Tuberculosis in Queensland

2016

Queensland Government

Tuberculosis in Queensland, 2016

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Summary

There were 189 notified cases of active tuberculosis (TB) in Queensland in 2016. Cases in Queensland comprised 14 per cent of the total cases of active TB notified in Australia. The notification rate of TB was 4.0 cases per 100,000 population per year, an increase from the previous two years but lower than the recent peak of 4.9 cases per 100,000 population per year in 2011. The overall rate of TB in Queensland remains low by global standards.

The majority of TB cases notified in Queensland were born in a high risk country for TB, with the number of cases of PNG residents diagnosed in the Torres Strait Protected Zone accounted for approximately five per cent of Queensland TB cases. Rates of TB in Aboriginal and Torres Strait Islander Queenslanders dropped in 2016 to be on par with that of other Queenslanders, though still over five times higher compared to the Australian-born, non-Indigenous population.

During 2016, 88 per cent of Queensland TB cases were laboratory confirmed, with 95 per cent of these confirmed by culture. Drug susceptibility testing (DST) was performed for all culture confirmed cases. Twelve per cent of cases were clinical diagnoses that were not able to be laboratory confirmed. Eighty-four per cent of culture confirmed cases had fully susceptible *M. tuberculosis* complex identified and five cases (3 per cent) were identified as multi-drug resistant tuberculosis (MDR-TB). All five cases were born overseas; four in countries considered to be high burden for TB and one born in a low burden country but a period of residency greater than three months in a high burden country. One cross border case had rifampicin resistance identified on GeneXpert™ only, and in the absence of culture or other molecular drug susceptibility testing would be considered a suspected case of MDR-TB.

Of the 183 notified cases in 2015, 87 per cent completed treatment (including those demonstrating cure and those with interrupted but completed treatment), 9 per cent were transferred out of Australia, 2 per cent of cases defaulted from treatment and 3 per cent died prior to the completion of treatment (of which only one case was considered to have died of TB). Ninety-eight per cent of cases notified in 2015 with a known outcome were considered to have a successful treatment outcome. Treatment outcomes for cases notified in 2016 will be reported in the 2017 report in line with the National Notifiable Diseases Surveillance System reporting.

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1. Introduction

Tuberculosis (TB) is caused by the bacterium *Mycobacterium tuberculosis* complex. TB transmission usually occurs through the inhalation of infectious droplets when a person with TB disease of the lungs 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, with a lifetime risk of reactivation of TB disease in a person with documented latent TB (LTB) generally accepted to be between 5-10 per cent (1-3). A recent study in Victoria suggested in their jurisdiction, the risk of reactivation may be as high as 14.5 per cent over a five year period (4).

According to the World Health Organization Global TB report, there were an estimated 10.4 million new cases of TB in 2015 worldwide, a decline in the incidence rate of 1.5 per cent from 2014 (5). Sixty per cent of new cases are in six countries; India, Indonesia, China, Nigeria, Pakistan, and South Africa. People living with Human Immunodeficiency Virus (HIV) accounted for 1.2 million (11%) of all new TB cases. There were an estimated 480,000 new cases of multidrug-resistant TB (MDR-TB) and an additional 100,000 people with rifampicin-resistant TB who were also newly eligible for MDR-TB treatment; with 45 per cent of rifampicin-resistant cases (including MDR-TB) occurring in India, China, and the Russian Federation. There were an estimated 1.4 million TB deaths in 2015. Although the number of TB deaths fell by 22% between 2000 and 2015, TB remained one of the top 10 causes of death worldwide in 2015 (5).

Australia is a low TB incidence country, with 5.7 notified cases per 100,000 population per year in 2016 (6). Australia has already achieved pre-elimination targets (<10 cases per million population per year) targets in the non-Indigenous, Australian-born population, though the rate in Australian-born Indigenous Australians was 4.6 cases per 100,000 population per year in 2013 (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. 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), though only active TB is notifiable. This report focuses on diagnoses of active TB in Queensland. 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 Regulations 2005*.

2. Methods

Tuberculosis is a pathological diagnosis and clinical diagnosis notifiable condition under Schedule 1 of the *Queensland Public Health Regulations 2005*. Pathology providers are required to notify the Department of Health of any positive tests for tuberculosis as per the Queensland notification criteria guidelines for laboratories (10). Cases were classified as per the national case definition for tuberculosis (11), however within Queensland, cases were additionally classified as confirmed (laboratory definitive evidence) and probable (clinical diagnosis only) (Box 1). Data are collected from Queensland tuberculosis services and physicians, including demographic details, risk factors, clinical symptoms, treatment, and outcomes. Visa status is collected by self-report – documentary evidence is not collected. Where a case transfers from Queensland to other states or territories during treatment, details on outcomes are sought from interstate tuberculosis control services.

Box 1: Queensland tuberculosis case definition

Confirmed case

Isolation of *Mycobacterium tuberculosis* complex (*M. tuberculosis, M. bovis* or *M. africanum,* excluding *M. bovis* variant Bacillus Calmette-Guérin [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.

Probable case

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 5 July 2017 for all confirmed and probable cases of tuberculosis notified between 1 January 2012 and 31 December 2016.

Papua New Guinea (PNG) residents diagnosed with TB who have entered Australia through the Torres Strait Protected Zone are counted in the number of TB cases in Queensland and are included in the report data unless otherwise stated. All cross border cases in PNG residents are considered to be residing in a high risk country for TB, and all without an arrival date were considered to have newly arrived within the previous year.

Laboratory confirmatory testing and drug susceptibility testing were conducted at the Queensland Mycobacterial Reference Laboratory, a World Health Organization 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. GeneXpert™ (introduced November 2010) is routinely performed on all new smear positive sputa, and on request for smear negative sputa and extra-pulmonary

specimens. 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 (12).

A successful outcome was defined as a case completing treatment. Unsuccessful outcomes included died of TB, treatment failure, and defaulted from treatment. 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.

Descriptive analyses were performed using Microsoft Excel™. 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. Notification rates were calculated using the Queensland Hospital and Health Service and Indigenous/non-Indigenous Estimated Resident Population (ERP) 2012-2015 (13). The 2015 ERP was used to calculate 2016 rates as the 2016 ERP was not available at time of report. Australian states and territories population values were taken at June 2016 (14). Australian-born and overseas born notification rates were calculated using 2015-2016 ERP(15).

3. Notifications of TB

Epidemiology of TB in Queensland

There were 189 notified cases of TB in 2016 in Queensland (Figure 1). These cases comprised 14 per cent of the total notified cases in Australia in 2016 (1,378 cases) (16), with Queensland making up 20 per cent of the Australian estimated resident population (June 2016). The annual notification rate of TB in 2016 in Queensland was 4.0 cases per 100,000 population per year.

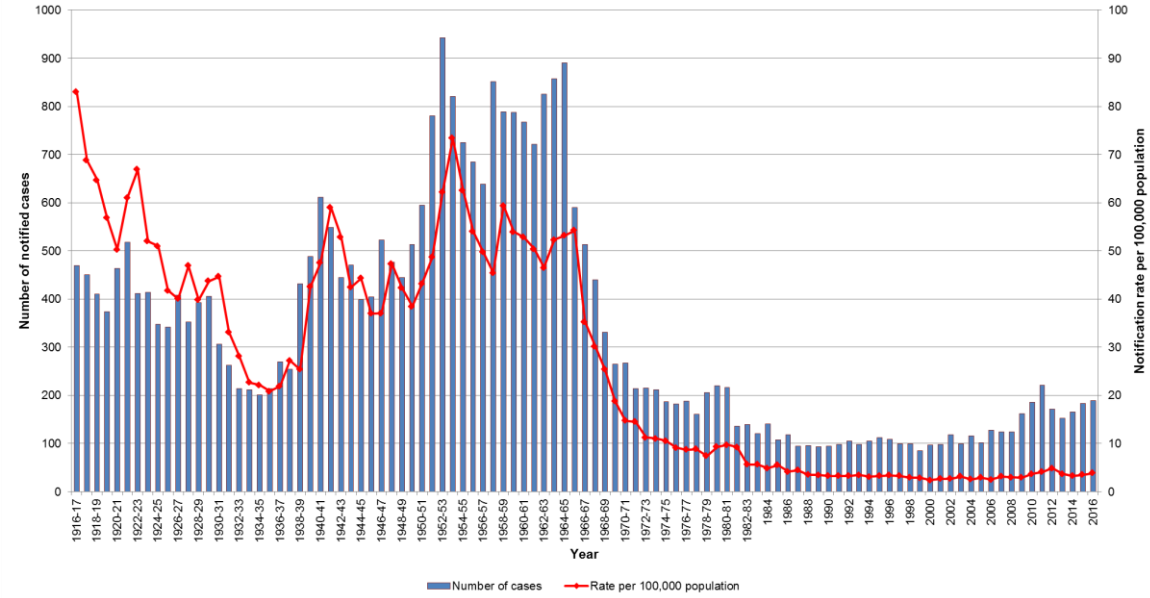

Figure 1: Number and notification rate^ of TB notifications in Queensland, 1916/17-2016*

^Rates for 2006 onwards calculated using the Queensland Estimate Resident Population - data source for rates pre-2006 is unknown

*Data adjusted to report by calendar year (compared to financial year) from 1983. Cases notified from Jan-Jun 1983 appear in both the 1982-83 column and the 1983 column

Distribution of cases by Hospital and Health Service of residence

In 2016, the majority of TB cases resided in South-East Queensland, with 54 cases (29 per cent) notified with a residential address in Metro South HHS and 36 cases (19 per cent) with a residential address in Metro North HHS. Nineteen cases (10 per cent) diagnosed in Queensland had an overseas residential address. The majority of these (12 cases, 63 per cent) had a residential address in PNG at the time of diagnosis, with seven other overseas residents all of whom previously resided in a country considered to be high risk for TB. Overseas residents are not included in HHS counts or notification rates. Taking into account population size, the highest notification rate in Queensland in 2016 was in the Torres and Cape HHS with 7.7 cases per 100,000 population per year (however rates were lower compared with 23.1 cases and 35.5 cases per 100,000 population per year in Torres and Cape HHS in 2015 and 2014 respectively), followed by West Moreton (5.6 cases per 100,000 population per year) and Cairns and Hinterland HHS (5.2 cases per 100,000 population per year) (Figure 2).

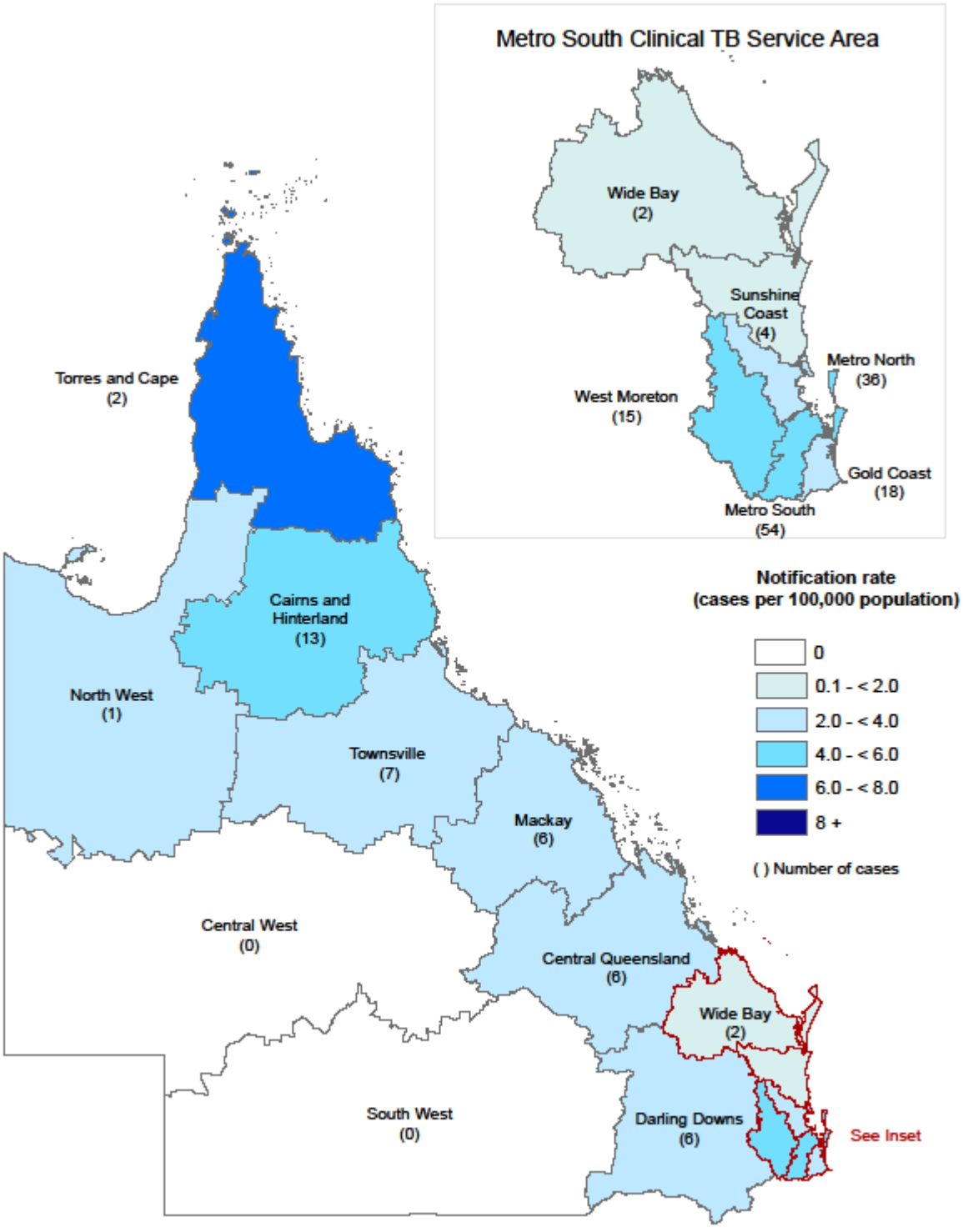

Figure 2: Number of cases and annual notification rate of TB by HHS of residence, Queensland, 2016

4. Demographic characteristics

Age and sex

In 2016, 52 per cent of TB cases were male and 48 per cent were female. The age of cases at onset of disease ranged from six months to 90 years, with a median age of 40 years. The most frequently notified age group was the 25-29 year age group, with notification rates highest in those aged 85 years and above (Figure 3).

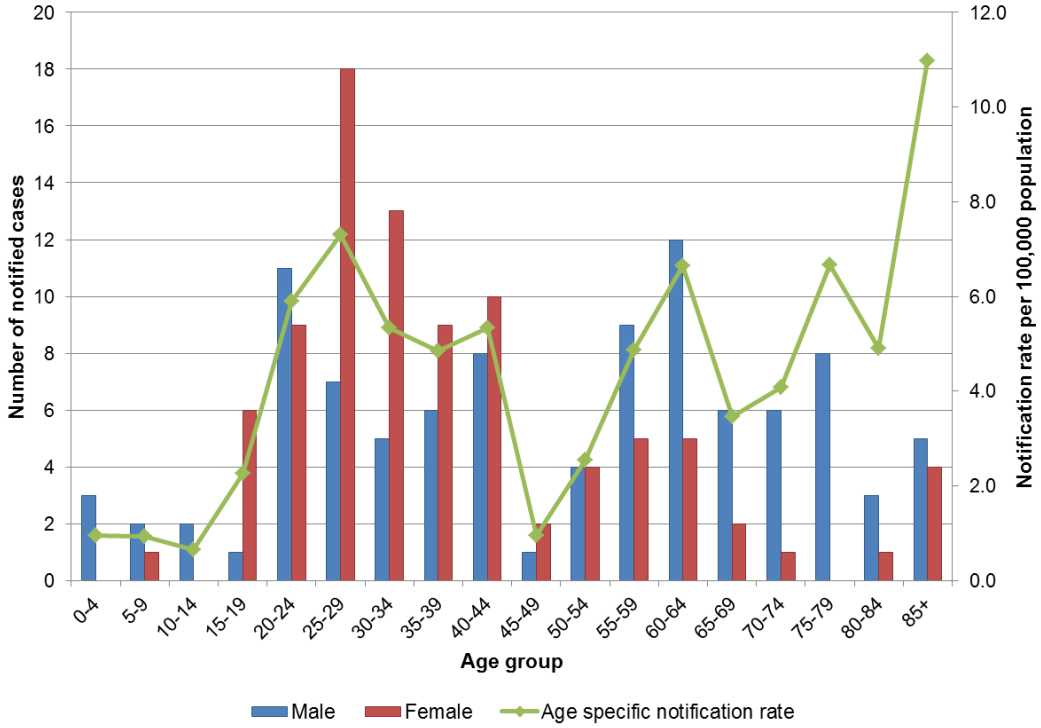

Figure 3: Number of TB cases and notification rate by sex and age group at onset of disease, Queensland, 2016

Aboriginal and Torres Strait Islander Queenslanders

There were eight cases (4 per cent) of TB in Aboriginal and Torres Strait Islander people in 2016 (Table 1).

Table 1: TB notifications by Aboriginal and/or Torres Strait Islander origin, Queensland, 2012-16

Indigenous status	2012	2013	2014	2015	2016
Aboriginal but not Torres Strait Islander origin	11 (6%)	6 (4%)	4 (2%)	10 (5%)	4 (2%)
Torres Strait Islander but not Aboriginal origin	4 (2%)	4 (3%)	13 (8%)	7 (4%)	3 (2%)
Both Aboriginal and Torres Strait Islander origin	0 (0%)	0 (0%)	1 (1%)	0 (0%)	1 (1%)
Neither Aboriginal nor Torres Strait Islander origin	156 (91%)	143 (93%)	148 (89%)	166 (91%)	181 (96%)
Total	**171 (100%)**	**153 (100%)**	**166 (100%)**	**183 (100%)**	**189 (100%)**

The annual notification rate of TB in Queensland's Aboriginal and Torres Strait Islander population ranged from 3.8 to 8.9 cases per 100,000 population per year in 2012-16 (Table 2). The notification rate for TB in Indigenous Queenslanders in 2016 was similar to the 2016 notification rate for non-Indigenous Queensland residents.

Table 2: TB cases and annual notification rates for Aboriginal and Torres Strait Islander and non-Indigenous Queenslanders, Queensland, 2012-16

Indigenous status	2012	2013	2014	2015	2016
Aboriginal and Torres Strait Islander Queenslanders	15	10	18	17	8
Rate (per 100,000 population per year)	*7.8*	*5.0*	*8.9*	*8.2*	*3.8*
Non-Indigenous Queenslanders	156	143	148	166	181
Rate (per 100,000 population per year)	*3.6*	*3.2*	*3.3*	*3.6*	*4.0*
Rate ratio	**2.2**	**1.6**	**2.7**	**2.3**	**1.0**

The rate of TB in Australian-born Aboriginal and Torres Strait Islander Queenslanders (4.4 cases per 100,000 population per year) is 6.3 times higher than the rate in Australian-born non-Indigenous Queenslanders (0.7 cases per 100,000 population per year) in 2016. A sensitivity analysis to account for people with unknown Indigenous status indicates TB rates in Aboriginal and Torres Strait Islanders are between 3.8-4.4 cases per 100,000 population per year (which is 5.5-6.4 times the rate in Australian-born non-Indigenous Queenslanders). These rates differ from those in Table 2 as these denominator data were obtained from the 2016 census data as this only accounts for Australian-born Aboriginal and Torres Strait Islander population and the ERP used for Table 2 is an estimate of populations based on 2011 census data.

Country of birth

In 2016, 159 cases (84 per cent) were born overseas and 30 cases (16 per cent) were born in Australia. Overseas-born cases notified in Queensland were predominantly from the World Health Organization (WHO) Western Pacific Region (114 cases, 60 per cent), including 84 cases (44 per cent) from countries in the Western Pacific Region other than Australia (Figure 4).

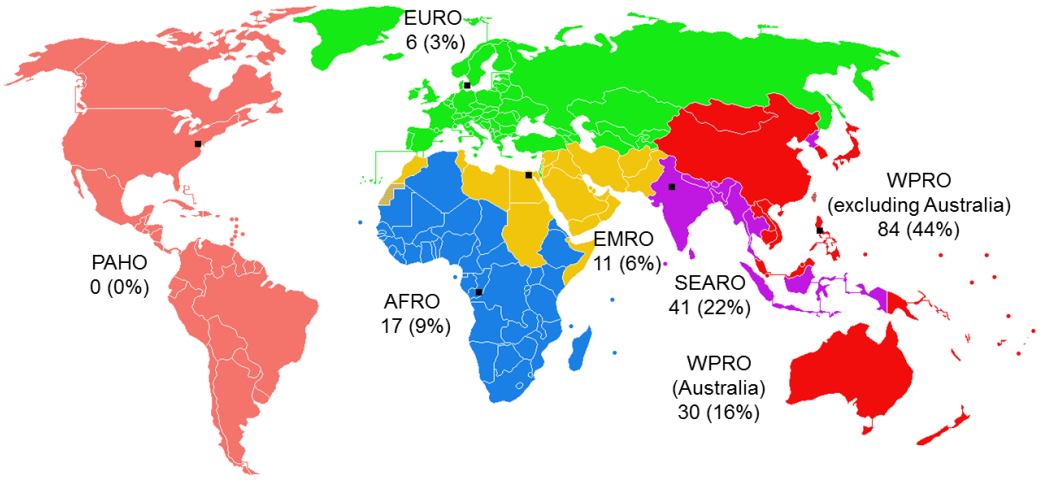

Figure 4: Number and proportion of TB cases notified by WHO region of birth, Queensland, 2016

Of the 159 overseas-born cases, the most common country of birth was the Philippines (25 cases, 16 per cent). Other overseas countries where the highest number of cases were born included PNG (20 cases, 13 per cent), India (18 cases, 11 per cent), Vietnam (13 cases, 8 per cent) and China (excluding SARs and Taiwan) (8 cases, 5 per cent). Of the 159 cases born overseas, 150 (94 per cent of overseas-born cases, 79 per cent of total cases) were born in countries considered to have high prevalence of TB in 2015 (estimated incidence rates of 40 cases per 100,000 population per year or higher) (17).

The notification rate for TB in overseas-born Queenslanders was 15.8 cases per 100,000 population per year compared with 0.9 cases per 100,000 population per year in Australian-born Queenslanders in 2016.

Australian-born TB cases had a median age of disease onset of 60 years (age range 18-87 years), whilst overseas-born TB cases had a median age of 35 years (age range 6 months-90 years).

5. Risk factors

Overwhelmingly, migrating from a country considered high risk and past travel to or residence for a period greater than 3 months in a high risk country continue to be the most commonly reported risk factors for TB cases in Queensland (Table 3). Past travel or residence in a high risk country, being employed in the health industry, and diabetes were the highest reported risk factors for Australian-born cases.

Table 3: Risk factors* reported for TB cases by Australian-born, overseas-born permanent and temporary migrants and PNG cross border cases, 2016

Risk Factors*	Australian-born cases	Overseas-born cases	Cross border cases	Total
Migrant from a high risk country[#]	0 (0%)	138 (97%)	n/a	**138 (73%)**
Past travel to or residence > 3 months in a high risk country/countries[#]	12 (41%)	104 (73%)	1 (9%)	**117 (62%)**
Household member or close contact with TB	4 (14%)	23 (16%)	5 (45%)	**32 (17%)**
Refugee	0 (0%)	31 (20%)	0(0%)	**31 (16%)**
Diabetic	6 (21%)	22 (15%)	0 (0%)	**28 (15%)**
Currently or previously employed in the health industry	8 (28%)	18 (13%)	0 (0%)	**26 (14%)**
Major abdominal surgery	5 (17%)	12 (8%)	0 (0%)	**17 (9%)**
Current residence in a high risk country[#]	n/a	n/a	11 (100%)	**11 (6%)**
Alcohol or non-intravenous drug abuse	5 (17%)	4 (3%)	1 (9%)	**10 (5%)**
Steroids/immunosuppressive therapy	0 (0%)	9 (6%)	0 (0%)	**9 (5%)**
Renal failure	0 (0%)	7 (5%)	0 (0%)	**7 (4%)**
Institutional living	2 (7%)	3 (2%)	0 (0%)	**5 (3%)**
HIV positive	1 (3%)	4 (3%)	0 (0%)	**5 (3%)**
Ever homeless	1 (3%)	0 (0%)	0 (0%)	**1 (1%)**
Australian-born child with 1 or more parents born in high risk country	0 (0%)	n/a	n/a	**0 (0%)**
Immunosuppression due to cancer (excluding skin cancer)	0 (0%)	0 (0%)	0 (0%)	**0 (0%)**
Intravenous drug abuse	0 (0%)	0 (0%)	0 (0%)	**0 (0%)**
Other risk factor	6 (21%)	5 (3%)	0 (0%)	**11 (6%)**
No known risk factors	1 (3%)	0 (0%)	0 (0%)	**1 (1%)**
Unknown risk factors or risk factors not assessed	1 (3%)	0 (0%)	0 (0%)	**1 (1%)**

* Multiple risk factors may be recorded for each case, percentages calculated for each risk factor as a proportion of the number of cases in each of the Australian-born, overseas-born, and PNG cross border cases, and for the total Queensland cases

[#] High risk country defined as those with an annual TB incidence of 40/100,000 per year or more in 2015, as per estimates in WHO Global Tuberculosis Report 2016 at the time the data were collected (17)

Visa status

Twenty-nine cases (15 per cent) notified in Queensland in 2016 were born in Australia. The largest proportion of cases diagnosed with TB was in overseas born, Australian citizens and permanent residents (38 per cent). The number of PNG residents diagnosed in Queensland who entered Australia through the Torres Strait Protected Zone in 2016 was similar to that seen in the previous two years; the two unauthorised persons were PNG residents presenting through the Torres Strait Protected Zone who were not residents of the PNG villages covered under the *Torres Strait Treaty Act 1984* (Table 4).

Table 4: Visa status of TB cases in Queensland, 2012-16

Visa status	2012	2013	2014	2015	2016
Australian-born	33 (19%)	20 (13%)	31 (19%)	38 (21%)	29 (15%)
Overseas-born Australian citizens and permanent residents	56 (33%)	78 (51%)	71 (43%)	73 (40%)	72 (38%)
Overseas student	14 (8%)	13 (8%)	20 (12%)	15 (8%)	20 (11%)
Overseas visitor	17 (10%)	9 (6%)	14 (8%)	17 (9%)	19 (10%)
Refugee/humanitarian	6 (4%)	5 (3%)	6 (4%)	12 (7%)	16 (8%)
Torres Strait Protected Zone visitation rights	21 (12%)	3 (2%)	9 (5%)	10 (5%)	9 (5%)
Unauthorised person	0 (0%)	0 (0%)	0 (0%)	1 (1%)	2 (1%)
Other	18 (11%)	15 (10%)	14 (8%)	17 (9%)	22 (12%)
Unknown	6 (4%)	10 (7%)	1 (1%)	0 (0%)	0 (0%)
Total	**171 (100%)**	**153 (100%)**	**166 (100%)**	**183 (100%)**	**189 (100%)**

Period of residence prior to diagnosis

In 2016, 27 per cent of overseas born TB cases were diagnosed within one year of arrival to Australia (Table 5). Seventy-one cases (45 per cent) arrived in Australia least five years prior to diagnosis.

Table 5: Period in Australia prior to diagnosis in TB cases born overseas, 2012-16

Visa status	2012	2013	2014	2015	2016
New arrivals - diagnosed within one year from arrival	55 (40%)	35 (26%)	33 (24%)	41 (27%)	43 (27%)
Diagnosed 1 - <2 years from arrival	11 (8%)	8 (6%)	11 (8%)	15 (10%)	17 (11%)
Diagnosed 2 - <5 years from arrival	24 (18%)	26 (20%)	19 (14%)	15 (10%)	27 (17%)
Diagnosed 5 years or more from arrival	39 (28%)	54 (41%)	57 (42%)	67 (46%)	71 (45%)
Unknown arrival date	8 (6%)	10 (8%)	15 (11%)	7 (5%)	1 (1%)
Total*	**137 (100%)**	**133 (100%)**	**135 (100%)**	**145 (100%)**	**159 (100%)**

*Excludes Australian-born TB cases and those with an unknown country of birth

Human immunodeficiency virus co-infection

The proportion of TB cases tested for HIV in 2016 was 86 per cent (Table 6). There were five cases (3 per cent) found to be co-infected with HIV at diagnosis.

Table 6: HIV testing amongst TB cases, Queensland, 2012-16

HIV testing history	2012	2013	2014	2015	2016
Tested	140 (82%)	122 (80%)	131 (77%)	145 (79%)	163 (86%)
Not tested	1 (1%)	0 (0%)	0 (0%)	1 (1%)	0 (0%)
Refused testing	27 (16%)	27 (18%)	22 (13%)	30 (14%)	26 (14%)
Unknown testing history	3 (2%)	4 (3%)	13 (8%)	7 (4%)	0 (0%)
Total	**171 (100%)**	**153 (100%)**	**166 (100%)**	**183 (100%)**	**189 (100%)**

TB in health care workers

Twenty-six cases (14 per cent) in 2016 reported having worked in a healthcare facility prior to their diagnosis with TB. Of these, 23 cases (88 per cent) were healthcare workers (HCW), with 3 cases (12 per cent) working as non-healthcare workers. Eight cases who reported being HCWs were born in Australia (31 per cent) and 18 cases were born overseas (69 per cent); with all of the overseas born cases born in a country with an annual estimated TB incidence of at least 40 cases per 100,000 population per year.

Fourteen cases were identified as working as HCWs in Australian healthcare facilities at or within the 12 months prior to diagnosis, of which three cases were deemed likely to have been infectious due to being smear positive on sputum or bronchoscopy. Contact tracing was undertaken by TB Control Units in healthcare settings where a HCW or patient was considered infectious (or where vulnerable populations were involved); no cases of active TB were identified where transmission from a HCW within a healthcare setting was suspected. There was one case notified in 2016 that had previously worked in a Queensland healthcare facility. Examination of the VNTR-MIRU database did not provide any evidence of links to previously identified TB cases since VNTR-MIRU was introduced, however the possibility of this case acquiring their infection in a Queensland Health facility could not be ruled out.

6. Diagnosis and clinical details

In 2016, 179 cases (95 per cent) diagnosed with TB were new cases and ten cases were relapse cases following past treatment of TB. Of the 10 relapse cases, 2 relapsed following full treatment in Australia, 1 relapsed following partial treatment in Australia, and 7 relapsed following full or partial treatment overseas. Previous TB treatment was reported for three cases that were not classified as relapse cases (two previously treated for latent TB and one treated for less than one month overseas).

Diagnosis primarily followed consultation with a general practitioner or specialist as a result of clinical symptoms consistent with their TB diagnosis (141 cases, 79 per cent). Forty-one cases (22 per cent) were found through TB screening. Of those cases found through TB screening, reasons for screening were immigration and/or health undertakings (29 cases, 71 per cent), HCW screening (4 cases, 10 per cent), high risk migrant screening (3 cases, 7 per cent) and contact screening of household and other close contacts (2 cases, 5 per cent) and other reasons (3 cases, 7 per cent). Seven cases (4 per cent) were recorded as having an incidental diagnosis of TB.

Site of disease

Pulmonary disease

In 2016, 122 cases (65 per cent) had pulmonary disease only, 16 cases (8 per cent) had pulmonary plus other sites of disease, and 51 cases (27 per cent) had extra-pulmonary disease only.

Extra-pulmonary disease

There were 67 cases (35 per cent) reported to have TB disease elsewhere than the lungs (including 16 cases with concurrent pulmonary disease). The most common extra-pulmonary sites recorded were lymph nodes (39 per cent of cases reporting extra-pulmonary sites of disease) and pleural (30 per cent) (Table 7).

Table 7: Sites of TB disease in cases reported with extra-pulmonary disease, Queensland, 2016

Site of disease	Number and proportion of cases reporting extra-pulmonary disease*
Lymph node	26 (39%)
Pleural	20 (30%)
Miliary (with millet seed appearance on chest x-ray)	5 (7%)
Bone/joint	3 (4%)
Meningeal	3 (4%)
Genitourinary	2 (3%)
Pericardial	2 (3%)
Disseminated (systemic symptoms)	1 (1%)
Gastrointestinal	1 (1%)
Soft tissue abscesses	1 (1%)
Other	9 (13%)

*Multiple sites of disease may be reported for one case

7. Laboratory testing and treatment regimens

Of the 189 TB cases notified in 2016, 166 (88 per cent) were laboratory confirmed (by 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 (11)). Of these, 158 cases (95 per cent) were confirmed by culture and 8 cases (5 per cent) were confirmed by nucleic acid testing only. There were four cases where *M. africanum* was isolated and five cases where *M. bovis* (excluding BCG variant) was isolated. The remaining cases were all confirmed as *M. tuberculosis*. Twenty-three clinically diagnosed cases (12 per cent) were unable to be laboratory confirmed.

Pulmonary cases

There were 133 laboratory confirmed pulmonary cases (including those with pulmonary TB plus other sites of disease). One hundred cases (75 per cent) were sputum culture positive, and 32 cases (24 per cent) had a positive culture result from a bronchoscopy (12 cases were culture positive on both sputum and bronchoscopy specimens). There were eight cases with a positive culture on a non-pulmonary site that also had symptoms consistent with pulmonary disease. Five pulmonary cases (4 per cent) were confirmed by nucleic acid testing only.

Of the laboratory confirmed pulmonary cases, 57 cases (43 per cent) were sputum smear positive (acid fast bacilli [AFB] detected by microscopy), 13 cases (10 per cent) had AFBs detected by microscopy from a bronchoscopy specimen other than sputum (four cases were smear positive on bronchoscopy and sputum), and 9 cases smear positive from other specimens.

Extra-pulmonary only cases

Thirty laboratory confirmed extra-pulmonary cases (91 per cent) were culture positive; 10 cases from a lymph node, 2 cases from purulent exudate from abscesses, 1 each from pleural fluid and a pleural biopsy and 16 cases from sites including cerebral spinal fluid, peritoneal, and other specimen types. Four cases were confirmed by nucleic acid testing only, and one case without laboratory confirmation had histology suggestive of TB.

Drug susceptibility testing

Phenotypic DST results were available for 156 cases (two cases who cultured M. tuberculosis also grew nontuberculous mycobacterium and were unable to have DST performed). One hundred and thirty-one cases (84 per cent) had fully sensitive *M. tuberculosis* complex identified (Table 8). Six cases (4 per cent) were resistant to isoniazid but not rifampicin, and 14 cases (9 per cent) were identified to have other first line resistance patterns but were not resistant to isoniazid or rifampicin.

Table 8: Phenotypic drug susceptibility testing of culture positive TB cases by site of disease, 2016

Drug susceptibility testing	Pulmonary (including those with other sites)	Extra-pulmonary disease only	Total
Fully susceptible	110 (87%)	21 (70%)	**131 (84%)**
Isoniazid (H) resistance (but sensitive to rifampicin [R])	3 (2%)	3 (10%)	**6 (4%)**
Rifampicin (R) resistance (but sensitive to isoniazid [H])	0 (0%)	0 (0%)	**0 (0%)**
Other resistance (but sensitive to isoniazid [H] and rifampicin [R])	8 (6%)	6 (20%)	**14 (9%)**
Multi-drug resistance (resistance to isoniazid [H] and rifampicin [R])	5 (4%)	0 (0%)	**5 (3%)**
Total	**126 (100%)**	**30 (100%)**	**156 (100%)**

Five cases (3 per cent) were considered to have MDR-TB; all with pulmonary disease with three cases sputum smear positive at diagnosis. All five cases had different resistance profiles (Table 9). There were no cases of extensively drug resistant TB (XDR-TB) or pre XDR-TB. All five cases were born overseas; four in countries considered to be high burden for TB and one born in a low burden country but with a period of residency greater than three months in a high risk country. One case of MDR-TB is likely to have acquired their infection through transmission in Australia from a close household contact. The cases had matching 26 digit VNTR-MIRU patterns, although susceptibility to ethambutol differed between the two cases. Testing for ethambutol susceptibility is known to be more variable than for other first line agents.

Table 9: Antibiotic resistance profiles of MDR-TB cases, 2016

Antibiotic susceptibility profiles*												
AK	**CAP**	**CYC**	**E**	**ETD**	**H.1**	**H.4**	**KAN**	**OFL**	**PAS**	**Z**	**R**	**S**
S[#]	S	S	S	S	R[#]	R	S	S	NT[#]	S	R	S
S	S	S	R	S	R	R	S	S	NT	S	R	S
S	S	S	R	S	R	R	S	S	NT	S	R	R
S	S	S	S	R	R	R	S	S	NT	S	R	R
S	S	S	R	R	R	R	S	S	NT	R	R	R
Total MDR-TB cases												

*Antibiotic abbreviations shown in Abbreviations table (page 26)
[#]S = sensitive, R = resistant, NT = not tested

There were seven cases where drug susceptibility results were only available through molecular methods (Table 10). Drug susceptibility testing (either through phenotypic or molecular techniques was not available for three cases whose TB was found through the use of an in-house PCR on tissue specimens (two lung tissue and one from paraffin fixed lymph node tissue).

Table 10: Molecular drug susceptibility testing of TB cases confirmed by GeneXpert™ only by site of disease, 2016

Molecular drug susceptibility only	Pulmonary (including those with other sites)	Extra-pulmonary disease only	Total
Rifampicin sensitive	4 (80%)	2 (100%)	6 (84%)
Rifampicin resistant	1 (20%)	0 (0%)	1 (14%)
Total	**5 (100%)**	**2 (100%)**	**7 (100%)**

Of the 28 Australian-born TB cases with phenotypic or molecular DST results available, 24 cases (86 per cent) were fully susceptible, one case (4 per cent) was resistant to isoniazid but not rifampicin, one case (4 per cent) were resistant to other drugs but not to isoniazid or rifampicin, and two cases (7 per cent) were susceptible to rifampicin on GeneXpert™ only.

Treatment was commenced for 175 cases (93 per cent) in 2016. Fourteen cases (7 per cent) did not commence treatment; 11 cases (79 per cent) had their care transferred out of Australia, and 3 cases (21 per cent) died of causes other than TB prior to commencing TB treatment.

Eighty-seven per cent of cases that commenced treatment were commenced on a standard four drug regimen of isoniazid (H), rifampicin (R), ethambutol (E), and pyrazinamide (Z) (Table 11). A small number of cases (7 cases, 4 per cent) with fully susceptible disease were commenced on three drug regimens (either HRE or HRZ). Sixteen cases (9 per cent) commenced, or were changed to non-standard regimens. Other prescribed drugs included amikacin, clarithromycin, clofazimine, cycloserine, ethionamide, linezolid, moxifloxacin, para amino salicylate, and rifabutin.

Table 11: Chemotherapy regimens of notified TB cases by antibiotic susceptibility results, 2016

Antibiotic susceptibility	HREZ	HRE	HRZ	Non-standard	Total
Fully susceptible	114 (90%)	4 (3%)	3 (2%)	6 (5%)	127 (100%)
Rifampicin sensitive (GeneXpert™ only)	4 (80%)	0 (0%)	0 (0%)	1 (20%)	5 (100%)
Isoniazid (H) resistance (but sensitive to rifampicin [R])	4 (67%)	0 (0%)	0 (0%)	2 (33%)	6 (100%)
Other resistance (but sensitive to isoniazid [H] and rifampicin [R])	13 (93%)	0 (0%)	0 (0%)	1 (7%)	14 (100%)
Multi-drug resistance (resistant to isoniazid [H] and rifampicin [R])	0 (0%)	0 (0%)	0 (0%)	5 (100%)	5 (100%)
No susceptibility results	17 (94%)	0 (0%)	0 (0%)	1 (6%)	18 (100%)
Total	**152 (87%)**	**4 (2%)**	**3 (2%)**	**16 (9%)**	**175 (100%)**

8. Treatment outcomes

The treatment outcomes of an annual patient cohort are reported in the following year's report. This allows adequate time for all cases notified to begin treatment and for the opportunity for a treatment outcome to be recorded for the majority of cases. This section covers outcomes from TB cases notified in 2015. Treatment outcomes for 2016 will be reported in subsequent years. Treatment outcomes are defined by the National Notifiable Diseases Surveillance System dataset (Appendix 2).

Of the 183 notified cases in 2015, 158 (87 per cent) completed treatment (including those demonstrating cure and those with interrupted but completed treatment), 17 cases (9 per cent) were transferred out of Australia, and 5 cases (3 per cent) died prior to the completion of treatment (Table 11).

Table 12: Treatment outcome for notified TB cases, 2015

Treatment outcome	Number of cases (%)
Cured (bacteriologically confirmed)	17 (9%)
Completed treatment	140 (77%)
Completed treatment (with interruption of ≥ 2 months)	1 (1%)
Defaulted from treatment	3 (2%)
Died of TB	1 (1%)
Died of other cause	4 (2%)
Transferred overseas	17 (9%)
Total	**183 (100%)**

Of the five cases notified in 2015 that died before completion of treatment, one was considered to have died from TB and four died of other causes. The case that was considered to have died from TB was a cross border PNG case with presumed miliary/disseminated disease that died on the day they presented for clinical care in Australia.

Of the 17 cases were transferred overseas, eight cases were cross border PNG patients (seven treaty visitation rights and one unauthorised visitor) (Table 13).

Table 13: Visa status of notified TB cases with an outcome of transferred overseas, 2015

Visa status	Number of cases (%)
Torres Strait Protected Zone visitation rights	7 (41%)
Overseas visitor	4 (24%)
Overseas student	3 (18%)
Overseas-born Australian citizens and permanent residents	2 (12%)
Unauthorised person	1 (6%)
Total	**17 (100%)**

There were seven cases of MDR-TB diagnosed in 2015. Four cases completed treatment, and three cases were transferred back to PNG.

Ninety-eight per cent of all cases with a known outcome were considered to have a successful treatment outcome.

For the 158 cases that completed treatment (including those bacteriologically confirmed as cured and those with an interrupted treatment), the minimum length of treatment was six months and the maximum length of treatment was 21 months. Fifty-eight per cent of cases that completed treatment had six to eight months of treatment. The minimum, median, and maximum treatment lengths for cases based on their antibiotic susceptibility results are shown in Table 14.

One patient with no susceptibility results had a treatment length of 15 months, which was due to an interruption in treatment. Another case with no susceptibility results had a treatment length of 14 months and was treated empirically as having MDR-TB.

Table 14: Minimum, median and maximum months of chemotherapy for cases that completed treatment by antibiotic susceptibility profile, 2015

Antibiotic susceptibility	Total cases	Minimum	Median	Maximum
Fully susceptible	108 (68%)	6	6	16
Rifampicin sensitive (GeneXpert™ only)	1 (1%)	6	6	6
Isoniazid (H) resistance (but sensitive to rifampicin [R])	13 (8%)	6	10	18
Rifampicin (R) resistance (but sensitive to isoniazid [H])	2 (1%)	12	13	14
Other resistance (but sensitive to isoniazid [H] and rifampicin [R])	8 (5%)	6	9	11
Multi-drug resistance (resistant to isoniazid [H] and rifampicin [R])	4 (3%)	19	20	21
No susceptibility results	22 (14%)	6	9	15
Total	**158 (100%)**	**6**	**7**	**15**

9. Discussion

The rate of TB in Queensland remains low by global standards. The majority of TB cases notified in Queensland continue to be born in a high risk country for TB. The World Health Organization Framework towards tuberculosis elimination targets low incidence countries, including Australia, for TB elimination (18), reflected in *National Strategic Plan for Control of Tuberculosis in Australia: 2011 – 2015* with the goal of eliminating TB in the Australian-born population (19). The notification rate for TB in all Australia-born Queensland population was 0.9 cases per 100,000 population per year in 2016, which meets the pre-elimination target of less than 10 notified cases per million population per year, with the elimination target generally considered less than 1 case per million population per year (18).

Rates of TB in Aboriginal and Torres Strait Islander Queenslanders dropped in 2016 to be on par with that of other Queenslanders, though still over five times more compared to the Australian-born non-Indigenous population. Continued work is required to meet the Australian National Tuberculosis Advisory Committee's goals to eliminate TB in the Australian-born population and to reduce differences in the incidence of TB between the overall Australian rate and specific higher risk groups (19). A new TB Control Unit was opened on Thursday Island in the Torres and Cape HHS in January 2016. This area was previously covered by outreach services from Cairns Hospital. The new unit would be unlikely to alter the number of notified cases in the Torres and Cape HHS in 2016, however having a specialised unit geographically based in the Torres Strait allows for a more rapid response for activities such as contact tracing, BCG administration and education to control TB in the HHS.

The number of cases of PNG residents diagnosed in the Torres Strait Protected Zone continued to account for approximately five per cent of Queensland TB cases. There were also two unauthorised visitors from villages not covered under the *Torres Strait Treaty Act 1984.* This has remained reasonably consistent following the nadir of cross border cases in 2013. MDR-TB was not identified through phenotypic methods for any of the cross border cases, however one case had rifampicin resistance identified on GeneXpert™ only, and in the absence of culture or other molecular drug susceptibility testing would be considered a suspected case of MDR-TB.

TB-HIV co-infection remains a serious concern internationally, with people living with HIV accounted for 1.2 million (11%) of all new TB cases (5). Co-infection with TB and HIV in Queensland remains low, with five cases (3 per cent) diagnosed in 2016. Queensland and international guidelines recommend all TB cases should be tested for HIV (20, 21). HIV testing in people diagnosed with TB is important as there is evidence that active TB infection in TB-HIV co-infected cases is associated with increased immunodeficiency and mortality (22). HIV testing in TB cases increased to 86 per cent in 2016; the highest proportion of annual cases tested in the past five years.

Ninety per cent of cases with fully susceptible disease that commenced treatment received a standard four drug HREZ regimen, with an additional four per cent of fully susceptible cases who received either HRE or HRZ. Sixteen cases (9 per cent) commenced, or were changed to non-standard regimens. Reasons for non-standard regimens could include both drug resistance and drug intolerance (23).

Ninety-eight per cent of cases with a known outcome were considered to have a successful treatment outcome in 2015, an improvement on that seen in recent years (91 per cent in 2014, 93 per cent in 2012-2013) (8, 24). It was not possible to determine whether the two cases noted as relapses following full treatment in Australia were relapses or re-infection as no culture was available for the second episode for both cases. Both were positive on nucleic acid testing and one case had AFBs detected on microscopy in 2016.

Priorities for TB control in Queensland continue to closely reflect activities outlined in the World Health Organization Framework towards tuberculosis elimination (18). These include addressing the disparity between Aboriginal and Torres Strait Islander Queenslanders, capturing high risk migrant groups for appropriate screening for active and latent TB, and minimising the likelihood of developing active disease following latent TB infection. An increased challenge in 2016 was the unavailability of BCG vaccine in Queensland (25) to prevent serious disease in young children at high risk for TB. Continued efforts to monitor TB control and improve the quality of TB surveillance and reporting remain at the forefront of the public health management for TB in Queensland, and continue to be of importance given Australia's population demographics, migration patterns, and the high burden of TB and MDR-TB in the Western Pacific region.

Appendix

NNDSS Field: TB_Outcomes

Patient outcomes after anti-tuberculosis treatment (26)

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 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

Antibiotic abbreviations used:

AK	Amikacin
CAP	Capreomycin
CYC	Cycloserine
E	Ethambutol
ETD	Ethionamide
H.1	Isoniazid 0.1
H.4	Isoniazid 0.4
KAN	Kanamycin
OFL	Ofloxacin
PAS	Para Amino Salicylate
Z	Pyrazinamide
R	Rifampicin
S	Streptomycin

Other abbreviations used:

AFB	Acid-fast bacilli
AFRO	Regional Office for Africa (World Health Organization)
BCG	Bacillus Calmette-Guérin
DST	Drug susceptibility testing
EMRO	Regional Office for the Eastern Mediterranean (World Health Organization)
ERP	Estimated resident population
EURO	European Regional Office (World Health Organization)
HIV	Human Immunodeficiency Virus
HCW	Healthcare worker
HHS	Hospital and Health Service
LTB	Latent tuberculosis infection
MDR-TB	Multi drug resistant tuberculosis
PAHO	Pan American Health Organization
PNG	Papua New Guinea
SEARO	South-East Asia Regional Office (World Health Organization)
TB	Tuberculosis
WHO	World Health Organization
WPRO	Western Pacific Regional Office (World Health Organization)
XDR-TB	Extensively drug resistant tuberculosis

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