Tuberculosis in New South Wales

Surveillance Report 2019

NSW GOVERNMENT

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Summary

- There were 590 tuberculosis (TB) cases notified in New South Wales (NSW) in 2019, 16% higher than the number of cases notified in 2018.
- The notification rate was 7.3 cases per 100,000 population per year.
- Overseas-born TB cases accounted for 549 cases (93%). The most frequently reported countries of birth were India, China and Philippines.
- Of the 41 Australian-born cases, two (5%) identified as Aboriginal or Torres Strait Islander people.
- Notification rates were highest in Western Sydney Local Health District (WSLHD) and Sydney Local Health District (SLHD).
- The most frequently reported risk factors were birth or past residence (≥3mths) in a high-risk country for TB; known contact with TB; or having an immunosuppressive health condition or being on immunosuppressive therapy.
- 453 cases (77%) were laboratory confirmed by culture or polymerase chain reaction (PCR), with 137 cases (23%) receiving a clinical diagnosis only.
- Of those cases with laboratory confirmation, 11 cases were classified as having multi-drug resistant TB (MDR-TB). This represents 3% of culture confirmed cases and is consistent with previous years. No cases had extensively drug resistant TB (XDR-TB).

	2019	**Change since 2018**
TB cases (number)	590	↑ 16% (n=509)
TB notification rate	7.3 per 100,000	↑ 14% (6.4 per 100,000)
Australian-born non-Indigenous cases (number)	41	↑ 21% (n=34)
Australian-born non-Indigenous rate	0.7 per 100,000	↑ 17% (0.6 per 100,000)
Australian-born Aboriginal cases (number)	2	↓ 33% (n=3)
Australian-born Aboriginal notification rate	0.8 per 100,000	↓ 38% (1.3 per 100,000)
MDR-TB cases	11	↑ 10% (n=10)
% cases tested for HIV at diagnosis	92%	↑ 2% (90%)

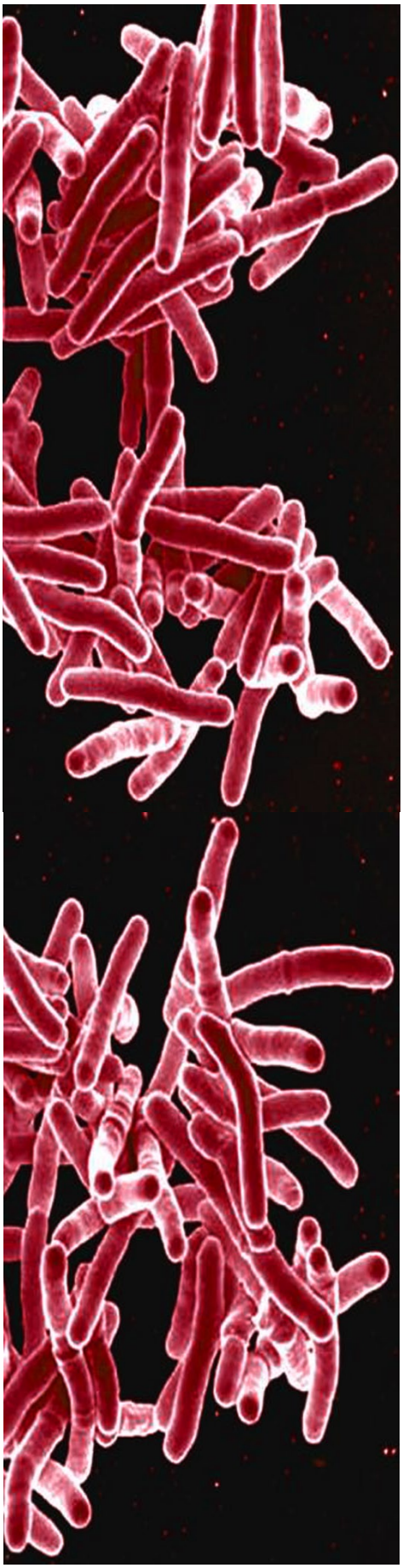


Image: CDC PHIL #18139: Scanning Electron Microscopy image of Mycobacterium Tuberculosis Credit: National Institute of Allergy and Infectious Diseases (NIAID)

Introduction

Tuberculosis (TB) is a bacterial disease caused by infection with *Mycobacterium tuberculosis.* Globally, TB remains a disease of public health significance with the World Health Organization (WHO) estimating 10 million new cases in 2019, and an estimated 1.4 million deaths [1]. Drug-resistant TB is an increasing threat globally, with over 465,000 cases of rifampicin-resistant TB estimated worldwide in 2019, of which 78% had multi-drug resistant TB (MDR-TB) [1]. Almost half of these cases were reported from three countries – India, China, and the Russian Federation [1].

Australia continues to have a low incidence of TB, with the Commonwealth Department of Health reporting a rate of 6.0 cases per 100,000 population in 2019 [2]. In 2018, the proportion of TB cases with HIV/TB co-infection in Australia was reported at 2% [3]. Mortality from TB in Australia is very low with 1% of cases reported to have died from TB in 2017 [2].

The NSW TB Program, through a network of dedicated TB services across the state, continue to focus on active case finding, early diagnosis, and effective treatment of cases and contacts to minimise local transmission of TB in NSW.

Surveillance of TB in NSW is conducted under the NSW *Public Health Act 2010*.

The purpose of this report is to describe the epidemiology of TB in NSW in 2019.

Methods

Data were extracted from the Notifiable Conditions Information Management System (NCIMS) on 29 March 2021 for all confirmed cases of TB notified from 1 January to 31 December 2019. Population data including NSW mid-year population estimates, estimated populations by country of birth and population estimates by local health district (LHD) were obtained from the Australian Bureau of Statistics (ABS) via the Secure Analytics for Population Health Research and Intelligence System (SAPHaRI).

Phenotypic drug susceptibility testing was performed at the NSW Mycobacterium Reference Laboratory using the modified proportion method with the Bactec MGIT 960 system (Becton Dickinson), in liquid culture media. Isolates were tested at World Health Organization (WHO) defined critical concentrations for anti-mycobacterial agents. All isolates received phenotypic testing for isoniazid (H), rifampicin (R), pyrazinamide (Z) and ethambutol (E) (H/R/Z/E); second-line agents were tested for MDR-TB isolates, and upon clinician request. Select isolates also received testing for pyrazinamide susceptibility using Wayne's pyrazinamide assay.

High quality DNA of *M. tuberculosis* was extracted from positive cultures for whole genome sequencing by the NSW Mycobacterium Reference Laboratory. Library are prepared by the Microbial Genomics Reference Laboratory as per manufacture procedure for Nextera XT DNA preparation kit (Illumina). Sequencing was performed in NextSeq500 with 2 x 150 bp paired-end chemistry. Sequence data was trimmed with Trimmomatic and lineage determined using Mykrobe Predictor TB. Cluster detection was determined by SNP difference through Reddog pipeline. Cases were considered clustered if there was less than 12 SNPs difference between cases. Only cases notified in 2019 or earlier were included in the analysis.

Statistical analyses

Notification data were analysed using descriptive and analytic methods. Overseas-born cases were categorised into regions of birth using ABS standards. Notification rates per 100,000 population per year were calculated for the whole of NSW using select fields from demographic, clinical, risk factor and contact management data categories. Notification rates for TB by LHD of residence, and country of birth, were calculated and mapped using R (R core team, Vienna, Austria, 2018). The TB notification rate by country of birth was calculated utilising the 2016 ABS Census Data with country of birth for NSW residents as a denominator. Data were analysed using SAS® Enterprise Guide® (version 8.3, SAS Institute, Cary, NC, USA). The chi squared test was used for cell sizes of 5 or greater and fisher's exact test for samples sizes of less than 5. Significance was tested at the 0.05 level.

Definitions

Clinically diagnosed TB is when a clinician experienced in TB makes a clinical diagnosis of TB disease[4] without a culture or PCR result. Other laboratory suggestive evidence such as smear results for acid fast bacilli or histology may be taken into account. Cases of latent TB infection are not included.

Default is when a person did not commence treatment or ceased treatment early either by own choice or by the recommendation of the treating medical team.

Extrapulmonary TB is disease affecting any other region of the body, including the pleura.

Extensively drug-resistant TB (XDR-TB) are cases in which isolates demonstrated resistance to isoniazid and rifampicin, as well as additional resistance to any fluoroquinolone, and to at least one injectable second-line drug (capreomycin, kanamycin or amikacin) [5].

High risk countries are those with an annual TB incidence of 40 cases per 100,000 population per year or more in 2019 [1].

Laboratory confirmed TB is 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.

Medical default is a person who ceased treatment early on the recommendation of the treating medical team.

MDR-TB are cases with isolates that demonstrate resistance to at least isoniazid and rifampicin [5].

Overseas student is a person studying or seeking study, training, or skills development in Australia.

Permanent resident is a person who holds a permanent visa (or has become an Australian citizen) and is usually resident in Australia.

Pre-extensively drug-resistant TB (pre-XDR-TB) are cases in which isolates demonstrated resistance to isoniazid and rifampicin, as well as additional resistance to any fluoroquinolone or at least one injectable second-line drug (capreomycin, kanamycin or amikacin) but not both.

Pulmonary TB is disease affecting the lung, excluding the pleura.

Refugee / humanitarian is a person in humanitarian need overseas or a person already in Australia who arrived on a temporary visa or in an unauthorised manner, claiming Australia's protection.

SNP Single nucleotide polymorphisms.

Unauthorized person is an unlawful non-citizen.

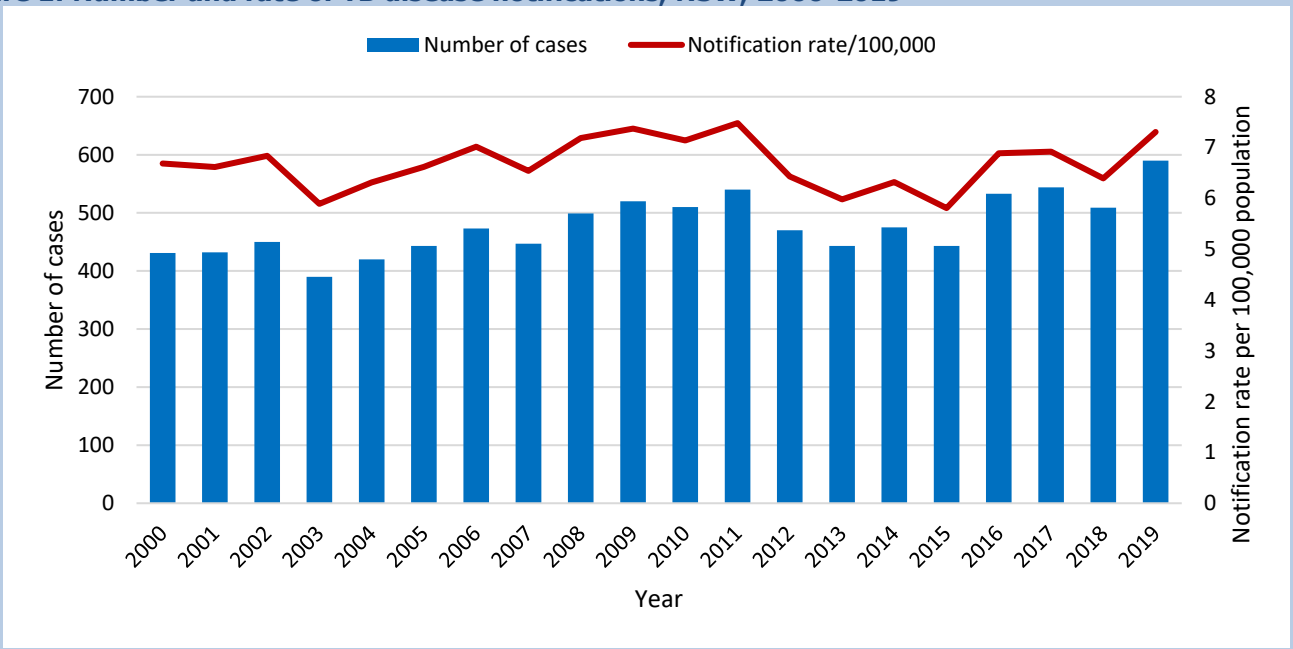
Visitor is a person entering Australia temporarily for tourism, to visit family and friends, to undergo pre-arranged medical treatment or for business related purposes.

Section 1: Demographics

There were 590 notified cases of TB in 2019 in NSW (Figure 1). These cases comprised 39% of the total notified cases in Australia in 2019 (1510 cases) [6]. It is unclear why case notifications fluctuate from year to year; underlying factors may include immigration and TB screening patterns. The number of notifications received in 2019 was 16% higher than the number notified in 2018 (509 cases). The number was the highest number of cases notified in a year in the past 20 years (Figure 1).

The annual notification rate of TB in 2019 in NSW was 7.3 cases per 100,000 population per year. The highest notification rate of the past 20 years was in in 2011 (7.5 cases per 100,000 population per year) (Figure 1).

Figure 1: Number and rate of TB disease notifications, NSW, 2000-2019



2019

590
Number of cases notified

7.3
Rate per 100,000 population

Demographics

Of the 590 cases of TB notified in 2019, 53% of cases were male (n=315). The median age among males was 36 years (range 2-93 years); while the median age among females was 33 years (range 11 months-95 years). The median age overall was 35 years (range 11 months-95 years). One case identified as transgender.

Over half of the cases notified were aged between 20 and 39 years (n=319) with a peak in the number of cases in the 25-29 year age group (n=108, rate=19.2 cases per 100,000) and the notification rate in the 20-24 year age group (n=78, rate=15.3 cases per 100,000). A second peak in the notification rate was observed in those aged 85+ years (n=26, rate=14.2 cases per 100,000). There were four cases (1%) in the 0-4 year age group (Figures 2 and 3).

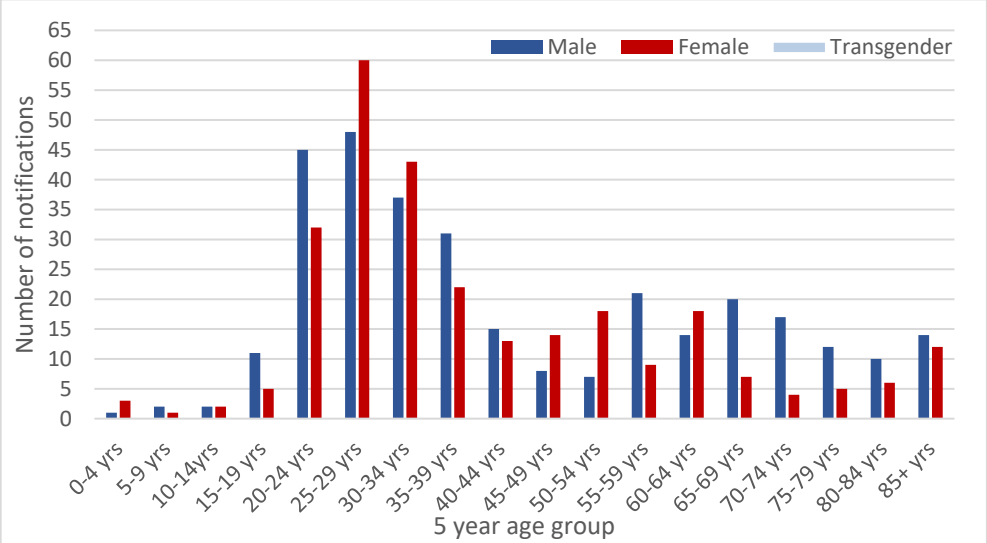
Age and Sex

Sex

53%
Male

47%
Female

Figure 2: Number of TB notifications by age group and sex, NSW, 2019



Age Overall

Range: 11 months-95 years
Median: 35 years

Age by Sex

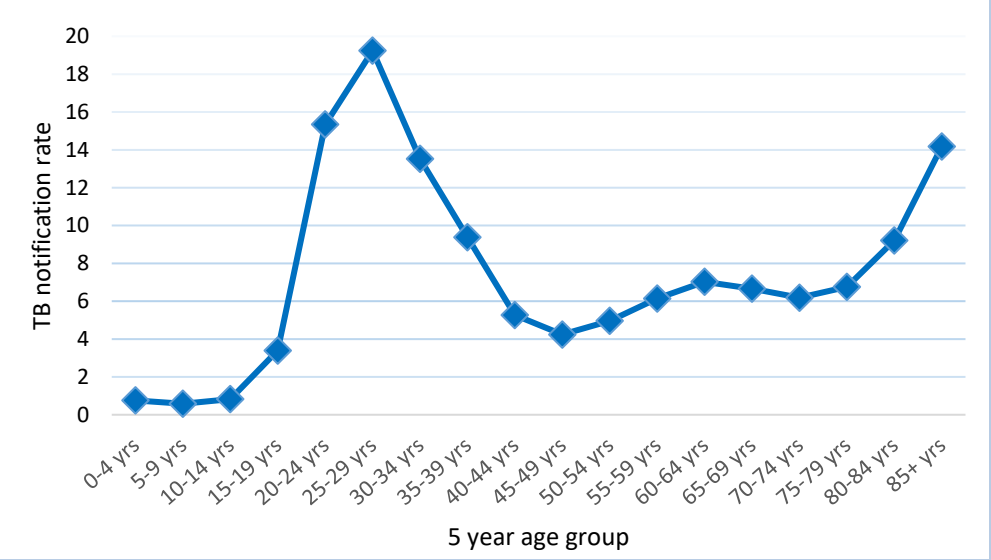
Male

Range: 2-91 years
Median: 36 years

Female

Range: 11 months-95 years
Median: 33 years

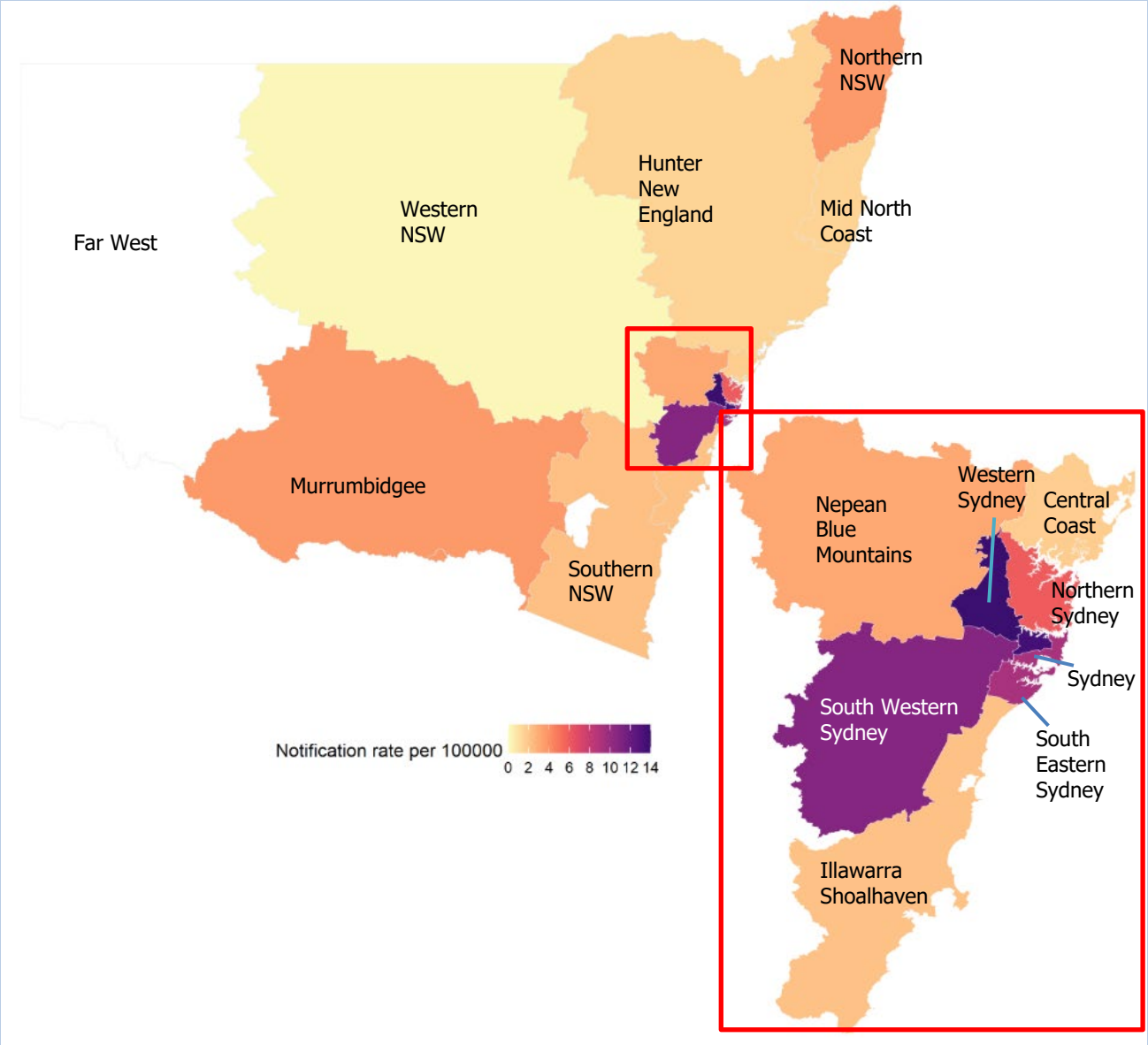
Figure 3: Age specific TB notification rate (per 100,000 population per year), NSW, 2019



Place of residence

Western Sydney Local Health District (LHD) had the highest notification rate, with 14.3 cases per 100,000 population per year (n=150), followed by Sydney LHD with 13.6 cases per 100,000 population per year (n=103) (Figure 4). Of LHDs comprising regional NSW, Murrumbidgee LHD had the highest rate at 3.7 cases per 100,000 per year (n=9) along with Northern NSW LHD at 3.7 cases per 100,000 per year (n=10). For data on individual LHDs see Table 1.

Figure 4: Age and sex standardised rate of notified TB cases per 100,000 population per year by Local Health District of residence, NSW, 2019



11.2

Rate per 100,000, Metropolitan Sydney
(Sydney, South Western Sydney, Western Sydney, Northern Sydney and South Eastern Sydney LHDs)

2.3

Rate per 100,000, Outer Sydney
(Illawarra Shoalhaven, Central Coast and Nepean Blue Mountains LHDs)

2.0

Rate per 100,000, Regional NSW
(Far West, Western NSW, Northern NSW, Mid North Coast, Hunter New England, Southern NSW and Murrumbidgee LHDs)

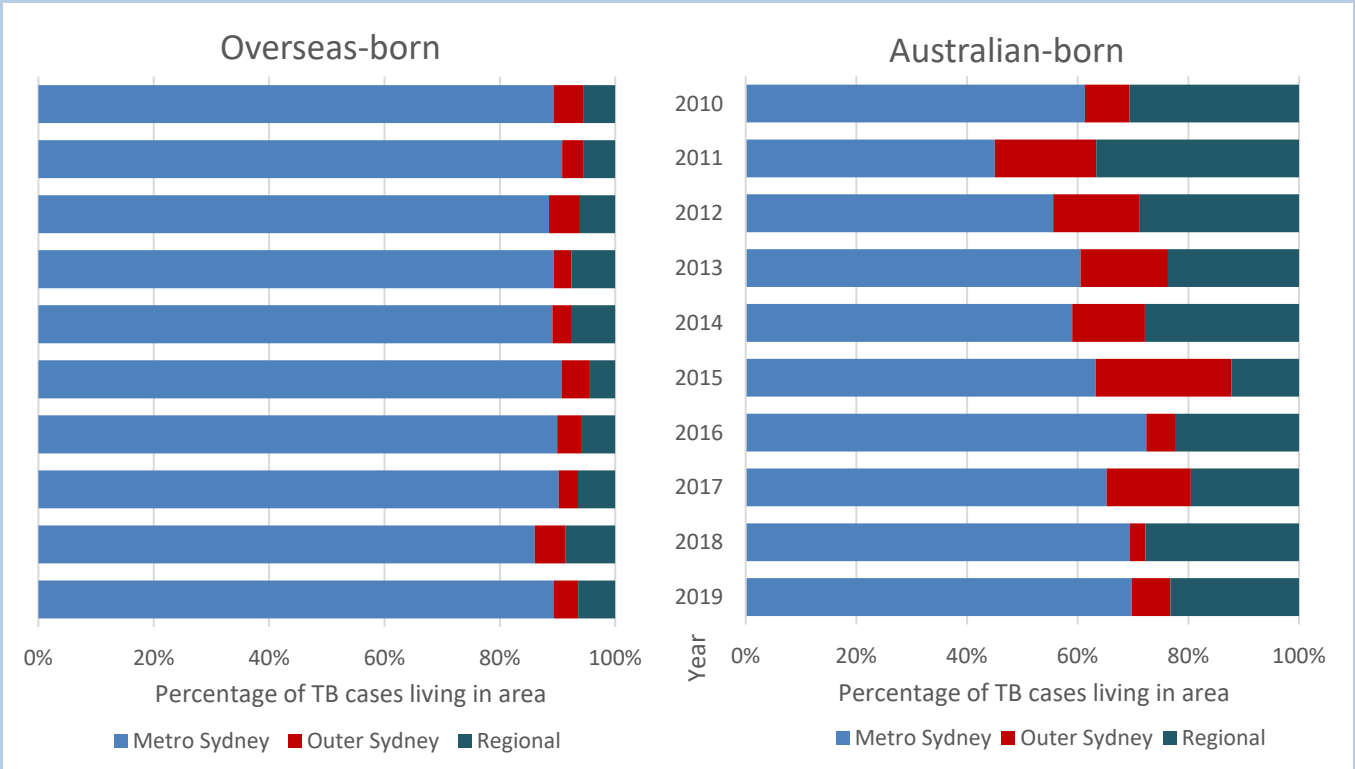
Table 1: Age and sex standardised rate of notified TB cases per 100,000 population per year by Local Health District of residence, NSW, 2019

Local Health District	Number	Rate (95% CI)
Western Sydney	150	14.3 (10.9-16.3)
Sydney	103	13.6 (10.9-16.3)
South Eastern Sydney	99	9.3* (7.5-11.2)
South Western Sydney	110	10.8 (8.7-12.8)
Murrumbidgee	9	3.7 (1.2-6.1)
Northern Sydney	57	5.9 (4.3-7.4)
Mid North Coast	3	1.6 (0-3.5)
Nepean Blue Mountains	12	3.2 (1.4-5.0)
Central Coast	5	1.8 (0.2-3.4)
Southern NSW	6	2.3 (0.3-4.4)
Hunter New England	16	1.6 (0-3.5)
Illawarra Shoalhaven	9	2.2 (0.7-3.7)
Northern NSW	10	3.7 (1.2-6.1)
Western NSW	1	0.2 (0-0.7)
Far West	0	0

*Excludes one case which could not be standardised against the ABS standard population

Australian-born cases are more likely to reside in outer Sydney or regional NSW when compared with overseas-born cases. In 2019, 30% (n = 13) of Australian-born cases resided in outer Sydney or regional NSW compared to 11% (n=58) of overseas-born cases. For overseas-born TB cases this trend has largely not changed over the past ten years while for Australian-born TB cases the number of cases in metropolitan areas fluctuates year to year but has generally increased over the same period (Figure 5). Australian-born cases in regional NSW were more likely to be older (median 66 years) than Australian-born cases in metropolitan areas (median 33 years). There was no difference in age for overseas-born cases diagnosed between regional and metropolitan areas.

Figure 5. Percentage of overseas-born and Australian-born cases diagnosed in metropolitan, outer Sydney and regional areas, NSW, 2019



Country of Birth

In 2019, 93% of cases (n=546) were born overseas. Of these, 97% (n=509) were born in a current high risk country (HRC) for TB. There were 64 individual countries of birth reported among NSW TB cases (Figure 6), with the most commonly reported countries of birth being India (15% of all cases, n=87), China (12%, n=73), Philippines (12%, n=72), and Nepal (12%, n=71) (Table 2). The TB notification rate by country of birth was calculated utilising the 2016 ABS Census Data with country of birth for NSW residents as a denominator (Table 2 and Figure 7). Notification rates for the countries with the highest proportion of cases varied from 0.8 cases per 100,000 for Australian-born cases to 206.0 per 100,000 for Nepalese born cases. There were three other countries of birth with notification rates greater than 200 per 100,000; however, each country had five or less TB notifications with high rates due to small population numbers (<2,000) in NSW. The total notification rate for all overseas-born cases was 23.5 per 100,000 compared to 0.8 per 100,000 for Australian-born cases (Table 2).

Table 2: Countries of birth of TB cases, NSW, 2019

Country of birth	Number of cases	Proportion of cases	Notification rate per country of birth per 100,000 population
India	88	15%	57.2
China (excludes SARs and Taiwan)	73	12%	28.5
Philippines	72	12%	76.5
Nepal	71	12%	206.0
Vietnam	44	7%	47.4
Australia	43	7%	0.8
Indonesia	31	5%	91.0
Bangladesh	15	3%	55.1
Thailand	12	2%	41.8
Afghanistan	10	2%	67.4
Republic of Korea	9	2%	15.5
Other countries	124	21%	7.9
Total overseas-born	547	93%	23.5
Total	**590**	**100%**	**7.3**

Figure 6. Number of TB cases by country of birth, NSW, 2019

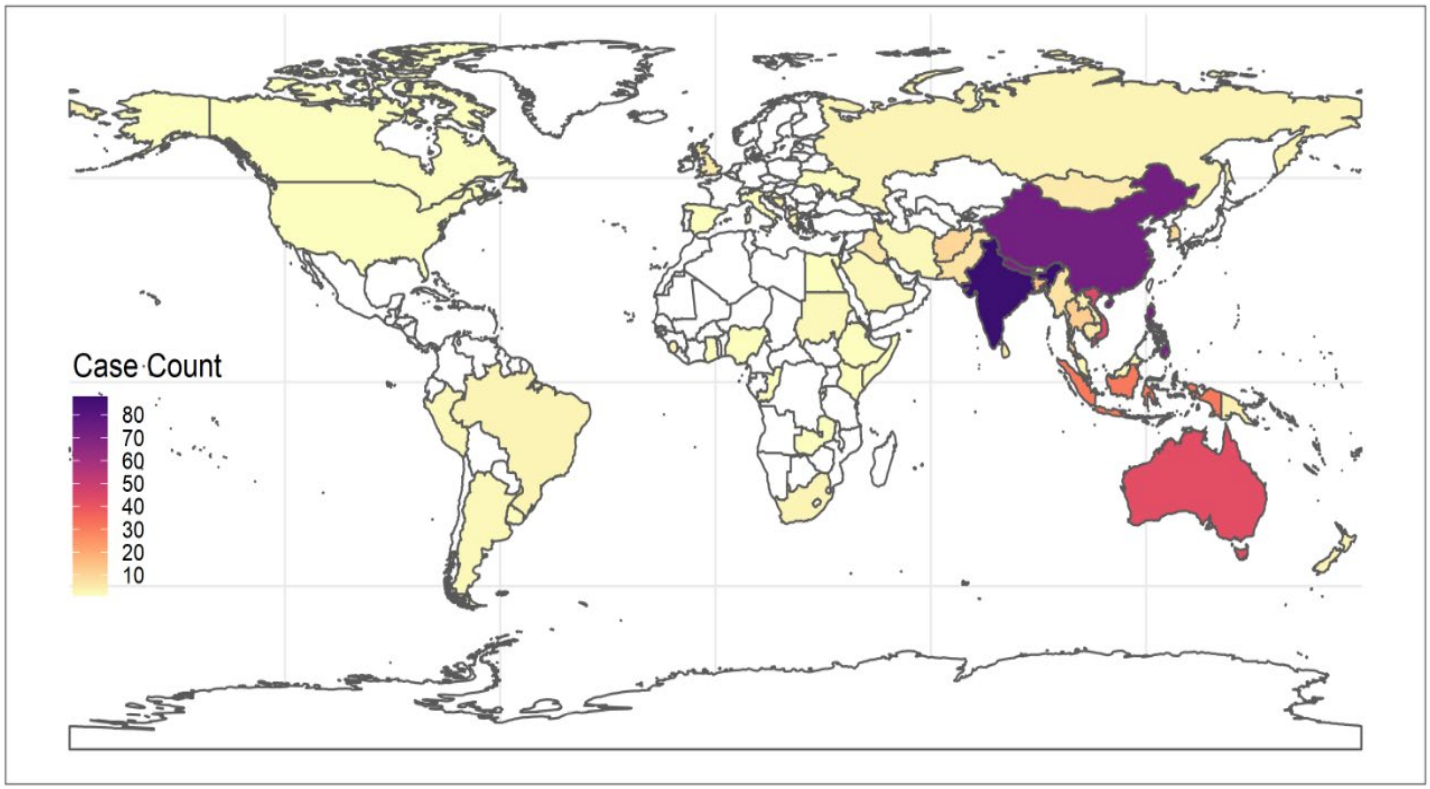
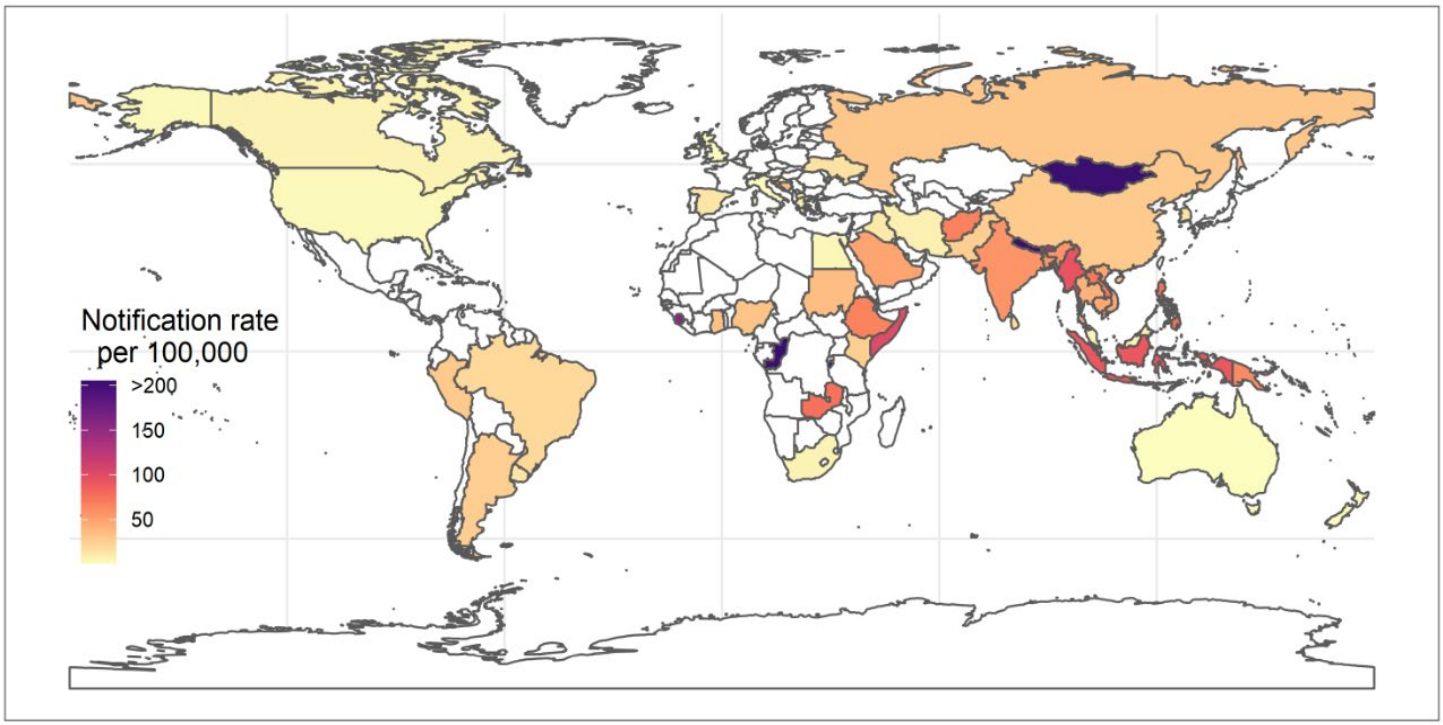


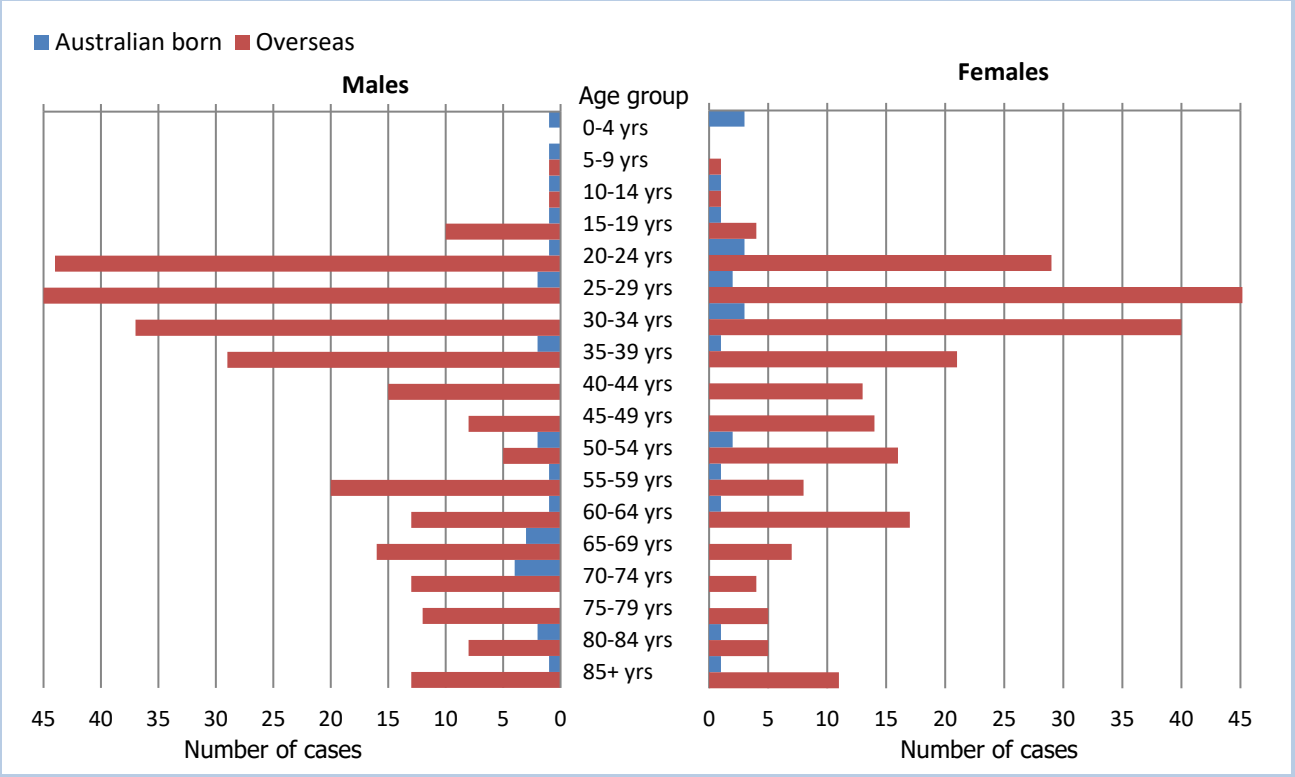
Figure 7. Notification rate of TB cases by country of birth*, NSW, 2019



*Notification rate by country of birth calculated utilising ABS 2016 Census Data for country of birth for residents of NSW

The median age of Australian-born cases is generally higher than the median age of overseas-born cases. Males tended to be older at diagnosis compared to females in Australian-born cases. This is consistent with previous years. In 2019, the median age at diagnosis for Australian-born cases was 38 years; 31 years for females (range 11 months-87 years) and 58 years for males (range 2-90 years). For overseas-born cases, the median age at TB diagnosis was 35 years; 34 years for females (range 5-95 years), and 35 years for males (range 9-93 years). Over 50% of overseas-born cases were aged between 20 and 39 years at diagnosis (Figure 8).

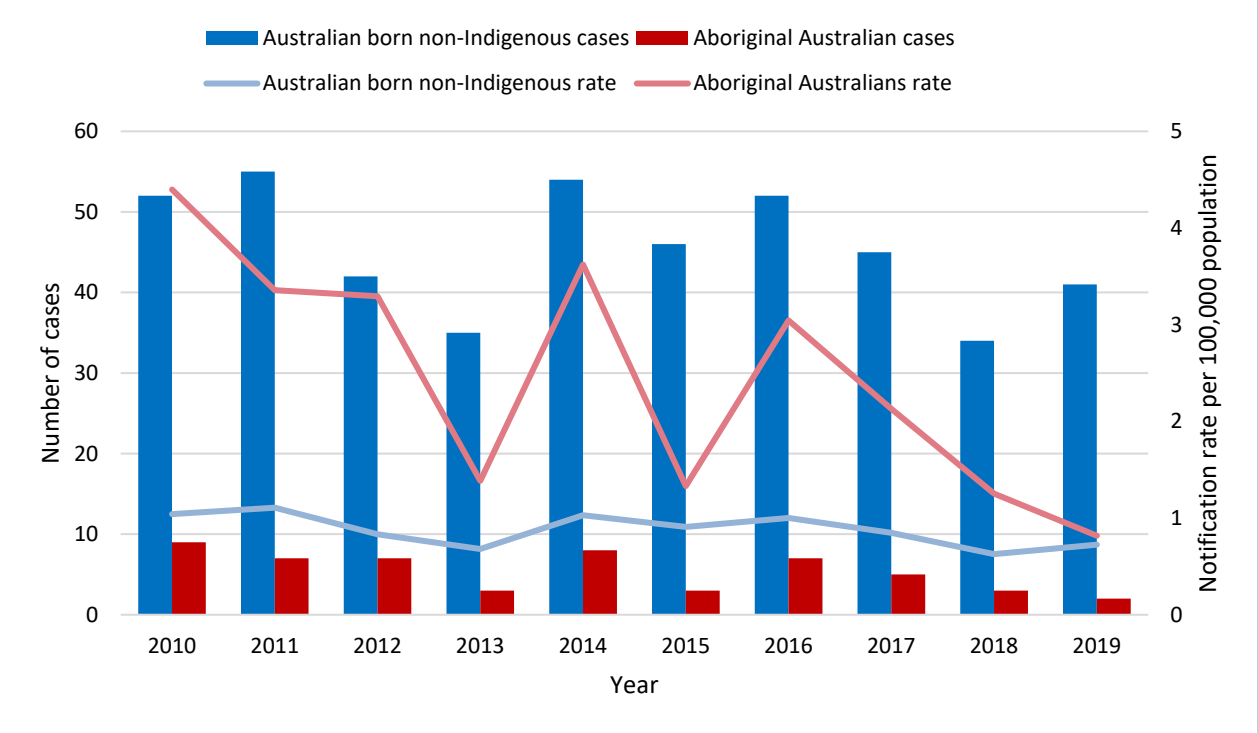
Figure 8: Age group at TB diagnosis, by place of birth and sex, NSW, 2019



Australian-born cases

Of the 43 Australian-born cases in 2019, two cases (5%) identified as Aboriginal people (Figure 9). The number of TB cases who identify as Aboriginal and Torres Strait Islander people fluctuates from year to year and the number notified in 2019 is less than the average number notified per year (n=5) since 2010. The average rate of TB among Aboriginal and Torres Strait Islander people over the past 10 years is over double than that of non-Indigenous Australian-born cases (RR 2.8, 95% CI 2.1-3.7, p<0.0001). Over the 10 years to 2019, the rate in Aboriginal and Torres Strait Islander Australians and Australian-born non-Indigenous people in NSW has decreased. In 2019, there was no statistically significant difference between the rate of TB in Aboriginal and Torres Strait Islander people and non-Indigenous Australian-born cases (RR 1.1, 95% CI 0.3-4.6, p.0.84). The notification rate of TB in Aboriginal and Torres Strait Islander people is its lowest in the past ten years (0.82 per 100,000 population per year).

Figure 9: Number and rate of notified TB in Australian-born cases by Aboriginal and Torres Strait Islander status, NSW, 2010-2019



Overseas-born cases

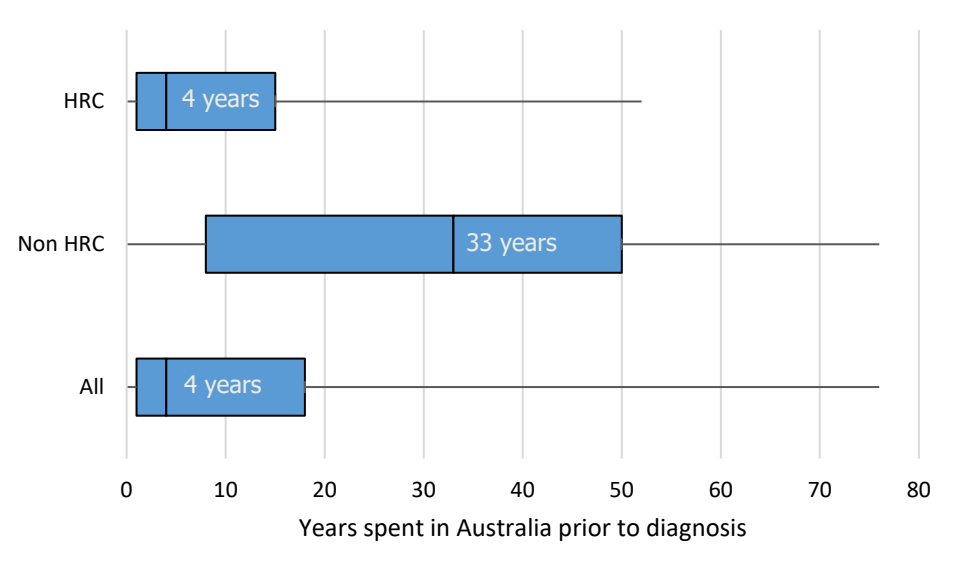
Of the 546 overseas-born cases in 2019, those who had migrated from a current HRC (as of 2019) for TB (n=509) had a shorter median length of stay in Australia prior to diagnosis of TB (4 years, range 0-52 years) when compared to the other overseas-born cases (n=37) (33 years, range 0-76 years) (Figure 10).

Over half of the overseas-born cases were permanent residents at the time of diagnosis (n=292, 53%), 22% (n=120) were overseas students, 10% (n=52) were visitors, 2% (n=12) were refugees, <1% (n=1) were unauthorised persons, 10% (n=53) were on other types of visas, and 3% (n=16) had an unknown or missing Australian visa status (Table 3).

Some Australian visas require the applicant to undergo a medical examination prior to the visa being granted. These include all permanent visa applicants and some temporary visa applicants depending on how long they intend to stay in Australia, if they intend to work or study, and their country of origin. If the medical examination shows that the visa applicant might be at increased risk of developing active TB, applicants screened overseas are placed on a TB Health Undertaking (TBU) and applicants that apply or re-apply in Australia are placed on an Onshore Deferral. Both are required to be followed up by TB services in Australia. Of the 546 TB cases born overseas, 18% (n=98) were on a TBU or Onshore Deferral at the time of diagnosis, a further 7% (n=39) had previously been on a TBU or onshore deferral, 70% (n=387) had never been on a TBU or onshore deferral and for 4% (n=22) this was unknown (Figure 11).

Length of Stay in Australia

Figure 10: Median years spent in Australia prior to TB diagnosis among overseas born cases, by country of birth risk category, NSW, 2019



HRC = High risk country (TB incidence >40 cases per 100,000 population per year)

Table 3: Residency status of overseas-born TB cases at diagnosis, NSW, 2019

Residency status	Number of cases	Percentage
Permanent resident	292	53%
Overseas student	120	22%
Visitor	52	10%
Refugee / humanitarian entrant	12	2%
Unauthorised person	1	<1%
Other	53	10%
Unknown	17	3%
Total	**547**	**100%**

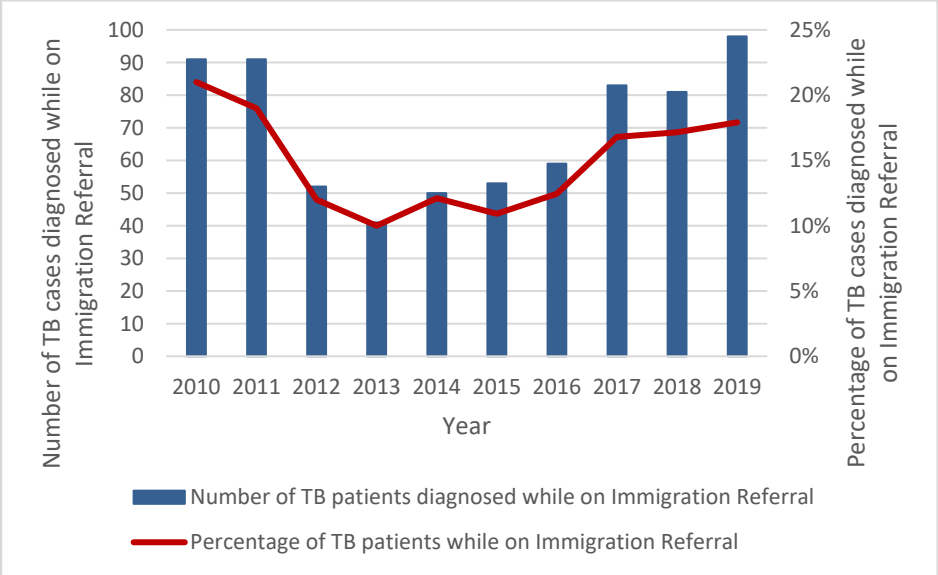
18%

Proportion of NSW TB cases currently on a TB Health Undertaking or Onshore Deferral at diagnosis with TB

7%

Proportion of NSW TB cases who have previously been on a TB Health Undertaking or Onshore Deferral

Figure 11: TB patients diagnosed while on Immigration Referral



Risk Factors

The most commonly reported risk factor for all cases in 2019 was being born overseas in a HRC for TB (89%, n=528). Being born in a HRC is recorded, as well as country of birth, as some countries may have been high incidence when the person was born but are no longer considered a HRC. Having either a household member or another close contact with TB (15%, n=88) and immunosuppression (due to health condition or medication) (15% n=88) were the next highest reported risk factors. Past residence for three months or more in a HRC was reported by 12% (n=73) of all cases (Table 4). There was variation in reported risk factors between Australian-born and overseas-born cases. In Australian-born cases, the most frequently reported risk factor was past residence in a HRC (more than 3 months) (21%, n=9), and having a household or close contact with TB (21%, n=9). For overseas-born cases, 96% (n=528) were born in a HRC. Other reported risk factors can be found in Table 4.

Table 4: Reported risk factors for TB* among notified case, by place of birth, NSW, 2019

	All cases		Australian-born		Overseas-born	
	N	%	N	%	N	%
Total	**590**	**100%**	**43**	**100%**	**547**	**100%**
Born in a HRC^	528	89%	n/a	n/a	528	97%
Household member or close contact with TB	88	15%	9	21%	79	14%
Immunosuppressive health condition/therapy	88	15%	8	19%	80	15%
Past residence (≥3 months) in a HRC	73	12%	9	21%	64	12%
Previously diagnosed with TB	31	5%	1	2%	30	5%
CXR suggestive of old untreated TB	36	6%	1	2%	35	6%
Ever employed in healthcare	27	5%	1	2%	26	5%
Australian-born child of parent(s) born in HRC	8	1%	8	19%	n/a	n/a
Ever resided in a correctional facility	4	1%	1	2%	3	1%
Ever homeless/residing in a shelter	5	1%	1	2%	4	1%
Ever employed in an institution	2	0%	0	0%	2	0%
Other	6	1%	0	0%	6	1%
Not able to be determined	26	4%	15	35%	11	2%

*Multiple risk factors can be recorded
^Born in a HRC is recorded as well as country of birth, as some countries may have been high incidence when the person was born but are no longer considered HRC

Australian-born cases

=1st ≥3 months spent in a high risk country

=1st Household member or close contact with TB

3rd Immunosuppressive health condition/therapy

Overseas-born cases

1st Born in a high risk country

2nd Immunosuppressive health condition/therapy

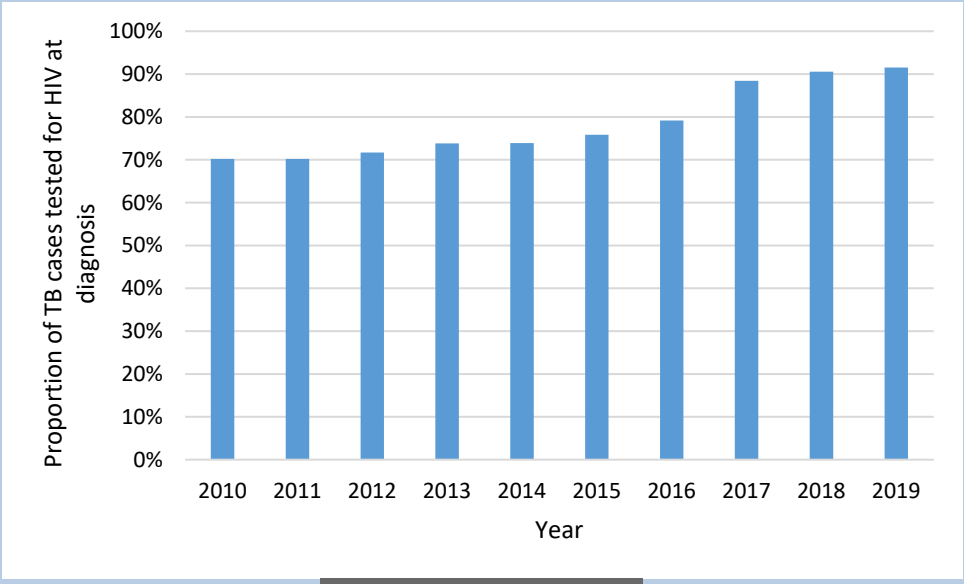
3rd Household member or close contact with TB

HIV Testing

Over the 10-year period to 2019, there has been a 22% increase in the proportion of TB cases tested for HIV at the time of TB diagnosis, from 70% in 2010 to 92% (n=542) in 2019 (Figure 9). Of cases tested in 2019, 2% (n=9) were co-infected with HIV and TB.

Of the nine TB-HIV co-infected cases in 2019, 56% (n=5) were male, and 100% (n=9) were overseas-born. More than half (67%, n=6) were newly diagnosed with HIV around the same time as TB. Three had been previously diagnosed with HIV (33%).

Figure 12: Proportion of TB cases tested for HIV at TB diagnosis, NSW, 2010 - 2019



92%

Proportion of NSW TB cases tested for HIV at diagnosis, 2019

9

Number of NSW TB cases co-infected with HIV, 2019

100%

Target for TB cases tested for HIV at diagnosis

Section 2: Clinical Presentation

Site of Infection

In 2019, 66% (n = 392) of all cases had pulmonary involvement. Fifty-six per cent of cases (n=332) had pulmonary disease only, a further 10% (n=60) had pulmonary disease plus other sites and 34% (n=198) had extrapulmonary TB only (Figure 13). Of extrapulmonary sites reported, lymph node was the most common (n = 116, 45% of cases with extrapulmonary involvement), followed by infection of the pleura (n=35, 14%) and infection of the gastrointestinal tract (n=20, 8%) (Table 5).

Figure 13: Site of disease for TB cases, NSW, 2019

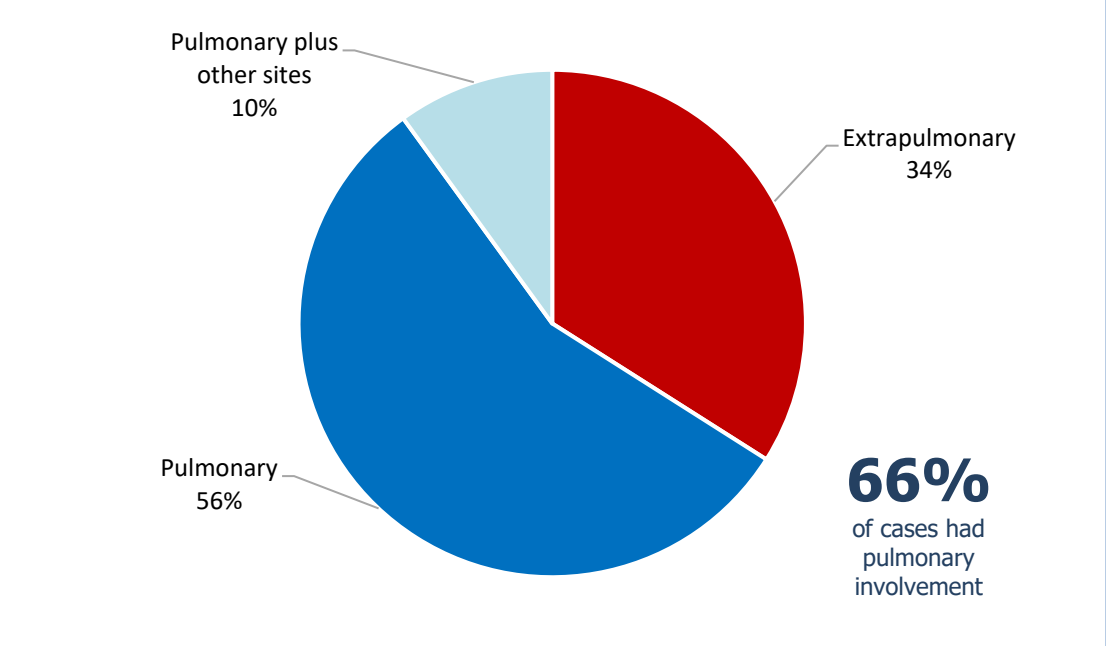


Table 5: Extrapulmonary sites* of disease for TB cases with extrapulmonary involvement, NSW, 2019

Site	Number of cases	Percentage
Lymph node	117	55%
Pleura	35	17%
Gastrointestinal tract	21	10%
Eye	20	9%
Other	19	9%
Brain/central nervous system/meninges, dural sinus, choroid plexus	15	7%
Genitourinary tract	15	7%
Disseminated disease	11	5%
Skin	7	3%
Bone	6	3%
Joints (synovial fluid)	4	2%
Pericardium	3	1%

*Multiple sites can be recorded

Clinical Presentation and Treatment

Of the 590 cases notified in 2019, 95% (n=560) were new diagnoses of TB; while 5% (n=28) were classified as a TB recurrence, following treatment either in Australia (1%, n=6) or overseas (4%, n=22) (Table 6). TB recurrences may either be due to relapse or reinfection.

The majority of cases notified in NSW in 2019 (390, n=66%) were tested for TB as part of an investigation of clinical symptoms. An additional 126 cases (21%) were tested for TB as a result of screening, while only 12 cases (2%) were identified via contact investigation. The proportion of cases detected while symptomatic has significantly decreased by 9% (p 0.0002) over the past ten years, while the proportion of cases detected through screening has increased by 8% (p <0.0001) (Figure 14).

The median time from first health presentation to treatment for Australian-born cases was 32 days (range 0 – 1827 days), and 25 days (range 0 – 4156 days) for overseas-born cases. Cases with pulmonary involvement were commenced on treatment sooner (20 days, range 0 – 1827 days) than those cases with extrapulmonary disease only (40 days, range 0 - 4156 days). There was a delay of greater than one year from time of first health presentation to treatment for 10 cases, 60% of cases (n=6) were extrapulmonary and 40% of cases (n=4) were pulmonary. The majority of the cases (80%, n = 8) were born overseas. Of the four pulmonary cases with greater than one year from time of first health presentation to treatment, one case had non-specific abdominal symptoms with no signs or symptoms of pulmonary disease and the other three cases had been known to TB services for an extended period of time due to undergoing asymptomatic screening (contact screening and immigration screening) for TB and there was no delay in diagnosis once the cases became symptomatic.

Almost all cases were commenced on antimicrobial treatment in NSW following diagnosis (98%, n=579). Twenty-five per cent of cases (n=149) that commenced on treatment did so within 7 days of their first health presentation, with 45% (n=265) commencing within 21 days of first health presentation.

Of the eleven cases (2%) who were not commenced on antimicrobial treatment in NSW, seven (64%) had died prior to their TB diagnosis, two (18%) had returned overseas prior to commencing treatment and their diagnosis was referred to the relevant country, one (9%) had transferred interstate prior to commencing treatment and one (9%) defaulted prior to commencing treatment.

Table 6: Disease classification* of TB cases, NSW, 2019

Disease classification	Number of cases	Percentage
New	560	94%
Recurrence following full treatment only in Australia	4	1%
Recurrence following partial treatment only in Australia	2	<1%
Recurrence following full treatment overseas	19	3%
Recurrence following partial treatment overseas	3	1%
Unknown	2	<1%
Total	**590**	**100%**

*Recurrence may include cases who have relapsed or have been reinfected

98%

Proportion of cases commenced on antimicrobial therapy in NSW

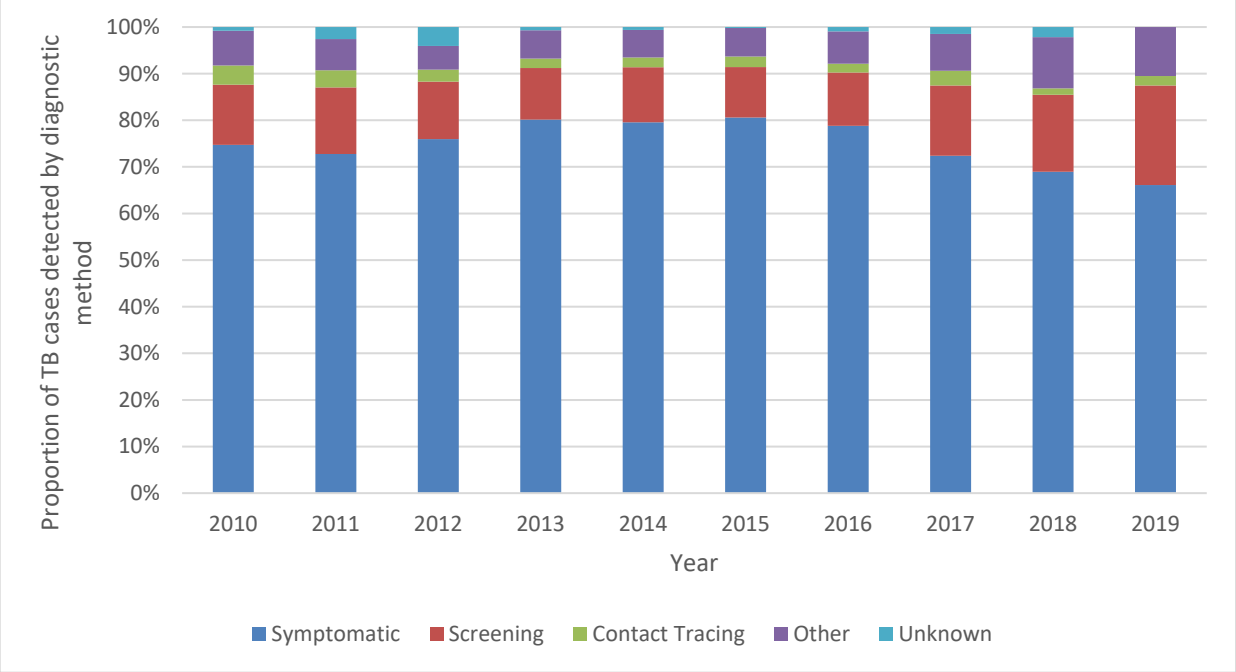
26 days

Median time to treatment from first health presentation

20 days

Difference in median time to treatment between pulmonary and extrapulmonary cases

Figure 14: Method of TB case identification, NSW, 2019



66%

Proportion of TB cases identified via investigation of symptomatic disease

21%

Proportion of NSW TB cases identified via immigration, occupational or other health screening

9%

Increase in NSW TB cases detected through screening since 2010

Section 3: Laboratory

Laboratory Testing

Of the 590 TB cases in 2019, 76% of diagnoses (n=451) were laboratory confirmed; 67% (n=398) were cultured, 9% laboratory diagnosed by polymerase chain reaction (PCR) only (n=53), and the remaining 24% of cases (n = 139) were diagnosed clinically (Figure 15). Laboratory confirmation was more commonly obtained for pulmonary involvement (84%, n=330), compared to those with extrapulmonary disease only (61%, n=121). A greater proportion of laboratory confirmation by PCR only occurred in extrapulmonary cases (14%, n=27), compared to PCR only confirmation of pulmonary cases (7%, n=26). For the ten-year period to 2019, there has been a significant increase in the proportion of cases confirmed using PCR only (p=<0.0001) (Figure 16).

84%

Proportion of NSW TB cases with pulmonary involvement with laboratory confirmation

61%

Proportion of NSW TB cases with extrapulmonary disease only with laboratory confirmation

Figure 15: Method of diagnosis of TB, laboratory vs. clinical, NSW, 2019

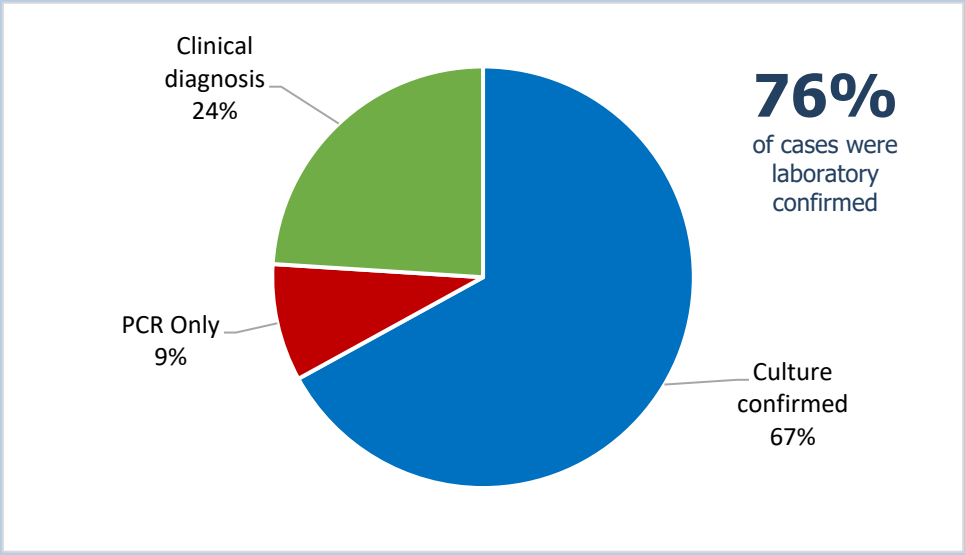
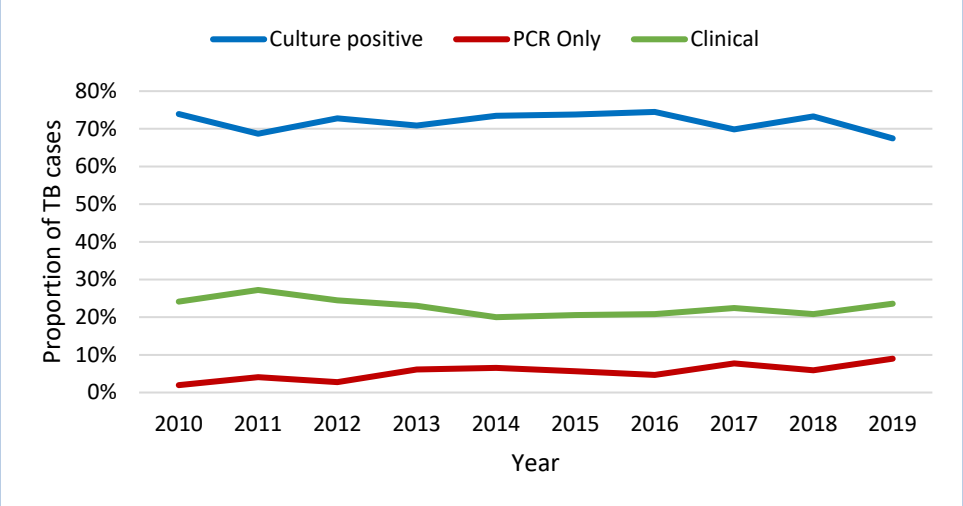


Figure 16: Method of laboratory confirmation of diagnosis of TB cases, NSW, 2010-2019



0%

Change in proportion of diagnoses made on clinical grounds only since 2010

7%

Increase in diagnoses confirmed by PCR only since 2010

6%

Decrease of diagnoses confirmed by culture since 2010

Drug susceptibility testing (DST)

Of the 398 culture positive TB cases in NSW in 2019, 99% (n=394) had drug susceptibility results reported. Of these, 89% (n=350) were fully susceptible to first line TB drugs, 8% (n=33) were resistant to one or more first line TB drug, and 3% (n=11) were classified as MDR-TB (Figure 17). These proportions have not significantly changed over the last 10 years (Table 6). Of the four cases without DST, three were mixed infections with another mycobacterium and one case was unable to be re-cultured by the reference laboratory which prevented DST from being performed.

Of the eleven cases classified as MDR-TB or pre-XDR-TB, 73% (n=8) were new cases and 27% (n=3) were relapses following treatment overseas. There were no MDR-TB cases in Australian-born people. The countries of birth for the MDR-TB cases were China (n=4), India (n=3), Philippines (n=2), Vietnam (n=1), and Nepal (n=1).

89%

Proportion of culture positive cases (with DST) fully susceptible to first line TB drugs

8%

Proportion of culture positive cases with mono-resistance to any first line TB drug

3%

Proportion of culture positive cases which were MDR-TB

Figure 17: Drug susceptibility of culture confirmed cases, NSW, 2010-2019

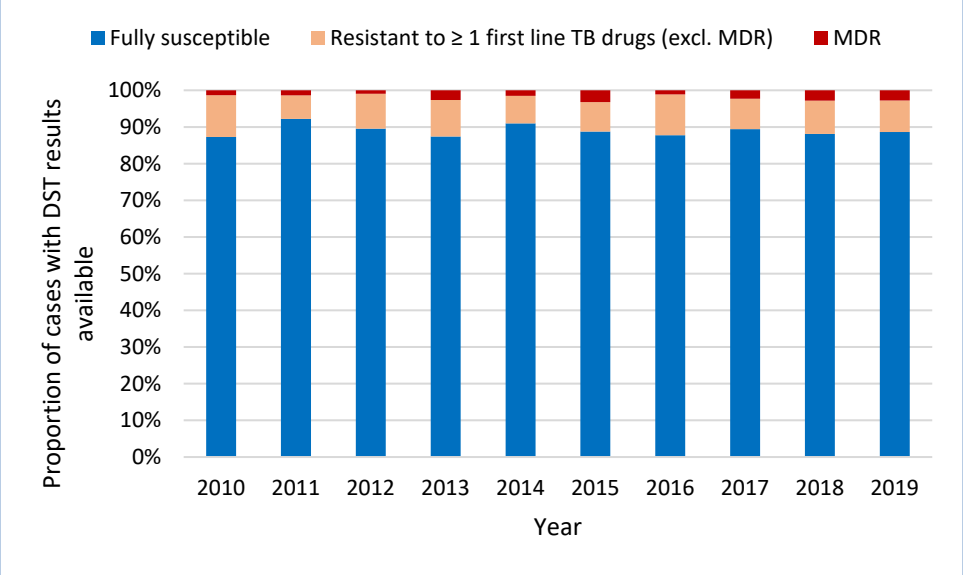


Table 7: Drug susceptibilities of culture confirmed TB cases with DST results available, NSW, 2010-2019

Drug Susceptibility		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Fully susceptible		322 (87%)	311 (92%)	283 (90%)	264 (87%)	303 (89%)	276 (89%)	308 (88%)	312 (89%)	311 (88%)	350 (89%)
Ethambutol	Mono-resistance	0 (0%)	0 (0%)	1 (<1%)	0 (0%)	2 (1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (<1%)
Isoniazid		35 (9%)	21 (6%)	26 (8%)	23 (8%)	25 (7%)	20 (6%)	35 (10%)	24 (7%)	26 (7%)	28 (7%)
Pyrazinamide		3 (1%)	2 (1%)	2 (1%)	4 (1%)	3 (1%)	1 (<1%)	3 (1%)	5 (1%)	3 (1%)	3 (1%)
Rifampicin		2 (1%)	0 (0%)	0 (0%)	1 (<1%)	0 (0%)	2 (1%)	0 (0%)	0 (0%)	2 (1%)	0 (0%)
Resistant to ≥2 first line drugs (but not MDR)		2 (1%)	0 (0%)	1 (<1%)	2 (1%)	3 (1%)	2 (1%)	1 (<1%)	0 (0%)	1 (<1%)	1 (<1%)
MDR*		3 (1%)	5 (1%)	3 (1%)	7 (2%)	4 (1%)	9 (3%)	2 (1%)	8 (2%)	10 (3%)	10 (3%)
Pre-XDR**		1 (<1%)	0 (0%)	0 (0%)	1 (<1%)	1 (<1%)	0 (0%)	2 (1%)	0 (0%)	0 (0%)	1 (<1%)
XDR***		1 (<1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (<1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

* Multi Drug Resistant: Resistance to at least Isoniazid AND Rifampicin
**Pre-Extensively Drug Resistant: Resistance to Isoniazid AND Rifampicin, AND any fluoroquinolone
*** Extensively Drug Resistant: Resistance to Isoniazid AND Rifampicin, AND any fluoroquinolone AND at least 1 injectable TB drug

Cluster analysis

In 2019, 390 (98%) of culture positive cases had whole genome sequencing (WGS) performed on one or more isolates. Of these, 36 (9%) were found to be part of a cluster with another TB case notified in NSW from 2019 or earlier. The remaining 354 culture positive cases (91%) were not linked to any other NSW case prior to 2019 at the time of analysis.

Of the 36 clustered cases, 22 (61%) were male, the median age was 30 years (range 17-91 years) and 94% (n=34) lived in a metropolitan LHD (Sydney, Western Sydney, Northern Sydney, South Eastern Sydney, or South Western Sydney). Cases with pulmonary involvement accounted for 81% (n=29), with 52% (n=15) with a positive smear on a respiratory specimen, and 19% (n=7) had extrapulmonary disease only.

Of the 354 non-clustered cases, 202 (57%) were male, the median age was 37 years (range 2 months-95 years) and 90% (n=318) lived in a metropolitan LHD. Cases with pulmonary involvement accounted for 76% (n=270), with 38% (n=102) with a positive smear on a respiratory specimen, and 24% (n=84) had extrapulmonary disease only.

The top countries of birth for clustered cases were Australia (n=9, 25%), Nepal (n=5, 14%) and China (n=3, 8%). For non-clustered cases the top countries of birth were China (n=49, 14%), Philippines (n=49, n= 14%), India (n=46, 13%), Nepal (n=46, 13%), and Vietnam (n=34, 10%).

There was no difference found between clustered and non-clustered cases regarding gender, Aboriginal and Torres Strait Islander status, residence in a metropolitan or regional/rural LHD, site of infection, or smear status for respiratory cases (Table 8).

Cases born in Australia were more likely to be clustered then cases born in other countries (RR 1.25, CI 1.04 to 1.52; p=<0.01). There was no significant difference found for cases born in other countries analysed (China, India, Nepal, Philippines, Vietnam, Indonesia, Thailand, Afghanistan, Korea and, Cambodia) (Table 9).

Table 8: Demographic and clinical analysis for whole genome sequenced cases, NSW, 2019

		Clustered		Not clustered		Relative risk
		N	%	N	%	
Cases	Total number of cases	**36**	**100%**	**354**	**100%**	**-**
Age	Median age (age range)	33 years (17-91 years)		37 years (2 months -95 years)		-
Gender	Male	22	61%	203	57%	RR = 0.94 (95% CI 0.71 – 1.23) p = 0.66
	Female	14	49%	151	43%	
Indigenous status (Australian-born)	Aboriginal	1	3%	1	<1%	RR = 1.03 (95% CI 0.97 – 1.08) p = 0.18
	Not Aboriginal	35	97%	353	100%	
Place of residence	Metropolitan Sydney#	34	94%	318	90%	RR = 1.83 (0.45 – 7.29) P = 0.38
	Rural or regional NSW#	2	6%	36	10%	
Site of infection	Pulmonary involvement	29	80%	271	77%	RR = 1.21 (95% CI 0.60 – 2.40) p = 0.59
	Extrapulmonary only	7	20%	83	23%	
Respiratory smear positive*	Smear positive	15	54%	102	41%	RR = 1.26 (95% CI 0.84 – 1.90) p = 0.22
	Smear negative	13	46%	144	59%	

#Metropolitan Sydney LHDs –Sydney LHD, Western Sydney LHD, Northern Sydney LHD, South Eastern Sydney LHD, South Western Sydney LHD

#Regional or rural LHDs – Nepean Blue Mountains LHD, Central Coast LHD, Illawarra Shoalhaven LHD, Hunter New England LHD, Mid North Coast LHD, Northern NSW LHD, Western NSW LHD, Far West LHD, Murrumbidgee LHD, Southern NSW LHD.

*Pulmonary cases only with smear results available

Table 9: Countries of birth of whole genome sequenced cases, NSW, 2019

Country of Birth#	Clustered		Not clustered		Relative risk
	N	%	N	%	
China	3	(8%)	49	(14%)	RR = 0.94 (95% CI 0.84 – 1.05) p = 0.45
Nepal	5	(14%)	46	(13%)	RR = 1.01 (95% CI 0.88 – 1.16) p = 0.88
Philippines	1	(3%)	49	(14%)	RR = 0.89 (95% CI 0.83 – 0.95) p = 0.07
India	2	(5%)	46	(13%)	RR = 0.92 (95% CI 0.84 – 1.00) p = 0.29
Vietnam	2	(5%)	34	(10%)	RR = 0.96 (95% CI 0.88 – 1.04) p = 0.56
Australia	9	(27%)	21	(6%)	RR = 1.25 (95% CI 1.04 – 1.52) p = <0.01
Indonesia	2	(5%)	22	(6%)	RR = 0.99 (95% CI0.91 – 1.08) p = 0.99
Bangladesh	0	(0%)	9	(3%)	RR = 0.97 (95% CI 0.96 – 0.99) p = 0.99
Republic of Korea	2	(5%)	5	(1%)	RR = 1.04 (95% CI 0.96 – 1.13) p = 0.13
Afghanistan	0	(0%)	6	(2%)	RR = 0.98 (95% CI 0.97 – 1.00) p = 0.99
Thailand	1	(3%)	5	(1%)	RR = 1.01 (95% CI 0.96 – 1.07) p = 0.44
Cambodia	0	(0%)	5	(1%)	RR = 0.99 (95% CI 0.97 – 1.00) p = 0.99
Total number of cases	**36**	**100%**	**354**	**100%**	-

#Countries of birth with five or more cases with WGS results available analysed

*RR = Relative Risk, CI = Confidence Interval

The 36 clustered cases were in 26 different clusters ranging in time from 2014 to 2019. Eight clusters (31%) were confined to transmission of infection within the household or among known casual contacts. These clusters tended to contain a small number of cases. There were six clusters (23%) resulting from household transmission plus casual contact and/ or community transmission. These clusters were larger in the number of cases and investigations into the epidemiological links are ongoing. Two clusters (7%) involved community transmission only. There were ten (38%) clusters where the epidemiological links were unknown at the time of reporting. There was one new case added to the North Coast cluster (cluster 14-0003) that has been described elsewhere [7, 8] (Table 10). These classifications are subject to change as new cases are added to the clusters.

Table 10: Whole genome clusters where there was one or more new clustered cases in 2019, NSW*

Cluster name	Year cluster detected	Number of 2019 cases	Year of first case	Total number of WGS cases	SNP differences	Epidemiological links#	Epidemiological links description^
14-0002	2014	1	2011	8	0-9	B, C, D	Household & community
14-0003	2007	1	2000	35	0 - 7	B, C, D	Household, casual & community
15-0002	2015	1	2015	4	1-10	B, C, D	Casual
16-0006	2016	1	2013	12	0-1	B, C, D	Household & community
16-0012	2016	1	2014	3	1-5	D	Unknown
17-0009	2017	1	2015	13	0 - 4	B, C, D	Household & community
18-0001	2018	3	2013	12	0 - 11	B, C, D	Household, casual & community
18-0006	2018	1	2012	9	0 - 6	C, D	Community
18-0012	2018	1	2017	3	0-2	A	Household & casual
18-0015	2018	1	2018	4	0-1	C, D	Community
18-0017	2019	1	2018	2	0	A	Casual
18-0018	2019	1	2013	2	0	D	Unknown
19-0001	2019	1	2018	2	0	A	Casual
19-0002	2016	1	2019	2	0	A	Casual
19-0004	2019	1	2010	8	0-12	B, C, D	Household, casual & community
19-0005	2019	2	2019	2	6	D	Unknown
19-0006	2019	2	2019	2	3	D	Unknown
19-0007	2019	1	2015	3	3-5	D	Unknown
19-0008	2019	3	2019	3	1	D	Unknown
19-0009	2019	1	2017	2	3	D	Unknown
19-0010	2019	2	2019	2	0	A	Household
19-0011	2019	1	2016	3	0-5	D	Unknown
19-0012	2019	2	2019	2	11	A	Household
19-0013	2019	2	2019	2	1	A	Household
19-0014	2019	1	2016	2	0	D	Unknown
19-0015	2019	2	2019	2	0	D	Unknown

*Exclude clinically diagnosed cases or cases without WGS links.

#Epidemiological links	^Epidemiological links description
A. Confirmed epidemiological links all cases; B. Confirmed epidemiological links some cases; C. Plausible community transmission (when the index case was infectious it is plausible that they could have transmitted their infection to another member, or members, of the cluster in a place where both cases were known to have been); D. Unable to be determined.	Household contacts – Cases who live together in the same house. Casual contacts – Cases who either know each other socially or have come into contact with each other in other casual situations such as in a public place, workplace, or educational facility. Community contacts – Cases with no known social or casual links but transmission is plausible based on based on the infectious period of the index case and travel to a common place Unknown – epidemiological links are unknown

Section 4: Outcomes

Clinical Outcomes

Clinical outcomes are reported for cases diagnosed in the previous year (for non MDR-TB cases) or two years previously (for MDR-TB cases) to allow time for treatment completion. Clinical outcomes for non MDR-TB cases from 2018 and MDR-TB cases from 2017 are recorded in Table 11 Of the non-MDR 2018 cases, 89% (n=444) completed treatment, consisting of 5% (n=22) who were considered cured (culture positive prior to treatment and culture negative after completion of treatment) and 95% (n=422) who completed treatment (without demonstration of cure). There were eight TB-related deaths reported. Five cases (1%) defaulted before completion of treatment, of which three were medical defaults. The remaining 9% (n=42) had either transferred overseas, died of a non-TB related cause, or the cause of death was unknown.

Of those cases in 2018 where the outcome was known (excluding transferred overseas, died unrelated or unknown if related to TB and outcome unknown), 97% of cases successfully completed treatment.

Of the eight cases classified as MDR-TB in 2017, 88% (n = 7) completed treatment in NSW and one case (12%) transferred overseas before completing treatment. Of the MDR-TB cases where the outcome was known (excluding continues on treatment, transferred overseas, died unrelated or unknown if related to TB and outcome unknown), 100% of cases successfully completed treatment.

97%

Proportion of cases with a successful outcome in 2018

100%

Proportion of successfully treated MDR-TB cases in 2017

Table 11: Clinical outcomes of non MDR-TB cases diagnosed in 2018 and MDR-TB cases diagnosed in 2017*, NSW

		Year of diagnosis	
		2018 Non MDR cases	**2017 MDR-TB**
Total cases		**499 (100%)**	**8**
Alive	Completed treatment	422 (85%)	7 (88%)
	Cured	22 (4%)	-
	Defaulted	5 (1%)	-
	Transferred overseas	24 (5%)	1 (12%)
	Treatment failure	-	-
	Outcome unknown	-	-
Died	Cause related to TB	8 (2%)	-
	Unrelated to TB	13 (3%)	-
	Unknown if related to TB	5 (1%)	-

*Outcome data are reported for the year prior for non MDR cases and 2 years prior for MDR cases to allow time for treatment completion

Contact Investigations

Of the 590 TB notifications received in 2019, 98% (n= 580) had contact information completed in NCIMS at the time of analysis. A total of 4,605 contacts had been identified and of these, 59% (n=2,725) were recorded to have completed screening. Of the 2,725 contacts screened, <1% (n=14) were found to have TB disease, 1% (n=39) had a tuberculin skin test (TST) or interferon gamma release assay (IGRA) conversion (indicating likely recent tuberculosis infection from the case patient), and 14% (n=373) had a positive TST or IGRA result on a single screen. A total of 105 contacts were identified that were under the age of 5 and of these, 80% (n=84) were recorded to have completed screening. Of the 84 contacts screened, 15% (n=13) had a positive TST or IGRA, and 77% (n=10) of these were commenced on treatment. An additional seven contacts under five without a positive IGRA were commenced on preventative treatment.

The median number of contacts per case was two (range 0-630), and 6% (n=34) of contact investigations involved more than 25 contacts.

98%	4,605	59%
Proportion of NSW TB cases, 2019, with contact information recorded	**Total contacts identified 2019**	**Proportion of identified contacts completing screening, 2019**

There were 121 sputum or respiratory smear positive cases notified in 2019, these cases are generally considered to be more infectious than smear negative cases. Over 99% of smear positive cases (n=120) had contact information available identifying 2871 contacts. Of these contacts, 1591 (55%) were recorded as having completed screening where 9 (1%) were found to have active TB disease, 24 (2%) had TST or IGRA conversion, and 213 (13%) had a positive TST or IGRA result on initial screening. There were 110 (7%) contacts commenced on preventative treatment and 124 (8%) of contacts commenced on chest x-ray surveillance. Smear positive cases were identified as having a total of 36 contacts under the age of 5, of which 30 (83%) completed screening. Of the 30 contacts screened, 23% (n=7) contacts had a positive IGRA and 71% (n=5) were commenced on treatment. At the time of reporting 80% (n=4) of contacts under the age of five with a positive IGRA has completed treatment. An additional six contacts under the age of five without a positive IGRA were commenced on preventative treatment.

Section 5: Discussion

TB notifications increased in 2019, representing the highest number of TB cases in NSW over the past 20 years. This increase followed a small decrease in cases in 2018. Most TB cases in NSW continue to occur in persons born overseas, particularly among those born in countries with a high incidence of TB. The burden of TB disease in NSW is concentrated in local health districts with large populations of migrants from countries in the South-East Asian and Western Pacific regions, reflective of both the global epidemiology of TB, and current trends in migration patterns. The rate of TB in NSW remains low by global comparison [2].

The proportion of Australian-born TB cases has decreased over the past ten years for both Aboriginal and Torres Strait Islander people as well as non-Indigenous Australians. The notification rate in the Australian-born non-Indigenous population in NSW has remained relatively steady for more than a decade and has decreased over the last three years. The rate in Australian-born Aboriginal and Torres Strait Islander people in NSW is on average 2.8 times higher than in non-Indigenous Australian-born people over the past 10 years, this is lower than the national rate which is five to six times higher on average [3]. The notification rate for Aboriginal and Torres Strait Islander people in NSW has decreased over the last three years to 0.82 cases per 100,000 in 2019, the lowest rate in the last 10 years.

Risk factors reported among NSW TB cases in 2019 were similar to those reported in previous years in NSW and nationally [3]. Birth or previous residence for longer than three months in a TB high risk country remain the most commonly reported risk factors. The proportion of TB cases diagnosed with an immunocompromising health condition or on immunosuppressive therapy has increased.

Drug resistance, including multi-drug resistance and mono-resistance to isoniazid and rifampicin, continue to pose a challenge to the control and management of TB, both globally and within NSW. There has been no significant change to the proportions of drug resistant cases as a group or to individual drugs over a 10-year period in NSW. Monitoring and review of NSW TB cases identified as drug resistant continues to be a priority of the NSW TB Program. There were significant changes made in the management recommendations of multi-drug resistant TB by the WHO in 2019 which include standardised shorter MDR-TB regimens which at the time of report have not been used in NSW [9].

The proportion of NSW TB cases tested for HIV at the time of diagnosis continues to increase, with 92% tested in 2019. The prevalence of HIV among NSW TB cases remains low, with two per cent of cases tested found to have HIV.

Ninety-seven per cent of non MDR-TB cases in 2018 successfully completed treatment (excluding continues on treatment, transferred overseas, died unrelated or unknown if related to TB, and outcome unknown). Mortality of TB cases remained stable (6%), there were eight cases reported to have died due to TB in 2018. NSW continued to see low rates of treatment default (1%) and treatment failure (0%), among TB cases in 2018. Of the eight MDR-TB cases in 2017, seven successfully completed treatment and one transferred overseas with the treatment outcome unknown.

Despite the low incidence, management and prevention of TB in Australia remains an ongoing challenge. TB cannot be viewed in the context of one country alone, and the global epidemiology of this disease has significant impact on control measures in low incidence countries, due to increasing international travel to and migration from high incidence countries. From 2013-2014 to 2018-2019 Australia saw an increase in the number of migrants from South-East Asia and South and Central Asia from 142,105 to 206,483 [10] which remain high incident TB areas with 62% of global TB

cases occurring in the Western Pacific, and South East Asian regions [1]. In 2019, seven of the top ten countries of birth for overseas-born residents in Australia were classified as high-risk countries for TB by the WHO [10].

Conclusion:

The number of TB cases in NSW increased in 2019 and was the highest number of cases reported over the past 20 years. It is important to note that although the number of cases and notification rate in NSW and Australia remain low compared to global incidence, the control and elimination of TB in an individual country must be considered in the context of the global epidemiology of TB. Increasing rates of travel and migration from high burden countries remains one of the ongoing challenges to TB elimination in Australia.

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