NSW Health

Tuberculosis in New South Wales

Surveillance Report 2022

NSW GOVERNMENT

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Contents

Summary

- There were 528 tuberculosis (TB) cases notified in New South Wales (NSW) in 2022, 5% lower than the number of cases notified in 2021.
- Notification rate was 6.5 cases per 100,000 population per year.
- Ninety-one percent of people notified with TB were born overseas (n=481). The most frequently reported countries of birth were India, Nepal, and the Philippines.
- Of the 47 Australian born cases, 2 (4%) identified as Aboriginal people.
- Notification rates were highest in Western Sydney and South Western Sydney Local Health Districts (LHDs).
- The most frequently reported risk factors were being born, or past residence (≥ 3 months), in a high-risk country for TB; known contact with TB; or immunosuppressive health condition or therapy.
- 404 cases (77%) were laboratory confirmed by culture or polymerase chain reaction (PCR), with 124 cases (23%) receiving a clinical diagnosis only.
- Of those cases with laboratory confirmation, 9 cases were classified as having multi-drug resistant TB (MDR-TB), no cases had extensively drug resistant TB (XDR-TB). This represents 3% of culture confirmed cases.

	2022	**Change since 2021**	**Ten-year average (2013-2022)**
TB cases (number)	528	↓ 5% (n=558)	↑ 1% (n=524)
TB notification rate	6.5 per 100,000	↓ 5% (6.8 per 100,000)	↓ 3% (6.7 per 100,000)
Australian born non-Indigenous cases (number)	45	↑ 7% (n=42)	↑ 5% (n=43)
Australian born non-Indigenous rate	0.8 per 100,000	- (0.8 per 100,000)	- (0.8 per 100,000)
Australian born Aboriginal cases (number)	2	↓ 50% (n=4)	↓ 50% (n=4)
Australian born Aboriginal notification rate	0.7 per 100,000	↓ 50% (1.4 per 100,000)	↓ 56% (1.6 per 100,000)
MDR-TB cases	9	↑ 80% (n=5)	↑ 13% (n=8)
% cases tested for HIV at diagnosis	97%	↑ 3% (94%)	↑ 10% (87%)

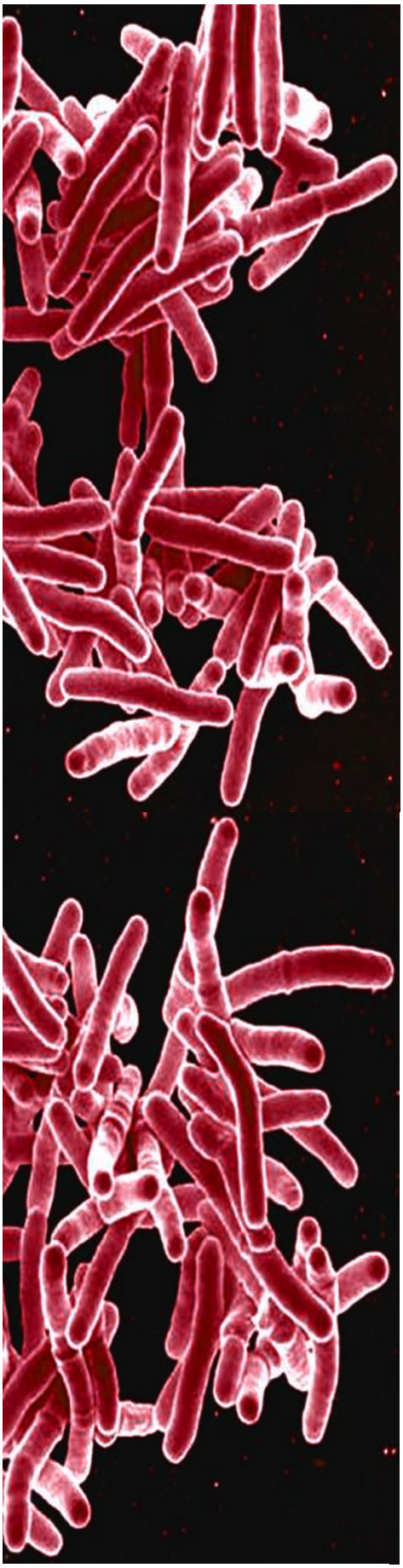


Image: CDC PHIL #18139: Scanning Electron Microscopy image of Mycobacterium Tuberculosis Credit: National Institute of Allergy and Infectious Diseases (NIAID)

Introduction

Tuberculosis (TB) is a bacterial disease caused by infection with *Mycobacterium tuberculosis.* Globally, TB remains a disease of public health significance. The World Health Organization (WHO) reported 6.4 million new cases in 2021. This is a 10% decline from pre-pandemic cases reported in 2019 but potentially explained by the delayed diagnosis of cases due to the global COVID-19 pandemic [1]. Drug resistant TB is an increasing threat globally, with over 161,746 cases of drug resistant TB (rifampicin-resistant, MDR-TB, pre-XDR, or XDR) worldwide in 2021, of which 15% had pre-XDR or XDR TB [1].

TB case numbers reported in NSW increased in the second half of 2022 which is most likely attributable to increased immigration to Australia since the removal of border restrictions. The incidence of TB in NSW remains low at 6.5 cases per 100,000.Australia continues to have a low incidence of TB, with the Commonwealth Department of Health reporting a rate of 5.0 cases per 100,000 population in 2022 [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 2022.

Methods

Data were extracted from the Notifiable Conditions Information Management System (NCIMS) on 18 July 2023 for all confirmed cases of TB notified from 1 January 2003 to 31 December 2022. 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, rifampicin, pyrazinamide and ethambutol; 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. When phenotypic drug susceptibility was unavailable drug resistance was determined by SNP calling using Snippy with inhouse scripts and CRyPTIC database for mutations associated with drug resistance.

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 2022 or earlier were included in the analyses.

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 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, 2022). The TB notification rate by country of birth was calculated utilising the 2021 ABS Census Data with country of birth for NSW residents as a denominator. Information was collected on the ethnicity or ancestry of Australian born cases utilising the definitions on ancestry provided by the Australian Bureau of Statistics [3]. People can specify up to two distinct ethnicities. 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. Data were analysed using R (R core team, Vienna, Austria, 2022). 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 by their own choice.

Ethnicity is the broad ancestral or ethnic group a person belongs to. Ethnicity is a shared identity or similarity of a group of people based on one or more distinguishing characteristics. This includes a long-shared history, cultural tradition, common geographic origin, common language, common literature, common religion, being a minority, being racially conspicuous [3].

Extrapulmonary TB is disease affecting any organ of the body except the lung, 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 additional Group A drug (levofloxacin, moxifloxacin, bedaquilline and linezolid) [5].

High risk countries are those with an annual TB incidence of 40 cases per 100,000 population per year or more in 2021 [1].

Laboratory confirmed TB is isolation of Mycobacterium tuberculosis complex (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 [5].

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 is a single nucleotide polymorphism.

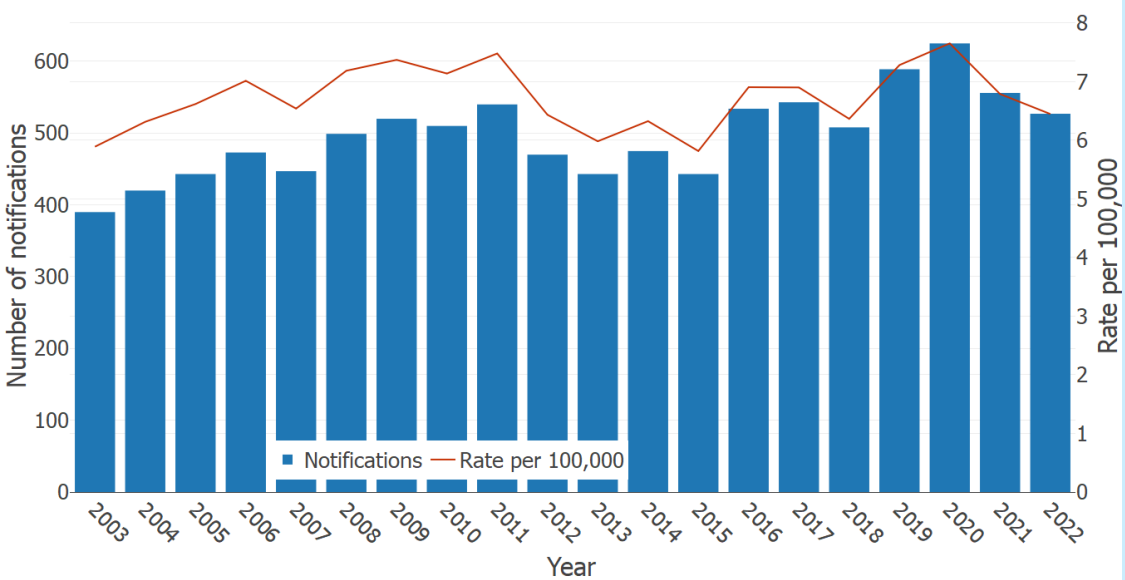
Unauthorized person is an unlawful non-citizen.

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: TB Cases

There were 528 notified cases of TB in 2022 in NSW (Figure 1). These cases compromised 41% of the total notified cases in Australia in 2022 (1,302 cases). The reason for case notification fluctuations year to year is not fully understood but it is influenced by underlying factors including immigration and TB screening patterns.
The number of notifications received in 2022 was 5% lower than the number notified in 2021.The annual notification rate of TB in 2022 in NSW was 6.5 per 100,000 population per year (Figure 1).

Figure 1: Number and rate of TB disease notifications, NSW, 2003-2022



2022

528
Number of cases notified

6.5
Rate per 100,000 population

Demographics

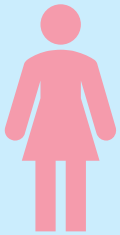
Of the 528 cases of TB notified in 2022, 61% of cases were male (n=321). The median age among males was 44 years (range 1-95 years); while the median age among females was 39 years (range 8 months-91 years). The median age overall was 42 years (range 8 months-95 years).

In 2022, 42% of cases were aged between 20 and 39 years (n=223), with a peak in the number of cases in the 25-29 yrs age group (n=69, rate=12 cases per 100,000). A second peak in the notification rate was observed in those aged 80-84 yrs (n=21, rate=11.2 cases per 100,000). There were 4 cases (1%) in the 0-4 year age group (Figures 2 and 3).

Age and sex

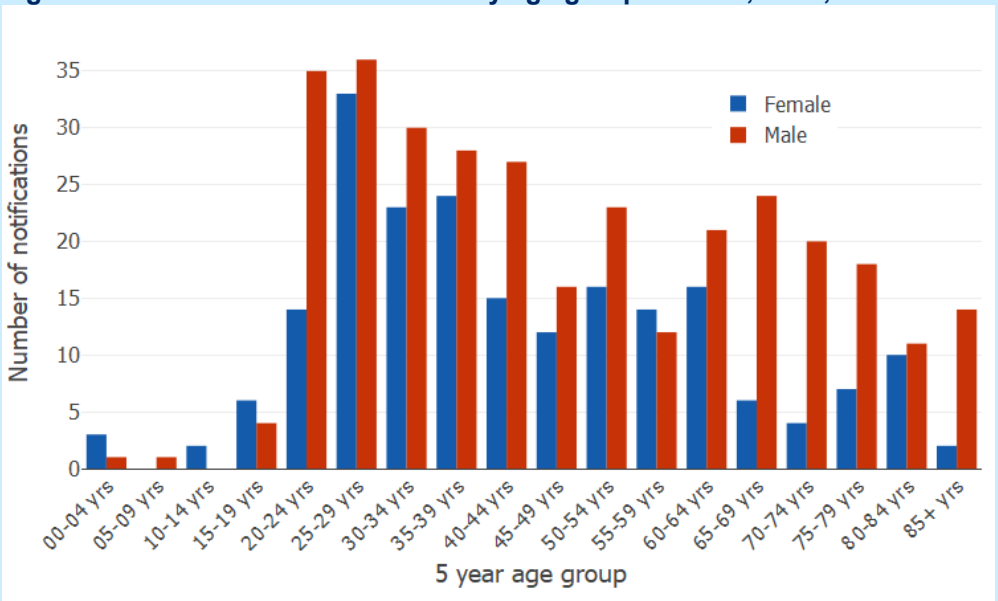
Sex

61%
Male



39%
Female

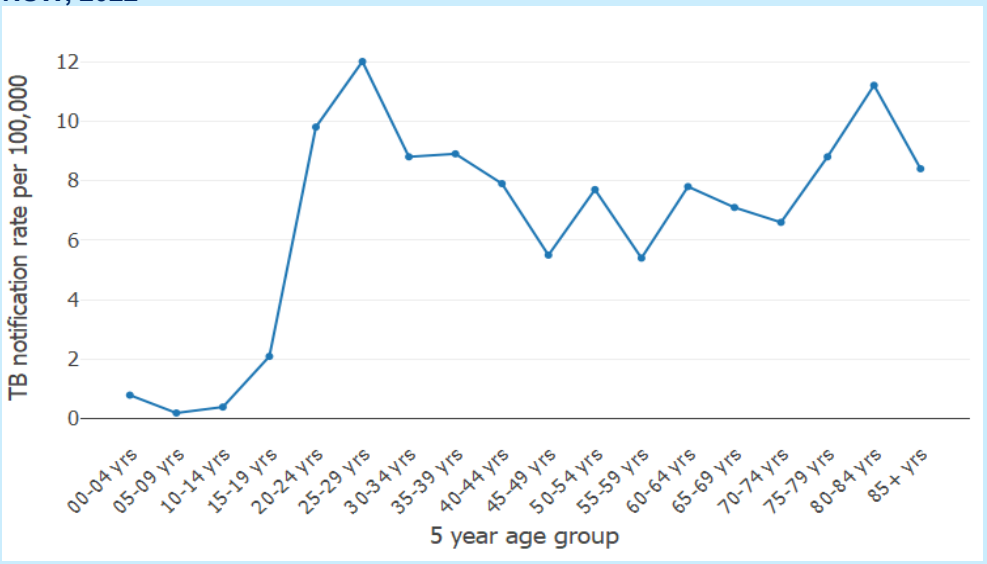
Figure 2: Number of TB notifications by age group and sex, NSW, 2022



Age Overall

Range: 8 months-95 years
Median: 42 years

Figure 3: Age specific TB notification rate (per 100,000 population per year), NSW, 2022



Age by Sex

Male

Range: 1-95 years
Median: 44 years

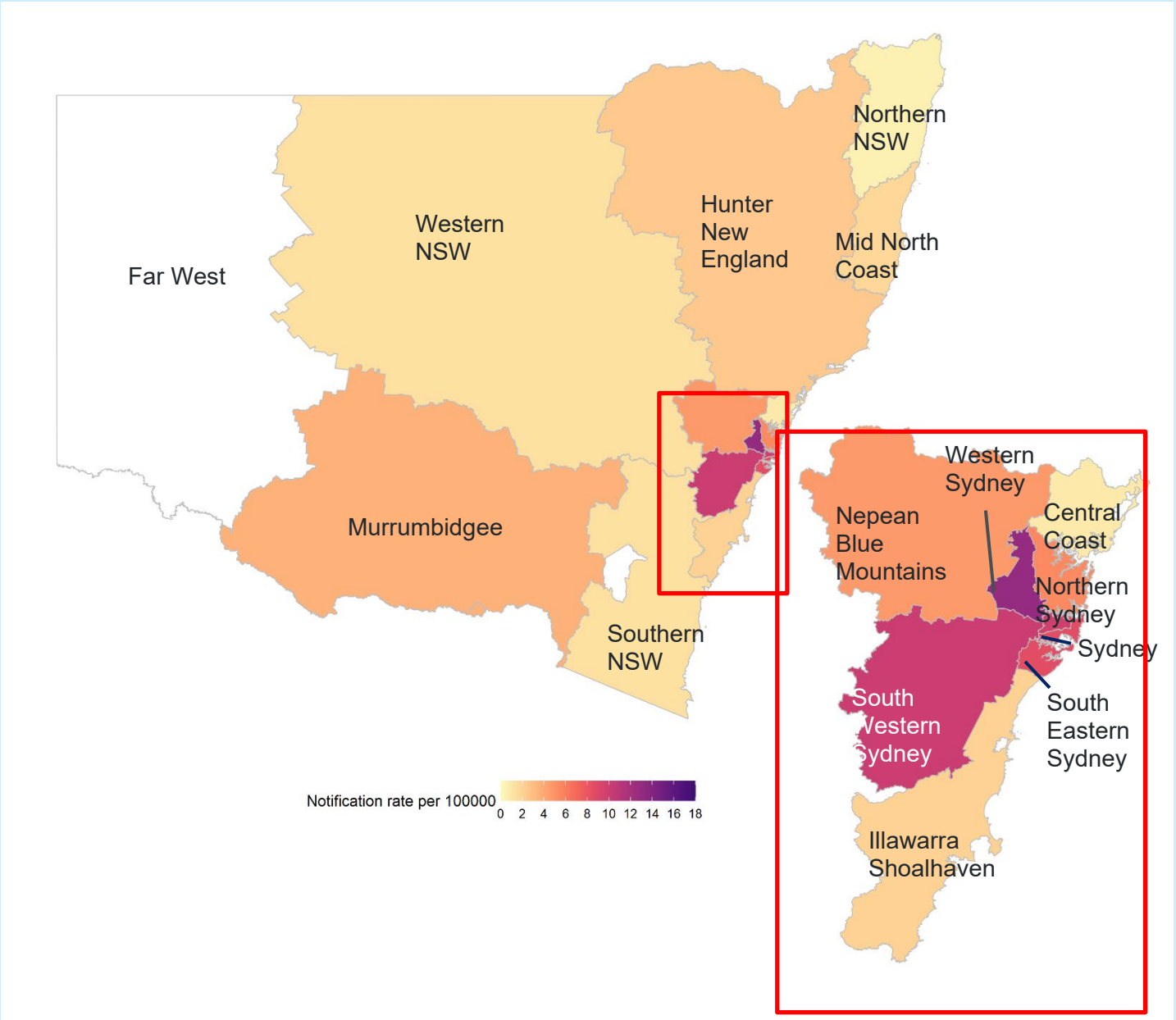
Female

Range: 8 months-91 years
Median: 39 years

Place of residence

Western Sydney LHD had the highest notification rate, with 13.0 per 100,000 population per year (n=136), followed by South Western Sydney LHD with 10.1 cases per 100,000 population per year (n=106) (Figure 4). Of the LHDs in rural and regional NSW, Nepean Blue Mountains LHD had the highest rate at 4.7 cases per 100,000 per year (n=18) followed by Murrumbidgee LHD with 3.6 cases per 100,000 population (n=11). 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, 2022



9.5

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, Regional/Rural NSW

(Illawarra Shoalhaven, Central Coast, Nepean Blue Mountains, Far West, Western NSW, Northern NSW, Mid North Coast, Hunter New England, Southern NSW and Murrumbidgee LHDs)

Table 1: Notifications and crude rate of notified TB cases per 100,000 population per year by Local Health District of residence, NSW, 2022

Local Health District	Number	Crude rate
Western Sydney	136	13.0
South Western Sydney	106	10.1
Sydney	68	9.8
South Eastern Sydney	81	8.7
Northern Sydney	53	5.5
Nepean Blue Mountains	18	4.7
Murrumbidgee	11	3.6
Hunter New England	24	2.5
Illawarra Shoalhaven	9	2.1
Mid North Coast	4	1.8
Southern NSW	3	1.4
Western NSW	4	1.4
Central Coast	3	0.9
Northern NSW	2	0.6
Far West	0	0.0

Country of birth

In 2022, 91% of cases (n=481) were born overseas. Of these, 93% (n=445) were born in a current TB high-risk country (TB-HRC). There were 60 individual countries of birth reported among NSW TB cases (Figure 5), with the most reported countries of birth being India (20%, n=104), Nepal (13%, n = 68), Philippines (12%, n=61), Vietnam (9%, n=48) and Australia (9%, n=47) (Table 2). The TB notification rate by country of birth for the countries with the highest proportion of cases varied from 0.9 cases per 100,000 for Australian born cases to 104.7 per 100,000 for Nepalese born cases (Table 2, Figure 6). There were 4 other countries of birth with notification rates greater than 150 per 100,000; all had only one TB notification with high rates due to small population numbers (<1,000) in NSW. The total notification rate for all overseas born cases was 20.6 per 100,000 compared to 0.9 per 100,000 for Australian born cases (Table 2).

Table 2: Notifications and crude rate of country of birth per 100,000 population per year by Local Health District of residence, NSW, 2022

Country of birth	Number of cases	Notification rate per country of birth per 100,000 population
India	104 (20%)	49.8
Nepal	68 (13%)	104.7
Philippines	61 (12%)	57.0
Vietnam	48 (9%)	49.0
Australia	47 (9%)	0.9
China (excludes SARs and Taiwan)	43 (8%)	17.4
Indonesia	16 (3%)	42.2
Malaysia	12 (2%)	30.3
Afghanistan	11 (2%)	75.2
Bangladesh	11 (2%)	37.2
Other countries	107 (20)	12.2
Total overseas born	481 (91%)	20.5
Total	**528 (100%)**	**6.5**

Figure 5. Number of TB cases by country of birth, NSW, 2022

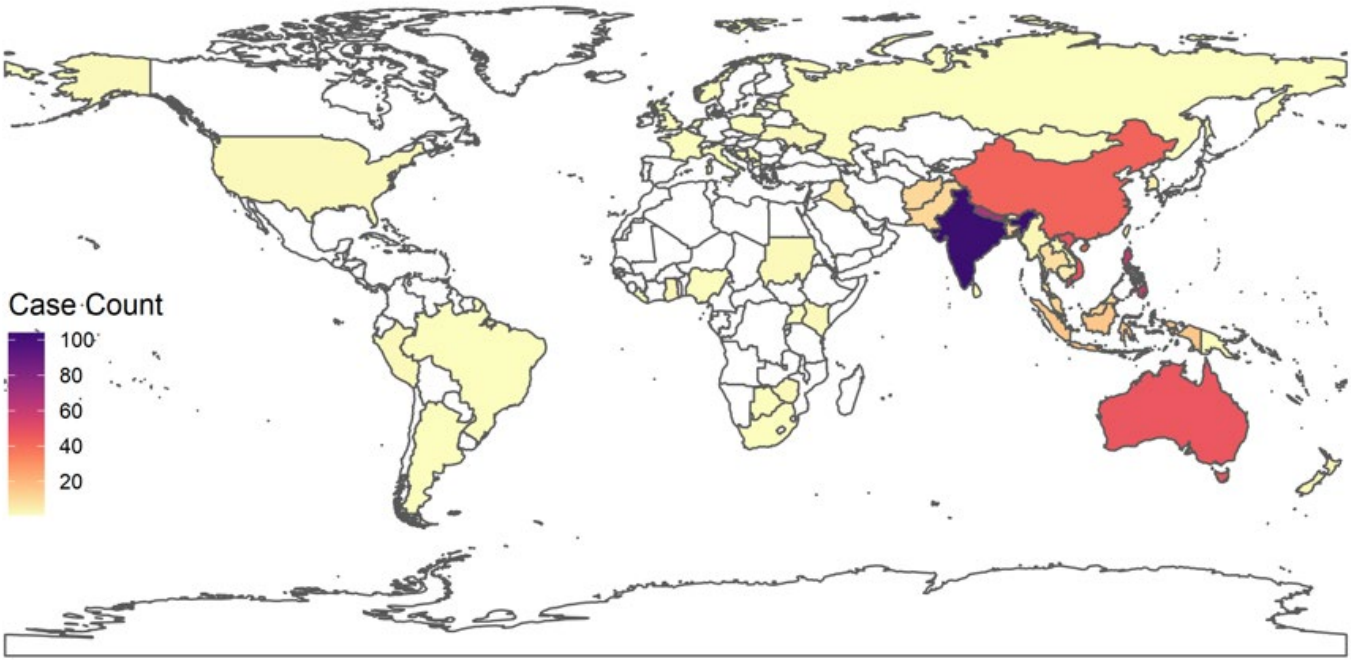
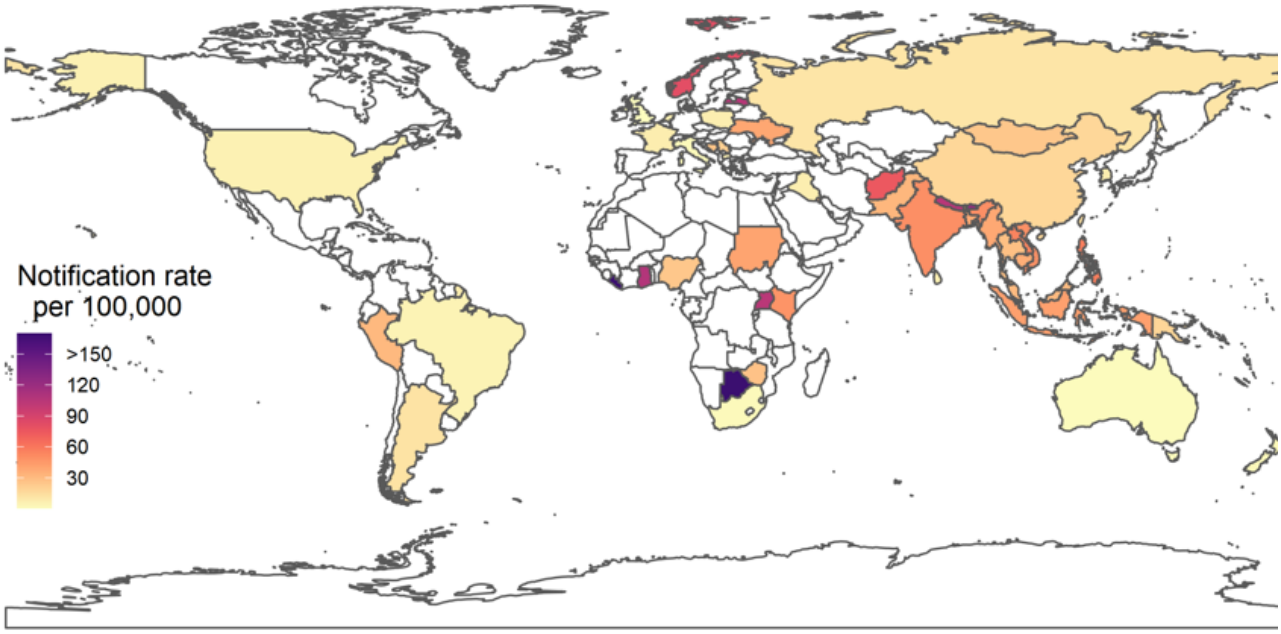


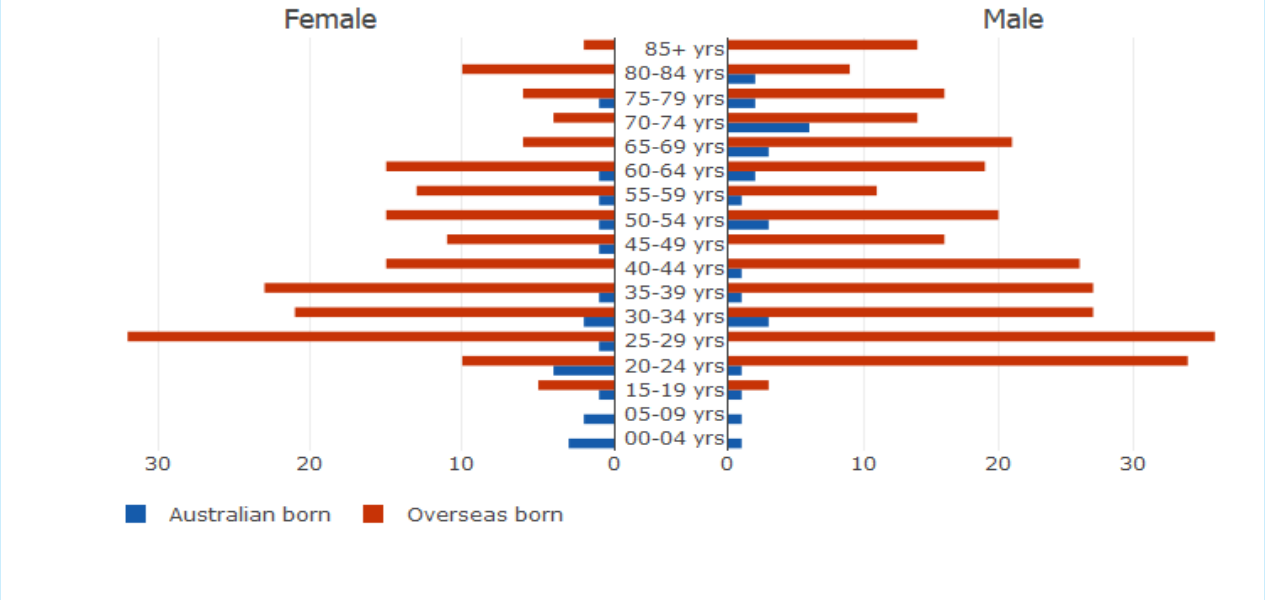
Figure 6. Notification rate of TB cases by country of birth*, NSW, 2022



*Notification rate calculated utilising ABS Census Data 2021, population by country of birth NSW

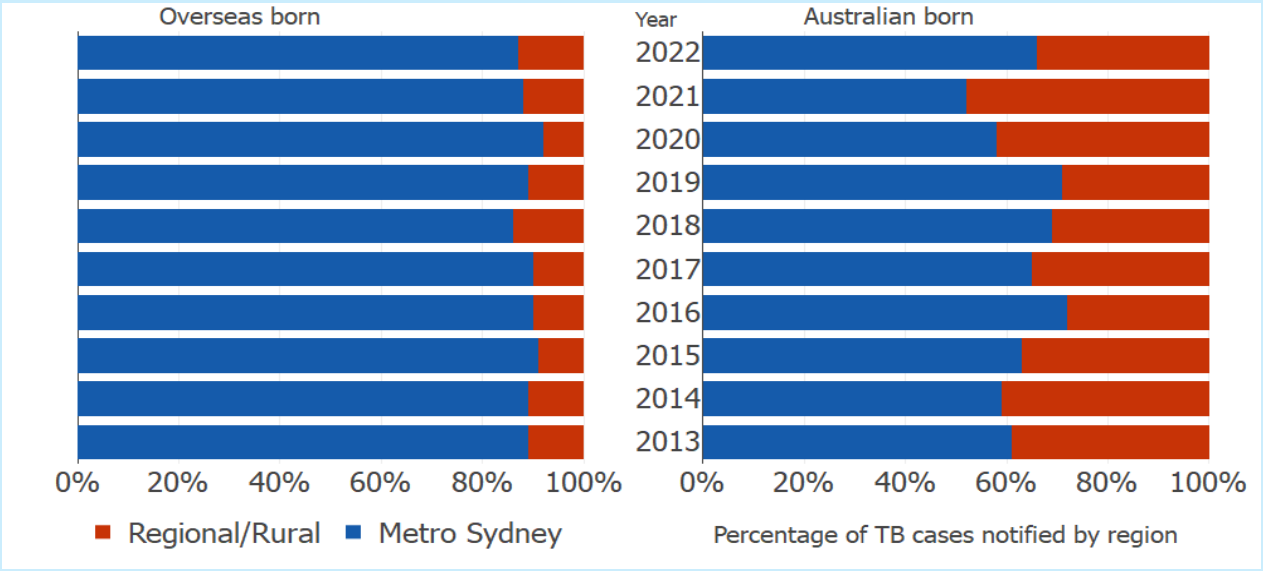
Generally, the median age of Australian born cases is higher than the median age of overseas born cases. In 2022, the median age at diagnosis for Australian born cases was 49 years; 24 years for females (range 8 months-78 years) and 60 years for males (range 1-83 years). For overseas born cases, the median age at TB diagnosis was 42 years; 40 years for females (range 16-91 years), and 43 years for males (range 19-95 years). Forty per cent of overseas born cases were aged between 20 and 39 years at diagnosis (Figure 7).

Figure 7: Age group at TB diagnosis, by place of birth and sex, NSW, 2022



Australian born cases are more likely to reside in regional or rural NSW when compared with overseas born cases. In 2022, 34% (n = 16) of Australian born cases resided in regional or regional NSW compared to 13% (n=62) 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 this fluctuates year to year, the proportion of Australian born cases located in metropolitan areas in 2022 was less than average (Figure 8). Australian born cases in regional or rural NSW were more likely to be older (median 55 years) than Australian born cases in metropolitan areas (median 35 years). The median age for overseas born cases in regional/rural areas was 39 years, and 42 years for metropolitan areas.

Figure 8. Percentage of overseas born and Australian born cases diagnosed in metropolitan and regional/regional areas, NSW, 2022



#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, Norther Western NSW LHD, Far West LHD, Murrumbidgee LHD, Southern NSW LHD.

Australian born cases

Of the 47 Australian born cases in 2022, 2 cases (4%) 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 2022 is less than the average number notified per year (n=5) since 2013. The average rate of TB among Aboriginal and Torres Strait Islander people over the past 10 years is nearly double that of non-Indigenous Australian born cases (RR 1.9, 95% CI 1.4 – 2.6, p<0.001). In 2022, 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 0.8, 95% CI 0.14 – 2.68, p=0.79). The most common specific ancestry was Australian (32%, n=16), followed by Vietnamese (12%, n=6), and Irish (8%, n=4) (Figure 10).

Figure 9: Number and rate of notified TB in Australian born cases by Aboriginal and Torres Strait Islander status, NSW, 2013-2022

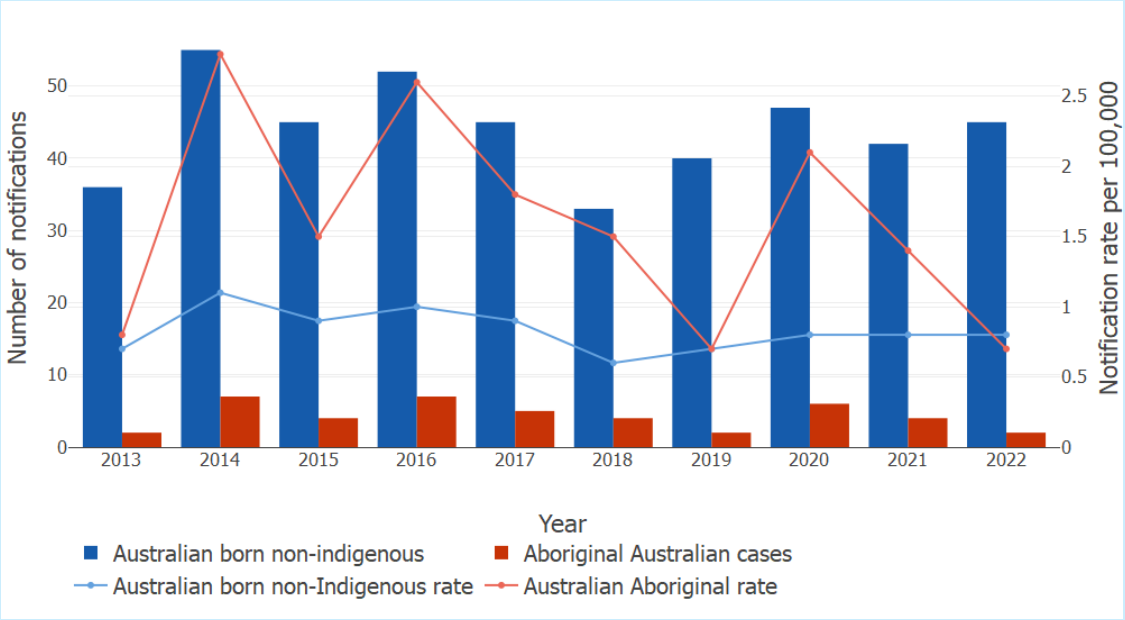
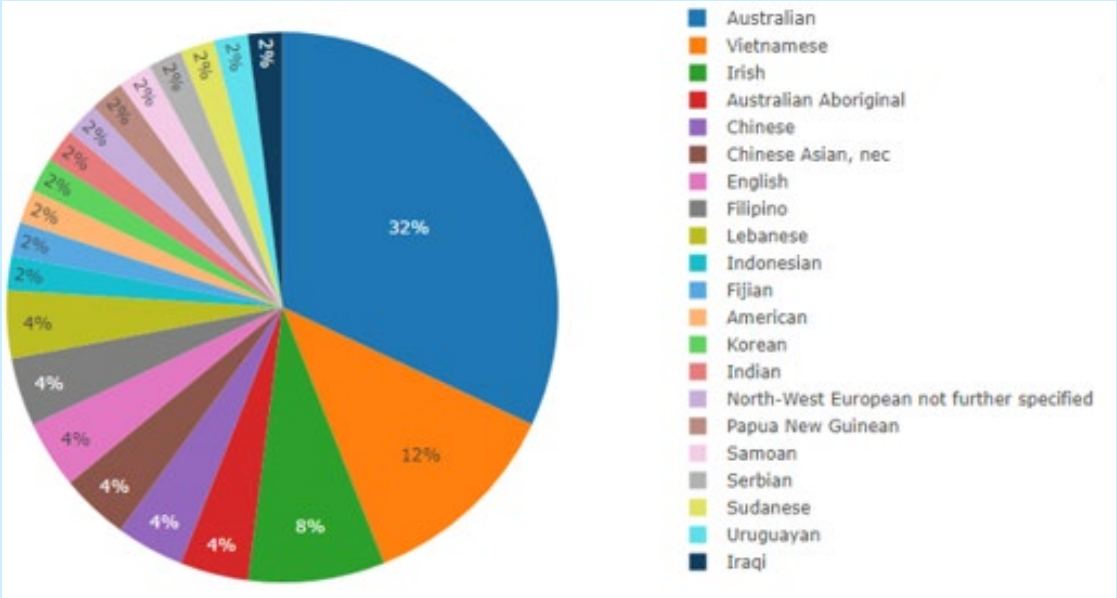


Figure 10: Ethnicity of Australian born TB cases[a], NSW, 2022



[a] People can specify up to 2 distinct ethnicities, in 2022, 3 cases supplied two ethnicities

Overseas born cases

Of the 481 overseas born cases in 2022, those who had migrated from a current HRC (as of 2021) for TB (n=445) had a shorter median length of stay in Australia prior to diagnosis of TB (8 years, range 0-53 years) when compared to the other overseas born cases (n=36) (20 years, range 1-68 years) (Figure 11).

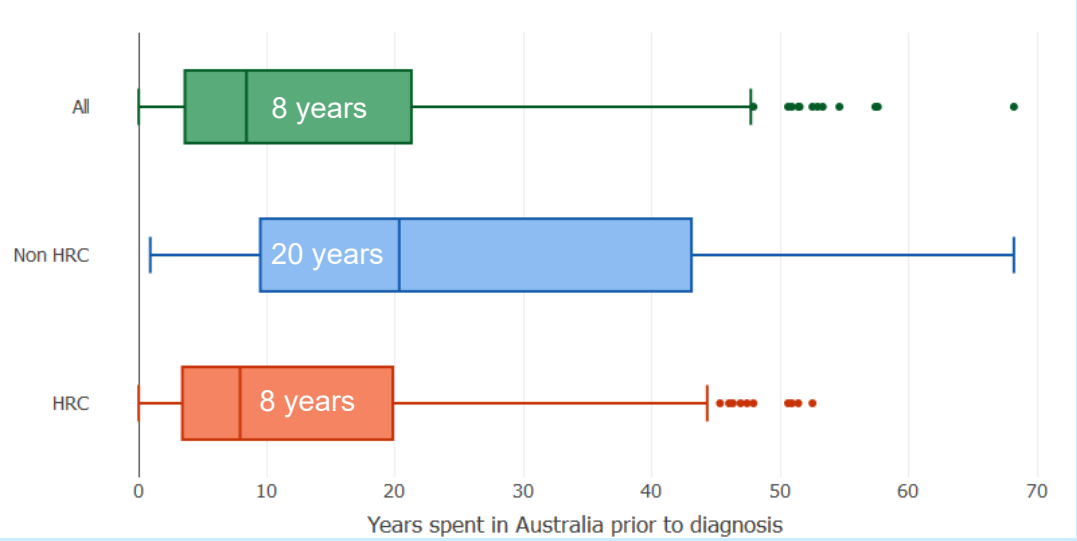
Over half of the overseas born cases were permanent residents at the time of diagnosis (n=303, 63%), 15% (n=72) were overseas students, 9% (n=9) were visitors, 1% (n=7) were refugees, <1% (n=2) were unauthorised persons, 10% (n=46) were on other types of visas, and 1% (n=7) had an unknown or missing 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.

Immigration referrals to the NSW TB Program for patients to undergo screening required for a TBU more than doubled in 2022 (n=1087) compared to the previous year (n=465). The number of people referred to the TB program and placed on an onshore deferral in 2022 (n=651) also increased compared to the previous year (n=483). This is a direct result of border closures ending that limited immigration to Australia during the global COVID-19 pandemic.

Of the 481 TB cases born overseas, 15% (n=73) were on a TBU or onshore deferral at the time of diagnosis, a further 5% (n=23) had previously been on a TBU or an onshore deferral, 74% (n=356) had never been on a TBU or onshore deferral and for 6% (n=29) this was unknown (Figure 12). These numbers are consistent with the proportion of overseas born cases diagnosed on an immigration referral in previous years. The proportion of cases diagnosed while on an TBU decreased from 5% pre-COVID-19 pandemic in 2019 to 2% in 2022. The proportion of cases diagnosed while on an onshore deferral decreased from 15% in 2020 to 13% in 2022, this was consistent with pre-COVID-19 pandemic numbers in 2019 (Figure 12).

Figure 11: Median years (and interquartile range) spent in Australia prior to TB diagnosis among overseas born cases, by country of birth risk category, NSW, 2022



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, 2022

Residency status	Number of cases	Percentage
Permanent resident	303	63%
Overseas student	72	15%
Visitor	44	9%
Refugee / humanitarian entrant	7	1%
Unauthorised person	2	<1%
Other	46	10%
Unknown/ missing status	7	1%
Total	**481**	**100%**

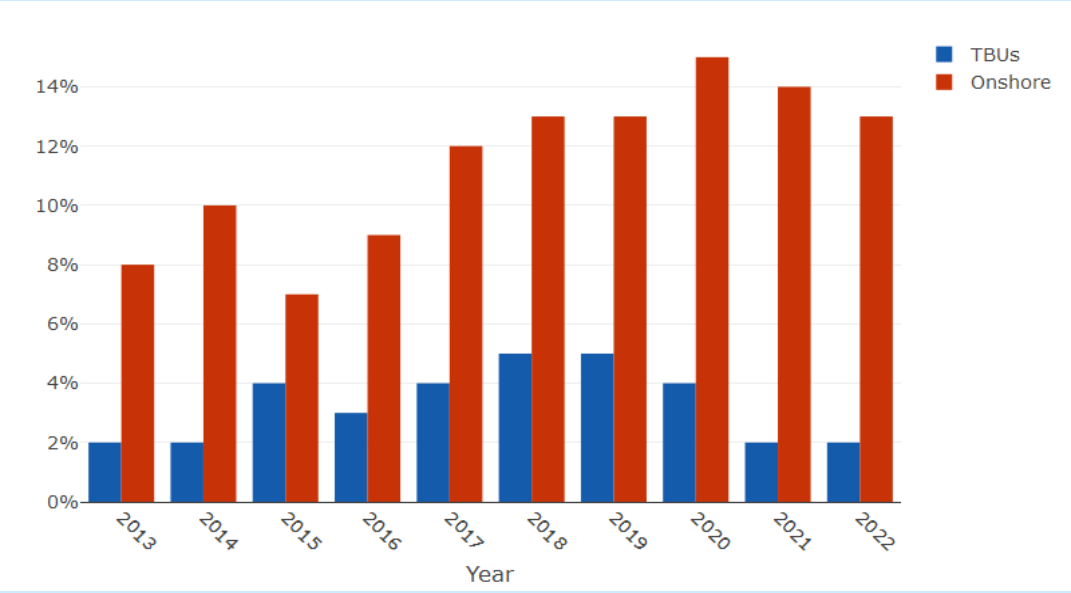
15%

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

5%

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

Figure 12: Proportion of TB cases diagnosed on health undertakings, NSW, 2013-2022



Risk factors

The most common reported risk factor for cases in 2022 was being born overseas in a HRC for TB (85%, n=451). Being born in a TB-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 TB-HRC. Past residence for three months or more in a TB-HRC (17%, n=88) and having either a household member or another close contact with TB (16%, n=84) were the next highest reported risk factors. Immunosuppression (due to health condition or medication) was reported by 9% (n=48) 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 having a household member or close contact with TB (38%, n =18) followed by past residence in a TB-HRC (more than 3 months) (28%, n=13). For overseas born cases, 94% (n=451) were born in a TB-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, 2022

	All cases		Australian born		Overseas born	
	N	%	N	%	N	%
Total	**528**	**100%**	**47**	**100%**	**481**	**100%**
Born in a HRC^	451	(85%)	-	-	451	(94%)
Past residence (≥3 months) in a TB-HRC	88	(17%)	13	(28%)	75	(16%)
Household member or close contact with TB	84	(16%)	18	(38%)	66	(14%)
Immunosuppressive health condition/therapy	48	(9%)	4	(9%)	44	(9%)
Ever employed in healthcare	34	(6%)	5	(11%)	29	(6%)
Previously diagnosed with TB/CXR suggestive of old untreated TB	22	(4%)	2	(4%)	20	(4%)
Australian born child of parent(s) born in TB-HRC	8	(2%)	8	(17%)	-	-
Ever resided in a correctional facility	5	(1%)	2	(4%)	3	(1%)
Other	5	(1%)	4	(9%)	1	(0%)
Ever homeless/residing in a shelter	3	(1%)	1	(2%)	2	(<1%)
Ever employed in an institution	1	(<1%)	0	(0%)	1	(<1%)
Not able to be determined	14	(3%)	8	(17%)	6	(1%)

*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	2nd	3rd
Household member or close contact with TB	≥3 months spent in a high risk country	Australian born child of parent(s) born in HRC

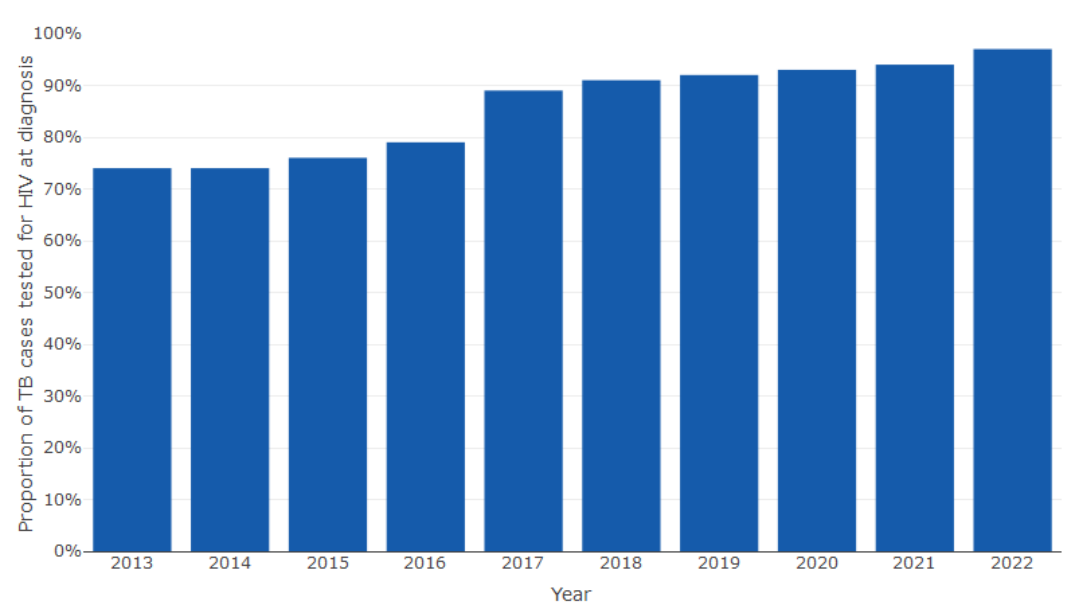
Overseas born cases

1st	2nd	3rd
Born in a high risk country	≥3 months spent in a high risk country	Household member or close contact with TB

HIV Testing

Over the 10-year period to 2022, there has been a 23% increase in the proportion of TB cases tested for HIV at the time of TB diagnosis, from 74% in 2013 to 97% (n=510) in 2022 (Figure 13). Of cases tested in 2022, 1% (n=5) were co-infected with HIV and TB. All the TB-HIV co-infected cases in 2022 were male and born overseas. Two cases (40%) were newly diagnosed with HIV at approximately the same time as receiving a TB diagnosis; 3 had been previously diagnosed with HIV (60%).

Figure 13: Proportion of TB cases tested for HIV at TB diagnosis, NSW, 2013 – 2022



97%

Proportion of NSW TB cases tested for HIV at diagnosis

5

Number of NSW TB cases co-infected with HIV

100%

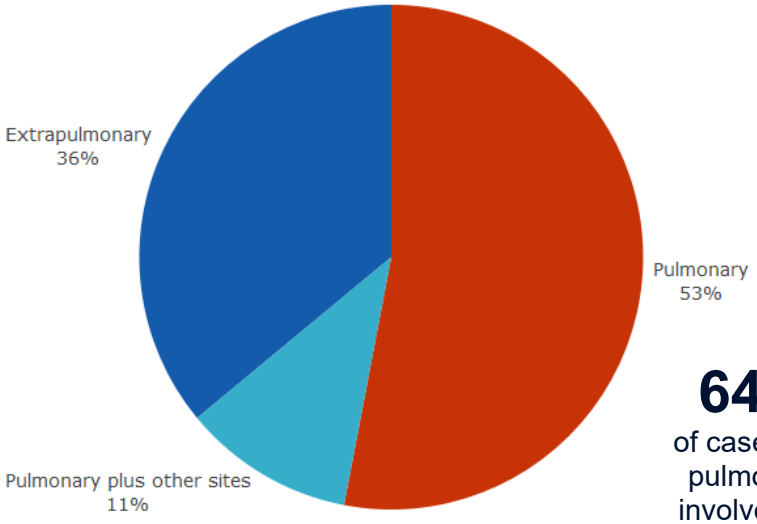
Target for TB cases tested for HIV at diagnosis

Section 2: Clinical Presentation

Site of Infection

In 2022, 64% (n=338) of cases had pulmonary involvement. 53% of cases (n=280) had pulmonary disease only, a further 11% (n=58) had pulmonary disease plus other sites. Extrapulmonary TB only was reported for 36% (n=190) of cases (Figure 14). Of extrapulmonary sites reported, lymph node was the most common (n = 102, 41% of cases with extrapulmonary involvement), followed by infection of the eye (n=33, 13%) and infection of the pleura (n=32, 13%) (Table 5).

Figure 14: Site of disease for NSW TB cases, 2022



64%
of cases had pulmonary involvement

53%
Pulmonary only

11%
Pulmonary plus other sites

36%
Extra pulmonary only

Table 5: Extrapulmonary sites* of infection for NSW TB cases with extrapulmonary involvement, 2022

Site	Number of cases	Percentage
Lymph node	101	41%
Eye	33	13%
Pleura	32	13%
Disseminated disease	16	6%
Brain/central nervous system/meninges, dural sinus, choroid plexus	15	6%
Gastrointestinal tract	15	6%
Genitourinary tract	13	5%
Spinal cord	11	4%
Bone	7	3%
Skin	6	2%

*Multiple sites can be recorded

Clinical Presentation and Treatment

Of the 528 cases notified in 2022, 97% (n=511) were new diagnoses of TB; while 3% (n=15) were classified as a TB recurrence, following treatment either in Australia (1%, n=4) or overseas (2%, n=11) (Table 6). TB recurrences may either be due to relapse or reinfection.

The reason a person is tested for TB is collected, with more than one reason allowed to be documented. The most frequent reason for testing in 2022 (n=360, 68%) was as part of an investigation of clinical symptoms. An additional 128 cases (24%) were tested for TB due to screening, while 11 cases (2%) were identified via contact investigation. The proportion of cases detected while symptomatic has significantly decreased by 15% (p=<0.0001) over the past ten years, while the proportion of cases detected through screening has increased by 12% (p=<0.0001) (Figure 15).

The median time from first health contact to treatment for Australian born cases was 24 days (range 0–425 days), and 27 days (range 0–2331 days) for overseas born cases. Cases with pulmonary involvement were commenced on treatment sooner (21 days, range 0–339 days) than those cases with extrapulmonary disease only (42 days, range 0-2331 days). There were 14 TB cases with pulmonary involvement with a time to treatment from first health contact greater than 180 days. Four cases were due to delayed further investigation of pulmonary symptoms or delayed referral. In one of these cases the symptoms were attributed to a post COVID-19 syndrome. The delay in 3 cases was due to healthcare services not being able to engage patients in follow-up investigations. Three cases initially presented with extrapulmonary symptoms, including scleritis and gastrointestinal symptoms and were given alternative diagnoses. They were later diagnosed with TB when they failed to respond to treatment and upon further investigation found to also have pulmonary involvement. In one case, the delay to treatment was due to uncertainty of the diagnosis and in 3 cases the reason for the delay was unknown.

Almost all cases were commenced on antimicrobial treatment in NSW following diagnosis (98%, n=520). Of the eight cases (2%) that did not commence antimicrobial treatment, 3 were diagnosed post-mortem, 1 died prior to starting treatment, 2 did not have treatment commenced as they were being palliated for other comorbidities and 2 transferred overseas prior to starting treatment.

Table 6: Disease classification*, NSW TB cases 2022

Disease classification	Number of cases	Percentage
New	511	97%
Recurrence following full treatment only in Australia	2	<1%
Recurrence following partial treatment only in Australia	2	<1%
Recurrence following full treatment overseas	8	2%
Recurrence following partial treatment overseas	3	1%
Unknown	1	<1%
Total	**528**	**100%**

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

98%

Proportion of cases commenced on antimicrobial therapy in NSW

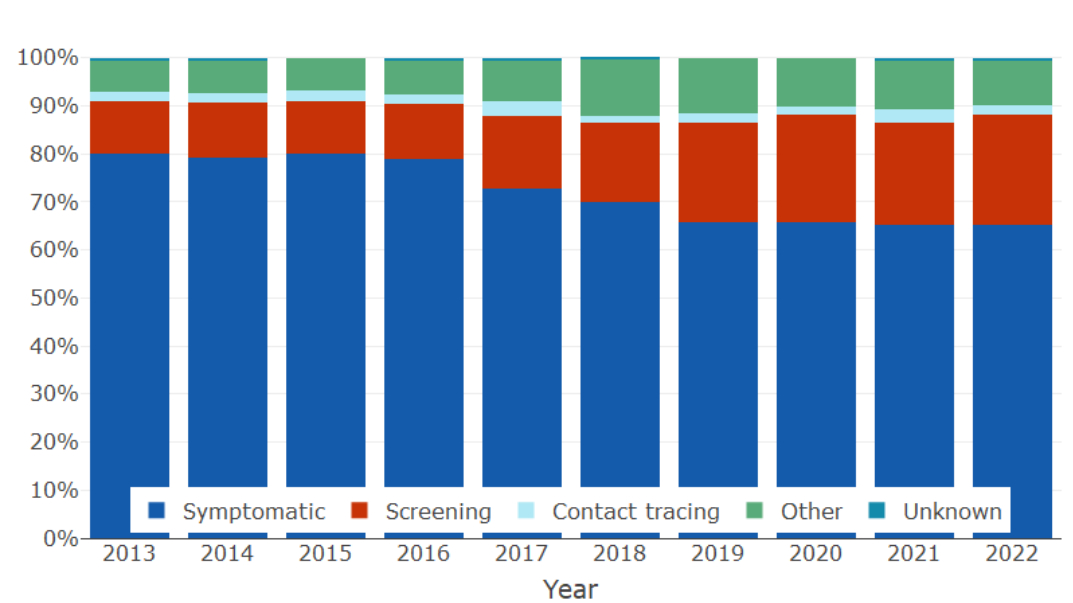
26 days

Median time to treatment from first health presentation

21 days

Difference in median time to treatment between pulmonary and extrapulmonary cases

Figure 15: Proportion of detection methods responsible for the detection of TB cases, NSW 2022



68%

Proportion of TB cases identified via investigation of symptomatic disease

24%

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

12%

Increase in NSW TB cases detected through screening since 2013

Section 3: Laboratory

Of the 528 TB cases in 2022, 77% of diagnoses (n=404) were laboratory confirmed; 68% (n=357) were cultured, and 9% diagnosed by polymerase chain reaction (PCR) only (n=47). The remaining 23% of cases (n=124) were diagnosed clinically (Figure 16). Laboratory confirmation was more commonly obtained for pulmonary involvement (85%, n=286), compared to those with extrapulmonary disease only (62%, n=118). Extrapulmonary cases were more likely to be diagnosed clinically (38%, n=72) or by PCR (11%, n=21) compared to pulmonary cases (15%, n=52 diagnosed clinically; 8%, n=26 diagnosed by PCR). For the ten-year period to 2022 there has been a significant increase (p=<0.0001) in the proportion of cases confirmed using PCR only and a significant decrease in the proportion of cases confirmed using culture (p=<0.0001).

85%

Proportion of NSW TB cases with pulmonary involvement with laboratory confirmation

62%

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

Figure 16: Method of diagnosis of TB, laboratory vs. clinical, NSW, 2022

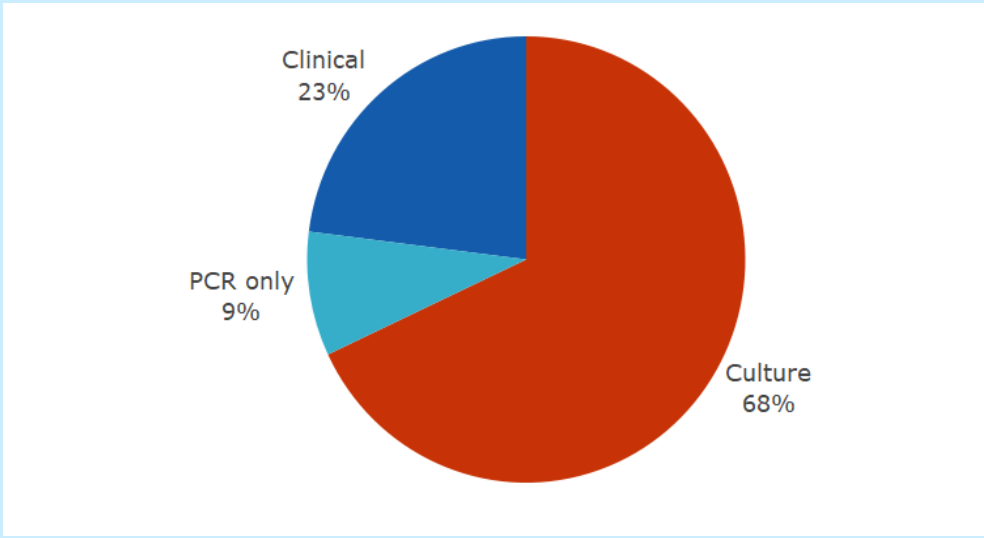
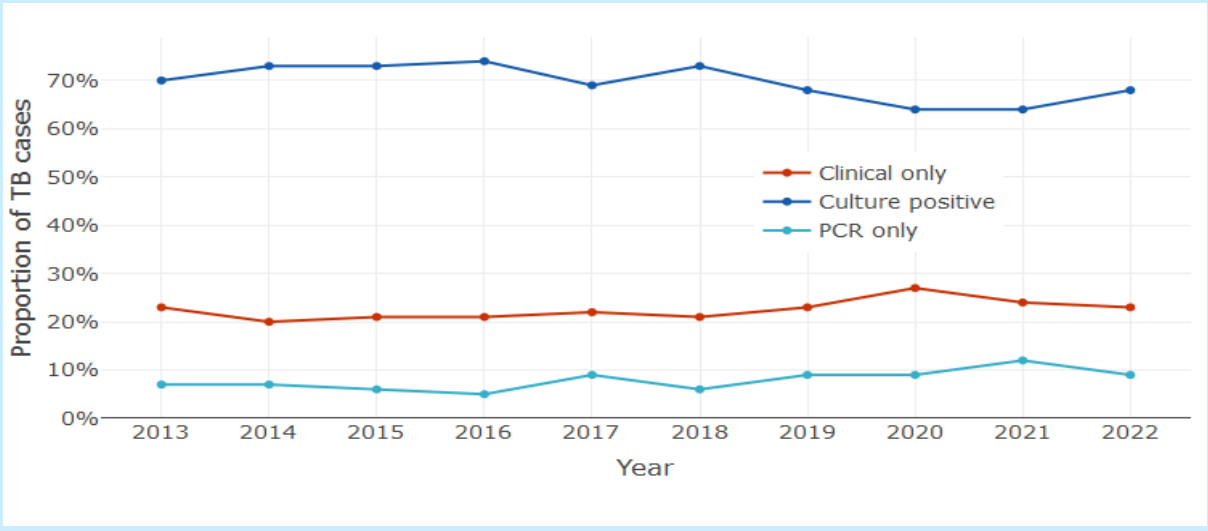


Figure 16a: Method of laboratory confirmation of diagnosis of TB cases, NSW, 2013-2022



Drug Susceptibility Testing (DST)

Of the 357 culture positive TB cases in NSW in 2022, 98% (n=351) had drug susceptibility results reported. Of these, 86% (n=302) were fully susceptible to first line TB drugs, 11% (n=40) were resistant to one or more first line drugs, and 3% (n=9) were classified as MDR-TB or pre-XDR-TB (Figure 17). These proportions have not significantly changed over the last ten years (Table 7). Of the 6 cases without DST, 4 were mixed infections with another mycobacterium which prevented DST from being performed, 1 specimen could not have DST performed due to viability issues and 1 specimen was tested overseas and DST was not available. The countries of birth for the MDR-TB cases were Vietnam (n=3), China (n=2), Australia (n=1), India (n=1), Peru (n=1), and the Philippines (n=1).

86%

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

11%

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

3%

Proportion of culture positive cases which were MDR-TB

Figure 17: Drug susceptibility of culture confirmed cases, NSW, 2013-2022

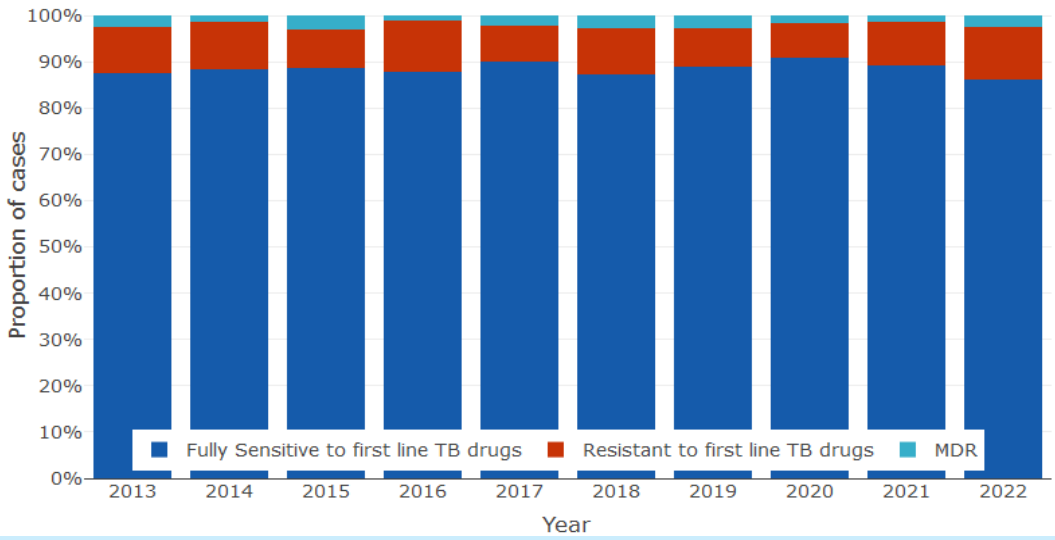


Table 7: Drug susceptibilities of culture confirmed TB cases with DST results available, NSW, 2013-2022

Drug Susceptibility		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Fully susceptible		269 (88%)	305 (88%)	281 (89%)	316 (88%)	332 (90%)	318 (88%)	351 (89%)	365 (91%)	315 (89%)	302 (86%)
Ethambutol	Mono-resistance	2 (1%)	2 (1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (<1%)	0 (0%)	0 (0%)	2 (1%)
Isoniazid		25 (7%)	26 (8%)	21 (7%)	36 (10%)	23 (6%)	28 (8%)	27 (7%)	24 (6%)	29 (8%)	30 (9%)
Pyrazinamide		3 (1%)	4 (1%)	1 (<1%)	3 (1%)	6 (2%)	3 (1%)	3 (1%)	2 (<1%)	1 (<1%)	6 (2%)
Rifampicin		0 (0%)	0 (0%)	2 (1%)	0 (0%)	0 (0%)	3 (1%)	0 (0%)	3 (1%)	1 (<1%)	1 (<1%)
Resistant to ≥2 first line drugs (but not MDR)		2 (1%)	3 (1%)	2 (1%)	1 (<1%)	0 (0%)	1 (<1%)	2 (<1%)	1 (<1%)	2 (1%)	1 (0%)
MDR		7 (2%)	4 (1%)	9 (3%)	2 (1%)	8 (2%)	10 (3%)	10 (3%)	5 (1%)	5 (1%)	7 (2%)
Pre-XDR		1 (<1%)	1 (<1%)	0 (0%)	2 (1%)	0 (0%)	0 (0%)	1 (<1%)	2 (<1%)	0 (0%)	2 (1%)
XDR		0 (0%)	0 (0%)	1 (<1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Pre-XDR and XDR definitions were updated by the World Health Organisation in 2021. These new definitions, supplied in the definitions section have been utilised for cases after this date.

Cluster Analysis

In 2022, 349 (98%) of culture positive cases had whole genome sequencing (WGS) performed on one or more isolate. Of these, 46 (13%) were found to be part of a cluster with another TB case notified in NSW from 2022 or earlier. The remaining 303 culture positive cases (87%) were not linked to any other NSW case in or prior to 2022 at the time of analysis.

Of the 46 clustered cases, 22 (48%) were male, the median age was 34 years (range 8 months-77 years) and 37 (80%) lived in a metropolitan LHD.

Cases with pulmonary involvement are more likely to be infectious then those with extrapulmonary disease only. A sputum smear–positive case is much more infectious than a pulmonary case with a positive culture only. Cases who had pulmonary involvement were more likely to be clustered than cases with only extrapulmonary involvement (RR 5.28 (95% CI 1.68 – 16.62, p=<0.02). There was no significant difference found between clustered and non-clustered cases in relation to gender, indigenous status, Pasifika ethnicity, place of residence or respiratory smear status.

Cases born in Australia were more likely to be clustered than cases born in other countries (RR 7.48, 95% CI 4.76 – 11.76, p = <0.01). There was no significant difference found for cases born in other countries for which analysis was done (Table 9).

Table 8: Demographic and clinical analysis for whole genome sequenced cases, NSW, 2022

		Clustered		Not clustered		Relative risk (95% CI)	p value
		N	%	N	%		
Cases	Total number of cases	**46**	**100%**	**303**	**100%**	-	
Age	Median age (age range)	34 years (0-77 years)		46 years (16-95 years)		-	
Gender	Male	22	48%	180	59%	0.67 (0.39 – 1.14)	0.14
	Female	24	52%	123	41%		
Indigenous status	Aboriginal	1	2%	1	<1%	3.86 (CI 0.94 – 15.83)	0.25
	Not Aboriginal	45	98%	302	100%		
Pasifika ethnicity	Pasifika	0	0%	3	1%	0.93 (0.07 – 12.64)	0.96
	Not Pasifika	46	100%	300	99%		
Place of residence	Metropolitan Sydney	37	80%	267	88%	0.61 (0.32 – 1.17)	0.15
	Rural or regional NSW	9	20%	46	12%		
Site of infection	Pulmonary involvement	43	93%	212	70%	5.28 (1.68 – 16.62)	<0.01
	Extrapulmonary only	3	7%	91	30%		
Respiratory smear positive	Smear positive	21	60%	77	34%	1.61 (CI 0.90 – 2.89)	0.10

Table 9: Countries of birth of whole genome sequenced cases, NSW, 2022

	Clustered N	Clustered %	Not clustered N	Not clustered %	Relative risk (95% CI)	p value
Total number of cases	**46**	**100%**	**303**	**100%**	**-**	
India	5	(11%)	52	(17%)	0.62 (0.62 – 0.26)	0.39
Nepal	5	(11%)	36	(12%)	0.92 (0.38 – 2.19)	0.84
Vietnam	3	(7%)	37	(12%)	0.54 (0.18-1.66)	0.33
Philippines	2	(4%)	35	(12%)	0.38 (0.10 – 1.52)	0.20
China	3	(7%)	32	(11%)	0.63 (0.20 – 1.91)	0.60
Australia	19	(41%)	11	(4%)	7.48 (4.76 – 11.76)	<0.01
Indonesia	0	(0%)	12	(4%)	0.28 (0.02 – 4.28)	0.34
Malaysia	2	(4%)	8	(3%)	1.54 (4.33 – 5.45)	0.63
Bangladesh	0	(0%)	9	(3%)	0.37 (0.02 – 5.54)	0.47
Pakistan	1	(2%)	6	(2%)	1.09 (0.17 – 6.80)	0.93
Thailand	1	(2%)	6	(2%)	1.09 (0.17 – 6.80)	0.93
Afghanistan	0	(0%)	7	(2%)	0.46 (0.03 – 6.84)	0.57
Korea	0	(0%)	4	(1%)	0.74 (0.05 – 10.46)	0.82

*CI = Confidence Interval

The 46 clustered cases were in 33 different clusters ranging in time of first case from 2000 to 2022. There were 21 clusters (64%) involving 2 cases only, 7 clusters (21%) contained either 3 or 4 cases and 5 clusters (15%) which contained 5 or more cases.

There were 7 clusters (21%) involving only transmission within households. One cluster (3%) involved some household transmission with also community, causal or unknown links.

There were 13 (39%) clusters where the epidemiological links were unknown at the time of writing this report, these clusters tended to have a larger genomic variation between cases (>6 single nucleotide polymorphisms or SNPs).

There was one new case added to cluster 18-0001, which is a large cluster of 24 cases which has mostly compromised people of Pasifika descent. This cluster was previously described in the 2021 report [6]. The new case added to the cluster in 2022 was not of Pasifika descent and had no known links to previous cases.

There was one new case added to cluster 19-0015, this cluster occurred in a large metropolitan hospital from a highly infectious source case with extensive pulmonary disease. This cluster was described in the 2020 report [7].

There was one new case added to cluster 21-0002 which occurred in a workplace in a non-patient contact area of a large metropolitan hospital. This cluster was described in the 2021 report [6].

Cluster 22-0013 has identified likely transmission of MDR-TB in NSW. No epidemiological link has been established at this stage.

Table 10: Whole genome clusters with 2022 cases*

Cluster name	Year cluster detected	Number of 2022 cases	Year of first case	Total number of WGS cases	SNP differences	Epidemiological links#	Epidemiological links description^
14-0002	2015	2	2011	10	0-13	B, C, D	Casual & community
16-0009	2016	1	2015	3	7-9	D	Unknown
18-0001	2018	1	2013	24	0 - 11	B, C, D	Household, casual & community
19-0004	2019	1	2010	9	0-12	B, D	Household, casual
19-0015	2019	1	2019	9	0-1	B, D	Casual
21-0002	2021	1	2021	6	0-1	A	Casual
21-0007	2021	1	2016	3	4-9	B	Casual
21-0017	2021	1	2021	3	0	A	Casual
21-0019	2022	1	2019	2	4	D	Unknown
21-0020	2022	1	2018	2	7	D	Unknown
22-0001	2022	3	2011	4	5-12	B, D	Casual
22-0002	2022	1	2018	2	2	A	Casual
22-0003	2022	1	2011	2	3	D	Unknown
22-0004	2022	1	2012	2	4	A	Casual
22-0005	2022	1	2013	3	7-10	D	Unknown
22-0006	2022	2	2022	2	1	A	Household
22-0007	2022	1	2017	2	8	D	Unknown
22-0009	2022	1	2020	2	2	D	Unknown
22-0010	2022	2	2022	2	2	A	Household
22-0012	2022	1	2019	2	2	D	Unknown
22-0013	2022	1	2019	2	3	D	Unknown
22-0014	2022	2	2022	2	2	A	Household
22-0015	2022	1	2020	3	0	A	Household
22-0016	2022	1	2021	2	5	A	Household
22-0017	2022	1	2020	2	8	D	Unknown
22-0018	2022	2	2022	2	0	A	Household
22-0019	2022	2	2022	2	1	A	Casual
22-0020	2022	2	2022	2	2	A	Household
22-0021	2022	2	2022	2	11	D	Unknown
22-0024	2022	2	2022	2	7	D	Unknown
22-0025	2022	2	2022	2	5	D	Unknown
22-0026	2022	2	2022	2	2	A	Casual
22-0028	2022	1	2022	2	3	D	Unknown

*Excludes 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 for non-MDR cases from 2021 and MDR-TB cases from 2020 are recorded in Table 11. Of the non-MDR cases in 2021, 91% (498) completed treatment, consisting of 4% (n=20) who were considered cured (sputum culture positive prior to treatment and sputum culture negative after completion of treatment) and 96% (n=478) who completed treatment (with assumed cure). There were 4 TB-related deaths reported. There were 7 cases (1%) that defaulted before completion of treatment of which 2 were recommend ceasing treatment by their clinician with ongoing monitoring (medical default). The remaining 7% (n=40) had either transferred overseas, died of a non-TB related cause, or died from unknown cause.

Of those cases in 2021 where the outcome was known (excluding transferred overseas, died unrelated or unknown if related to TB and outcome unknown), 98% of cases successfully completed treatment.

Of the seven cases classified as MDR-TB in 2020 100% (n=7) successfully completed treatment.

98%

Proportion of cases with a successful outcome in 2021

100%

Proportion of successfully treated MDR-TB cases in 2020

Table 11: Clinical outcomes of non MDR-TB cases diagnosed in 2021 and MDR-TB cases diagnosed in 2020*

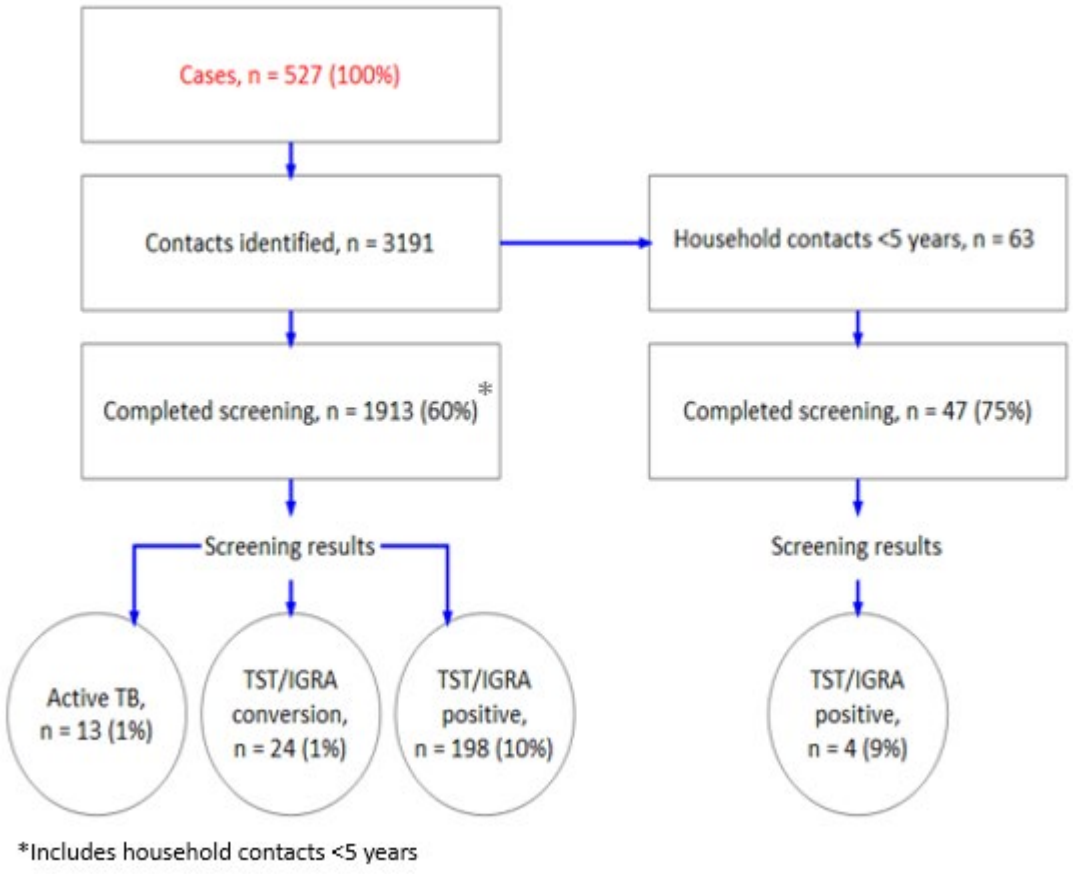
		Year of diagnosis	
		2021 Non MDR cases	2020 MDR-TB
Total cases		**550 (100%)**	**7 (100%)**
Alive	Completed treatment	498 (91%)	7 (100%)
	Defaulted	7 (1%)	-
	Transferred overseas	14 (3%)	-
	Treatment failure	0 (0%)	-
	Outcome unknown	1 (<1%)	-
	Remains on treatment	0 (0%)	
Died	Cause related to TB	4 (1%)	-
	Unrelated to TB	21 (4%)	-
	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

Section 5: Contact Investigations

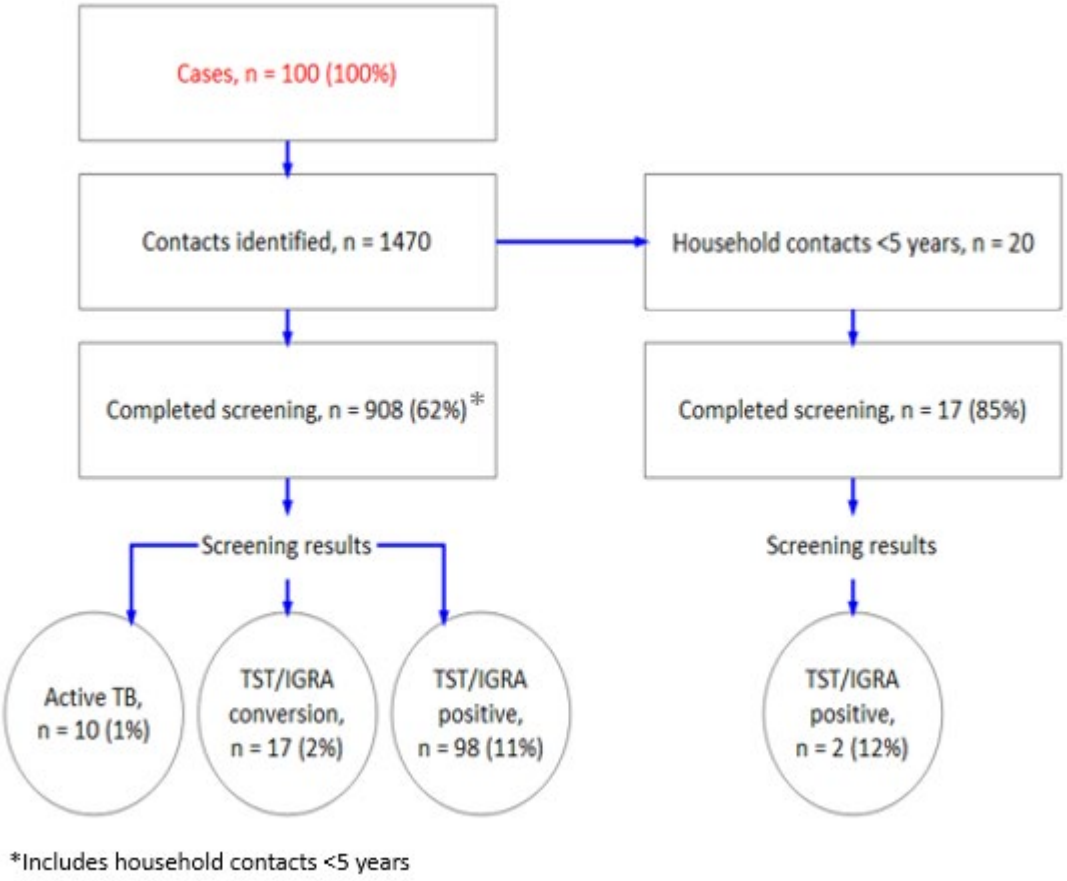
Of the 528 TB notifications received in 2022, all but one had contact information completed at the time of analysis. The median number of contacts per case was 2 (range 0-240), and 5% (n=24) of contact investigations involved more than 25 contacts. A total of 3,191 contacts had been identified, including 63 household contacts under the age of five years, and of these 60% (n=1,913) were recorded to have completed screening. Of the 1,913 contacts screened, 1% (n=13) were found to have active TB disease, 1% (n=24) had a tuberculin skin test (TST) or interferon gamma release assay (IGRA) conversion (indicating recent tuberculosis infection from the case patient), and 10% (n=198) had a positive TST or IGRA result on a single screen. Screening outcomes are shown in Figure 18.

Figure 18: Contact investigation outcomes from TB cases diagnosed in 2022, NSW



There were 100 sputum or respiratory smear positive cases notified in 2022, these cases are generally considered to be more infectious than smear negative cases. All smear positive cases (100%) had contact information available identifying 1470 contacts, including 20 household contacts under 5 years of age. Of these contacts, 908 (62%) were recorded as having completed screening where 10 (1%) were found to have active TB disease, 17 (2%) had TST or IGRA conversion, and 98 (11%) had a positive TST or IGRA result on initial screening. Screening outcomes are shown in Figure 19.

Figure 19: Contact investigation outcomes from TB pulmonary smear positive cases diagnosed in 2022, NSW



Discussion

TB notifications decreased in 2022, most likely as a delayed effect of the extended border closures reducing immigration to Australia from early 2020 to early 2022. TB cases in NSW continue to occur more frequently 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 LHDs 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 [1].

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 Australian-born people. The notification rate in the Australian born non-Indigenous population in NSW has remained relatively steady for more than a decade and has overall decreased over the last five years with some yearly fluctuation. The rate in Australian born Aboriginal and Torres Strait Islander people in NSW is over two times higher than in non-Indigenous Australian born people over the past ten years. The rate difference is lower than the Australian born Aboriginal and Torres Strait Islander national rate difference which is five to six times higher on average [8]. In 2022, the rate in Australian born Aboriginal and Torres Strait Islander people in NSW was not significantly higher than the rate in non-Indigenous Australian born people.

Over the past ten years the proportion of cases detected while symptomatic in NSW has significantly decreased, while the proportion of cases detected through screening has significantly increased, demonstrating the impact of immigration and contact screening programmes on earlier detection of TB. This was notable in 2022, with the reopening of borders leading to increased numbers of people being diagnosed on a TBU compared to during the COVID-19 pandemic years. Risk factors reported among NSW TB cases in 2022 were like those reported in previous years in NSW and nationally [8]. Birth in a TB-HRC, or household member or close contact with another TB case are the most frequently reported risk factors.

Drug resistant TB continues to pose a challenge to the control and management of TB; both globally and within NSW. There has been no significant change to the proportion 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. New shorter MDR-TB regimens were recommended by the WHO in May 2022 which have been utilised in NSW for the first time in 2022 [9].

The proportion of NSW TB cases tested for HIV at the time of diagnosis continues to increase, with 97% tested in 2022. The prevalence of HIV among NSW TB cases remains low, with one per cent of cases tested found to have HIV. Ninety-eight per cent of non MDR-TB cases in 2021 successfully completed treatment (excluding cases, transferred overseas or died unrelated or unknown if related to TB). Mortality among NSW TB cases remained stable (6%), there were 4 cases reported to have died due to TB diagnosed in 2021. NSW continued to see low rates of treatment default (1%) and treatment failure (0%), among TB cases diagnosed in 2021. Of the seven MDR-TB cases in 2020 all successfully completed treatment within NSW.

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. In 2011-2012, the largest group of migrants to Australia were from North-West Europe (20%). By 2019-2020 South and Central Asia had become the most common region for migrants to Australia with 140,220 arrivals followed by North-East Asia with 104,040 arrivals. Migration from all areas decreased dramatically during 2020-2021, while it began returning to pre-COVID-19 levels during 2021-2022 [10]. In 2021, eight out of the ten countries with the largest increase in migrant population in Australia since 2011 were classified as high-risk countries for TB by the WHO [11] and these countries are featured in the most frequent countries of birth for TB cases in NSW.

Overall, migration to Australia increased in the June 2021-June 2022 period with 395,000 migrants, an increase of 171% from the previous reporting year [10]. This is due to the removal of changes in border policies implemented in March 2020 which generally prevented non-Australian citizens from entering Australia. This increase has resulted in more TB undertakings received by the NSW TB Program for individuals migrating to Australia and requiring screening in 2022. The decline in TB numbers in 2022 – largely due to low number of notifications in the first half of the year – likely due to the decreased immigration since 2020 due to the COVID-19 pandemic.

Conclusion

The number of TB cases in NSW decreased in 2022 compared to the previous 3 years. It is important to remember 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, it remains to be seen what impact COVID-19 related migration changes will have on TB notification rates in the next few years.

Acknowledgements

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