Government of Western Australia
North Metropolitan Health Service
Mental Health, Public Health and Dental Services

Western Australian Tuberculosis Control Program

Tuberculosis notifications in Western Australia 2019

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EXECUTIVE SUMMARY

In 2019 Western Australia (WA) recorded 138 cases of tuberculosis (TB) at a rate of 5.3 cases per 100 000 population. This is stable compared to the last 10 years and equivalent to the national rate of TB (last reported 2018, 5.8 cases per 100 000). This indicates continued control of TB in WA. However, it also shows a lack of decline in incidence of TB towards elimination, which is the aim of the Australian National TB Strategic Plan.

The main reason for the persistent incidence of TB continues to be migration from countries where TB is common. Nearly 90% of people diagnosed with TB were born overseas, at a rate of 17 per 100 000, and 57% come from one of 7 countries – Philippines, India, Vietnam, Bhutan, China, Indonesia and Burma. This reflects high migration from these countries to WA, as well as their high prevalence of TB. Further, nearly half of these migrants develop TB within 5 years of their migration. It is likely they are reactivating latent TB infection (LTBI) rather than being cases of missed active TB at migration screening. In future reports it will be interesting to see to what extent the curtailment of migration by COVID-19 in 2020 affects TB incidence.

Delay in the diagnosis of TB within the WA health system persists. More than one third of cases took greater than 90 days from first presentation to diagnosis and effective treatment. More importantly, when the delay is examined from the perspective of adverse clinical or public health consequence, half the notifications were classified as adversely delayed. This delay is potentially causing excess morbidity in the patient with TB and an increased risk of TB transmission.

In 2019 the highest proportion of sputum smear positive TB since 2013 was reported (65% of pulmonary cases). Smear positive sputum indicates more advanced TB, which is consistent with the delay in diagnosis reported above. It is also the more infectious form of TB, so represents a risk of transmission of TB that could threaten control within WA. Further work done on genotype cluster analysis (also reported here) aims to identify TB transmission occurring within our borders. The introduction of Whole Genome Sequencing of TB isolates in WA in 2020 will improve the discriminatory power of this local transmission analysis.

In 2019 more drug resistant cases were reported, after a trend to lower incidence over 6 years. This included 2 cases with resistance to all first line drugs, but no cases of extensive drug resistance (XDR-TB). The number of drug resistant cases remains small and the increase in 2019 is considered to be due to natural fluctuation rather than indicating a loss of control. However, increased drug resistant TB substantially increases the workload of the program due to the complexity of management.

The strategic aim to eliminate TB referred to above requires identification and treatment of latent TB infection (LTBI) to prevent it from reactivating and causing TB disease. This report shows a further increase in the TB program's activity in this area with a 23% increase in the diagnosis of LTBI and a high rate of treatment completion (90%). This has been achieved through focus on key at-risk groups. The TB program has established a new, more comprehensive system of recording contact tracing, which will improve the reporting in this area as well as highlight opportunities for improvement. Another key risk group are health care workers, who represented 6% of TB notifications in 2019, but are also being screened and treated for LTBI more than before, representing 33% of people treated for LTBI. The largest group for targeted LTBI treatment are migrants, especially from the countries identified above. More migrants are being treated for LTBI in the TB program, but the number remains

small. To address this, a new program establishing LTBI diagnosis and treatment in primary care is being developed.

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Acknowledgements: This report is largely based on data drawn from the TB notifications in the WA Notifiable Infectious Diseases Database (WANIDD), which is maintained by the Communicable Diseases Control Directorate, the mycobacterial data provided by the state Mycobacterium Reference Laboratory, and the data provided and maintained by TB Case Managers at the WA TB Control Program. The report has been reviewed and endorsed by the Western Australian Tuberculosis & Leprosy Advisory Council (WATLAC).

TB in WA: 2019 SNAPSHOT

- Number of notifications = **138**
- Incidence rate = **5.3/100,000** population
    - Similar to 2018 rate (5.2/100,000)
- Australian-born population: slight increase = **1.0/100,000** population, 0.9/100,000 in 2018
    - **No** Aboriginal cases, decreased from 3 cases in 2018.
- Overseas-born population: **88%** of cases, similar to 2018
    - Nearly half (43%) present within **5 years** of arrival.
    - Residency status: permanent residents = **64%**, overseas students =**12%**
- Geospatial distribution: narrower: 30 Local Government Areas, 36 in 2018
    - Most in Perth metropolitan area **92%**, (85% in 2018)
    - Regional TB rate, **2.5/100,000,** decreased (4.0/100,000 in 2018)
    - Highest regional rate: **Great Southern = 4.9/100,000**
- Culture confirmation: **71%** (98 cases), similar to 2018 (71%)
    - **14 %** had resistance to any first line drug, 5% in 2018
    - **2%** Multi-Drug Resistant (MDR) TB cases, 0% in 2018
- Health System Delay: Overall median delay = **45 days** (60 in 2018)
    - Pulmonary TB more likely to be classified as delayed **(OR 1.07)**
- Genotyping: **99%** molecularly typed – **5%** clustering rate
    - One epidemiologically confirmed cluster in 2019
- TB Risk Factors: most common, travel to high risk country **27.5%** and close contact of TB **24.6%**
- TB in Health Care Workers: **8.4%** of 2019 cases
    - Two pulmonary TB, one sputum smear positive
- Treatment outcome (2018 notifications): – **97%** assessable cases successfully treated (95% in 2017).
    - Death due to TB (case fatality rate) 2.2% similar to 2017 (2.3%)
- Latent TB: **549** commenced treatment in 2019, 23% increase from 2018
    - **89.9%** completion rate, 81.4% in 2018
    - 32.8% as part of Health Care Workers screening
- Contact Investigation: **1576** contacts identified in 2019
    - **80% contact of Pulmonary TB**
    - **75.2% no evidence of TB infection or disease**
    - **17.7% LTBI**
    - **0.8% secondary active TB**

DATA SOURCES

TB notifications:

Tuberculosis (TB) notification data recorded on the WA Notifiable Infectious Diseases Database (WANIDD), is used in this report. Under the Public Health Act 2016, medical practitioners, including laboratory pathologists are required to notify TB cases to the WA Department of Health Communicable Disease Control Directorate. Notification data includes information such as the type of TB, case demography, clinical details, laboratory results, risk factors and some case management details.

The total number of TB cases is based on persons who were in WA at the time of diagnosis. Persons diagnosed in other parts of Australia or abroad who moved into WA were excluded. Treatment outcomes are given for cases notified in the previous year (2018), because of the length of time taken for the treatment of TB to be completed.

Population data used to calculate disease rates in this report has been derived from the Australian Bureau of Statistics (ABS) Estimated Resident Population data (ERP) for 2019 based on 2016 census data. Molecular typing data is provided by the WA Mycobacterium Reference Laboratory. Most TB culturing and all TB isolates identification and molecular typing in WA is undertaken by the reference laboratory.

Latent TB and Contact Investigation:

Data presented in this report is collated and extracted from the WA TB Control Program (WATBCP) working databases. These are data collection tools setup primarily to assist with TB case managers' workload. Measures to ensure the uniformity and completeness of the data collections sheets were introduced to maintain and enhance data quality.

OVERALL NUMBERS AND RATES

In 2019 in Western Australia (WA), a total of 138 cases of TB were notified, at a rate of 5.3 cases per 100,000 population (95% confidence interval (95% CI) = 4.4-6.1) (Figure 1, Table 1). This represented a slight increase of 1.5% from figures noted in 2018 (136). While TB cases and rates remain higher than the overall trend noted since 1990, the increase in both crude notification numbers and rates from 2010 to 2019 was not statistically significant using regression analysis.

Figure 1: Tuberculosis notifications numbers and rates, WA, 2010-2019

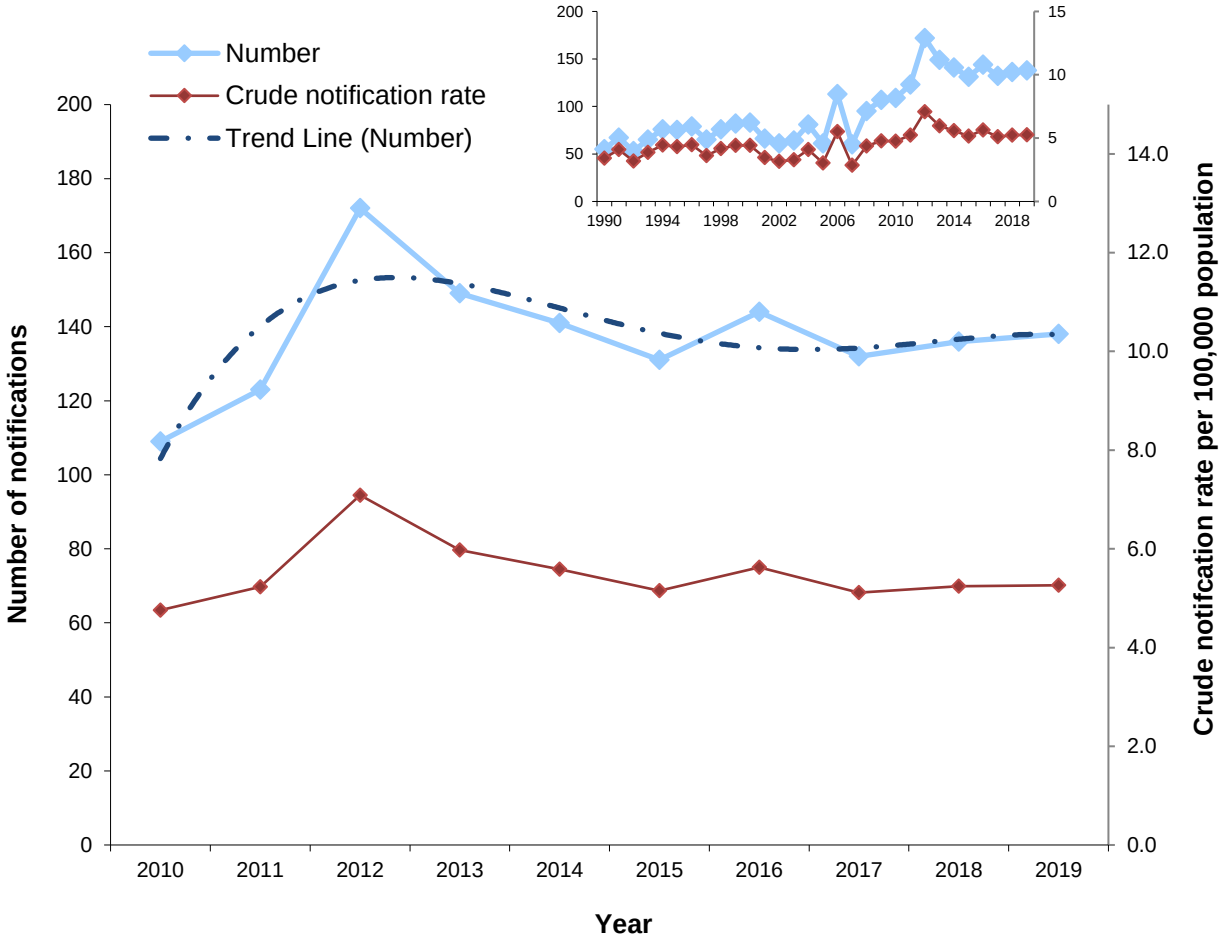


Table 1: Tuberculosis notifications numbers and rates, WA, 1990-2019

Year	Number	Rate[1] (95% CI)[2]	Annual change in case numbers (%)	Annual change in rate (%)
1990	55	3.4 (2.5 – 4.3)	-	-
1991	67	4.1 (3.1 – 5.1)	21.8%	20.1%
1992	53	3.2 (2.3 – 4.1)	-20.9%	-21.9%
1993	65	3.9 (2.9 – 4.8)	22.6%	21.2%
1994	76	4.5 (3.5 – 5.5)	16.9%	15.2%
1995	75	4.3 (3.3 – 5.3)	-1.3%	-3.1%
1996	79	4.5 (3.5 – 5.5)	5.3%	3.5%
1997	65	3.6 (2.7 – 4.5)	-17.7%	-19.1%
1998	76	4.2 (3.2 – 5.1)	16.9%	15.2%
1999	82	4.4 (3.5 – 5.4)	7.9%	6.3%
2000	83	4.4 (3.5 – 5.4)	1.2%	-0.1%
2001	66	3.5 (2.6 – 4.3)	-20.5%	-21.6%
2002	61	3.2 (2.4 – 4.0)	-7.6%	-8.8%
2003	64	3.3 (2.5 – 4.1)	4.9%	3.5%
2004	81	4.1 (3.2 – 5.0)	26.6%	24.7%
2005	61	3.0 (2.3 – 3.8)	-24.7%	-26.0%
2006	113	5.5 (4.5 – 6.5)	85.2%	82.2%
2007	60	2.8 (2.1 – 3.6)	-46.9%	-48.3%
2008	95	4.4 (3.5 – 5.3)	58.3%	53.6%
2009	107	4.8 (3.9 – 5.7)	12.6%	9.2%
2010	109	4.8 (3.9 – 5.6)	1.9%	-0.4%
2011	123	5.2 (4.3 – 6.2)	12.8%	9.8%
2012	172	7.1 (6.1 – 8.2)	39.8%	35.6%
2013	149	6.0 (5.0 – 6.9)	-13.4%	-15.7%
2014	142	5.6 (4.7 – 6.5)	-5.4%	-6.5%
2015	131	5.1 (4.3 – 6.0)	-7.1%	-7.9%
2016	144	5.6 (4.7 – 6.5)	9.9%	9.3%
2017	132	5.1 (4.2 – 6.0)	-8.3%	-9.1%
2018	136	5.2 (4.4 – 6.1)	3.0%	2.4%
2019	138	5.3 (4.4 – 6.1)	1.5%	0.5%

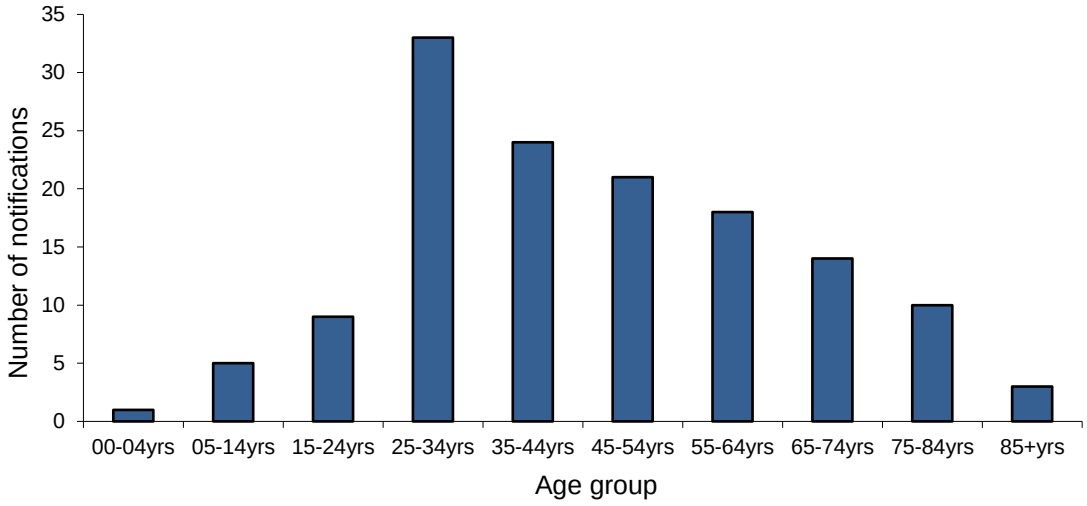
[1] *Crude notification rate per 100,000 population*

[2] *95% Confidence interval*

DEMOGRAPHIC CHARACTERISTICS

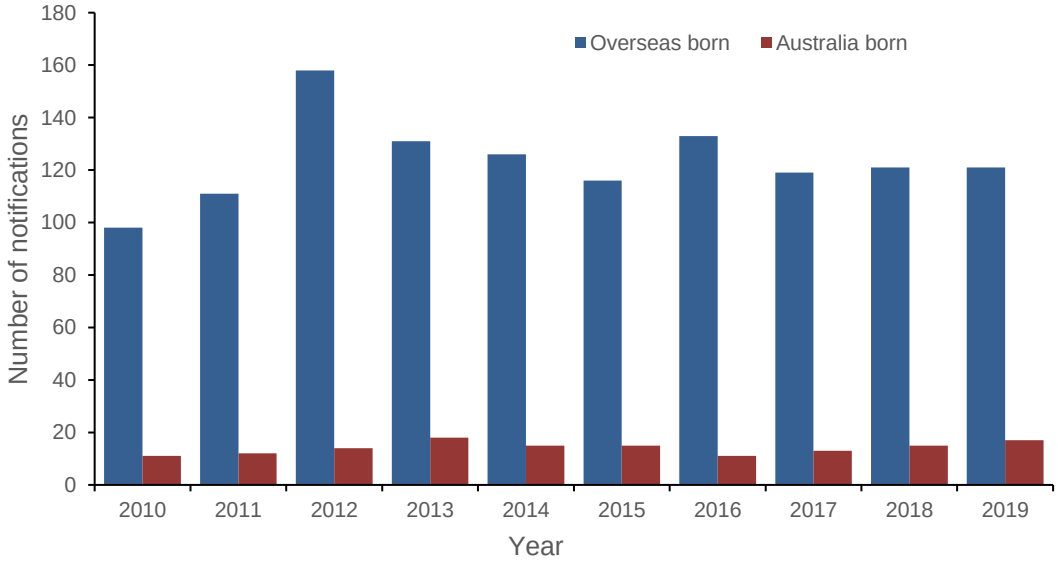
In 2019 the female predominance noted in 2018 continued and females represented 56% (n=77) of notified TB cases with a male to female ratio of 1:1.3. On the other hand, the age distribution followed the previously observed trend with young adults representing the biggest proportion of TB cases with the 15 to 44 age group representing 48% (n=66) of cases notified in 2019 (Figure 2). Cases aged 45 to 64 years accounted for 28%, and those 65 years and over for 20% of all cases. After declining to 2% (0.6/100,000) in 2018, the number of TB cases among children less than15 years of age increased to 4% (n=6) of the 2019 TB caseload with a rate of 1.2 per 100,000 population. Despite of this increase WA rates were still in line with the national rate of 1.1/100,000. Only one of the 6 children with TB was less than 5 years old (0-4 age group), This child together with another 2 were Australian born.

Figure 2: Tuberculosis by age group, WA 2019



Similar to previous years, information on the place of birth (Australian born/overseas born) was recorded for 100% of cases notified in 2019. The majority of cases, 88% (n=121), were born overseas with an incidence rate of 17.0 per 100,000 population (Figure 3). The proportion of TB in the Australian born population increased slightly to 12% (n=17) of 2019 caseload. This is an incidence rate of 1.0 per 100,000, compared with 0.9/100,000 and 0.8/100,000 in 2018 and 2017 respectively. No TB cases were notified among the Australian Aboriginal population in WA in 2019 while there were 3 Aboriginal TB cases in 2018.

Figure 3: Tuberculosis cases by place of birth, WA, 2010 - 2019



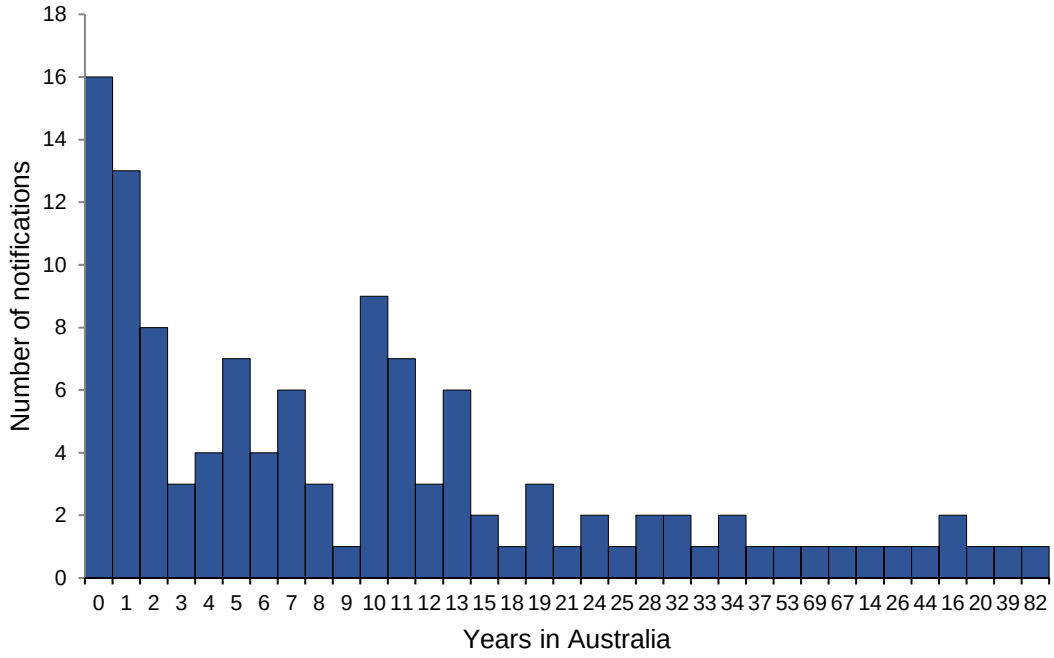
As in previous years, the majority of overseas born cases originated from TB high burden countries e.g. Philippines, India, Vietnam, Bhutan, China, and Indonesia (Table 2).

Table 2: Tuberculosis cases by place of birth, WA 2019

Country of Birth	Number	% Total
Philippines	22	16%
India	21	15%
Australia	17	12%
Vietnam	11	8%
Bhutan	7	5%
China	7	5%
Indonesia	6	4%
Burma (Myanmar)	4	3%
New Zealand	4	3%
Other	39	28%
Total	138	100%

The date of entry to Australia was known for 100% (n=119) of overseas born cases (excluding two immigration detainees). The interval between the date of arrival in Australia and the TB notification date ranged from 0 to 82 years, with a median interval of 18 years (Interquartile range (IQR)=8-33). Similar to previous years, new migrants had the highest burden of TB disease among the overseas born population with 31% (n=37) diagnosed within two years and 43% (n=51) within five years of entering Australia (Figure 4).

Figure 4: Overseas born notified tuberculosis cases by time since entry to Australia



NOTIFICATION BY IMMIGRATION CATEGORIES

Immigration status of those born overseas, as reported by cases at time of diagnosis, was available for 100% (n=121) of the cases notified in 2019. Similar to previous years, the majority were identified as permanent residents (64%, n=77). Overseas students (12%, n=15) was the second most common immigration category, followed by overseas visitors (11%, n=13) and family visa holders/applicants (5%, n=6) (Table 3).

Table 3: Tuberculosis cases among overseas born by immigration status, WA 2019

Immigration Status	Number	% Total
Permanent resident	77	64%
Overseas student	15	12%
Overseas visitor	13	11%
Family visa	6	5%
Work visa	3	2%
NZ resident/citizen	1	1%
Unauthorised person	2	2%
Other	4	3%
Total	121	100%

Only 2 TB cases were notified among immigration detainees demonstrating the continuous decline of TB notified from this setting since its peak in 2013 (18% n=27)).

GEOGRAPHICAL DISTRIBUTION

The geographical distribution of TB cases in 2019 was relatively narrower than previously observed with TB notified in 30 Local Government Areas (LGA) compared with 36 in 2018. The previously noted increasing numbers of TB cases in country WA was not observed in 2019 and there were more cases notified from Metropolitan Perth area (including Peel) than has been the case in the past few years. The metropolitan area accounted for 92%, (n=127) of all cases with a rate of 6.1/100,000 population (95% CI 5.0-7.1) (Tables 4) compared to 88% in 2018. TB cases and incidence rate in country regions (outside Perth metropolitan area) decreased to 8% (n=11) compared to 15% in 2018, representing an incidence rate of 2.5/100,000 (95% CI -1.1-6.6) which decreased from the 3.6/100.000 and 4.0/100,000 reported for 2017 and 2018 respectively. Local government areas of City of Stirling, City of Swan, City of Gosnells and City of Canning, had the highest numbers of TB cases in the state accounting together for 43% (n=59) of all WA TB burden in 2019.

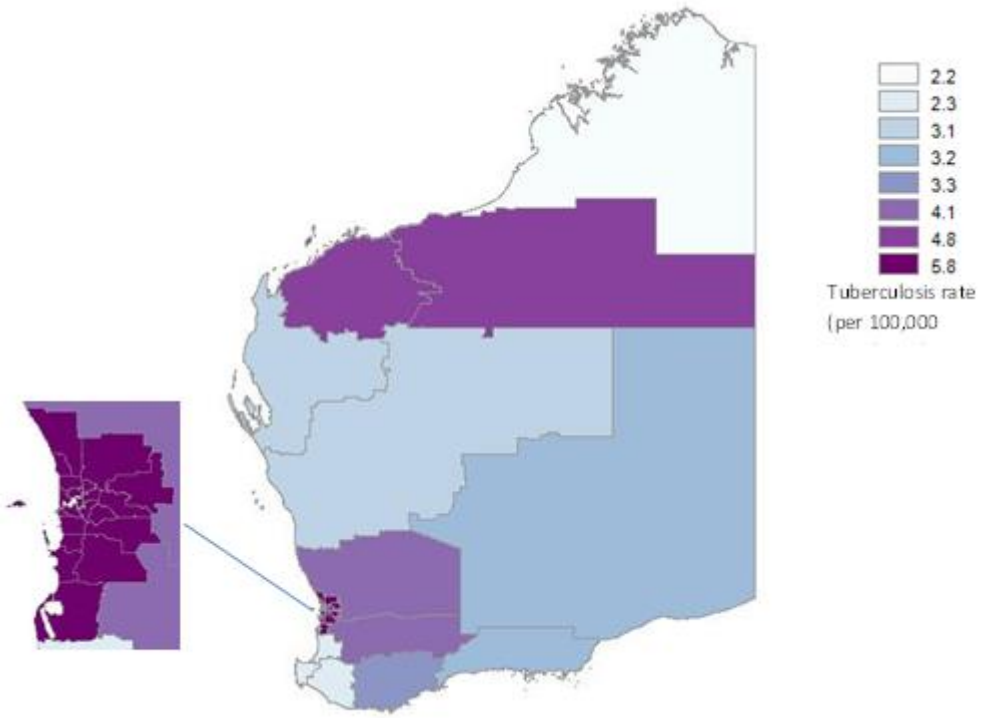
Table 4: Tuberculosis notification numbers and rates, WA Regions 2019

Region	Number	Rate[1] (95% CI)[2]
Metropolitan Perth	127	6.1 (5.0 – 7.1)
Great Southern	3	4.9 (-0.6 – 10.5)
Midwest- Gascoyne	2	3.2 (-1.2 – 7.7)
Pilbara	2	3.2 ((-1.2 – 7.7)
Wheatbelt	2	2.8 (-1.1 – 6.6)
South West	2	1.1 (-0.4 – 2.7)
Goldfields-Esperance	0	-
Kimberley	0	-

[1] *Crude notification rate per 100,000 population*
[2] *95% Confidence interval*

The 5 years average rates of regional TB was highest in Perth metropolitan area with an average rate of 5.8/100,000 population (Figure 5), followed by the Pilbara, the Wheatbelt and the Great Southern regions with average rate of 4.8, 4.1 and 3.3/100,000 population respectively.

Figure 5: Five-year average tuberculosis incidence rates by WA Regions 2015-2019



Compared with TB cases from Perth metropolitan area, cases from country areas showed similar age distribution, while gender distribution showed male predominance (male to female ratio of 1.8:1) compared to the ratio of 1:1.4 among cases notified in Perth metropolitan area. Place of birth distribution was also similar with most patient born overseas (90% of country patients and 87% of metropolitan patients). Over 60% of country patients were diagnosed with extra-pulmonary TB, this was in contrast with the 2018 data that showed higher incidence of pulmonary TB among country patients (66.7%). Health system (HS) delay, defined as time from patient's first presentation to treatment start, was measured by number of days (lag time) as well as determination of clinically significant delays. Although the lag-time was significantly higher among country patients with a median of 100 days delay compared with a median delay of 45 days among metropolitan patients, only 45.5% of this delay was shown to of clinical significance. (Table 5).

Table 5: Regional comparison of tuberculosis notifications, WA 2019

			Metro	Country	P value
Age	Median (IQR)		42 (29-63)	49 (26-60)	>0.05
Sex	Male	N (%)	54 (42.5%)	7 (63.6%)	>0.05
	Female	N (%)	73 (57.5%)	4 (36.4%)	
Place of Birth	Australia	N (%)	16 (12.6%)	1 (9.1)	>0.05
	Overseas	N (%)	111 (87.4%)	10 (90.9%)	
TB Type	PTB	N (%)	74(58.3%)	4 (36.6%)	>0.05
	XPTB	N (%)	53 (41.7%)	7 (63.6%)	
HIV Status	Positive	N (%)	1 (0.8%)	0 (0.0%)	>0.05
	Negative	N (%)	114 (89.8%)	11 (100.0%)	
	Not tested or refused	N (%)	6 (4.7%)	0 (0.0%)	
	Unknown	N (%)	6 (4.7%)	0 (0.0%)	
HS lag time	Median (IQR)		45 (14-120)	100 (14-183)	<0.05*
HS Delay	Yes	N (%)	61 (48.8%)	5 (45.5%)	>0.05
	No	N (%)	64 (51.2%)	6 (54.5%)	

*significant difference

CLINICAL CHARACTERISTICS

In 2019, the site of TB was reported for all 138 notified cases. More than half had pulmonary disease (57%, n=78). This was similar to the figures reported in 2018. One in five cases with pulmonary disease (n=15) were also reported to have extra-pulmonary disease in at least one additional site (Table 6).

Table 6: Tuberculosis notifications by site of disease, WA 2019

Site	Number	% Total
Pulmonary only	63	46%
Pulmonary plus other sites	15	11%
Extrapulmonary only	60	43%
Total	136	100%

The extra-pulmonary TB disease sites in 2019 showed a noticeable increase in peritoneal and gastrointestinal TB from 4% (n=3) in 2018 to 13 cases representing 16% of extra-pulmonary cases and featuring as the second most reported extra-pulmonary site after lymph node. (Table 7).

Table 7: Extra-pulmonary TB notifications by site of disease, WA 2019

Site of extra-pulmonary TB	Number	% Total
Lymph Node	31	39%
Peritoneal (includes all GI sites)	13	16%
Pleural	10	13%
Bone-Joint	6	8%
Meningeal	5	6%
Ocular	5	6%
Genitourinary	3	4%
Cutaneous	2	3%
Disseminated TB	1	1%
Other	3	4%
Total	79	100%

Of the 138 TB cases reported in 2019, 99% (n=136) were new cases while 1% (n=2) had relapsed after previous treatment. Both cases relapsed after treatment overseas.

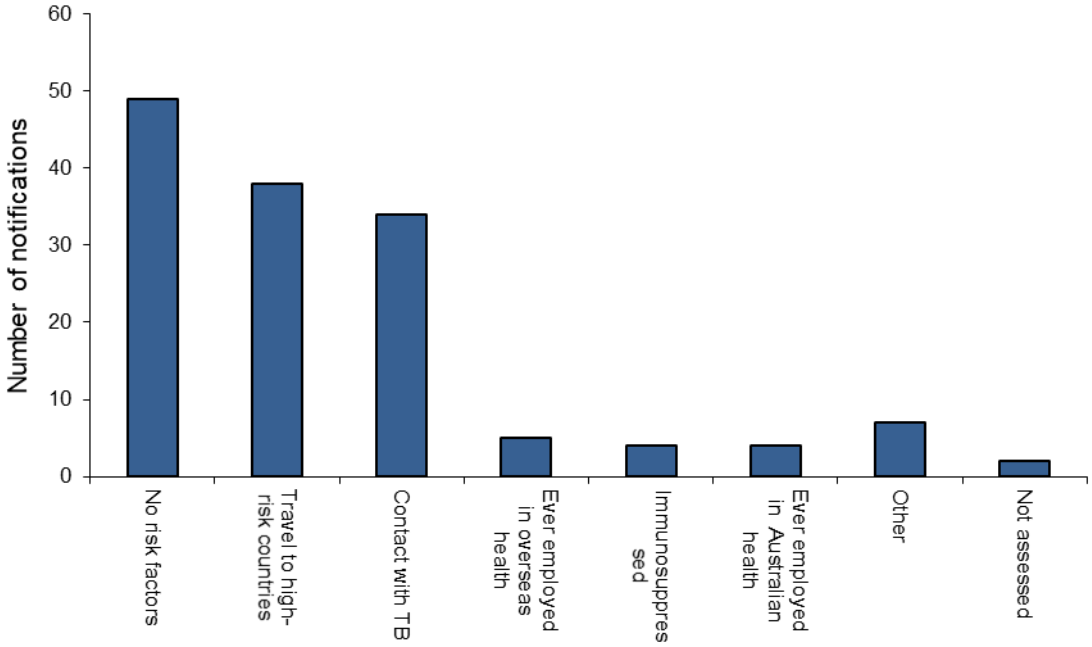
The proportion of TB cases with known HIV status increased in 2019 to 91% (n=126) from 88% in 2018. One of the tested cases with known results was HIV positive. Those without HIV status recorded were of unknown status (4%, n=6) or were not tested (6%, n=6).

TB RISK FACTORS

TB risk factors are situations and conditions that increase the risk of TB infection or the subsequent progression from latent TB infection (LTBI) to active TB disease. The identification of these factors will provide opportunities for control of TB through screening and treatment of LTBI among exposed or affected individuals.

Similar to 2018, the percentage of cases with available information for the various risk factors in 2019 was 96% (n=132). No risk factors were identified in 35.5% (n=49) of the cases. For those with identified risk (n=89), the most common risk factor reported was past travel to, or residence in, high risk country(ies) (27.5%) followed by being household member or close contact with TB (24.6%). (Figure 6).

Figure 6: Risk factors reported for tuberculosis notifications, WA 2019



TB among health care workers

Even in TB low risk countries like Australia, evidence suggest that Health Care Workers (HCW) are at higher risk of acquiring TB compared to the general population[1]. The importance of TB among health care worker is further highlighted by the risk of transmission within health care facilities to those under their care requiring control measures that often involve extensive and occasionally sensitive contact investigation.

In 2019, information on occupation was known for 99% (n=104) of the 105 cases aged between 20 and 64 years. Of those with known occupation, 9% (n=9) reported working as health care workers. Two of these patients had pulmonary TB with one considered potentially infectious due to sputum smear positive disease. Contact investigation of the smear positive patient revealed 102 contacts of which no cases of active TB were identified and 9 contacts were diagnosed with

Latent TB Infection (LTBI). All the health care workers were overseas born from high TB risk countries.

HEALTH SYSTEM (HS) DELAY

In 2019 and similar to the previous year, health system delay, defined as time from first TB related health contact to starting TB treatment, was known for 99% (n=136) of cases. Of these, 41.2% (n=56) started treatment within 30 days of first health contact, 22.8% (n=31) started treatment between 30 and 90 days and 36.0% (n=49) started treatment more than 90 days after their initial health contact. The median time from the first health contact to the start of treatment in 2019 was 45 days (IQR=14-129) compared to 60 days (IQR=33-113) and 56 days (IQR=23-132) in 2018 and 2017 respectively. Delay by TB type showed that pulmonary TB cases had a median delay of 30 days (IQR=10-94) compared to 88 days median delay (IQR=20-194) for extra-pulmonary cases.

Significant delay was again assessed, using the delay matrix introduced in 2016. The matrix classifies the lag time from patient first presentation to treatment start as delayed or not delayed, according to several parameters including: TB type, disease severity, transmissibility and adverse outcomes. Based on this, delayed TB treatment was noted in 48.5% of 2019 cases (n=66), this was slightly less than the delay observed among 2018 cases (50.4%). The matrix also showed a decrease in the difference in delay between pulmonary and extra-pulmonary TB cases with pulmonary TB marginally more likely to be delayed (50% vs 46.6%). This difference was not statistically significant with an odds ratio of 1.07 (95% CI= 0.75-1.5). In comparison in 2018, pulmonary TB cases were 4 times more likely to be delayed than extra-pulmonary TB cases.

MYCOBACTERIAL LABORATORY DATA

Similar to 2018, the percentage of culture confirmed TB cases in 2019 were 71% (n=98). Pulmonary TB cases had higher percentage of positive cultures when compared with extra-pulmonary cases (87% versus 50%). This was slightly less than the 90% observed in 2018, but exceeded the target of 80% culture confirmation of all new pulmonary TB cases set by the European Centre for Disease Prevention and Control[2]. On the other hand, culture confirmation of extra-pulmonary TB cases slightly increased from 48% in 2018 to 50% in 2019. Of the extra-pulmonary TB cases with no culture confirmation, 73% (n=22) had negative culture result. Most of those with no culture done had disease that was not easily amenable to sample collection (e.g. ocular TB). All 98 cultures positive cases were identified with *Mycobacterium tuberculosis* infection (Table 8).

Sputum smear positive cases represented 33% (45/138) of all TB notifications and 65% (44/68) of cases with culture positive pulmonary disease. This was the highest percentage of smear positive pulmonary TB reported since 2013 (Table 8). Interestingly, an extra-pulmonary TB case was sputum smear positive due to necrotic mediastinal lymph nodes rupturing through the trachea wall.

Table 8: Tuberculosis Notifications by culture and sputum smear result, WA 2019

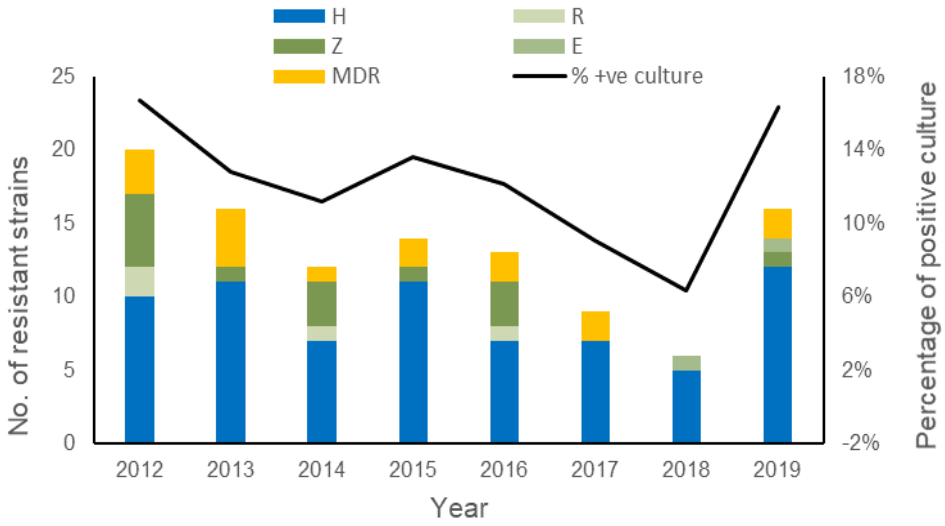
Site	Culture Positive		Sputum Smear Positive	
	Number	% Site	Number	% Site*
All TB notifications	98	71%	45	33%
Pulmonary only	55	87%	36	57%
Pulmonary plus other sites	13	87%	8	53%
Extrapulmonary only	30	50%	1	2%

*Percentage of all cases including culture negative

Drug susceptibility

In reversal of the previously noted declining trend of drug resistance, 2019 data presented the highest rates of drug resistance noted since 2012 (Figure 7). Drug susceptibility testing (DST) results for first line TB drugs were available for 99% (n=97) of the 98 culture-confirmed cases due to the failure of obtaining pure culture in one of the cases. Of those with DST result, 86% (n=83) were fully susceptible to all first line drugs and 12% (n=12) were resistant to isoniazid. This was a marked increase from the 5% (n=5) isoniazid resistance reported in 2018. Two multi-drug resistant TB (MDR-TB) cases were detected in 2019. These 2 cases were resistant to all first line TB drugs. Two of the cases with drug resistance were born in Australia; both patients had a history of long stay in TB high risk countries.

Figure 7: Tuberculosis cases with drug resistance, WA, 2012-2019



GENOTYPING AND STRAIN IDENTIFICATION

In the presented results, a genotyped cluster is defined as isolates sharing identical 15/24 loci VNTR-MIRU type[3]. Also, to allow for the lag time between exposure and disease development, often observed in TB, the data from the previous 4 years as well as the current year were included in the reported genotype analysis. The MIRU-VNTRplus website (http://www.miru-vntrplus.org) was used to assign each of the 15/24 MIRU-VNTR patterns into lineages[4].

In 2019, TB molecular typing results were available for 97 of the 98 culture-positive TB cases, excluding one case where culture decontamination failed. Of these, 9 cases were in 4 molecular clusters, with a median cluster size of two cases and 88 cases had a unique strain type with an overall clustering rate of 5% *(Clustering rate = (nc-c) / n, where nc is the total number of*

clustered isolates, c is the number of isolate clusters, and n is the total number of isolates in the sample)[5]. Epidemiological links were identified in one of the clusters involving household setting providing strong evidence of recent transmission. In the remaining 3 clusters there were no clear epidemiological links and will require further assessment to explore the possibility of non-conventional transmission scenarios.

Overall, for culture confirmed cases notified between 2015 and 2019, 496 isolates had strain typing with MIRU-VNTR completed for at least 15 loci. Of these, 94 (19%) had non-unique molecular types and were in 34 separate molecular clusters with a median cluster size of 2 cases (range 2-8). Beijing and East African Indian (EAI) strains were the most common strains among molecular clusters accounting for 10 clusters each and 59% of the clustering strains. Of these clusters, 13 clusters involving 33 cases were epidemiological linked suggesting local transmission.

Strain identification was completed for 61.3% of the typed isolates between 2015 and 2019. Indo-Oceanic (lineage 1) was the most prevalent representing 24.2%, followed by the East-Asian (lineage 2) (20.2%), Euro-American (lineage 4) (12%) and East African-Indian (lineage 3) (4.6%) (Table 9).

Table 9: MIRU-VNTR tuberculosis strains, WA 2015-2019

Global lineage	Sub-lineage	(%)
Indo-Oceanic (lineage 1)	East African-Indian (EAI)	24.2%
East-Asian (lineage 2)	Beijing	20.2%
East African-Indian (lineage 3)	Delhi/Central Asian (Delhi/CAS)	4.6%
Euro-American (lineage 4)	Haarlem	3%
	LAM	2%
	NEW-1	2%
	Uganda II	1%
	TUR	1%
	Cameroon	1%
	S	1%
	X	0.2%
	Uganda I	0.2%
	Ghana	0.2%
West African 1 (lineage 5)	West African 1	0.2%
	Multiple matches	0.8%
	Unknown	38.7%

TREATMENT OUTCOMES, 2018

Due to the length of time taken for the treatment of TB to be completed, the data presented in this section are for the 136 TB cases notified in 2018. Of those, 135 cases were commenced on treatment for TB and one case refused treatment.

Treatment outcome was assessed for 95% (n=128) of the 135 cases which started TB treatment in 2018 after excluding those transferred outside of Australia, or died of other causes. There were no cases still on treatment. The proportion of cases successfully treated (including cured and completing treatment) was 97% (n=124) of assessable cases, increasing from the 95% reported in 2017 (Table 10).

Table 10: Tuberculosis treatment outcome, WA, 2018

Outcome	Number	% Total
Assessable outcomes		
Treatment success	124	97%
Cured (bacteriologically confirmed)	0	0%
Completed treatment	124	97%
Interrupted treatment	0	0%
Died of TB (died during treatment of TB, as a result of TB disease)	3	2%
Defaulter	1	1%
Failure	0	0%
Not followed up, outcome unknown	0	0%
Total assessable	128	100%
Non-assessable outcomes		
Transferred out of Australia	2	1%
Died of other cause (died during treatment of cause other than TB)	5	4%
Still under treatment	0	0%
Total	135	100%

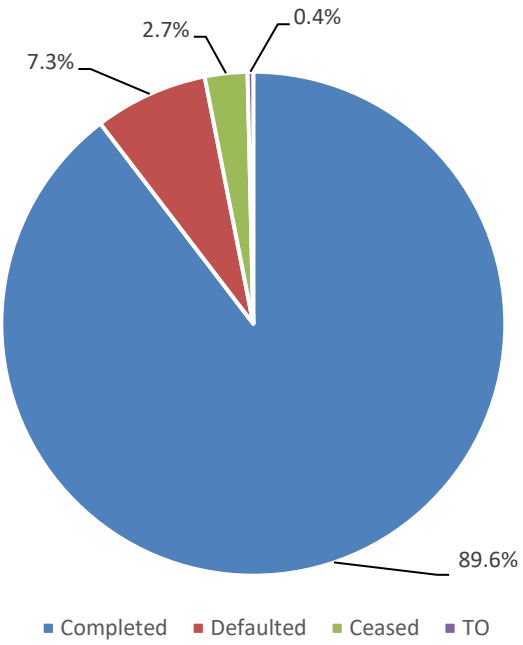
For assessable outcomes, the reported reasons for not completing treatment were death due to TB (2%) and defaulting before treatment completion (1%). Death during TB treatment from other cause (4%) was the most common reason for non-assessable treatment outcomes. Death from all causes represented 6%, this was an increase from the 5% and 4% reported in 2017 and 2016 respectively. On the other hand, TB caused or contributed to 3 deaths, giving a TB case fatality rate of 2.2%. This was similar to 2017 rate (2.3) and was an increase from the 0.7% and 0.8% case fatality rates reported for 2016 and 2015 respectively. Two of the 3 TB related deaths were 80 years old while the third case was in mid-thirties and developed TB on a background of severe immunocompromising medical condition.

LATENT TB

The detection and treatment of Latent TB Infection (LTBI) as a fundamental strategy in TB control in Australia is highlighted by the fact that most of TB cases are the result of reactivation of LTBI[6].

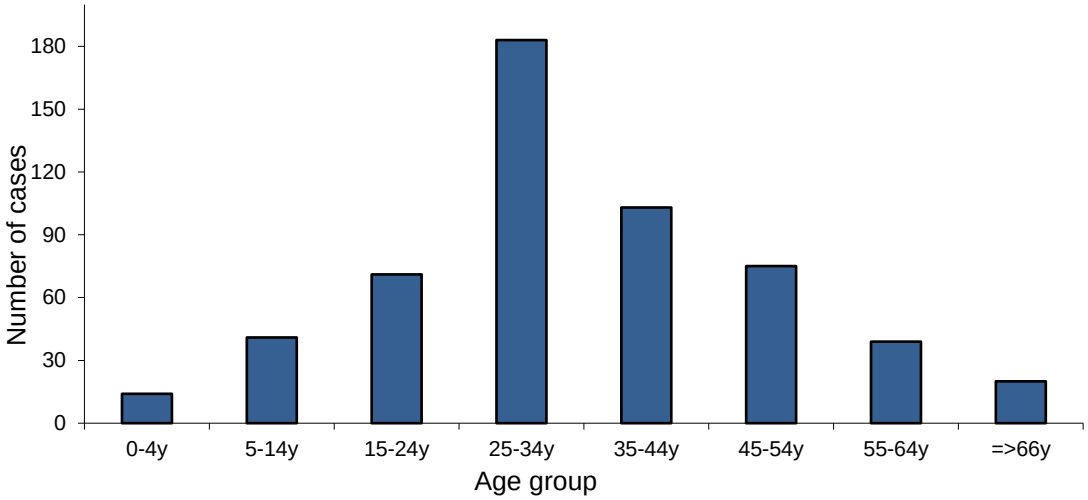
In 2019, a total of 549 individuals started LTBI preventive treatment, a 23% increase from the 2018 LTBI treatment cohort (n=446). Treatment outcomes were available for all cases after excluding those who were transferred out (TO) whilst on treatment. Treatment completion rates improved in 2019 with 89.9% (n=492) completing the prescribed treatment course compared with 81.4% completion rate in 2018 (Figure 8).

Figure 8: LTBI treatment outcomes, WA 2019



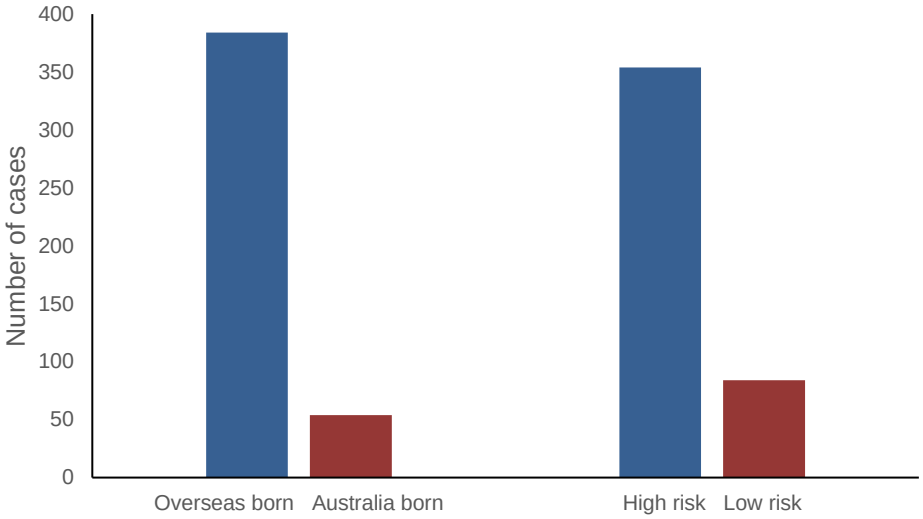
Gender distribution among those starting LTBI treatment was similar to 2018 with males representing 42.8% (n=235) with a male to female ratio of 1:1.3. the majority were less than 35 years of age (56.6%) with the age group 25-34 representing the biggest age group and accounting for 33.5% of those starting LTBI treatment (Figure 9).

Figure 9: LTBI treatment by age group, WA 2019



Where place of birth was recorded, 87.7% of those starting LTBI treatment were among overseas born individuals and 80.8% were born in TB high risk countries (countries with annual TB rate of ≥ 40/100,000 population) (Figure 10).

Figure 10: LTBI cases by place of birth, WA 2019



The reason for LTBI screening and treatment was recorded for all of 2019 LTBI cases. Of these 32.8% were identified with LTBI as part of healthcare worker (HCW) screening, 29.7%, had recent history of TB contact, 23.4% were either recent migrants or newly arrived refugees and 7.8% were screened prior to starting immunosuppressive treatment. (Table 11)

Table 11: LTBI cases by screening reason, WA 2019

Country of Birth	Number	% Total
Healthcare worker screening	180	32.8%
TB Contacts	163	29.7%
Recently arrived refugee	64	11.7%
Recent migrant	64	11.7%
Immunosuppressive treatment	43	7.8%
Other	35	6.4%

Of those failing to satisfactorily complete treatment in 2019, 3% (n=17) did so for reasons that are not amenable to intervention (adverse drug reactions (3.7%) and leaving the state (0.4%)), on the other hand, 7.3% (n=40) failed to complete LTBI treatment for reasons that can potentially be improved with additional targeted interventions (non-adherence, lost to follow up) (Table 12).

Table 12: LTBI treatment outcomes, WA 2019

		Treatment Outcomes					
		Completed		Did not complete		Total	
Sex	Male	212	91%	22	9%	234	43%
	Female	280	89%	33	11%	313	57%
Age Category	0-4y	12	86%	2	14%	16	3%
	5-14y	40	98%	1	2%	26	8%
	15-24v	65	92%	6	8%	64	13%
	25-34v	159	87%	23	13%	101	33%
	35-44v	92	89%	11	11%	55	19%
	45-54v	68	91%	7	9%	33	14%
	55-64v	34	89%	4	11%	22	7%
	=>66y	20	100%	0	0%	13	4%
Place of Birth	Australia	50	93%	4	7%	54	12%
	Overseas	341	89%	41	11%	382	88%
TB Risk	Low risk	78	93%	6	7%	84	19%
	High risk	313	89%	39	11%	352	81%
LTBI Medication	H	86	90.5%	9	9.5%	95	17%
	R	285	90%	32	10%	317	58%
	HR	120	90%	14	10%	134	24%
	Mfx	1	100%	0	0%	0	1%
Reason for Screening	TB Contact	146	90%	16	10%	162	30%
	Refugee	59	94%	4	6%	63	12%
	HCW	154	86%	26	14%	180	33%
	Migrant	59	92%	5	8%	64	12%
	Immuno-suppressed	41	95%	2	5%	43	8%
	Other	33	94%	2	6%	35	6%

Did not complete = Defaulted +Treatment ceased
H: isoniazid, R: rifampicin, Mfx: moxifloxacin

TB CONTACT INVESTIGATION

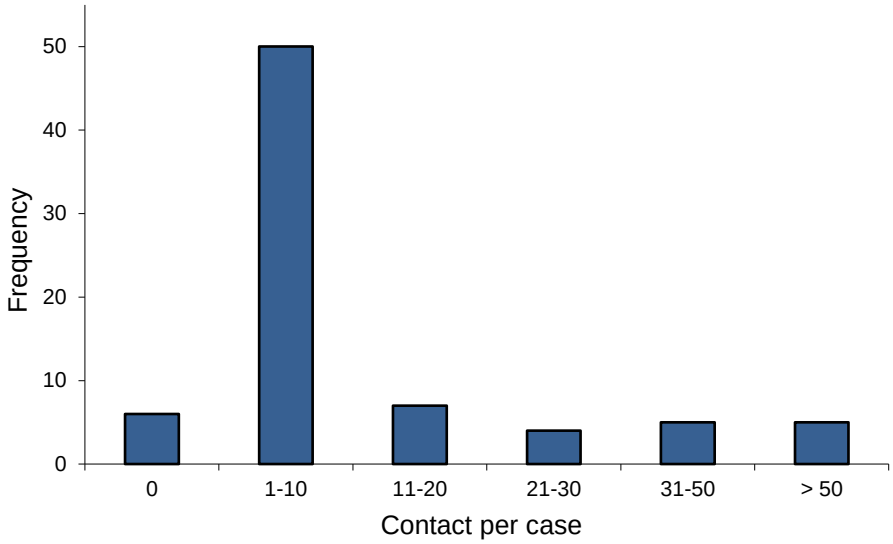
Contact investigation involves identifying individuals who may be at risk of having TB infection or active TB disease as a result of sharing air space with an active TB case. Contacts investigation is prioritised based on to the type of TB, duration of contact, and contact risk factors. The data presented in this report is for contact investigation of notified cases in WA as well as contacts of cases diagnosed in other jurisdictions and airplane contacts of non-resident cases.

In 2019, a total of 1576 contacts were identified and were associated with 138 active TB cases. Of these, 80% (n=1267) were contacts of 71 pulmonary TB (PTB) cases and 20% (n=309) were contacts of 53 extra-pulmonary TB (XPTB) cases. No contacts were identified for 6 pulmonary TB cases and 8 extra-pulmonary TB cases and one case had no contact investigation recorded.

The maximum number of contacts associated with a single case was 270 contacts with a mean number of contacts of 12.8 per case and a median of 4 contacts per case. The minimum number of one contact per case was identified in 12 TB cases.

The mean number of contacts of pulmonary TB cases was 17.8 contacts with a median of 6 contacts per case. Majority of pulmonary TB cases (73% n=56) had 10 or fewer listed contacts. Sixteen cases (21%) had 11 to 50 contacts while five cases (6%) had more than 50 contacts identified (Figure 11). There were 26 children less than 5 years of age identified as contacts, representing 2% of pulmonary TB contacts.

Figure 11: number of contacts per respiratory case, WA 2019



Contact investigation outcomes

In 2019, 35.0% of all contacts (n=551) did not attend, did not complete or there was no recorded outcome of their TB screening, this was an increase of the 30% contacts with no outcome recorded in 2018. Eighteen contacts (1.1%) died before screening completion and 4 contacts (0.3%) were transferred to the jurisdiction of their normal residence. Of those fully screened, 75.2% (n=754) had negative screening results, 17.7% (n=178) were diagnosed with LTBI, 6.3% (n=63) had a past history of TB or LTBI and 0.8% (n=8) represented secondary active TB cases identified by contact investigation. Over one third of the pulmonary TB contacts less than 5 years of age (38% n=10) had no screening outcome recorded mostly due to non-attendance while 10 had negative screening results, 5 were diagnosed with LTBI and one transferred out.

DATA QUALITY AND COMPLETENESS

Notification data

TB notification data is collected through core notification data similar to all other notifiable infectious diseases and an enhanced TB database that collects disease specific information not captured by the core notification data. A completion audit of primary notification data fields is presented. Fields that had their records extracted from other database fields were excluded.

Core notification data

All audited variables were complete with no missing values. Data cleaning undertaking as part of this report preparation continues to contribute to this data quality improvement.

Enhanced TB surveillance data

Six of the audited 16 enhanced surveillance variables had missing values, this was an increase of the only 3 variables with missing values in 2018. Similar to previous years, 'treatment end date' had the highest percentage of missing data, which is expected, giving TB relatively long treatment duration, and does not reflect data quality issues. The other variables with missing values were 'residence time in Australia' and 'Australia arrival date'. As noted in previous reports these were not actual missing values but were not recorded for Australian born cases and is primarily a reflection of the database design limitation that continues to identify Australian born cases in these fields with empty fields.

Latent TB and contact investigation data

The quality of LTBI data showed marked improvement in 2019 with only 2 variables having missing values and 20.6% (n=113) of the cases with one or more missing values. In comparison the 2018 data had missing values in 5 variables with 57.2% of the cases with one or more missing values. The 2 variables with missing values were 'patient country of birth' and 'patient date of birth' that had 20.2% and 0.5% incomplete records respectively. Overall, there were 114 (3.5%) missing values of the total possible 3294.

In 2019 a new contact investigation database was introduced and it was hoped that it will improve the quality and completeness of contact investigation data. While an improvement was noted in the decrease of cases with no recorded contact investigation from 24 in 2018 to only one case in 2019, the data quality improvement was not comprehensive and the 2019 data was in many aspects inferior to 2018 data. One area of concern is the documentation of contact investigation outcomes. Of the 1574 identified contacts, 10% (n=153) had no contact investigation outcomes recorded increasing from only 4% in 2018. Gaps also existed in basic demographic data with contacts date of birth missing in 17% (n=267) and gender missing in 7% (n=108). These data quality issues highlight the need for systematic and continuous monitoring and review of the collected data to ensure its completeness and accuracy.

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