)
Still under treatment	0 (0)	0 (0)	25 (13)
Transfer overseas	15 (8)	19 (10)	14 (7)
Total	182 (100)	188 (100)	191 (100)

Table 18. Treatment outcomes for MDR-TB cases, Queensland 2016-2018

Treatment outcome	2016–2018 n (%)
Cured (bacteriologically confirmed)	10 (45)
Completed treatment	5 (23)
Defaulted from treatment	0 (0)
Died of TB	0 (0)
Died of other cause	0 (0)
Not followed up, outcome unknown	0 (0)
Transfer overseas	7 (32)
Total	22 (100)

Of the 55 cases who transferred overseas (Tables 18 and 19), 23 were cross border PNG patients (21 treaty visitation rights and 2 unauthorised visitors). A further 23 cases were overseas visitors or students in Australia at the time of their diagnosis.

Table 19. Visa status of TB cases with an outcome of transferred overseas, non MDR-TB 2017-2019 and MDR-TB 2016-2018 in Queensland

Visa status	Total n (%)
Torres Strait Protected Zone visitation rights	21 (38)
Overseas visitor	14 (25)
Overseas student	9 (16)
Other	6 (11)
Overseas born Australian citizens and permanent residents	3 (5)
Unauthorised person	2 (4)
Total	55 (100)

Discussion

Queensland remains a low TB incidence jurisdiction from both an Australian and global perspective as demonstrated by the low notification rates of 3.8-4 cases per 100,000 population during 2017–2019. The majority of cases notified in Queensland were born overseas in high TB incidence countries and a quarter of these arrived in Australia during the 12 months preceding their diagnosis. Though migrants make up the majority of TB notifications, the prevalence of TB within all migrants to Australia has been declining and is low compared to the prevalence of TB in their countries of origin.[18]

Although overseas born cases are more prevalent in TB notifications in Queensland, the rate of TB seen in Aboriginal and Torres Strait Islander peoples remains of concern with approximately 8–15 times the rate seen in non-Indigenous Australian born people during 2017–2019. This is also reflected in national data where the rates of TB in Aboriginal and Torres Strait Islander peoples were 5–6 times the rate of TB in non-Indigenous Australian born people during 2015–2018.[6]

During the period of this report, an outbreak was identified that confirmed transmission of TB among predominantly Aboriginal and Torres Strait Islander peoples since early 2000s. This highlights the ongoing need for engagement with First Nations communities in Queensland to work towards reducing TB transmission, a key priority area identified in the Strategic Plan for the control of TB in Australia.[19]

This outbreak was confirmed using whole genomic sequencing methods and highlights the benefit of genomic analysis to identify transmission between historical and recent cases of TB. The extent of the outbreak and identification of likely transmission pathways could not have been identified using conventional typing methods. Queensland is working towards routine use of WGS, which is the preferred method used in other eastern Australian states.

Persons treated for TB in Queensland generally have very successful outcomes. The percentage of cases who completed treatment, with the exception of those who did so overseas, was 96 per cent and 100 per cent for non MDR-TB and MDR-TB respectively. It should be noted that 9 per cent of non MDR-TB cases and almost a third (32%) of MDR-TB cases complete their treatment overseas with outcomes unknown.

Mortality due to TB disease in Queensland remains low but as TB is both preventable and treatable, careful surveillance of TB related death remains of public health importance.

A small but consistent proportion of notifications in Queensland are MDR-TB (3–4 per cent per year during 2013–2019) and represent an ongoing challenge as MDR-TB rates remain high in the Asia-Pacific region. A national review of MDR-TB from 1999–2018 highlighted the unique challenge Queensland faces with PNG being the most common country of birth for overseas born MDR-TB cases diagnosed in Australia.[20] The majority of those were PNG residents diagnosed in the Torres Strait Protected Zone and contributed the greatest number of deaths due to MDR-TB recorded during this period in Australia.[20]

There have been recommended changes to drug regimens including the all oral MDR-TB regimen. Monitoring these changes is limited as surveillance data is not always complete for documenting regimen changes at the individual patient level.

The healthcare workers notified with TB in Queensland are predominantly in persons from high risk countries. During the last 5 years, the Queensland Health HCW screening tool has moved to a risk-based approach to promote early detection of LTB and identify those persons likely to benefit from treatment. The diagnosis and treatment of LTB is one of the priority action areas identified in the strategic plan for control of TB in Australia and LTB is currently under consideration by Communicable Diseases Network Australia for national notification.

Queensland continues to work towards the goal of TB elimination in Australia and remains focussed on the priority areas for TB control identified in the national strategic plan. These include reducing the disease disparity between First Nations peoples and non-Indigenous Australian born, supporting cross border initiatives for TB control in the Torres Strait Protected Zone, strengthening migrant screening programs, implementing a consistent national approach to the diagnosis and treatment of LTB, and ongoing commitment to TB control programs in Australia and our neighbouring regions.

Appendices

Appendix 1. NNDSS definitions of patient outcomes

Outcome	Description
Cured (bacteriologically confirmed)	A pulmonary sputum smear positive and culture positive patient who was culture negative in the last month of treatment and on at least one previous occasion and completed treatment.
Completed treatment	Patient who has successfully completed treatment but who does not meet the criteria to be classified as a cure or a failure.
Interrupted treatment	Patient whose treatment was interrupted for two months or more but completed treatment.
Died of TB	Patient died during the course of treatment as a result of TB disease.
Died of other cause	Patient died during the course of treatment of a cause other than TB disease.
Defaulted	Patient defaults from treatment.
Treatment failure	A patient who is sputum culture positive at 5 months or later during treatment.
Transferred out	Patient who has been transferred overseas and treatment outcome is unknown.
Still under treatment	Patient currently under treatment in Australia.
Not followed up, outcome unknown	Patient should have completed treatment in Australia, but outcome is unknown.

Abbreviations

AFB	Acid-fast bacilli
BCG	Bacillus Calmette-Guérin
DST	Drug susceptibility testing
ERP	Estimated resident population
HIV	Human Immunodeficiency Virus
HCW	Healthcare worker
HHS	Hospital and Health Service
HRC	High risk country
LTB	Latent tuberculosis infection
MDR-TB	Multi drug resistant tuberculosis
MSCTBS	Metro South Clinical TB Service
NAT	Nucleic acid testing
PCR	Polymerase chain reaction
PNG	Papua New Guinea
RR	Rifampicin resistant
TB	Tuberculosis
TBCU	Tuberculosis Control Unit
TSPZ	Torres Strait Protected Zone
VNTR-MIRU	Variable number tandem repeat - mycobacterial interspersed repetitive unit
WGS	Whole genome sequencing
WHO	World Health Organization
XDR-TB	Extensively drug resistant tuberculosis

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