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Tuberculosis in the West Midlands
Annual review (2018 data)

Data from 2000 to 2018

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Executive summary

National and regional

In 2018, there were 613 tuberculosis (TB) case reports to the Public Health England (PHE) Enhanced Tuberculosis Surveillance system (ETS) for individuals resident in the West Midlands. The West Midlands has higher rates of TB than England as a whole. In 2018, the 613 cases equated to a rate of 10.4 cases per 100,000 population (95% confidence interval [CI] 9.6-11.2), compared to 8.3 per 100,000 (95% CI 8.1-8.6) in England overall [1]. In the West Midlands, both the number of cases and rate of TB decreased in 2018 compared to 2017, and the rate of TB in 2018 was statistically significantly lower than the rate in 2016 (12.3 per 100,000, 95% CI 11.5-13.3).

Local

Case numbers increased in 6 out of 14 local authorities, but reductions were observed in Warwickshire (24 cases versus 41 in 2017), Sandwell (54 versus 79 in 2017) and Walsall (41 versus 52 in 2017). The highest rates of TB in the West Midlands were seen in Coventry (20.7 per 100,000), Wolverhampton (20.2 per 100,000) and Birmingham (20.0 per 100,000) upper tier local authorities. The areas with the biggest increase in cases between 2017 and 2018 were Worcestershire (+56.3%, 25 versus 16 in 2017) and Dudley (+33.3%, 28 versus 21 in 2017). Although at the level of Local Authority some natural fluctuation of numbers is expected, it highlights the importance of having sufficiently resilient resourced services in place to deal with higher than expected numbers of cases.

Age and sex

The highest age and sex specific rates of TB in the West Midlands were recorded among men aged 40-49 years (18.4 per 100,000) and women aged 20-29 years (14.1 per 100,000), with very few paediatric cases reported. TB rates have declined in every age group, with the biggest decrease occurring in the 0-14 age group (-25%, 1.7 per 100,000 vs 2.3 in 2017) followed by the over 65 age group (-18%, 9.6 per 100,000 vs 11.6 in 2017).

Ethnic groups and origin

A country of birth outside of the UK was recorded for 63.2% of people with TB in 2018 (386/611). The rate of TB among people born outside the UK (48.1 per 100,000) was 10 times higher than the rate among UK born individuals (4.5 per 100,000).

In accordance with England overall, people with TB were more frequently born in Central and Eastern European countries[1] than in previous years [1]. The most common ethnic group among people with TB in the West Midlands was white (27.5%, 168/612), just under one-quarter of whom were born outside of the UK, most commonly in Romania and Poland. As in previous years, the majority of TB cases among people born outside the UK occurred in those that entered the UK 11 or more years prior to their TB diagnosis.

Occupation

In 2018 39.6% of people with TB aged 18-64 years were not in employment or education (187/472). Eleven percent of people with TB were in the education sector as either staff or students (10.6%, 50/472), and 7.2% were health care workers, health care laboratory staff or prison staff (34/472).

Clinical characteristics

As in previous years, over half (57.7%, 354/613) of people had pulmonary TB, approximately one-fifth were inpatients at the time of diagnosis (17.3%, 99/573), and 6.6% had previously been diagnosed with TB (39/591). Furthermore, 72.9% of pulmonary TB cases were confirmed by culture (258/354), which is below the national target of 80%. In 2018, 96% (340/354) of culture confirmed cases had a WGS result, of which one-third (112/340) were in a WGS cluster. Of these clustered cases, the majority were male (69%, 77/112), UK born (68%, 76/112) and most commonly white (48.2%, 54/112).

Treatment outcomes

Among people with pulmonary TB in 2018, 47.3% started TB treatment within 2 months of symptom onset (157/332). This is a 7.6% increase compared to 2017 and also the highest proportion in recent years. One-quarter of people with pulmonary TB (83/332) started treatment more than 4 months after symptom onset, consistent with a prolonged period of infectiousness. Extra-pulmonary cases of TB took on average 31 days longer to be diagnosed than pulmonary cases.

Treatment was completed within 12 months for 85.4% (505/591) of people with rifampicin sensitive TB reported in 2017 whose expected treatment duration was less than 12 months.[2] The most common outcome category for people who did not

[1] OECD term for the group of countries comprising Albania, Bulgaria, Croatia, the Czech Republic, Hungary, Poland, Romania, the Slovak Republic, Slovenia and the 3 Baltic States: Estonia, Latvia and Lithuania.

[2] Excludes cases with rifampicin resistance, and central nervous system, spinal, miliary or cryptic disseminated disease.

complete treatment was death (5.9%, 35/591). TB was recorded to be the cause or to have contributed to death in just under one-third of these individuals (31.4%, 11/35). The proportion of people who were lost to follow up declined compared to those reported in 2016.

Drug resistance

TB antibiotic sensitivity was known for 57.1% of cases in 2018 (350/613), of which 11.0% were resistant to at least 1 first line drug (39/350). Two percent (2.0%, 7/350) had multidrug-resistant or rifampicin resistant TB (MDR/RR-TB) or pre-extensively drug-resistant TB (pre-XDR TB). There were no cases of extensively drug-resistant TB (XDR-TB).[3]

Under-served populations

People with one or more social risk factors for TB, including drug and alcohol misuse, homelessness and prison were similar in number in 2018 (14.3%, 78/545) compared to 2017 (13.7%, 80/586). Much like previous years, the West Midlands is above the national average of people with risk factors, (13.3%) [1]. Between 2009 and 2018, individuals with risk factors were more likely to be male (84.2%, 581/690), UK born (62.9%, 432/687), white (45.7%, 315/685), have pulmonary TB (81.2%, 560/689), be sputum smear positive (70.5%, 277/393), and a previous diagnosis of TB (13.5%, 93/669). Between 2009 and 2017 treatment was completed by 81.7% (446/546) of patients with social risk factors at their last recorded outcome, compared to 90.2% (4,431/4,911) of patients with no risk factors. In 2018 half (50.7%, 311/613) of people with TB were resident in the most deprived areas of the West Midlands,[4] compared to 6.7% in the least deprived areas.

HIV co-infection

HIV tests were offered to 96.3% of eligible people with TB in 2018 (500/519). Overall in the West Midlands, 97% of all those offered an HIV test were tested. In 8 upper tier local authority areas, 100% of cases offered HIV testing received the test. A low proportion of people are estimated to have TB-HIV co-infection in the West Midlands in 2018 (1.9%). This is the second lowest percentage in England after the North East, and reflects the ongoing declining trend since peak rates in 2004 (6.0%).

[3] First line drugs: isoniazid, rifampicin, pyrazinamide and ethambutol. MDR-TB: cases initially resistant to at least isoniazid and rifampicin. XDR-TB: cases initially MDR and resistant to at least 1 injectable agent (amikacin, capreomycin or kanamycin) and at least 1 fluoroquinolone (moxifloxacin, ofloxacin or ciprofloxacin).

[4] Most deprived quintile of lower super output areas based on Index of Multiple Deprivation (IMD 2019) rank.

Conclusion

In conclusion, although the overall number of TB notifications has declined in the West Midlands, if we are to achieve the World Health Organisation's (WHO) End TB Strategy target of a 90% reduction in new notifications by 2035, TB needs to remain a priority. The epidemiology of TB in the West Midlands is changing; similarly to England overall there are more people with TB born in Central and Eastern European countries than in previous years, and we are increasingly seeing transmission between UK born cases, demonstrated through Whole Genome Sequencing (WGS) technologies. Importantly, this report demonstrates how the burden of TB falls on more socio-economically challenged groups, and the high number of individuals with TB and social risk factors represents a significant challenge in the West Midlands in ensuring that this health inequality is addressed.

An increasing proportion of people with TB should have access to high-quality diagnostics, including culture confirmation and WGS technology. In order to maximise treatment completion and minimise transmission, continued effort and investment to early diagnose TB and deliver effective packages of TB care in those with social risk factors is needed.

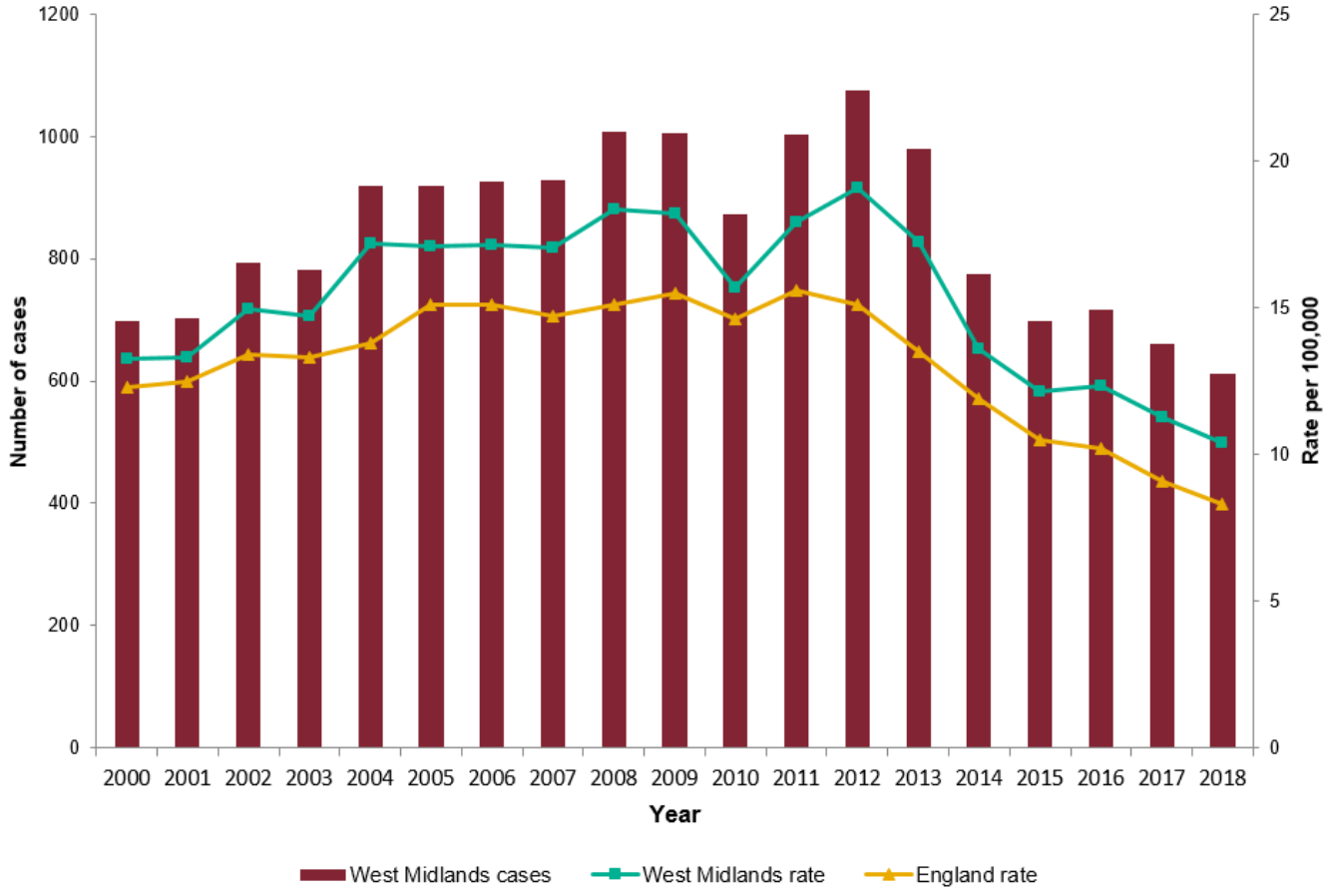
1. TB notifications and incidence

Overall numbers, rates and geographical distribution

In 2018, 613 cases of tuberculosis (TB) were reported among residents in the West Midlands (Figure 1), a crude rate of 10.4 cases per 100,000 population (95% confidence interval [CI] 9.6-11.2). The rate of TB in the West Midlands remains significantly higher than the overall rate for England (8.3 per 100,000) [1]. Case numbers have been gradually declining in the West Midlands since their peak in 2012, with 2018 reporting a statistically significantly lower rate than 2 years ago in 2016 (12.3 per 100,000, 95% CI 11.5-13.3).

TB Monitoring Indicator 1: Overall TB incidence per 100,000 population

Figure 1: TB case reports and rates, West Midlands, 2000 to 2018



Whilst rates take into account the size of the population from which cases arise, the actual number of cases should also be considered. Birmingham notified the largest number of cases in 2018 (228), while Herefordshire, and Telford and Wrekin reported the joint fewest (7). Case numbers increased in 6 out of 14 local authorities, with the

largest change seen in Worcestershire (+56%, 25 cases vs 16 in 2017). Substantial reductions in case numbers were observed in 2 local authorities: Warwickshire (-41%, 24 cases vs 41 in 2017) and Sandwell (-32%, 54 vs 79 in 2017).

TB case rates for upper tier local authorities (UTLAs) are presented in Figure 2. In recent years there has been an overall decreasing trend in some of the highest incidence areas such as Birmingham, Coventry, Sandwell, Solihull, Stoke-on-Trent, Walsall and Wolverhampton. The case rates for 2018 are also presented in Figure 3.

Figure 2: TB case rates, by upper tier local authority of residence, West Midlands, 2000 to 2018

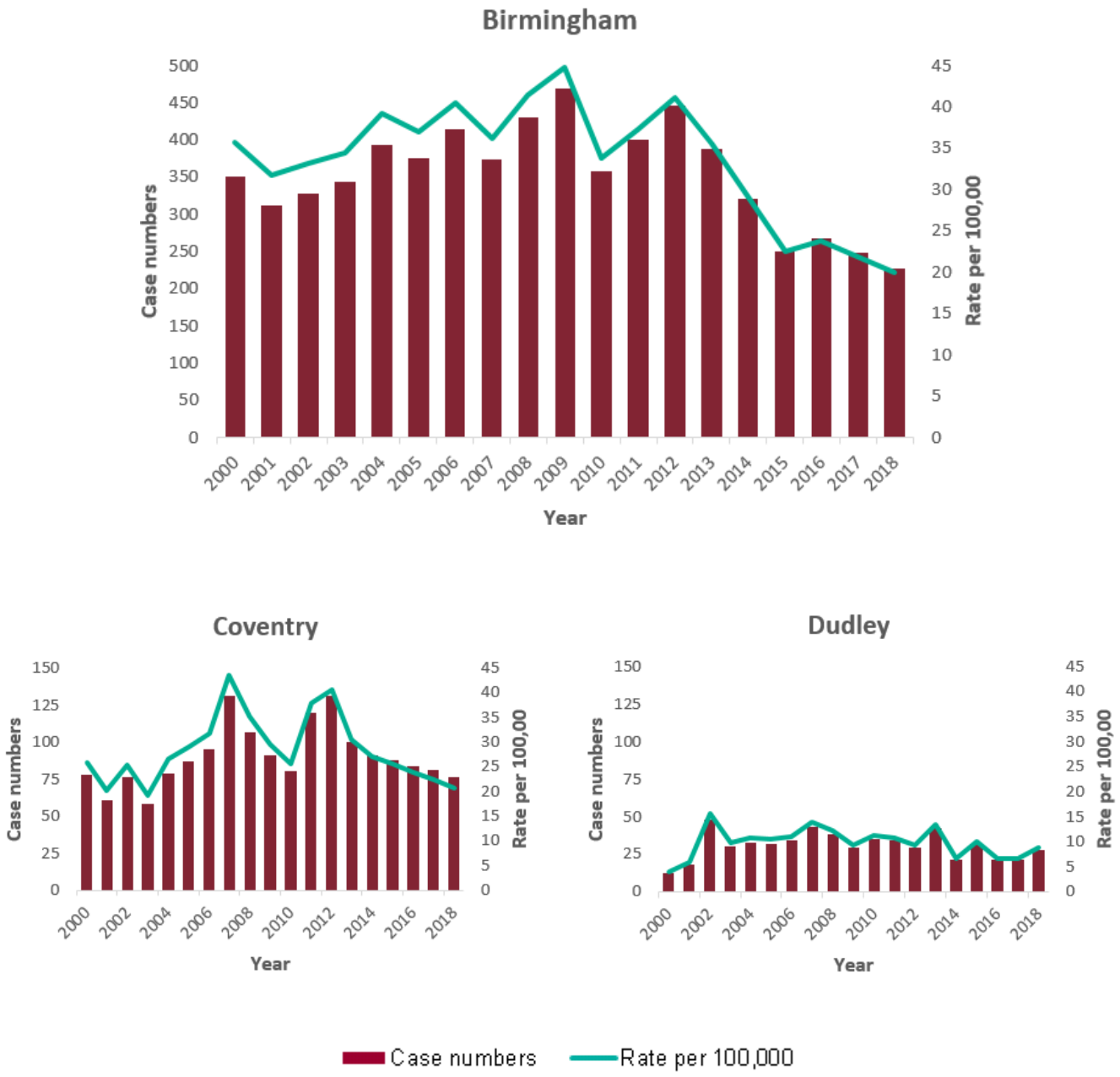


Figure 2: TB case rates, by upper tier local authority of residence, West Midlands, 2000 to 2018 (continued l)

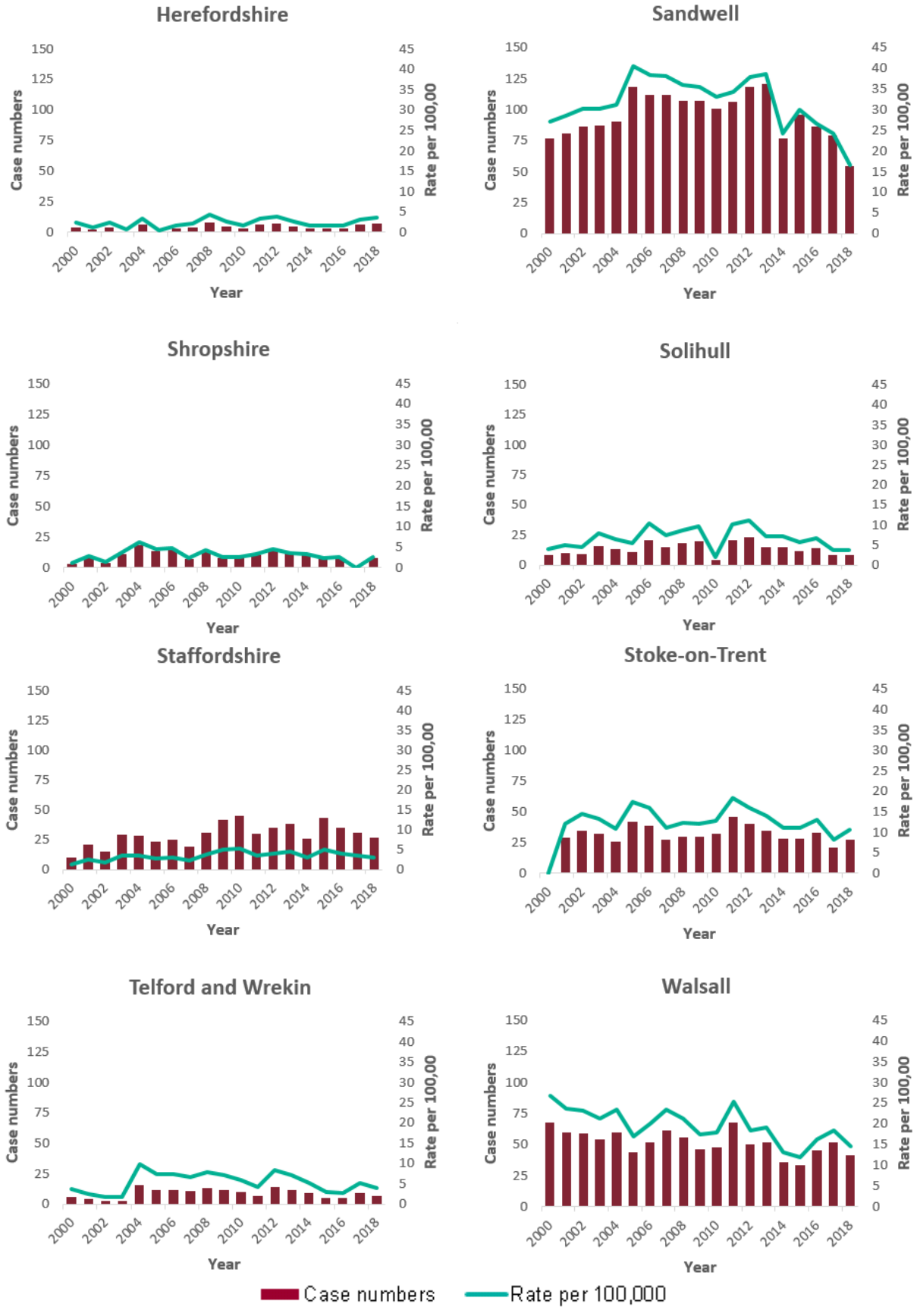


Figure 2: TB case rates, by upper tier local authority of residence, West Midlands, 2000 to 2018 (continued II)

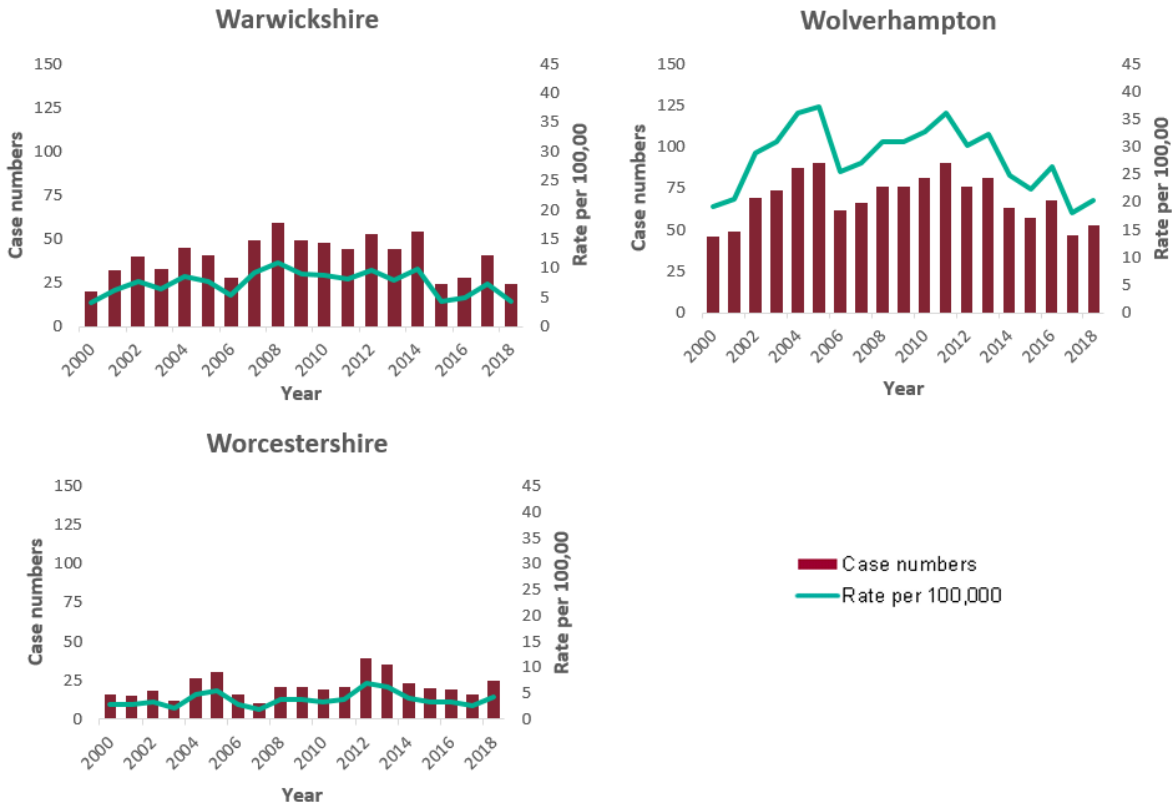
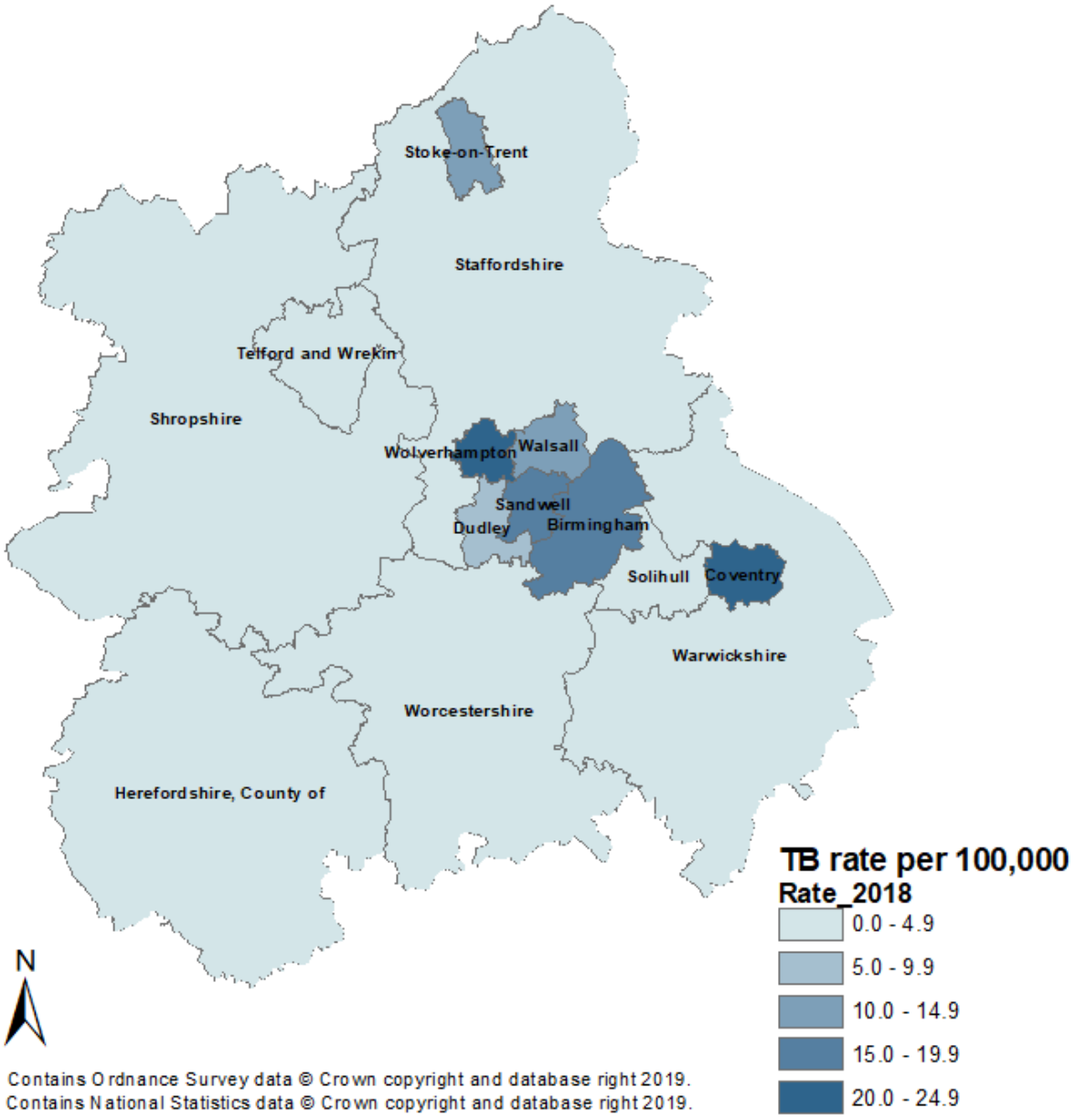


Figure 3: TB case rate by upper tier local authority of residence, West Midlands, 2018

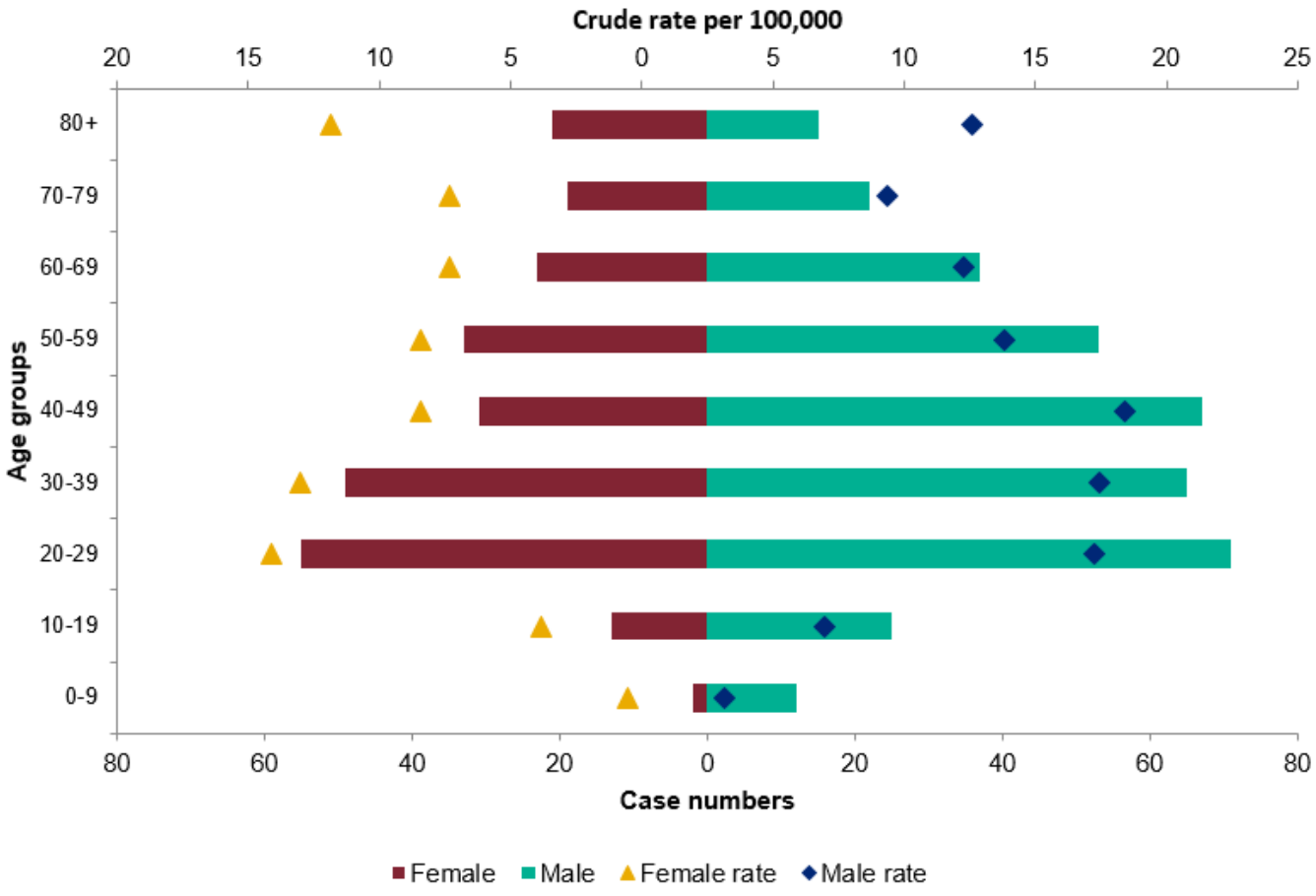


Demographic characteristics

Age and sex

The age sex pyramid for people with TB in 2018 was similar to previous years, with more males (59.9%) than females, and comparable median ages at notification (41 years in 2018 versus 42 years in 2017). Crude rates of TB among males were highest for those aged 40-49 years (18.4 per 100,000). This is a change compared to 2017, in which the highest rates of TB were among males aged 30-39 years (22.9 per 100,000). For females, the highest rate was among those aged 20-29 years (14.1 per 100,000). This also differs to the previous year, where the highest rates in females were seen in the 30-39 age group (15.7 per 100,000). In 2018 there were 14 TB cases in children aged less than 10 years, compared to 15 in 2017 (Figure 4).

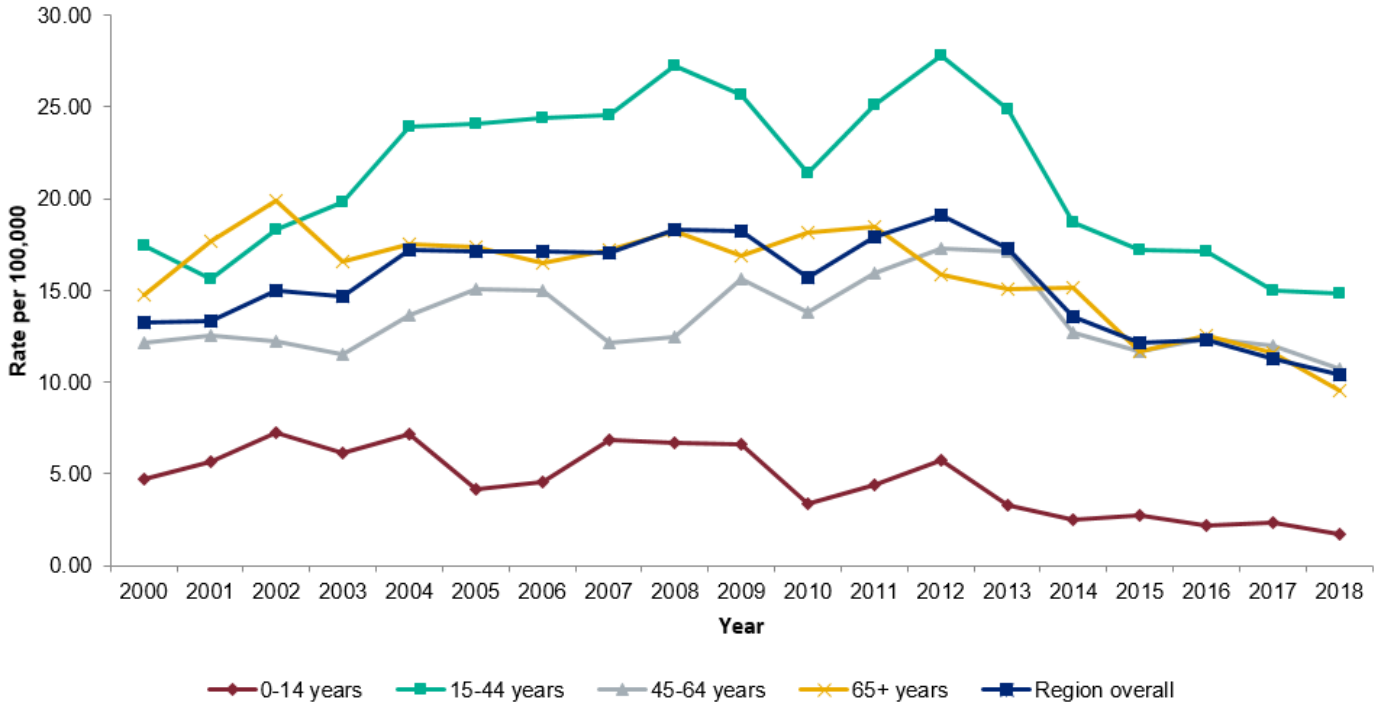
Figure 4: TB case reports and rate by age and sex, West Midlands, 2018



The rate of TB declined for all age groups compared to 2017, with the largest decrease occurring in the 0-14 age group (-25%, 1.7 per 100,000 compared to 2.3 in 2017) followed by the over 65 age group (-18%, 9.6 per 100,000 compared to 11.6 in 2017, Figure 5). The overall rate of TB in the West Midlands is primarily driven by people

aged 15-44 years. This is the age group with the highest rate, and has nearly halved since its peak in 2012 (-46.7%, 14.8 per 100,000 compared to 27.8 in 2012).

Figure 5: TB case rates by age group, West Midlands, 2000 to 2018



Place of birth and time since entry

The rates of TB among people born outside the UK should be interpreted in the context of changes to the pre-UK entry screening policies. In 2005 the UK piloted the pre-entry screening of long-term migrants to the UK for active pulmonary TB in 15 high TB incidence countries. In 2012 this pre-entry screening was extended to all countries with a high incidence of TB (>40 cases per 100,000 population) [2].

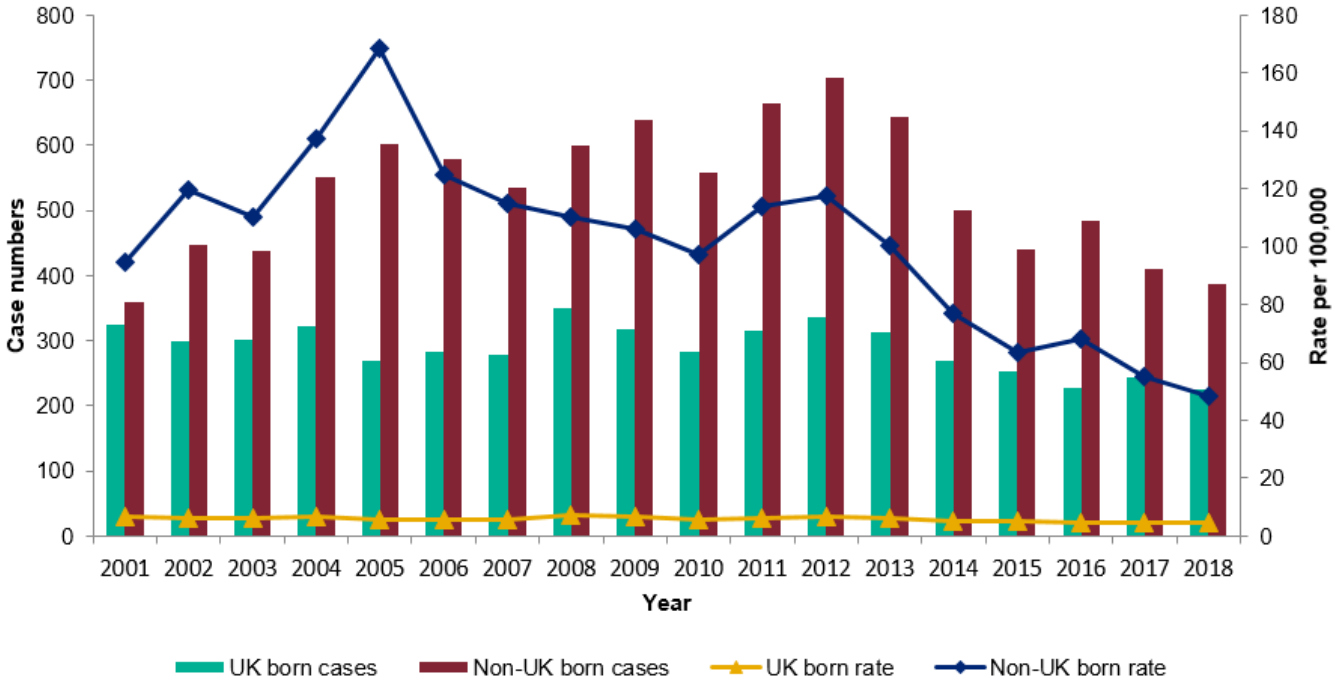
In 2018, 99.7% of people with TB had recorded a country of birth (611/613), and of these, 63.1% (386/611) were born outside the UK. The rate of TB was over 10 times higher among these people (48.1 per 100,000) compared to UK born people with TB (4.5 per 100,000). These rates should be interpreted with caution, as population estimates used as denominators for UK born and non-UK born groups were calculated using the Labour Force Survey, which is liable to sampling error for small population groups.[6] 2018 saw a similar decrease in both the number of UK born cases (-7.8%, 225 versus 244), and the number of non-UK born cases (-6.1%, 386 versus 411) compared

[6] The Labour Force Survey (LFS) was used to calculate population estimates based on a random sample of surveyed individuals, weighted to represent others in the region.

to 2017 (Figure 6) although during recent years there has been a much larger decrease in the non UK-born population.

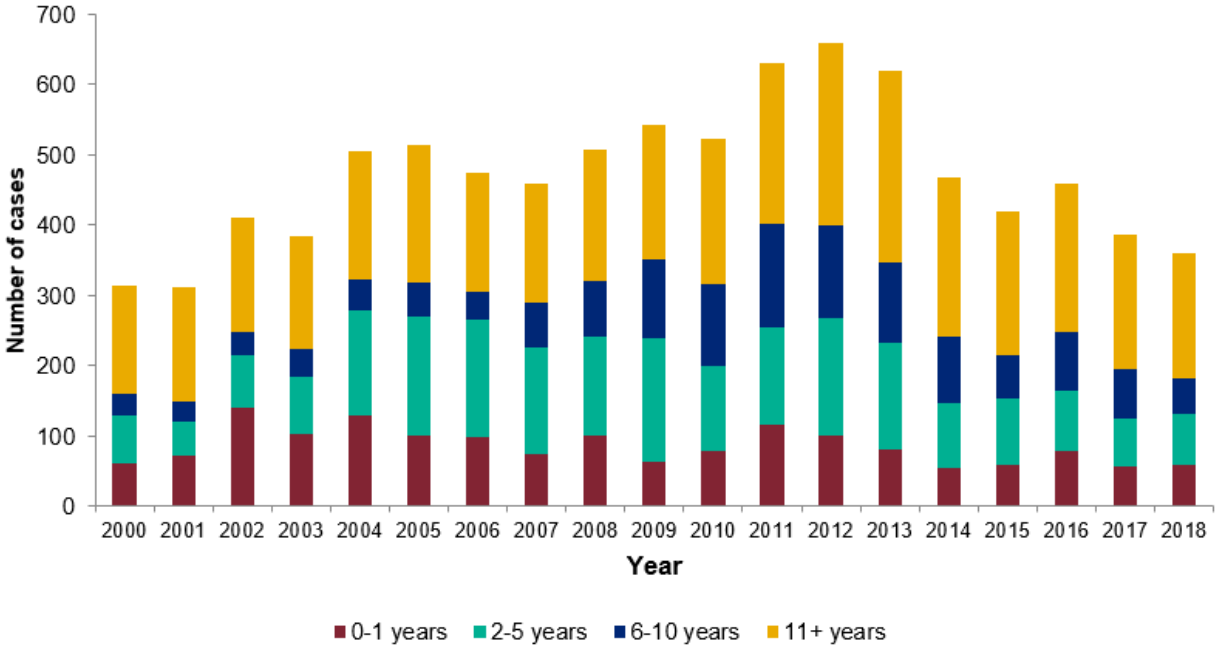
TB Monitoring Indicator 2: TB incidence in UK born and non-UK born populations

Figure 6: TB case reports and rate by place of birth, West Midlands, 2001 to 2018



In 2018 the year of entry to the UK was reported for 93.3% (360/386) of TB patients born outside the UK. Among those with a reported date of entry, 49.2% (177/360) had arrived in the UK 11 or more years prior to their TB diagnosis – the same proportion as the previous year (49.2%, 190/386, Figure 7).

Figure 7: Time between entry to the UK and TB notification for non-UK born patients by year, West Midlands, 2000 to 2018



The 10 most common countries of birth for TB patients born outside the UK and notified in 2018 were India (26.2%), and Pakistan (18.4%) followed by Romania, Eritrea, Bangladesh, Zimbabwe, Jamaica, Somalia, Nigeria and Poland (each <10.0%, Table 1). Of the more frequently occurring countries of birth, median time between entry to the UK and notification was longest for those from India and Pakistan compared to recent entry for those from Romania and Eritrea.

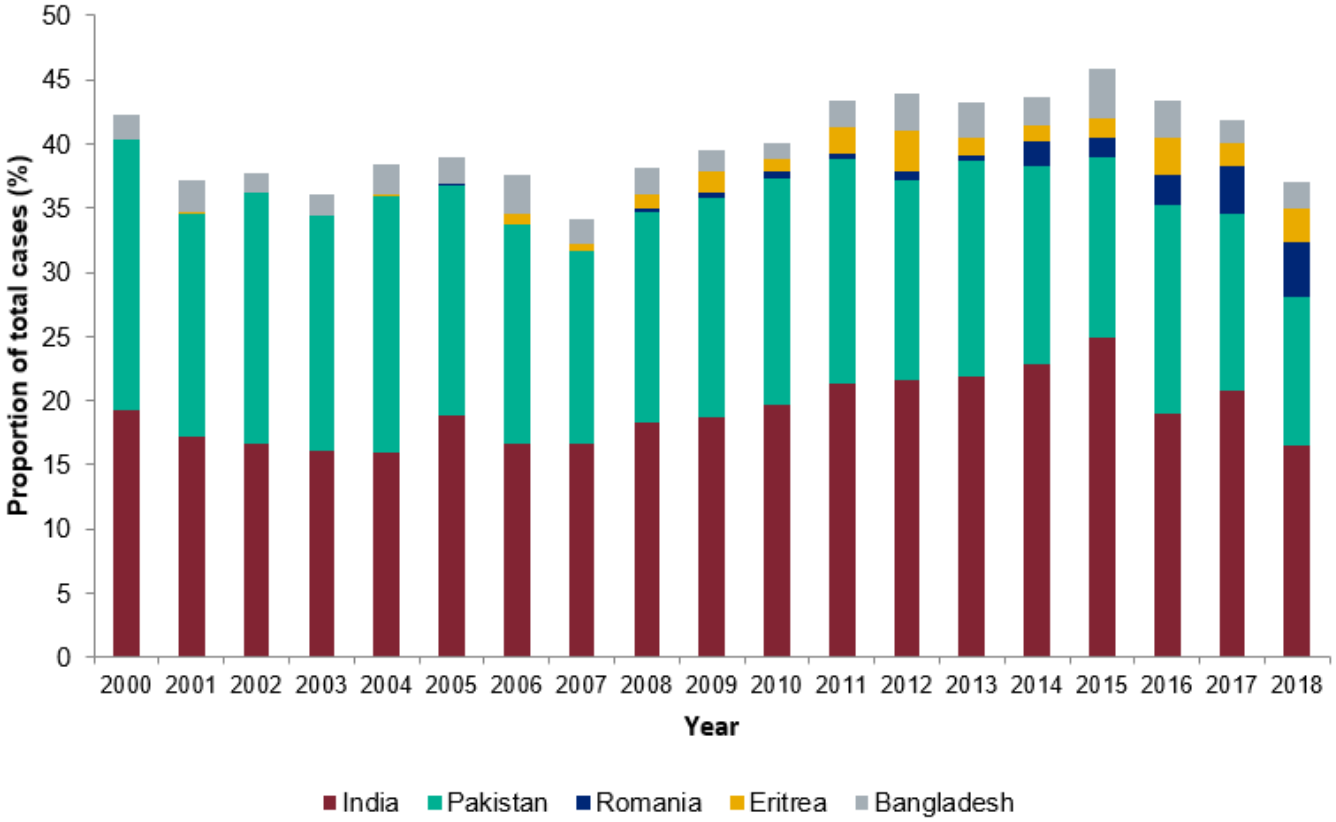
Table 1: 10 most common countries of birth of non-UK born TB patients, West Midlands, 2018

Country of origin	Number of patients	Proportion of non-UK born (%)	Time since entry (years)	
			Median	IQR*
India	101	26.2	16	7 44
Pakistan	71	18.4	17	7 40
Romania	26	6.7	3	1 5
Eritrea	16	4.1	2	1 3
Bangladesh	13	3.4	14	6 31
Zimbabwe	13	3.4	16	11 17
Jamaica	12	3.1	36	16 55
Somalia	11	2.8	6	2 12
Nigeria	10	2.6	1	0 11
Poland	9	2.3	7	5 9
Total	**282**			

*IQR: Interquartile range

Among the 5 most common countries of birth for TB patients born outside the UK, the largest increase in recent years has been in the proportion of patients from Romania, followed by Eritrea (Figure 8). There has also been a decline in the proportion of patients originating from India and Pakistan.

Figure 8: TB case reports by country of birth from the 5 most common countries of birth outside the UK, West Midlands, 2000 to 2018



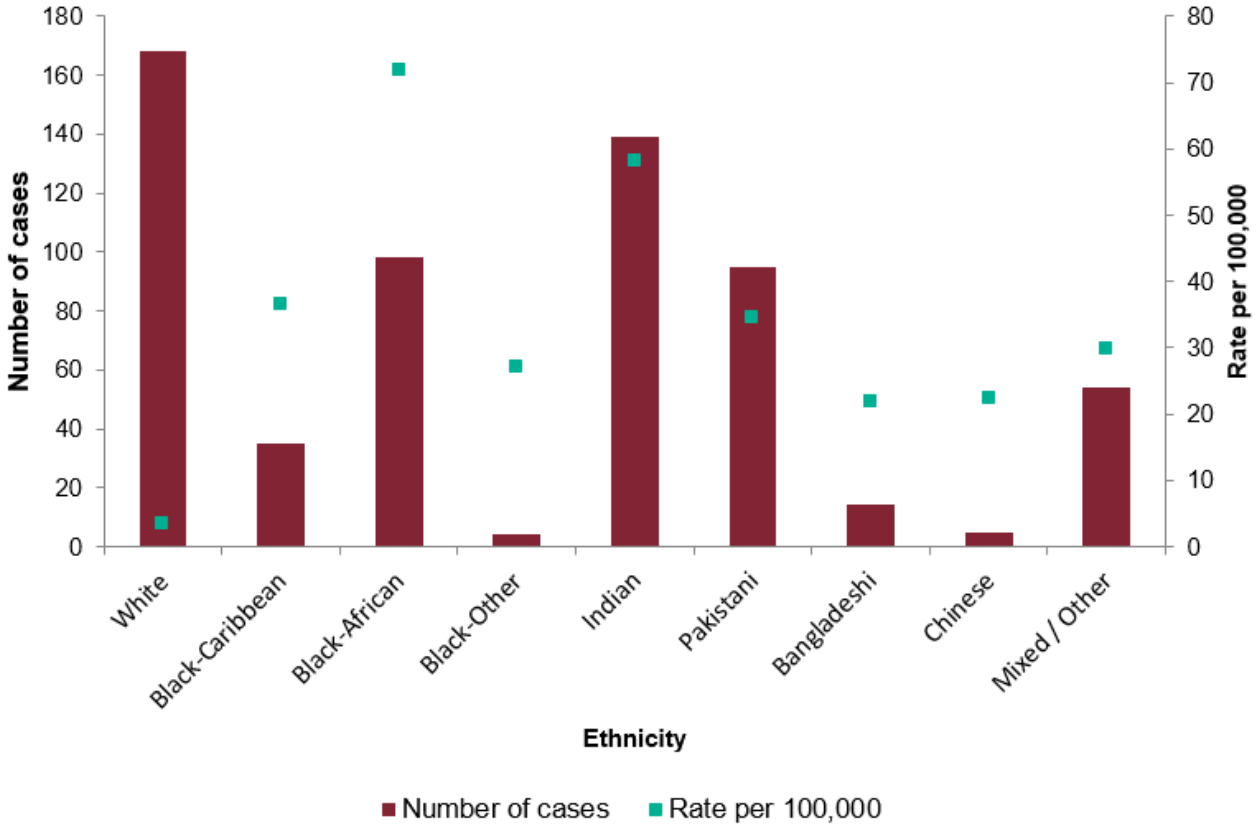
The age distribution of TB cases was largely similar between patients born within and outside the UK. Both groups had the highest proportion of cases in the 15-44 age group, accounting for 47.6% of UK born cases (107/225) and 57.8% (223/386) of non-UK born cases. Proportions in other age groups were also comparable between the UK born and non-UK born cases (29.5% versus 23.6% for 45-64, and 15.1% versus 18.1% in 65+ respectively). However, there was a significantly higher proportion of cases in UK born children compared to non-UK born children (approximately 8% and <1% respectively).

Although over half of TB cases in the West Midlands occurred among patients born outside the UK, some UTLAs recorded a large proportion of UK born cases. The UTLAs where 50% or more of TB cases were UK born included Stoke-on-Trent (59.3%, 16/27), Worcestershire (54.2%, 13/24), Dudley and Staffordshire (both 51.9%, 14/27).

Ethnicity

In 2018, almost all (612/613) patients with TB had an ethnicity recorded. The highest proportion of cases were recorded in the white ethnic group (27.5%, 168/612), equating to a rate of 3.5 cases per 100,000, followed by the Indian ethnic group (22.7%, 139/612). The highest rates of TB were seen for Black-African (71.9 per 100,000), Indian (58.3), Black-Caribbean (36.6) and Pakistani (34.6) ethnic groups[7] (Figure 9).

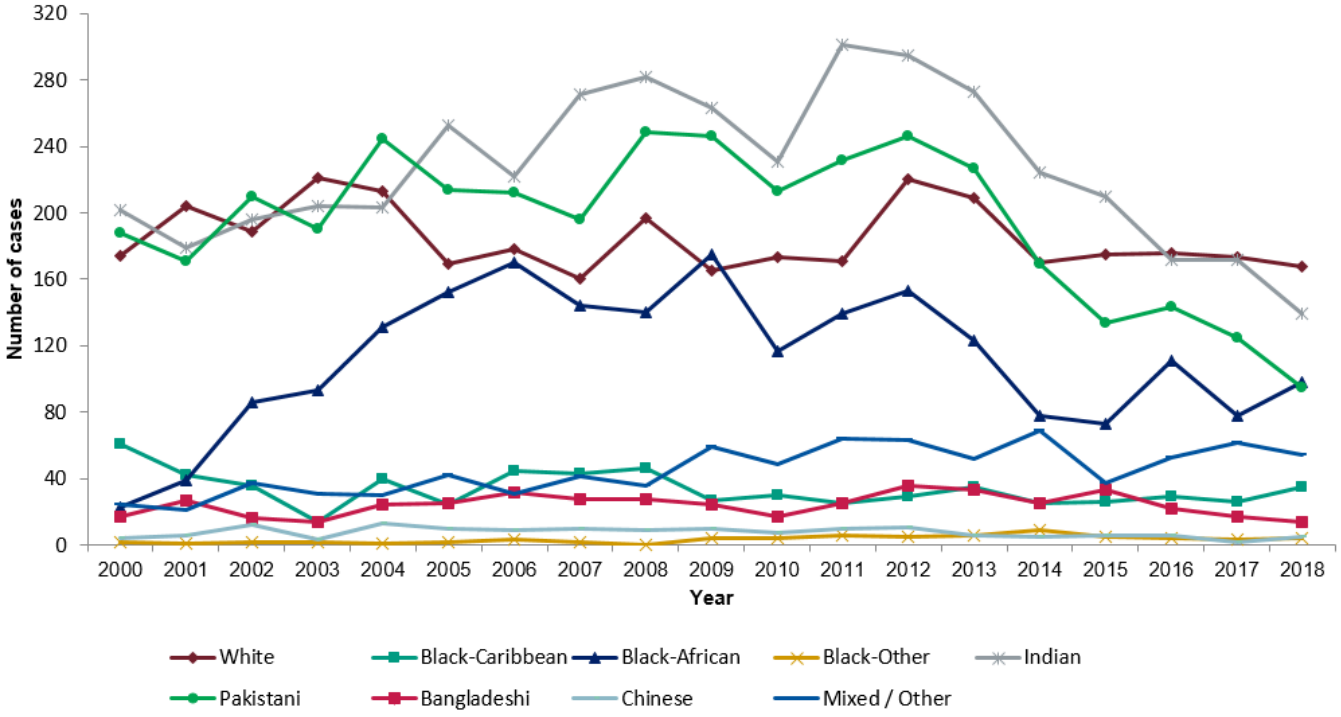
Figure 9: TB case number and rate by ethnic group, West Midlands, 2018



TB in those of Indian ethnicity continues to decline, with an all-time low figure of 139 cases for 2018. This is a decrease of 53.8% since cases peaked in 2011 (301 cases). Additionally, TB in those of Pakistani ethnicity has also declined considerably in recent years, with a decrease of 61.4% since cases peaked in 2012 (95 in 2018 versus 246 in 2012), (Figure 10).

[7] These rates should be interpreted with caution, as population estimates, used as the denominators for the different ethnic groups were calculated using the Labour Force Survey, which is liable to sampling error for small population groups. Small populations are often underrepresented in the LFS sample, which may inflate TB rates for ethnic groups such as black individuals.

Figure 10: TB case number by ethnic group, West Midlands, 2000 to 2018



Similar to 2017, approximately three-quarters of white TB patients in 2018 were born in the UK (76.2%, 128/168, Table 2). The most common countries of birth for non-UK born white TB patients were Romania (20 cases) and Poland (6 cases).

Table 2: Proportion of UK born TB patients by ethnic group, West Midlands, 2018

Ethnic group	Number of patients	Number UK born	Proportion (%)
White	168	128	76.2
Black-Caribbean	35	20	57.1
Black-African	98	9	9.2
Black-Other	4	0	0
Indian	139	31	22.3
Pakistani	95	22	23.2
Bangladeshi	14	1	7.1
Chinese	5	0	0
Mixed / Other	54	13	24.1

Occupation

In 2018, over one-third of TB patients aged 18-64 years (39.6%, 187/472) were not in employment or education. Unemployed individuals accounted for over half of this category (55.1%, 103/187). Overall, 10.6% were in the education sector as either students or staff (50/472) and 7.2% of cases were among healthcare workers,

healthcare laboratory staff and prison staff (34/472). 39.2% of cases reported working in other occupations (185/472) and 3.4% did not report an occupation (Table 3).

Table 3: Occupational category of TB patients aged 18 to 64 years, West Midlands, 2018

Occupation	Number of patients	Proportion (%)
None*	187	39.6
Other	185	39.2
Education	50	10.6
Health care worker†	34	7.2
Unknown occupation	16	3.4
Total	**472**	

* Includes housewives/husbands, retired, unemployed, asylum seekers and prisoners
† Also includes laboratory/pathology workers and social service/prison staff

Clinical characteristics

Site of disease

In 2018, site of disease was recorded for 99.7% of cases (611/613). Fifty-eight percent of patients (354/613) had pulmonary TB disease (with or without extra-pulmonary sites). The next most common sites of disease recorded were unknown extra-pulmonary disease, present in 17.5% of cases (107/613, Table 4) and extra-thoracic lymph nodes (17.0%, 104/613).

Table 4: Site of disease of TB patients, West Midlands, 2018

Site of disease	Number of cases	Proportion %†
Pulmonary*	**354**	**57.7**
Miliary	15	2.4
Laryngeal	1	0.2
Extra-pulmonary	**354**	**57.7****
Extra-pulmonary - unknown	107	17.5
Extra-thoracic lymph nodes	104	17.0
Other (extra-pulmonary)	68	11.1
Intra-thoracic lymph nodes	52	8.5
Pleural	52	8.5
Gastrointestinal	37	6.0
Genitourinary	17	2.8
Miliary	15	2.4
Bone/joint (spine)	12	2.0
CNS (meningitis)	12	2.0

Bone/joint (other)	9	1.5
CNS (other)	3	0.5
Laryngeal	1	0.2
Cryptic	0	0.0
Unknown	**2**	**0.3**

†Patients may have disease at more than one site, so the total proportion will not equal 100%
CNS: Central nervous system
*with or without disease at another site
**identical figure to pulmonary is purely coincidental

In 2018 UK born patients were more likely to have pulmonary disease (70.7%, 159/225) compared to non-UK born patients (50.3%, 194/386). Furthermore, 87.3% of patients who reported at least one social risk factor[8] (69/79) had pulmonary TB, compared to 52.3% of patients who reported no risk factors (252/482). People with pulmonary TB have the potential to be infectious to others.

Previous history of tuberculosis

In 2018 among patients who reported their clinical history, 6.6% of cases (39/591) had a previous diagnosis of TB at least 12 months prior to their most recent notification, which is unchanged to the rate in previous years in the West Midlands. These patients had a median of 5.5 years since their previous diagnosis (IQR 2.5-12.0 years). This is similar to the proportion of cases reporting a previous diagnosis of TB in England overall (6.2%), although these individuals had a longer median time since previous diagnosis (7 years, IQR 2-24 years)[1].

Hospital inpatient and directly observed therapy

Seventeen percent of patients (99/573) were inpatients around the time of diagnosis with TB. Hospitalisation was more common among those with pulmonary disease (21.3%, 71/334 compared to non-pulmonary, 11.7%, 28/239), a previous diagnosis of TB (30.6%, 11/36), multidrug-resistant[9] or rifampicin resistant TB (MDR/RR-TB, 71.4%, 5/7), or at least one social risk factor (25.3%, 19/75 compared to 16.0%, 73/456 with no social risk factors).

Since 2015 the proportion of patients who received directly observed therapy (DOT) has declined from its peak of 15.0% (105/699) to 10.8% of patients diagnosed with TB in 2018 (66/613). Nearly half of children aged 0-14 years received DOT (47.1%, 8/17), as did patients with one or more social risk factors (43.1%, 31/72), and almost three-quarters of patients with MDR/RR-TB (71.4%, 5/7).

[8] Social risk factors for TB include: prison, homelessness, alcohol and substance misuse.
[9] MDR-TB: cases initially resistant to at least isoniazid and rifampicin.

2. Laboratory confirmation of TB

Laboratory tests data collection

Laboratory data on culture confirmed TB isolates from the National Mycobacterium Reference Service were matched to TB case notifications, and the results were used to report culture confirmation. Results for microscopy, polymerase chain reaction (PCR) and histology are also collected in the PHE Enhanced Tuberculosis Surveillance system (ETS).

Culture confirmation and speciation

In 2018, 57.7% of all cases (354/613) were confirmed by culture of a TB isolate. Among pulmonary cases, 72.9% of cases (258/354) were culture confirmed. These proportions are lower than the previous year, where 62.4% (249/663) of all cases, and 73.8% (282/382) of pulmonary cases were culture confirmed.

Of the 354 culture confirmed cases in 2018, almost all were *M. tuberculosis* (98.9%, 350/354). The small number remaining were either *M. africanum* (<5%) or *M. bovis* (<1%).

TB Monitoring Indicator 8: Proportion of pulmonary TB cases that were culture confirmed

Sputum smear

As described in the last chapter, 57.7% of TB cases reported in 2018 were pulmonary. Among these individuals, 55.9% (198/354) had a sputum smear test, of which 59.1% were smear positive (117/198). This is slightly lower to figures for 2017, where 56.5% (216/382) had a sputum smear test, and 62.5% (135/216) were positive. The rate of sputum smear testing for pulmonary cases was lower in the West Midlands compared to England overall (65%), although the smear positivity rate for those tested was slightly higher than for England (56%) [1].

Other laboratory test results

Between 2016 and 2018, 17.7% (143/807) of cases that were not culture confirmed had an alternative positive laboratory result indicative of TB: either by microscopy, histology or PCR (Table 5). The majority of these alternative confirmations were provided by histology (12.6%, 102/807). A substantial proportion of cases not culture confirmed did not have any other positive test result reported (82.3%, 664/807), and therefore we interpret that these cases were diagnosed on the basis of imaging or

clinical assessment. Overall, one-third of all cases notified between 2016 and 2018 (33.4%, 664/1,991) were not confirmed by any laboratory method (culture, microscopy, histology or PCR).

Table 5: Number and proportion of non-culture confirmed TB cases by other laboratory diagnostic confirmation, West Midlands, 2016 to 2018

Laboratory test result*	Pulmonary		Extra-pulmonary		All cases†	
	n	%	n	%	n	%
Sputum smear positive	22	7.0	0	0.0	22	2.7
Smear positive (not sputum)	8	2.5	8	1.6	16	2.0
Histology positive	30	9.5	72	14.7	102	12.6
PCR positive	2	0.6	2	0.4	4	0.5
No known positive lab result	254	80.6	408	83.3	664	82.3
Total	**315**		**490**		**807**	

* Patients may have more than 1 alternative test result, so the total proportion will not equal 100%. Total row displays number of non-culture confirmed TB cases.

† Includes cases with an unknown site of disease

3. TB transmission

Rate of TB in UK born children

TB in UK born children is used as an indirect indicator for recent TB transmission within the UK, since TB in children is likely to be caused by recent exposure (as opposed to reactivation of latent TB infection acquired some time previously). In 2018, the rate of TB in UK born children in the West Midlands (aged 0 to 14 years), was 1.7 per 100,000 (95% CI 1.0-2.7). This is the lowest rate in recent years, and is 72% lower than the peak rate of 6.0 in 2004. It is however still higher than the national average (1.2 per 100,000) [1].

Figure 11. Rate of TB in UK born children aged under 15 years, West Midlands, 2001-2018

TB Monitoring Indicator 5: Incidence of TB in UK born children aged less than 15 years

Strain typing and clustering

The National TB Strain Typing Service in England, established in 2010, prospectively typed TB isolates using MIRU-VNTR. In December 2016, WGS was rolled out by NMRS-North and Central, covering the Midlands and North of England, at which time MIRU-VNTR typing (the previous method of strain typing) was discontinued.

WGS of *Mycobacterium tuberculosis complex* isolates provides information on Single Nucleotide Polymorphism (SNP) differences between isolates, and describes how isolates are related to each other. WGS provides good understanding of whether isolates are likely to be part of the same transmission chain, and may also help determine the timing and direction of transmission [3-5]. Epidemiologically linked

patients involved in transmission are unlikely to be identified at SNP distances of more than 12 [5], therefore WGS clusters of TB are defined as patients with one or more "near neighbour" patients whose TB sequences differ by 12 SNPs or fewer. Additional epidemiological information is required to assess whether recent transmission may have occurred, and whether any additional public health action should be taken.

In 2018, 96% (340/354) of culture confirmed cases had a WGS result, similar to the 95% of cases in 2017. Of these, 33% (112/340) of cases were in a WGS cluster (Table 5). Of the 112 clustered cases, the majority were UK born (68%, 76/112), male (63%, 214/340) and most commonly white (48.2%, 54/112). The majority of clustered patients had pulmonary TB (86.6%, 97/112) and 67.2%[10] (45/67) were sputum smear positive. Thirty 8 percent of all clustered cases in 2018 had at least one social risk factor recorded (43/112), and 11.6% (13/112) of clustered patients had previously been diagnosed with TB.

Restricting the definition of clustering to those cases that differ by 2 SNPs or fewer from any other case, 19% of isolates in 2018 were part of a cluster. Over half of patients within 2 SNPs of another were UK born (62%).

Table 5: Number and proportion of cases clustered using WGS by place of birth and size of new clusters, West Midlands, 2018

SNP cut off applied	Cases clustered within England		Non-UK born clustered		UK born clustered	
	Number	Proportion (%)	Number	Proportion (%)[a]	Number	Proportion (%)
2 SNPs	63	18.5	24	10.9	39	32.8
5 SNPs	87	25.6	27	12.2	60	50.4
12 SNPs	112	32.9	36	16.3	76	63.9

BCG vaccination status of TB patients

In 2018 Bacillus Calmette-Guérin (BCG) vaccination status was known for 74.4% of patients (456/613), 50.7% of whom (231/456) had previously been vaccinated. Forty-7 percent of all UK born paediatric patients had been vaccinated (7/15). Overall, receipt of BCG vaccination was similar among non-UK born patients (49.7%, 142/286) and UK born patients (52.4%, 89/170).

[10] - of those with a sputum result

4. Delay from onset of symptoms to start of treatment

Time from symptom onset to treatment start for patients with pulmonary TB

Overall, 576 patients started on TB treatment in 2018. Among patients with pulmonary TB who reported both date of symptom onset and date of treatment start, 47.3% (157/332) started treatment within 2 months of symptom onset (Table 6). This is a 7.6% increase compared to 2017 (39.7%) and also the highest proportion in recent years (second highest being 44.6% in 2011). In 2018, one-quarter of patients with pulmonary TB started treatment more than 4 months (120 days) after symptom onset (25.0%, 83/332), indicating a prolonged period of infectiousness. This is the lowest proportion in recent years, the highest being 33.0% (124/376) in 2016.

Forty-five percent of patients with extra-pulmonary TB started treatment more than 4 months after symptom onset (109/244). These long treatment delays are often thought to relate to delays in presenting to healthcare and in diagnosing extra-pulmonary disease, which is supported by the longer median time from symptom onset to diagnosis for extra-pulmonary cases (95 days) compared to pulmonary cases (64 days).

Table 6: Time between symptom onset and treatment start*, West Midlands, 2018

Time delay	Pulmonary		Extra-pulmonary only		Overall	
	n	%	n	%	n	%
<2 months	157	47.3	67	27.5	224	38.9
2-4 months	92	27.7	68	27.9	160	27.8
Over 4 months	83	25.0	109	44.7	192	33.3
Total	**332**		**244**		**576**	

*excluding asymptomatic patients, and those with missing onset dates

TB Monitoring Indicator 6: Proportion of pulmonary TB patients starting treatment within 2 months of symptom onset

TB Monitoring Indicator 7: Proportion of pulmonary TB patients starting treatment within 4 months of symptom onset

Characteristics of pulmonary TB patients with a delay from onset of symptoms to treatment of more than 4 months

In 2018, 61.4% of pulmonary TB patients (51/83) who experienced a treatment delay exceeding 4 months were male and 50.6% (42/83) were aged 15-44 years. Just over half of these patients were non-UK born (53.0%, 44/83), among whom 38.6% (17/44) entered the UK over 11 years prior to their TB diagnosis. Approximately one third of pulmonary cases with a treatment delay exceeding 4 months (31.3%, 26/83) were sputum smear positive. This was less than half the proportion seen in all pulmonary cases, regardless of delays (59.1% (117/198). Overall 24.7% (18/83) of patients with a treatment delay exceeding 4 months had at least one social risk factor, and 7.2% (6/83) had previously been diagnosed with TB.

5. TB outcomes in drug sensitive cohort

Drug sensitive cohort

For the purposes of TB outcome reporting, drug sensitive cases are defined as sensitive to rifampicin. Under this definition, cases with resistance to isoniazid, ethambutol and/or pyrazinamide but sensitive to rifampicin are included in the drug sensitive cohort. Drug resistant strains are defined as those with resistance to rifampicin; and cases with suspected rifampicin resistance (initial or acquired) including non-culture confirmed patients treated for presumptive MDR-TB [6]. TB outcomes among patients with drug resistant disease are considered in the next chapter (Chapter 6).

Treatment outcomes for the drug sensitive cohort are reported separately for:

- patients with an expected duration of treatment less than 12 months, outcomes at 12 months are reported. This group excludes individuals with central nervous system (CNS) disease, who would be treated for 12 months. In addition, those with spinal, cryptic disseminated or miliary disease are excluded from this group, as CNS involvement cannot be reliably ruled out for the purposes of reporting
- patients with CNS, spinal, cryptic disseminated or miliary disease, the last recorded treatment outcome is reported

1: Outcomes for TB patients with expected duration of treatment less than 12 months

85.4% of patients (505/591) diagnosed in 2017 with rifampicin sensitive TB and an expected treatment duration of less than 12 months (excluding CNS, spinal, miliary or cryptic disseminated disease) completed treatment within 12 months. This is similar to the treatment completion rates seen in recent years in the West Midlands (Table 7).

TB Monitoring Indicator 10: Proportion of drug sensitive TB patients who had completed a full course of treatment by 12 months

Table 7: Number and proportion completing treatment at 12 months, West Midlands, 2002 to 2017*

Year of diagnosis	Patients completing treatment at 12 months		
	Rifampicin sensitive cases	Number	Proportion (%)
2002	752	526	69.9
2003	733	514	70.1
2004	864	631	73.0
2005	830	570	68.7
2006	835	565	67.7
2007	871	673	77.3
2008	917	761	83.0
2009	908	743	81.8
2010	791	633	80.0
2011	891	724	81.3
2012	962	824	85.7
2013	857	736	85.9
2014	692	575	83.1
2015	621	516	83.1
2016	648	546	84.3
2017	591	505	85.4

*excludes rifampicin resistant TB, and patients with CNS, spinal, miliary or cryptic disseminated disease

The most common outcomes for patients who did not complete treatment at 12 months were death (which may or may not have been caused by TB) (5.9%, 35/591), continuation of treatment (5.2%, 31/591) and lost to follow up (1.9%, 11/591, Table 8). The proportion of patients notified in 2017 who died within 12 months of treatment start was similar to those notified in 2016 (6.9%). However, 2017 saw a reduction in the proportion of patients lost to follow up (1.9%) compared to those diagnosed in 2016 (3.7%).

Table 8: TB outcome at 12 months, West Midlands, patients diagnosed in 2017*

Outcome	Number of patients	Proportion (%)
Treatment completed	505	85.4
Died	35	5.9
Still on treatment	31	5.2
Lost to follow up	11	1.9
Treatment stopped	8	1.4
Not Evaluated	1	0.2
Total	**591**	

*excludes rifampicin resistant TB, and patients with CNS, spinal, miliary or cryptic disseminated disease

All children (aged 0-14) diagnosed with TB in 2017 completed their treatment (22/22). Patients aged 65 years or older had substantially worse treatment outcomes than average. In this age group, just 69.6% completed treatment within 12 months (78/112), and 20.5% died within 12 months (23/112) compared to 2.5% of patients aged under 65 years (12/479). Deaths were also higher than average among UK born patients (7.1% versus 4.4% in non-UK born), males (7.1% versus 4.1% in females), and patients with pulmonary TB (7.1% versus 4.2% in those with extra-pulmonary TB).

Non-UK born patients were over twice as likely to be lost to follow up than UK born patients (2.2%, 8/361 in non-UK born versus 0.9%, 2/224 in UK born). In particular, non-UK born patients who entered the UK 0-1 years prior to their TB diagnosis were most likely to be lost to follow up (9.8%, 5/51) compared to all others (1.1%, 3/295). For 63.6% of all patients lost to follow up (7/11), the reason recorded was because they had left the UK. The median age of patients lost to follow up was 42 years.

In 2017 22.9% of cases reported to have died (8/35) were diagnosed post-mortem. Causes of death reported by clinicians to ETS[11] indicated that TB was the primary cause of none of the deaths (0/35), but had contributed to the death of 31.4% of patients (11/35). TB was incidental to the death of 22.9% of patients who died (8/35) and the relationship between TB and death was unknown for 45.7% of patients (16/35). The median age of patients who died was 70 years.

2: Outcomes for drug sensitive cohort of patients with CNS, spinal, miliary or cryptic disseminated TB

At the last recorded outcome for patients diagnosed in 2017 with rifampicin sensitive TB and possible CNS involvement (which is no more than 24 months after starting treatment), 69.4% (43/62) had completed treatment (Table 9). The median treatment duration for these individuals was 321 days (IQR 210-365 days). This is a lower rate of treatment completion compared to similar patients diagnosed in 2016 (75.0%, 45/60) and also lower than the national average for 2017 [1].

[11] Causes of death reported to ETS were not necessarily based on review of death certificates completed in routine death registration.

Table 9: TB outcome for patients with rifampicin sensitive, CNS, spinal, miliary or cryptic disseminated disease, West Midlands, patients diagnosed in 2017*

Outcome	Number of cases	Proportion (%)
Treatment completed	43	69.4
Died	10	16.1
Still on treatment	<5	<7.0
Lost to follow up	<5	<7.0
Not Evaluated	<5	<7.0
Treatment stopped	<5	<7.0
Total	**62**	

*excludes rifampicin resistant TB

Ten patients with rifampicin sensitive TB and possible CNS involvement died (16.1%) (median age 78 years), of whom 4 were diagnosed post-mortem. TB contributed to death in 4 cases, was incidental to death in 2 cases and was unknown for the remaining 4 cases.

6. Drug resistant TB (including outcomes in the drug resistant cohort)

Drug resistance

Anti-TB antibiotic drugs are from different groups of drugs and resistance may occur to one or more of these antibiotics and can be in different combinations. A distinction is made between first, second and third line TB antibiotic drugs depending upon their clinical effectiveness [7]. First line drugs include rifampicin, isoniazid, pyrazinamide and ethambutol. Second line drugs include injectable agents (eg amikacin, capreomycin, kanamycin), fluoroquinolones (eg moxifloxacin, ofloxacin, ciprofloxacin) and other oral bacteriostatic agents. MDR-TB cases are initially resistant to at least isoniazid and rifampicin. Extensively drug resistant TB cases (XDR-TB) are initially MDR and resistant to at least 1 injectable agent and at least 1 fluoroquinolone [6].[12]

Overall initial drug resistance and geographical distribution

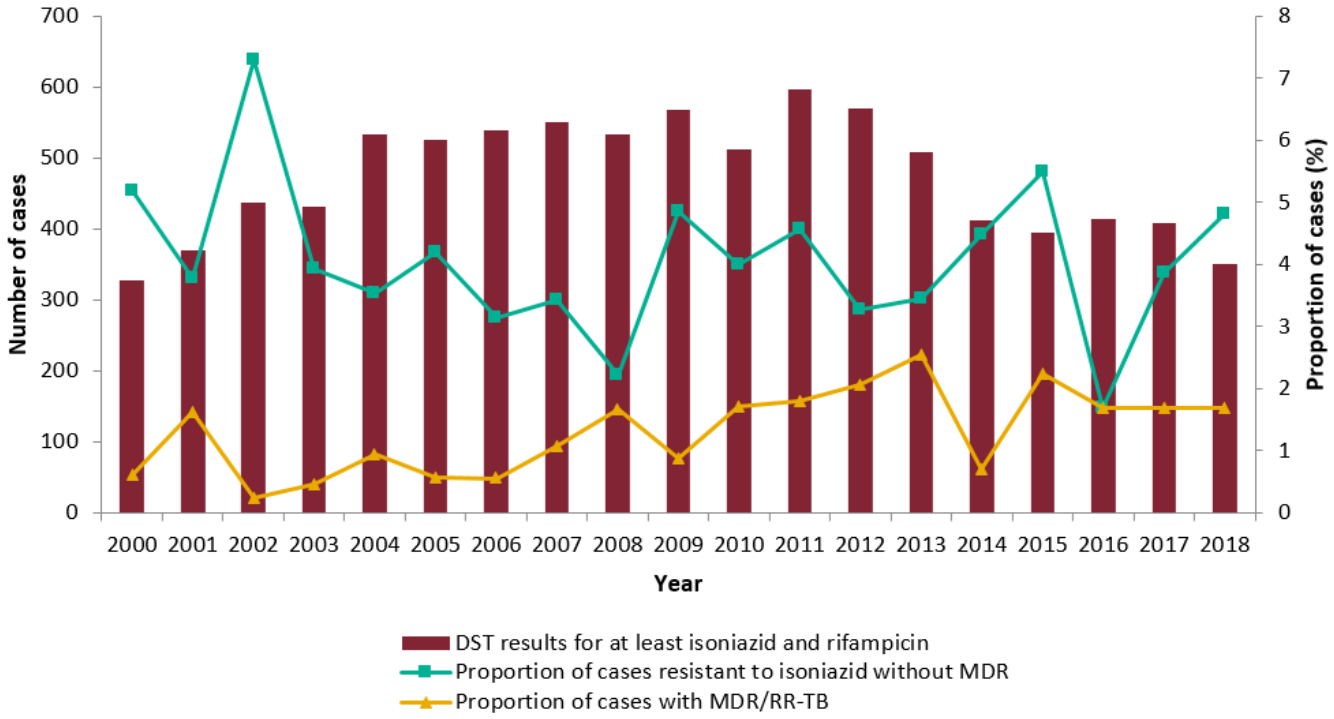
In 2018, among 350 culture confirmed cases of TB with phenotypic drug sensitivity testing (DST) for at least isoniazid and rifampicin, 11.0% (39/350) had first line drug resistance. This is the highest proportion recorded in the West Midlands since records began in 2000. The majority of these cases (4.8%, 17/350) were resistant to isoniazid but not rifampicin (INH-R), however 2.0% (7/350) had multi-drug resistant TB (including both MDR/rifampicin resistant TB, RR-TB, or pre-extensively drug resistant TB, pre-XDR TB) (Figure 11).

TB Monitoring Indicator 9: Proportion of culture confirmed TB cases with drug susceptibility testing reported for the 4 first line agents

TB Monitoring Indicator 18: Proportion of culture confirmed TB cases with any first line drug resistance

[12] Injectable agents: amikacin, capreomycin or kanamycin. Fluoroquinolones: moxifloxacin, ofloxacin or ciprofloxacin.

Figure 11: Proportion of TB cases with initial first line drug resistance, West Midlands, 2000 to 2018



DST: drug sensitivity testing; MDR: multidrug-resistant TB; RR-TB: rifampicin resistant TB (with or without resistance to other antibiotics).

Of the 39 cases with any first line drug resistance, the highest proportions occurred in patients aged 15-44 (71.8%, 28/39), and non-UK born patients (66.7%, 26/39, compared to 33.3% in UK born patients, 13/39). Amongst ethnic groups, those of Indian ethnicity have the highest proportion of first line resistance (23.1%, 9/39), followed by those of White and Pakistani ethnic origin (both 20.5%, 8/39). The majority of patients with first line resistance had pulmonary TB (74.4%, 29/39), over one-fifth had at least one social risk factor (22.2%, 8/39) and one tenth recorded a previous diagnosis (10.3%, 4/39). Among the subset of patients who had MDR/RR-TB or pre-XDR, the majority were male (85.7%, 6/7), aged 15-44 years (85.7%,6/7) and had pulmonary TB (85.7%, 6/7). Of the 7 patients with MDR TB, 4 were non-UK born (57.1%).

TB Monitoring Indicator 19: Proportion of culture confirmed TB cases with multi-drug resistant TB

Acquired drug resistance

Acquired drug resistance is defined as a newly emerged resistance to one or more anti-TB antibiotics identified on repeat culture 3 or more months after the first specimen date. In addition, cases with a change from sensitive to resistant result following commencement of anti-TB antibiotic treatment are reclassified as acquired resistance (even if this is within the 3-month period). It should be noted that patients who acquire resistance are recorded in the year they were notified, not the year that they acquired

resistance, therefore the numbers for recent years may still increase for those still on treatment.

TB outcome at 24 months for patients with rifampicin resistant disease

Of the 7 West Midlands cases with MDR TB notified in 2016, 3 have completed treatment (42.9%), the remaining 4 either died or were lost to follow up.

TB Monitoring Indicator 13: Proportion of drug resistant TB cases who had completed treatment at 24 months

7. TB in under-served populations

Social risk factors

Of the 594 patients with TB aged 15 years or older in 2018, risk factor status including homelessness, drug and alcohol misuse, and prison was recorded for 91.8% (545/594). Among those individuals, 14.3% (78/545) had at least one risk factor, which is similar to 2017 (13.7%, 80/586, Table 10).

Table 10: Social risk factors among TB patients, West Midlands, 2009 to 2018

Year	Total with status recorded	Any social risk factor	
		Number of patients	Proportion (%)
2009	365	46	12.6
2010	683	61	8.9
2011	819	61	7.4
2012	890	75	8.4
2013	831	87	10.5
2014	666	62	9.3
2015	619	78	12.6
2016	641	62	9.7
2017	586	80	13.7
2018	545	78	14.3

The most common risk factor reported in 2018 was drug misuse (8.9%, 50/564, Table 11) followed by imprisonment (7.5%, 41/548), alcohol misuse (5.0%, 28/562) and homelessness (3.8%, 21/559). Over half of patients with at least 1 social risk factor had multiple factors (51.3%, 40/78), of which almost half of these had a total of 3 or more (47.5%, 19/40).

Table 11: Social risk factors among TB patients, West Midlands, 2018

Risk factor	Total with status recorded	Number of patients	Proportion (%)
Drug use	564	50	8.9
Prison	548	41	7.5
Alcohol misuse	562	28	5.0
Homelessness	559	21	3.8

Among all cases notified between 2009 and 2018 with at least one social risk factor, the majority of patients were male (84.2%, 581/690). Compared to patients with no risk factors, those with social risk factors were more likely to be UK born, white, sputum smear positive, have pulmonary disease and have a previous diagnosis of TB (Table 12).

Table 12: Characteristics of patients aged 15 years or older in relation to social risk factors, West Midlands, patients diagnosed between 2009 and 2018

Characteristic	Patients with risk factors		Patients with no risk factors	
	Number of patients	Proportion (%)	Number of patients	Proportion (%)
Sex				
Female	109	15.8	2721	45.7
Male	581	84.2	3234	54.3
Age				
15-44	446	64.6	3378	56.7
45-64	219	31.7	1426	23.9
65+	25	3.6	1151	19.3
Country of birth				
Non-UK born	255	37.1	4164	70.5
UK born	432	62.9	1741	29.5
Ethnicity				
White	315	45.7	1182	19.8
Black-Caribbean	71	10.3	165	2.8
Black-African	79	11.4	760	12.8
Black-Other	9	1.3	37	0.6
Indian	104	15.1	1783	29.9
Pakistani	46	6.7	1377	23.1
Bangladeshi	3	0.4	182	3.1
Chinese	2	0.3	49	0.8
Mixed / Other	56	8.1	376	6.3
Unknown ethnicity	5	0.7	44	0.7
Clinical characteristics				
Pulmonary	560	81.2	3124	52.5
Sputum smear positive	277	70.7	921	45.1
Previous TB diagnosis	93	13.5	410	6.9
Drug sensitivity				
First line drug resistance	33	6.6	226	6.8
HIV test				
Offered	450	65.2	3563	59.8

Outcomes for patients aged 15 years or older with rifampicin sensitive TB with no CNS involvement with risk factors (notified in 2017) were less favourable than those with no risk factors. Treatment was completed by 78.9% (56/71) of patients with social risk factors at their last recorded outcome, compared to 87.2% (414/475) of patients with no risk factors. This is consistent with overall data from 2009 to 2017 (Table 13). This data shows patients with risk factors were more likely be lost to follow up and more likely to die.

Table 13: Last recorded TB outcome for patients aged 15 years or older, West Midlands, patients diagnosed 2009 to 2017

Last recorded outcome	Patients with risk factors		Patients with no risk factors	
	Number of patients	Proportion (%)	Number of patients	Proportion (%)
Treatment completed	446	81.7	4431	90.2
Died	37	6.8	245	5.0
Lost to follow up	41	7.5	139	2.8
Still on treatment	6	1.1	10	0.2
Treatment stopped	10	1.8	62	1.3
Not Evaluated	6	1.1	24	0.5
Total	**546**		**4911**	

*excludes rifampicin resistant TB, and patients with CNS, spinal, miliary or cryptic disseminated disease

TB Monitoring Indicator 17: Proportion of patients with drug sensitive TB with at least 1 social risk factor who completed treatment within 12 months

Among all individuals with social risk factors where DOT status is recorded, almost half (47.0%, 227/483) were known to have started on DOT.

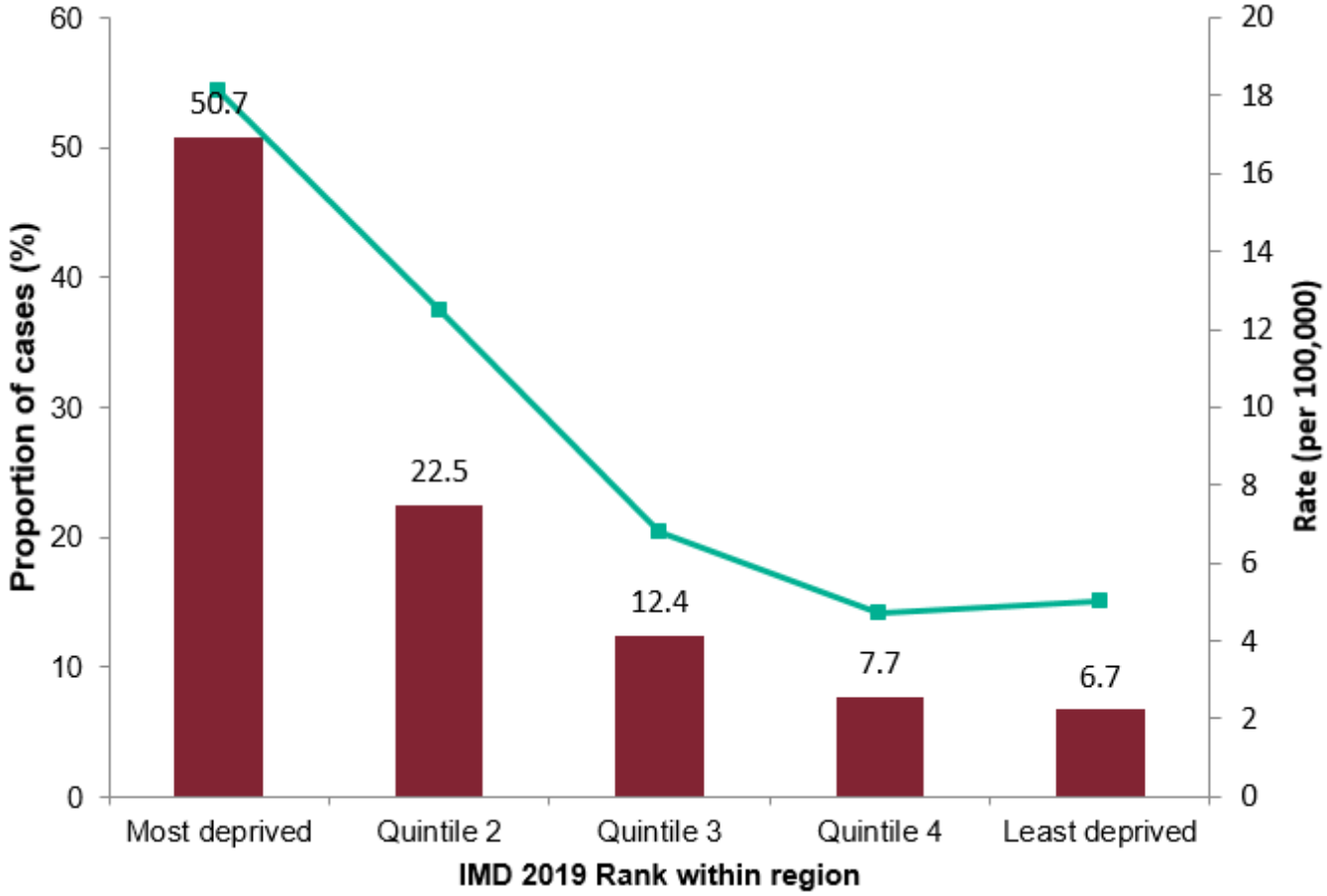
Deprivation

Based on the Index of Multiple Deprivation (IMD 2019) rank assigned to geographical areas in the West Midlands,[13] 50.7% (311/613) of patients were resident in the most deprived quintile (Figure 12). A substantial proportion of patients living in the most deprived areas (15.9%, 45/24) also had at least one social risk factor. As in previous

[13] The Index of Multiple Deprivation 2019 rank for each lower super output area (LSOA), based on deprivation score assigned, relative to other LSOAs in the PHE West Midlands area.

years, TB case rate has a linear association with deprivation, with lower proportions in the lesser deprived quintiles.

Figure 12: TB case rate[14] by deprivation, West Midlands, 2018



[14] Rate calculated using LSOA population estimates and IMD 2019 ranks within region

8. TB-HIV co-infection and HIV testing of TB patients

HIV testing

For some patients who have TB, treatment can be more complicated because they also have HIV infection. However both conditions can be successfully treated with a combination of antiretroviral therapy (ART) and appropriate TB antibiotic treatment [8]. In order to optimise their outcome and reduce the risk of TB and HIV transmission to others, it is essential that all patients with TB undergo HIV testing to allow curative TB treatment and ART to be started as soon as possible.

Of the 610 TB patients diagnosed in 2018 who were not diagnosed post-mortem, 2.6% (16/610) had an HIV status that was already known. For TB diagnoses with a previously unknown HIV status (594/610), HIV testing information was recorded for 87.4% (519/594) of cases. HIV tests were offered to 96.3% of patients with TB (500/519); 93.6% were offered and received a test (486/519), 2.1% were offered but did not receive this testing (11/519) and 0.6% were offered but declined a test (3/519). HIV tests were not offered to 3.7% of patients (19/519). Of patients not offered an HIV test, 63.2% (12/19) were female, 36.8% (7/19) were over 65 and 31.6% (6/19) were white.

In most areas of the West Midlands a large proportion of TB patients were offered and received an HIV test (Table 14).

Table 14: HIV testing by upper tier local authority of residence, West Midlands, 2018

UTLA name	Total number of patients	Offered		Offered and received	
		Number of patients	Proportion (%)	Number of patients	Proportion (%)
Birmingham	175	172	98.3	172	100.0
Coventry	67	61	91.0	57	93.4
Dudley	22	21	95.5	20	95.2
Herefordshire, County of	7	5	71.4	5	100.0
Sandwell	53	52	98.1	52	100.0
Shropshire	8	8	100.0	7	87.5
Solihull	6	5	83.3	5	100.0
Staffordshire	25	25	100.0	25	100.0
Stoke-on-Trent	24	24	100.0	24	100.0
Telford and Wrekin	5	5	100.0	5	100.0
Walsall	35	35	100.0	33	94.3
Warwickshire	19	18	94.7	17	94.4
Wolverhampton	51	48	94.1	43	89.6
Worcestershire	22	21	95.5	21	100.0
West Midlands	**519**	**500**	**96.3**	**486**	**97.2**

TB Monitoring Indicator 16: Proportion of TB patients offered an HIV test

TB-HIV co-infection rates

HIV status is not collected in ETS, but TB-HIV co-infection is estimated nationally by anonymously linking reports in ETS with the SOPHID and HANDD HIV datasets[15] for patients aged 15 years and older (see Tuberculosis in England: 2019 for methods) [1].

In 2018, 1.9% of TB cases in the West Midlands were also co-infected with HIV. This is the second lowest proportion of TB-HIV coinfection in England, with only the North East achieving a lower percentage (1.8%). In general, over the past decade, there has been a declining trend in the proportion of co-infected cases since its peak in 2004 (6.0% for West Midlands, Table 15). However, the demographics of co-infected cases have also been changing, with an increasing proportion of cases aged 45-54 years. People with TB-HIV co-infection are more frequently born outside the UK and often originate from sub-Saharan African countries. For more information, please refer to Tuberculosis in England: 2018 [1].

[15] SOPHID: Survey of Prevalent HIV Infections Diagnosed. HANDD: HIV and AIDS New Diagnoses Database

Table 15: Number and proportion of notified and un-notified* TB cases matched to an HIV case, West Midlands, 2001 to 2018

Year	TB-HIV co-infection	
	Number of patients	Proportion (%)
2001	<5	-
2002	30	4.1
2003	39	5.4
2004	51	6.0
2005	48	5.4
2006	41	4.6
2007	36	4.2
2008	36	3.8
2009	37	3.9
2010	27	3.2
2011	36	3.8
2012	28	2.8
2013	36	3.8
2014	25	3.3
2015	20	3.0
2016	16	2.3
2017	17	2.7
2018	11	1.9

*Un-notified TB case: case of TB identified by culture confirmation with no corresponding notification to ETS which matched to a person with HIV.

9. Latent TB infection testing and treatment

This report, derived from the ETS surveillance system, which is a national case register and management system for cases of active TB, does not include information on latent TB infection (LTBI). The establishment of a national programme for the screening and treatment of LTBI for new migrants was introduced by the Department of Health and PHE in April 2015. Information for this programme is currently collected separately to the ETS [9].

Individuals are eligible for the national LTBI testing programme if they are aged 16-35 years, and entered the UK from a high incidence country (≥150 cases per 100,000 or sub-Saharan Africa) within the last 5 years, and had been living in that high incidence country for 6 months or longer. Eligible individuals are primarily identified prospectively by GP practices during the new patient registration process, however some clinical commissioning groups (CCGs) also search retrospectively through GP clinical systems, or use community or secondary care services for identification.

Laboratory testing providers were selected for high TB incidence and burden CCGs[16] following a national NHS procurement process and establishing a laboratory provider framework [10]. As per national programme clinical guidelines, individuals who receive a positive diagnostic result (interferon-gamma release assay, IGRA) are referred to secondary care to rule out active TB and initiate LTBI treatment [10].

Between 2016 and 2018 in the West Midlands, the LTBI screening programme took place in selected GP practices and other health services in Birmingham and Solihull, Coventry and Rugby, Sandwell and West Birmingham, Stoke on Trent and Wolverhampton CCGs [1].

[16] High incidence is here defined as >20.0 cases per 100,000; high burden is defined as ≥0.5% of the TB case burden in England.

Discussion

The rate of TB in the West Midlands in 2018 was 10.4 cases per 100,000 population, representing a gradual decline which is statistically significantly lower than the rate of TB in 2016 (12.3 per 100,000). Rates of TB in the West Midlands have seen an overall decreasing trend in some of the highest incidence local authorities, most notably in Sandwell. Non-UK born individuals still experience significantly higher rates of TB than those born in the UK, with an increasing number of cases born in Central and Eastern European countries. As seen at a national level, case numbers remain high among settled migrants who arrive in the UK more than 10 years prior to their TB notification.

Antibiotic drug resistance is a relatively small but persistent issue in the West Midlands, with 30-40 cases of first line resistance per year. Rifampicin and multidrug-resistance remains rare, with 7 MDR TB cases notified in 2017.

Delays to treatment in those with pulmonary TB is the lowest seen in recent years, with one quarter (83/332) of patients starting treatment after 4 months of symptoms in 2018 compared to peak figures in 33.0% in 2016 (124/376). Culture confirmation in those with pulmonary TB in the West Midlands is also below the national target (73% vs 80%), but similar to last year's result of 74%.

Treatment completion was similar to previous years, with 85.4% of drug-sensitive patients notified in 2017 completing treatment within the expected duration of 12 months, compared to 84.3% in 2016. The proportion of patients who were lost to follow up has reduced from 3.7% in 2016 to 1.9% in 2017.

TB is still a substantial problem for under-served populations (those with a current or past history of drug and alcohol misuse, homelessness and prison). These individuals have a higher risk of developing TB, usually with pulmonary sites of disease, and have poorer outcomes (78.9% treatment completion). They have complex needs and frequently pose challenges to case managers. It is likely that social risk factors are under-recorded, and continuing efforts should be made to find and treat TB among individuals with social risk factors.

Recommendations

1. TB rates remain highest among the most socio-economically deprived areas of the West Midlands (50.7 per 100,000 in the most deprived quintile), compared with the least socio-economically deprived areas (6.7 per 100,000 population). A third of individuals were not in employment. Commissioners and partners should work to ensure that efforts are focused on these disadvantaged populations to address inequalities in health.
2. The number of cases with at least one social risk factor remains higher than the England average, highlighting that under-served populations must remain a priority for intervention. Strategy and interventions should continue to focus on reducing TB rates in these groups and reducing health and social inequalities.
3. Understanding how to engage with these hard to reach groups will be critical to control transmission between cases. This will require multi-agency working amongst partners to address the underlying social risk factors.
4. Focus must be maintained on reducing the average time from symptom onset to treatment start for people with pulmonary TB in order to reduce their infectiousness and the possibility of TB transmission.
5. PHE and partner organisations should continue to ensure cohort review is used as an opportunity to review local incidents to promote learning and sharing of ideas for case management, including paediatric cohort review.
6. The Collaborative Tuberculosis Strategy for England 2015 to 2020 [11] sets out the improvements that need to be achieved to bring about a sustained decline in TB in England; and the mechanism by which these improvements should be achieved. TB service providers should utilise the PHE TB Strategy Monitoring Indicators Tool [12] to track their performance and to support development of local TB action plans.
7. The NHS should offer HIV testing for all those diagnosed with tuberculosis; and ensure that tests are done in line with national guidance [8].

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Appendix A: Notes on the report

About the Field Service

The Field Service (FS) supports PHE Centres and partner organisations through the application of epidemiological methods to inform public health action. It does this in 2 main ways, firstly by providing a flexible expert resource, available, as and when needed, to undertake epidemiological investigations for key health protection work and secondly through the expert analysis, interpretation and dissemination of surveillance information to PHE Centres, local health partners, service providers and commissioners of services. Within the FS network, excellence and innovation is encouraged, we foster academic collaborations and take active part and lead in research, development and training.

Intended audience

This report is for use by healthcare professionals who diagnose and/or care for people with TB, commissioners involved in planning and financing TB services, public health professionals working to improve TB control and the health of at-risk populations, researchers with an interest in TB, and government and non-governmental organisations working in the field of TB. In particular this report is for the use of the West Midlands TB Control Board and local health protection forums.

Aim of report

This report describes the recent epidemiology of TB in the West Midlands. It includes local trends, which areas and population groups have a high burden of disease, and detail on the care of patients.

Further TB information

The national report of TB in England is available at: gov.uk/government/publications/tuberculosis-in-england-annual-report

Additional data on TB notifications in the UK to the end of 2018, and breakdowns by country, can be found in the Official Statistic for TB, 'Reports of cases of tuberculosis to enhanced tuberculosis surveillance systems: United Kingdom, 2000 to 2018. This is available at: www.gov.uk/government/statistics/reports-of-cases-of-tb-to-uk-enhanced-tuberculosis-surveillance-systems

As part of the Collaborative TB Strategy for England 2015-2020, TB Strategy Monitoring Indicators are available at:
gov.uk/government/uploads/system/uploads/attachment_data/file/403231/Collaborative_TB_Strategy_for_England_2015_2020_.pdf

Where data for these indicators are presented in this report, the indicator name is shown.

A number of TB indicators at Upper Tier Local Authority and Clinical Commissioning Group level can be found at fingertips.phe.org.uk/profile/tb-monitoring and were updated with data for 2018 in August 2019.

Appendix B: Description of data sources and definitions

Data sources

This report is based on TB case notifications made to ETS in England to the end of 2018. This information is updated annually to take into account denotifications (where the patient was found not to have TB), late notifications and other updates. The data presented in this report supersedes data in previous reports.

Diagnostic laboratories serving acute hospitals are the first place in which TB infection-related samples are received and processed within the pathway of clinical diagnosis and management of suspected TB cases. Results for microscopy, PCR, histology and culture are collected in ETS. Appropriate referral of clinical specimens to the Mycobacterium Reference Laboratories is an important part of the routine work of the diagnostic laboratories in the investigation and management of TB cases.

The National Mycobacterium Reference Service (NMRS) receives these diagnostic materials and undertake characterisation using culture and molecular diagnostic methods to define species of *Mycobacterium*, TB antibiotic (drug) susceptibility and organism relatedness. Historically, organism relatedness has been determined by MIRU-VNTR typing, however this has been superseded in recent years by WGS.

Definitions

BCG	Bacillus Calmette-Guérin vaccination
CI	Confidence interval
CCG	Clinical commissioning group
Cluster	2 or more patients notified within the time period of analysis with TB caused by indistinguishable strains, with at least 23 complete MIRU-VNTR loci
CNS	Central nervous system
Cohort review	The systematic review of all TB patients notified by a TB service in a 3-4 month period, looking at standard outcomes in terms of patient care and number of contacts screened
Cryptic disseminated TB	Systemic illness without localising features
DOT	Directly observed treatment
Drug	In the context of TB control, a drug is an anti-TB antibiotic
Drug resistant cohort	The drug resistant cohort includes any patients with rifampicin resistant TB (initial or acquired), including MDR-TB (initial or acquired), as well as those without culture confirmation treated with an MDR-TB regimen
Drug sensitive cohort	The drug sensitive cohort excludes all TB patients with rifampicin resistant TB (initial or acquired) including MDR-TB (initial or acquired), and non-culture confirmed patients treated with an MDR-TB regimen
DST	Drug sensitivity testing, based on phenotypic analysis of cultured TB isolates
ETS	Enhanced TB Surveillance system
First-line drug resistance	First-line anti-TB antibiotic drug resistance is defined as resistance to at least 1 of the first line antibiotics (isoniazid, rifampicin, ethambutol, pyrazinamide)
ART	Antiretroviral therapy
IGRA	Interferon-gamma release assay – blood test for TB infection which does not differentiate between active disease and LTBI
IMD 2019	The Index of Multiple Deprivation rank for each LSOA, based on deprivation score assigned, relative to other LSOAs in the PHE West Midlands area

IQR	Interquartile range
LSOA	Lower super output area (geographic definition)
LTBI	Latent TB infection
MDR	Multidrug resistance: cases initially resistant to at least isoniazid and rifampicin
Miliary TB	TB infection spread via the bloodstream to all parts of the body
MIRU-VNTR	Mycobacterial Interspersed Repetitive Unit-Variable Number Tandem Repeats
PCR	Polymerase chain reaction
Post-mortem diagnosis	A patient diagnosed at post-mortem is defined as where TB was not suspected before death, but a TB diagnosis was made at post-mortem, with pathological and/or microbiological findings consistent with active TB that would have warranted anti-TB treatment if discovered before death
Pulmonary tuberculosis	A pulmonary case is defined as a patient with TB involving the lungs and/or tracheobronchial tree, with or without extra-pulmonary TB diagnosis. In this report, in line with the WHO's recommendation and international reporting definitions, miliary TB is classified as pulmonary TB due to the presence of lesions in the lungs
Second-line drugs	Second-line drugs include injectable agents (eg amikacin, capreomycin, kanamycin), fluoroquinolones (eg moxifloxacin, ofloxacin, ciprofloxacin) and other oral bacteriostatic agents.
SNP	Single nucleotide polymorphism – mutation of 1 base pair in the genome of an *M. tuberculosis complex* isolate
TB	Tuberculosis
UTLA	Upper tier local authority (geographic definition)
WGS	Whole genome sequencing
XDR	Extensive drug resistance: cases initially MDR and resistant to at least 1 injectable agent (amikacin, capreomycin or kanamycin) and at least 1 fluoroquinolone (moxifloxacin, ofloxacin or ciprofloxacin)

Treatment outcome

Information on outcomes were reported for all patients reported in the previous year, excluding those with known rifampicin resistant disease: outcomes for these were reported at 24 months. Definitions for outcome are based on World Health Organization (WHO) and European definitions but adapted to the UK context. In this report, all data was obtained from the ETS matched dataset provided in August 2018.

Proportions

All proportions in this report are calculated among patients with known information or a known result, except where otherwise stated.

Confidence intervals

A 95% confidence interval for incidence was obtained using the relevant procedure in Stata, assuming a Poisson distribution.

Population denominator

Tuberculosis rates by geographical area (Centre, upper and lower tier local authority), age, sex and place of birth were calculated using ONS mid-year population estimates. Tuberculosis rates by ethnic group were calculated using population estimates from the Labour Force Survey (LFS) [www.esds.ac.uk/findingData/qlfs.asp]. The LFS is based on a population sample, so estimates are liable to sampling errors, particularly for small population subgroups, and should be interpreted with caution.

Cluster definitions

Strain typing was performed by the National Mycobacterial Reference Service using 24 MIRU-VNTR profiling. Analysis was undertaken on strain type clusters as defined above. Analysis of clustering in the West Midlands was carried out on cases that clustered in the West Midlands and notified between 2013 and 2018.

Appendix C: TB among West Midlands residents

Table Bi: TB case numbers by upper tier local authority of residence, West Midlands, 2000 to 2018

Upper tier local authority	Year																		
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Birmingham	351	312	328	343	393	376	414	373	431	470	358	401	447	388	320	251	268	249	228
Coventry	78	61	76	58	79	87	95	131	107	91	80	120	131	100	91	88	84	81	76
Dudley	12	18	48	30	33	32	34	43	38	29	35	34	29	42	21	32	21	21	28
Herefordshire	4	2	4	1	6	1	3	4	8	5	3	6	7	5	3	3	3	6	7
Sandwell	77	81	86	87	90	118	112	112	107	107	101	106	118	121	77	96	86	79	54
Shropshire	3	8	4	11	18	13	14	7	13	8	8	10	14	11	10	7	8	0	8
Solihull	8	10	9	16	13	11	21	15	18	20	4	21	23	15	15	12	14	8	8
Staffordshire	10	21	15	29	28	23	25	19	31	42	45	30	35	38	26	43	35	31	27
Stoke-on-Trent	0	29	35	32	26	42	39	27	30	30	32	46	40	35	28	28	33	21	27
Telford & Wrekin	6	4	3	3	16	12	12	11	13	12	10	7	14	12	9	5	5	9	7
Walsall	68	60	59	54	60	44	52	61	56	46	48	68	50	52	36	33	45	52	41
Warwickshire	20	32	40	33	45	41	28	49	59	49	48	44	53	44	54	24	28	41	24
Wolverhampton	46	49	69	74	87	90	62	66	76	76	81	90	76	81	63	57	68	47	53
Worcestershire	16	15	18	12	26	30	16	10	21	21	19	21	39	35	23	20	19	16	25
West Midlands	**699**	**702**	**794**	**783**	**920**	**920**	**927**	**928**	**1008**	**1006**	**872**	**1004**	**1076**	**979**	**776**	**699**	**717**	**661**	**613**

Table Bii: 3 year average TB rate* per 100,000 by lower tier local authority of residence, West Midlands, 2000 to 2018

LTLA name	Year																
	2000-2002	2001-2003	2002-2004	2003-2005	2004-2006	2005-2007	2006-2008	2007-2009	2008-2010	2009-2011	2010-2012	2011-2013	2012-2014	2013-2015	2014-2016	2015-2017	2016-2018
Birmingham, Solihull & the Black Country																	
Birmingham	33.5	33.1	35.6	36.9	38.9	38.0	39.4	40.8	40.0	38.6	37.4	38.0	35.3	29.0	25.1	22.7	21.9
Dudley	8.5	10.5	12.1	10.3	10.7	11.8	12.4	11.8	10.9	10.5	10.4	11.2	9.8	10.0	7.8	7.8	7.3
Sandwell	28.5	29.6	30.5	34.0	36.7	39.0	37.4	36.4	34.7	34.2	35.1	36.9	33.6	31.0	27.0	27.0	22.5
Wolverhampton	22.9	26.8	32.0	34.8	33.0	29.9	27.9	29.6	31.5	33.2	33.0	32.8	29.1	26.5	24.5	22.3	21.6
Walsall	24.5	22.7	22.6	20.5	20.2	20.2	21.6	20.7	18.9	20.2	20.6	20.9	16.9	14.7	13.7	15.5	16.4
Solihull	4.5	5.8	6.3	6.6	7.4	7.7	8.9	8.6	6.8	7.3	7.7	9.5	8.5	6.7	6.5	5.3	4.7
Coventry & Warwickshire																	
Coventry	23.7	21.6	23.7	25.0	29.1	34.8	36.7	36.0	30.1	31.0	34.7	36.3	32.7	27.7	25.5	23.9	22.3
North Warwickshire	3.8	3.2	2.2	4.3	4.3	5.4	4.8	5.4	5.9	7.0	7.5	5.4	4.3	2.7	2.7	2.1	3.6
Nuneaton and Bedworth	9.2	8.9	8.6	9.4	9.6	8.8	8.7	10.0	10.7	9.9	10.9	13.0	15.1	12.4	9.2	6.5	7.8
Rugby	12.2	12.1	12.3	8.5	8.4	10.0	16.4	19.4	17.8	11.8	10.6	10.5	11.5	9.4	7.4	7.0	5.7
Stratford-on-Avon	1.2	3.3	5.0	5.0	3.8	2.9	2.8	3.4	3.1	4.2	4.4	4.4	3.3	2.2	1.9	2.9	2.9
Warwick	4.2	6.2	8.4	9.3	8.7	9.3	9.3	10.2	10.2	9.9	10.1	8.2	9.4	7.9	8.6	7.4	6.4
Herefordshire																	
Herefordshire, County of	1.9	1.3	2.1	1.5	1.9	1.5	2.8	3.1	2.9	2.5	2.9	3.2	2.7	2.0	1.6	2.1	2.8
Staffordshire & Stoke-on-Trent																	
Cannock Chase	0.7	0.7	1.1	1.4	1.1	0.7	0.4	0.3	0.7	0.7	1.7	1.4	1.7	0.3	1.4	2.4	3.7
East Staffordshire	2.6	3.2	6.0	7.8	8.1	5.5	6.6	9.9	15.7	14.2	14.1	11.1	10.4	8.4	6.9	6.6	5.4
Lichfield	2.5	1.8	1.8	3.1	3.5	3.8	3.0	3.4	3.7	2.7	2.3	1.3	2.0	3.9	4.6	3.9	1.0
Newcastle-under-Lyme	3.0	4.4	4.3	3.5	3.5	3.0	4.3	3.8	3.8	4.0	4.0	4.3	3.7	4.2	5.2	4.7	6.2
South Staffordshire	1.9	3.8	4.4	4.1	3.4	2.2	1.9	1.9	2.5	2.8	2.2	1.2	1.2	2.7	3.0	4.8	2.7
Stafford	0.0	1.1	1.4	2.2	1.3	1.9	2.6	4.2	4.4	5.4	4.1	6.6	5.6	7.1	5.0	5.0	4.0
Staffordshire Moorlands	2.8	3.9	2.5	2.1	2.4	2.8	2.4	2.1	1.4	1.4	1.4	2.7	3.8	3.4	2.7	2.0	1.4
Tamworth	1.8	2.2	1.3	0.9	0.4	1.3	1.8	2.6	3.9	4.4	3.5	1.3	0.4	0.9	1.7	3.0	3.0
Stoke-on-Trent	8.9	13.3	12.9	13.8	14.7	14.8	13.1	11.8	12.5	14.5	15.8	16.2	13.7	12.1	11.8	10.8	10.6

Telford & Shropshire																	
Telford and Wrekin	2.8	2.1	4.6	6.4	8.3	7.2	7.3	7.3	7.1	5.8	6.2	6.6	6.9	5.1	3.7	3.6	4.0
Shropshire	1.8	2.7	3.8	4.8	5.1	3.9	3.8	3.1	3.2	2.8	3.5	3.8	3.8	3.0	2.7	1.6	1.7
Worcestershire																	
Bromsgrove	1.9	1.5	1.8	2.9	3.7	2.6	1.8	0.7	1.1	0.4	1.1	0.7	1.8	2.1	3.1	2.8	4.4
Malvern Hills	0.0	0.5	1.4	2.7	3.6	3.2	1.8	2.7	3.6	4.5	2.7	2.7	2.2	2.2	2.2	2.2	2.2
Redditch	4.2	3.8	5.9	8.8	9.6	6.6	4.5	4.0	4.4	5.2	14.6	18.6	18.9	9.1	6.7	4.7	5.1
Worcester	5.7	6.1	6.4	8.1	7.4	6.3	4.5	6.2	6.5	6.5	5.7	6.7	7.0	7.3	5.6	4.3	3.9
Wychavon	2.4	1.8	1.5	0.9	0.9	1.2	1.1	1.4	2.6	3.7	3.7	4.5	3.4	4.2	2.2	3.5	3.7
Wyre Forest	3.4	2.8	3.8	2.4	2.4	1.4	3.4	3.7	3.7	1.7	1.0	1.4	2.0	2.4	2.0	1.3	1.0
West Midlands cases	**13.8**	**14.3**	**15.6**	**16.3**	**17.1**	**17.1**	**17.5**	**17.9**	**17.4**	**17.3**	**17.5**	**18.1**	**16.6**	**14.3**	**12.7**	**11.9**	**11.3**

*rates calculated using ONS mid-year population estimates

Table Biii: TB case numbers and rate by age and sex, West Midlands, 2018

Age group (years)	Female					Male					Overall				
	Number	Rate	95% CI			Number	Rate	95% CI			Number	Rate	95% CI		
0-14	6	1.1	0.4	-	2.4	13	2.3	1.2	-	4.0	19	1.7	1.0	-	2.7
15-44	129	11.7	9.8	-	13.9	202	17.9	15.5	-	20.5	331	14.8	13.3	-	16.5
45-64	61	8.1	6.2	-	10.4	98	13.3	10.8	-	16.2	159	10.7	9.1	-	12.5
65+	50	8.5	6.3	-	11.2	54	10.8	8.1	-	14.1	104	9.5	7.8	-	11.6
All ages	**246**	**8.3**	**7.3**	**-**	**9.4**	**367**	**12.6**	**11.3**	**-**	**13.9**	**613**	**10.4**	**9.6**	**-**	**11.2**

*rates calculated using ONS mid-year population estimates

Table Biv: Drug resistance among TB patients with culture confirmed disease*, West Midlands, 2000 to 2018

Year	DST results	First line drug resistance		INH-R without MDR-TB		MDR/RR-TB		Pre-XDR		XDR	
	Number	Number	%	Number	%	Number	%	Number	%	Number	%
2000	328	19	5.8	17	5.2	2	0.6	0	0	0	0
2001	370	23	6.2	14	3.8	6	1.6	0	0	0	0
2002	438	34	7.7	32	7.3	1	0.2	0	0	0	0
2003	432	20	4.6	17	3.9	2	0.5	0	0	0	0
2004	533	26	4.9	19	3.5	5	0.9	0	0	0	0
2005	525	27	5.1	22	4.2	3	0.6	0	0	0	0
2006	539	21	3.9	17	3.1	3	0.6	0	0	0	0
2007	551	27	4.9	19	3.4	6	1.1	0	0	0	0
2008	534	22	4.1	12	2.2	9	1.7	0	0	0	0
2009	568	34	5.9	28	4.8	5	0.9	0	0	0	0
2010	512	31	5.9	21	4.0	9	1.7	0	0	0	0
2011	596	42	6.9	28	4.6	11	1.8	1	0.2	0	0
2012	570	32	5.5	19	3.3	12	2.1	0	0	0	0
2013	509	36	6.5	19	3.4	14	2.5	0	0	1	0
2014	412	23	5.4	19	4.5	3	0.7	0	0	0	0
2015	394	33	8.2	22	5.5	9	2.2	0	0	1	0
2016	415	15	3.6	7	1.7	7	1.7	2	0.5	0	0
2017	409	34	8.2	16	3.9	7	1.7	2	0.5	0	0
2018	350	39	11.0	17	4.8	6	1.7	1	0.3	0	0

*culture confirmed cases with drug susceptibility testing results for at least isoniazid and rifampicin

Appendix D: All TB patients notified by West Midlands clinics

Tables of further information about TB cases treated by hospital clinics and TB services based in the West Midlands can be requested by public health and clinical stakeholders from your local FS team.

Appendix E: Local authority TB epidemiological summaries

Local authority TB epidemiological summaries can provide further information about TB cases among residents of West Midlands upper tier local authorities with high rates of TB cases per year over the previous 3 years. These can be requested from your local FS team.