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Tuberculosis in the South West: 2019

Presenting data to end of 2018

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Executive summary

In 2018, there were 195 cases of tuberculosis (TB) notified among residents of the South West, a rate of 3.5 per 100,000 population (95% confidence interval (CI): 3.0 to 4.0). The England-wide TB rate for 2018 was 8.3 per 100,000 population.

The rate of TB in the South West has decreased in 2018 compared with 2017 and 2016, when the rate was 4.1 per 100,000 population (95% CI: 3.6 to 4.7). The rate of TB in the South West has decreased every year since 2014.

The following local authorities had the highest notification rates: City of Bristol (10.6 per 100,000 population), Swindon (6.3 per 100,000 population), and Plymouth (4.6 per 100,000 population).

The rate of notifications for females and males were 2.8 and 4.2 per 100,000 population respectively.

The highest rates were observed in the following age groups: 30-39 (6.3 per 100,000 population), 20-29 (4.1 per 100,000 population), and 70-79 (3.8 per 100,000 population) years.

The proportion of cases observed in children aged 0 to 14 years in 2018 is the highest proportion ever recorded in the South West (5.6%). Most of these cases were reported in City of Bristol.

In 2018 there were 9 cases reported in UK born children under 15 years. The rate in this group (an indicator for ongoing local transmission) was 1.0 per 100,000 population. This rate in 2017 was 0.9 per 100,000 and the rate in 2016 was 0.1 per 100,000. The 2018 rate is the highest recorded since 2012

The rate of TB among non-UK born persons was 18.7 per 100,000 population (93 cases) and the rate of TB among UK born persons was 2.0 per 100,000 population (98 cases).

The largest proportion of non-UK born cases were born in India (19, 16.2%) followed by Somalia (9, 7.7%), the Philippines (7, 6.0%) and Poland (7, 6.0%).

Ethnicity for the majority of cases was White (97, 50.8%) followed by Indian (25, 13.1%) and Black Caribbean (25, 13.1%).

The majority of cases were diagnosed with pulmonary disease (101, 51.8%).

In total, 119 (61.0%) cases were culture confirmed and 41 (61.2%) pulmonary cases were sputum smear positive.

The median delay between symptom onset and diagnosis was 86.5 days (inter-quartile range (IQR): 45.0 to 184.0).

The median delay between symptom onset and treatment start date was 92.5 days (IQR: 52.0 to 185.0).

Social risk factors (alcohol abuse, drug use, homelessness and/or imprisonment) were reported for 16 (10.6%) cases.

The postcodes of cases were linked to an Index of Multiple Deprivation (IMD) score as an indicator of socio-economic status. In 2018, the largest proportion of cases lived in areas from the most deprived IMD decile (50, 25.6%).

HIV status was already known for 8 (4.6%) cases. Of those where status was not known, HIV tests were offered to 164 (98.2%) cases.

Resistance to at least 1 first-line drug was present in 12 (10.1%) cases.

There were 4 (3.4%) cases that were resistant to at least 1 second-line TB drug.

There were no cases of multi-drug resistant (MDR) or extensively-drug resistant (XDR) TB.

Following a 12-month follow-up period, 165 (79.7%) drug sensitive cases notified in 2017 successfully completed treatment, 17 (8.2%) died, 10 (4.8%) were still on treatment, 7 (3.4%) were lost to follow-up, 3 (1.4%) stopped treatment and 5 (2.4%) cases were not evaluated.

Introduction

The South West PHE Centre area (PHEC) covers the upper tier local authority areas of Bath and North East Somerset, Bournemouth, Christchurch and Poole, the City of Bristol, Cornwall, Devon, Dorset, Gloucestershire, Isles of Scilly, North Somerset, Plymouth, Somerset, South Gloucestershire, Swindon, Torbay, and Wiltshire. The South West is traditionally a low incidence area for TB when compared with the rest of the UK. This reflects the socio-demographic characteristics of the population (low level of non-UK born migrants and a rural environment). There is only 1 local authority, the City of Bristol, with an annual incidence of TB routinely greater than the national rate. In 2016 and 2017, the incidence of TB in Swindon was higher than the national rate, but in 2018 the rate in Swindon reduced below the national rate.

Enhanced TB surveillance in England and Wales was launched in January 1999. It has the aim of providing detailed, comparable information on the epidemiology of TB following the worldwide resurgence of the disease, which prompted the World Health Organization to declare a ‘global emergency’ in 1993. The minimum dataset in the surveillance system includes notification, demographic, clinical and microbiological information on all cases of TB reported by clinicians at local level. In 2008 the Enhanced Tuberculosis Surveillance (ETS) system was rolled out across the UK. The ETS system is a secure website, enabling users to notify and de-notify cases, add treatment outcome monitoring information, generate reports and export case or laboratory information. The ETS system was implemented in the South West in November 2008. The system is real-time; once information is entered onto the website it is accessible at clinic, regional and national level. See Appendix A for a description of data sources and definitions.

As part of the Collaborative TB Strategy for England 2015-2020, a suite of TB Strategy Monitoring Indicators has been developed in this document [1]. Where data for these indicators are presented in this report, the indicator name is shown. Data for indicators which are presented for upper tier local authority can be found at http://fingertips.phe.org.uk/profile/tb-monitoring

Data for this report come principally from 3 different years which were:

- case data from TB notifications occurring in 2018
- outcome data for patients with drug sensitive TB infections from 2017 notifications
- outcome data for patients with drug resistant TB from 2016 notifications

Objectives

The objectives of this report are to:

- describe the overall epidemiology of TB in the South West
- highlight recent trends in TB epidemiology
- identify areas of high burden of disease
- identify at-risk population groups
- assist in the identification of opportunities to prevent further cases

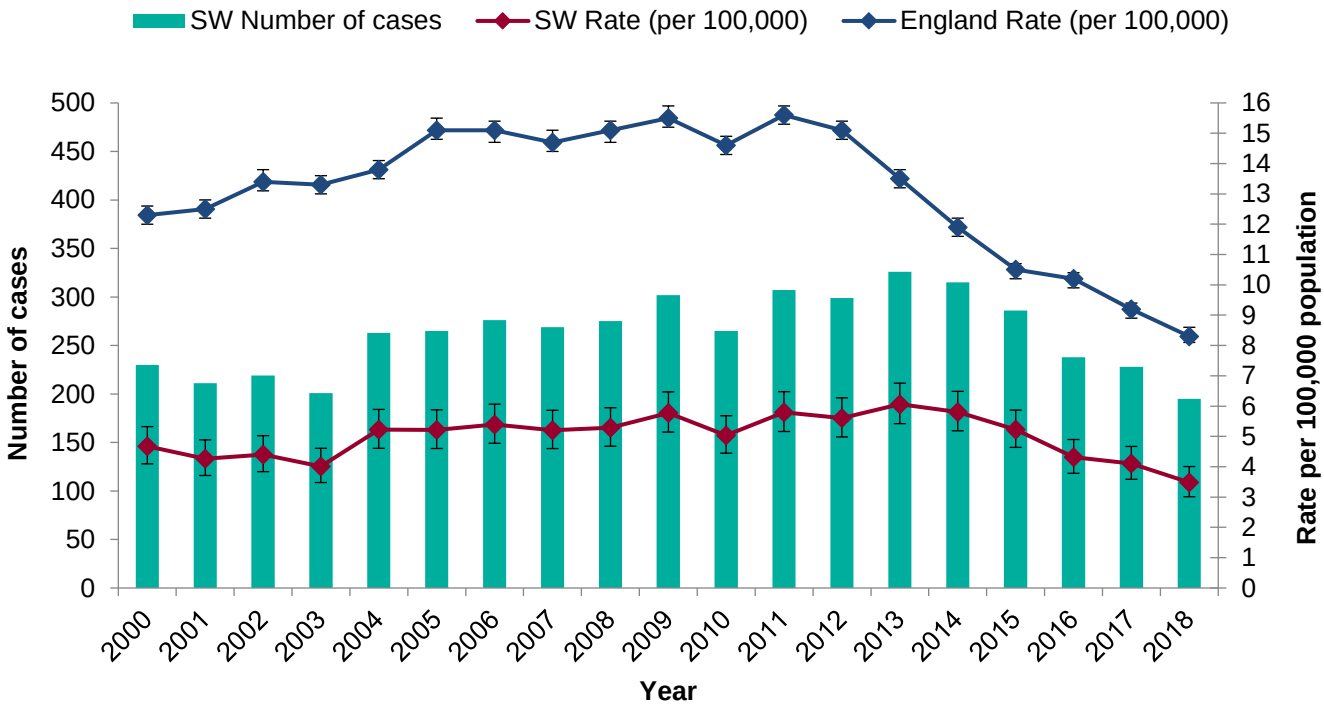
Tuberculosis epidemiology

Overall numbers, rates and geographical distribution

In 2018, there were 195 cases of TB notified among residents of the South West PHEC. This equates to a rate of 3.5 per 100,000 population (95% CI: 3.0 to 4.0). The rate in 2018 was a continuation of a year on year decrease that has occurred since 2013, see Figure 1. It is also the lowest rate ever recorded in the South West. The South West rate was lower than the overall England rate of 8.3 per 100,000 population. England has had a decrease in its annual TB incidence for a seventh consecutive year.

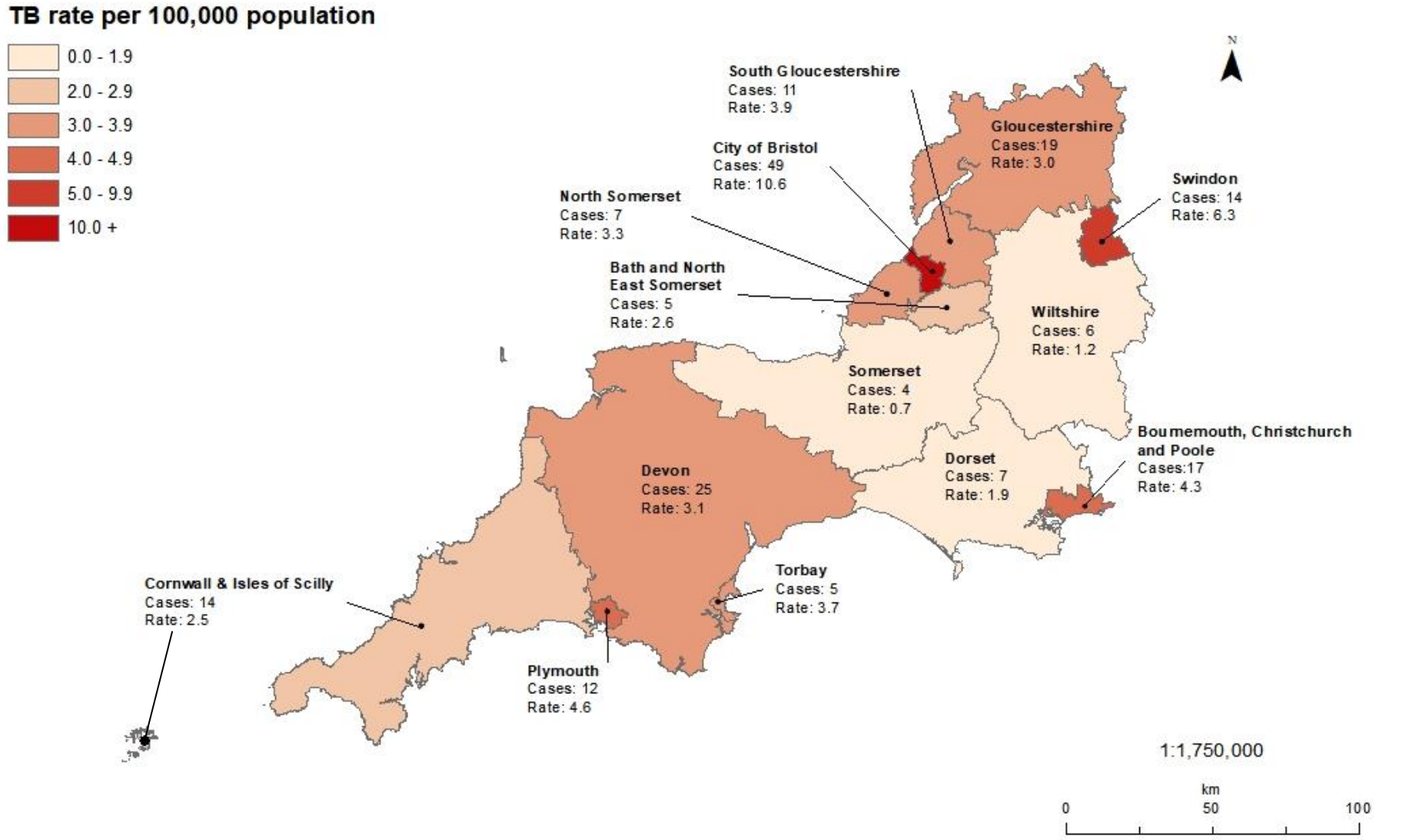
Within the South West, the highest TB rates were observed in the following local authorities in order of decreasing incidence: City of Bristol (10.6 per 100,000 population), Swindon (6.3 per 100,000 population), Plymouth (4.6 per 100,000 population), Bournemouth, Christchurch and Poole (4.3 per 100,000 population) and South Gloucestershire (3.9 per 100,000 population). The incidence rate for Bristol has now decreased in the 5 consecutive years since 2013 and is the lowest recorded since 2001.

Figure 1. Number of TB cases, rate and 95% confidence intervals, South West and England, 2000-2018



TB Monitoring Indicator 1: Overall TB incidence per 100,000 population (England and PHEC)

Figure 2. TB rate per 100,000 population by upper tier local authority of residence, South West, 2018



Note: data presented at upper tier local authority (UTLA) level, rates per 100,000 population and case numbers are presented

Demographic characteristics

Age and sex

There were 115 male (59.0%) and 80 female (41.0%) cases. This equates to a rate of 4.2 per 100,000 population for males (95% CI: 3.4 to 5.0) and 2.8 per 100,000 population for females (95% CI: 2.2 to 3.5). Both these rates are the lowest ever recorded for each sex in the South West.

The age of cases ranged from 2 to 92 years and the median age was 41.0 years (IQR: 29.0 to 61.0). Female cases had a median age of 40.5 years (IQR: 29.0 to 60.5) and for males the median age was 41.0 years (IQR: 29.0 to 62.0).

When examining age groups, the highest rates of TB were observed in those aged 30 to 39 (6.3 per 100,000 population), 20 to 29 (4.1 per 100,000 population), and 70 to 79 (3.8 per 100,000 population) years. The age distribution was similar for females and males but there was a consistently higher rate of male cases across all age groups, see Figure 3. The highest rates for males were in those aged 30 to 39 years (7.4 per 100,000 population) and 20 to 29 years (4.9 per 100,000 population). The highest rates for females were in those aged 30 to 39 years (5.2 per 100,000 population), 20 to 29 years (3.4 per 100,000 population) and 40 to 49 years (3.4 per 100,000 population), see Figure 3.

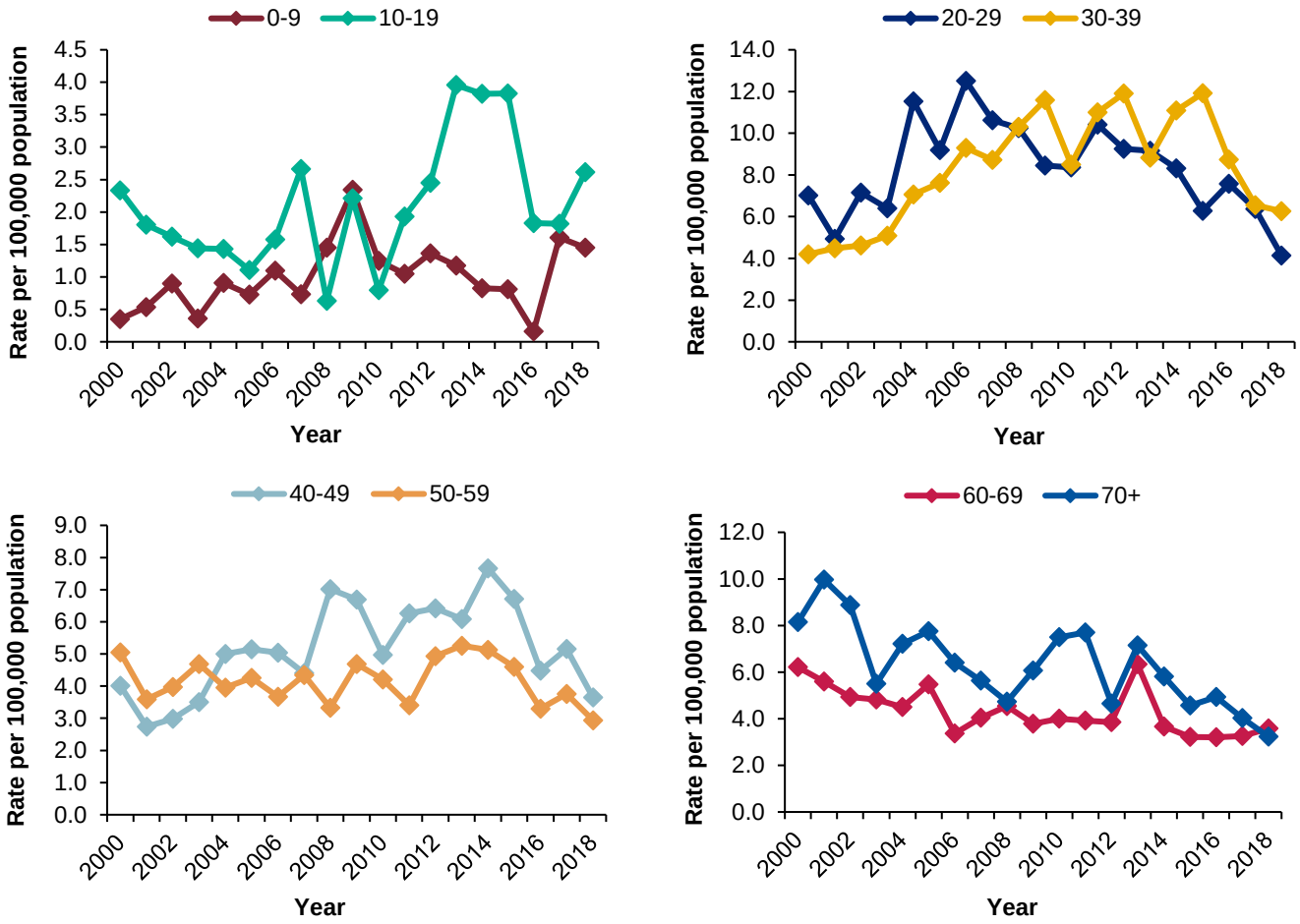
The rate in children under 5 years was 1.7 cases per 100,000 population (95% CI: 0.5 to 3.9), compared with 1.3 cases per 100,000 (95% CI: 0.4 to 3.4) in 2017. The rate in children aged 5 to 9 years was 1.2 per 100,000 (95% CI: 0.3 to 3.2) which is lower than the rate in 2017 of 1.9 per 100,000 (95% CI: 0.7 to 4.0). The rate in those aged 10 to 14 years was 0.7 per 100,000 (95% CI: 0.1 to 2.4) which is higher than rate in 2017 of 0.3 per 100,000 (95% CI: 0.0 to 1.9), and the rate in those aged 15 to 19 years was 4.6 per 100,000 (95% CI: 2.5 to 7.7), compared with 3.3 per 100,000 in 2017 (95% CI: 1.6 to 6.0).

There were 11 notifications of TB in children aged 0 to 14 years giving a rate of 1.2 per 100,000 population (95% CI: 0.6 to 2.1). This is the same as the number of cases and rate per 100,000 in this age group in 2017. However, the proportion of TB cases occurring in this age group increased in 2018 (5.6%) compared with 2017 (4.8%) and 2016 (0.8%). The proportion of cases occurring in this age group in 2018 is the highest proportion ever recorded in the South West. Most paediatric TB cases in 2018 were UK born (9, 81.8%) and most had pulmonary TB (8, 72.7%). The most common ethnic group among paediatric cases was Asian-Other (4, 36.4%) and most cases were recorded in City of Bristol (8, 72.7%).

In 2018, the rates in the 20 to 29 and 40 to 49 age groups decreased the most compared with 2017. The rates in the 10 to 19 and 60 to 69 age groups increased in 2018 after decreasing or remaining stable since 2014. Further trends in TB rate by age group are displayed in Figure 4.

Figure 3. Number of TB cases and rate by age and sex, South West, 2018

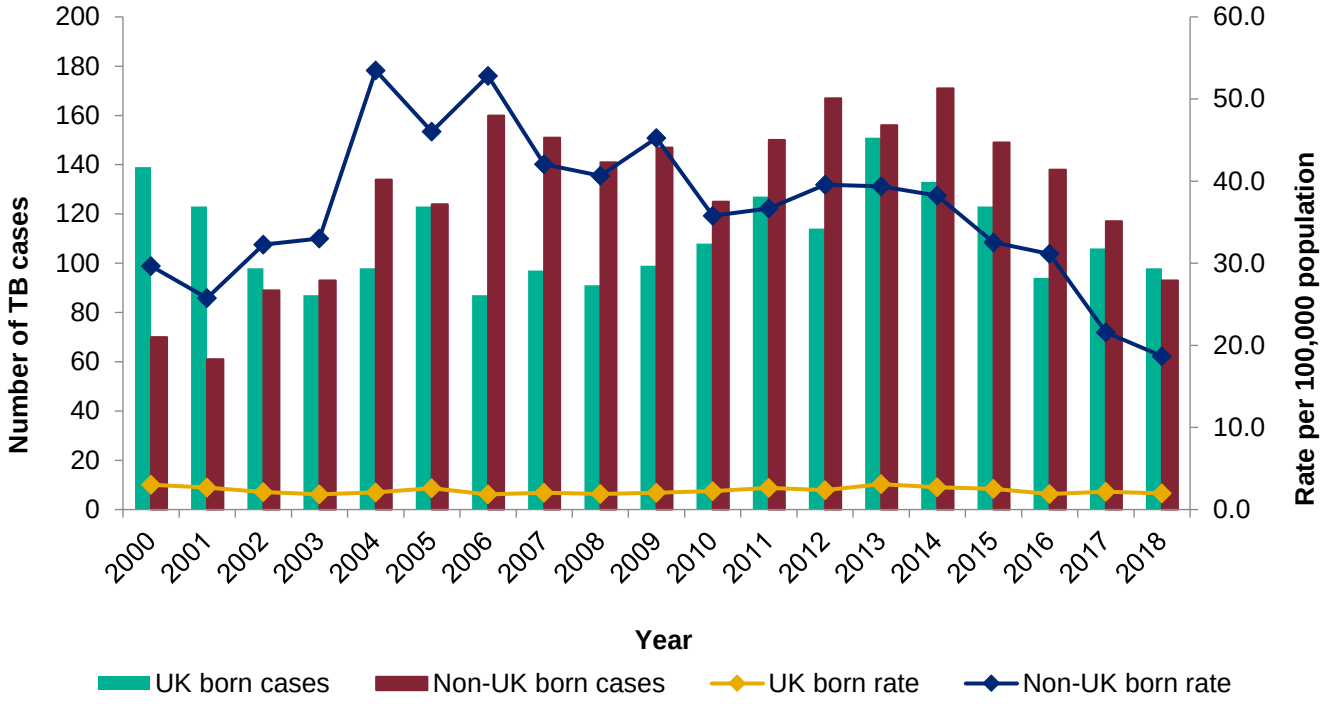
Figure 4. TB rate by age group, South West, 2000-2018



Place of birth and time since entry to the UK

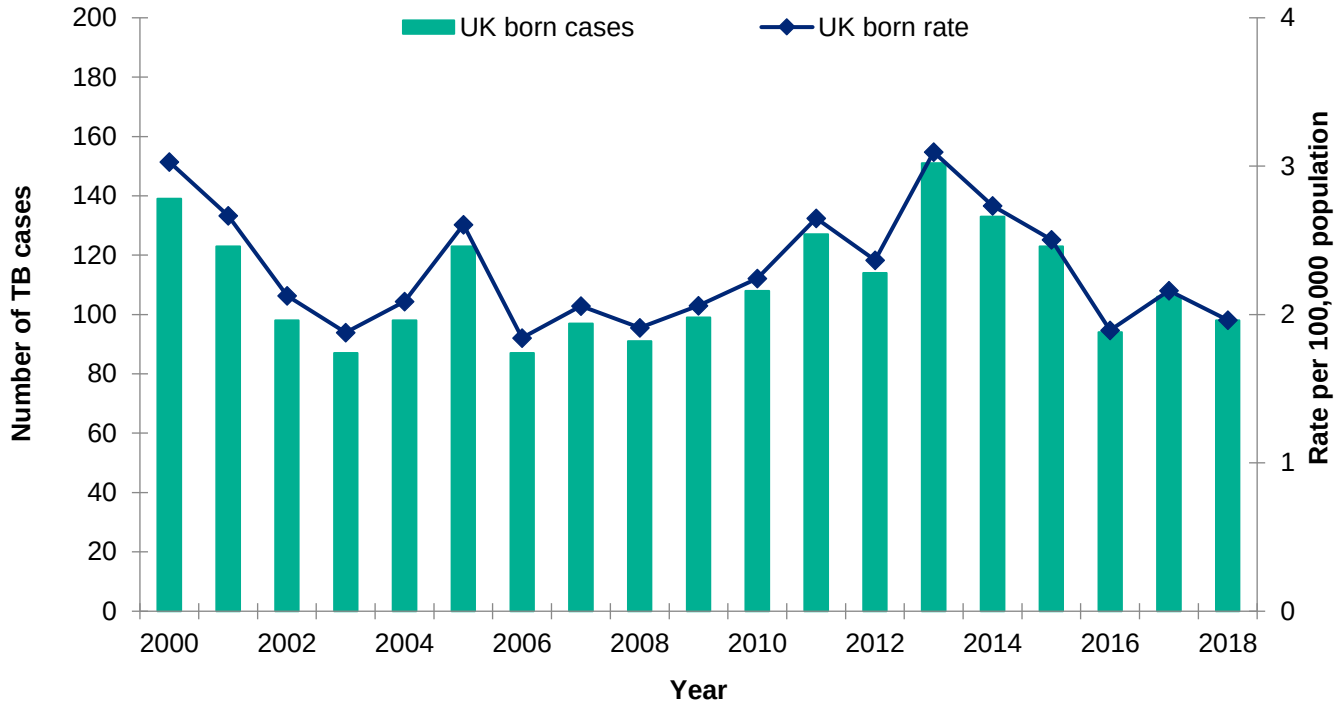
In 2018, data on whether a case was born in the UK were available for 191 (97.9%) cases. Of these cases 93 (48.7%) were born outside the UK, resulting in a non-UK born rate of 18.7 per 100,000 population. This is the lowest rate recorded for the non-UK born population since 2000. However, as in previous years, this rate is substantially higher than the rate of 2.0 per 100,000 population observed in the UK born population, see Figure 5. There has been fluctuating numbers of cases in the UK born population and the rate has decreased substantially since a peak in 2013, see Figure 6.

Figure 5. TB cases and rate by place of birth, South West, 2000-2018



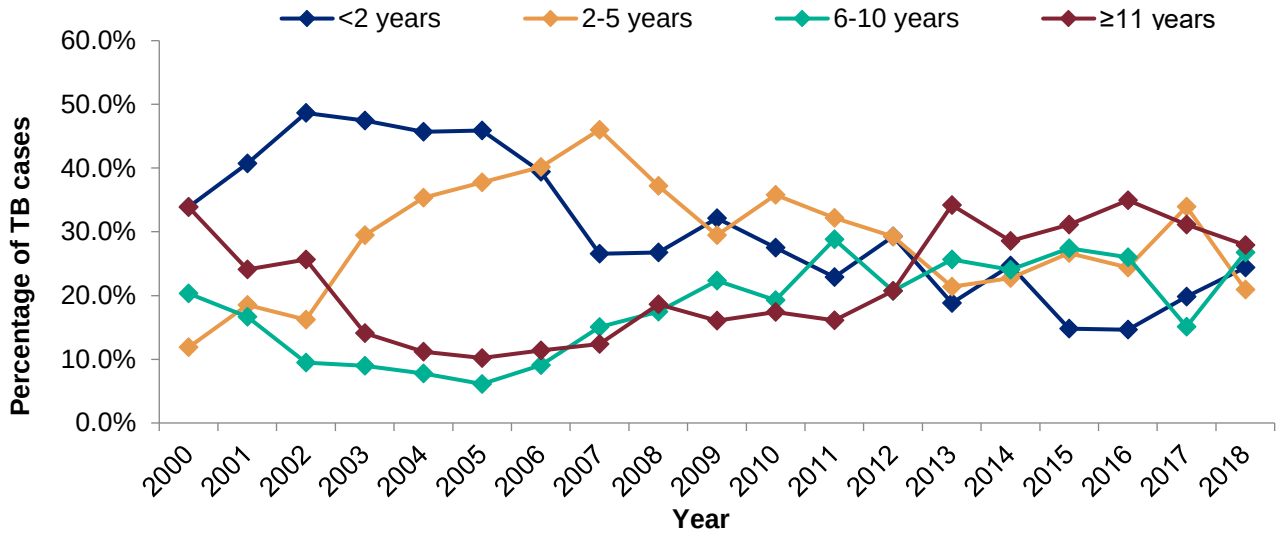
TB Monitoring Indicator 2: TB incidence in UK born and non-UK born populations (England)

Figure 6. TB cases and rate for the UK born population, South West, 2000-2018



In 2018, data were available on time since entry to the UK for 86 (92.5%) non-UK born cases. Of these, a total of 24 (27.9%) cases had a time between entry to the UK and TB diagnosis of ≥11 years, 41 (47.7%) cases entered the UK between 2 and 10 years prior to diagnosis and 21 (24.4%) cases had a time between entry and diagnosis of less than 2 years. In 2018, the proportion of cases with a time between entry and diagnosis of less than 2 years increased from 19.8% (21) in 2017 to 24.4% (21) in 2018. The proportion of cases diagnosed between 2 and 5 years after entry decreased in 2018 to 20.9% (18) from 34.0% (36) in 2017. This is the lowest proportion recorded since 2002. The proportion of cases diagnosed 6 to 10 years after entry increased from 15.1% (16) in 2017 to 26.7% (23) in 2018. The proportion of cases diagnosed more than 10 years after entry decreased again in 2018 from 31.1% (33) in 2017 to 27.9% (24) in 2018, see Figure 7.

Figure 7. Time between entry to the UK and TB diagnosis for non-UK born cases by year, South West, 2000-2018



Country of birth data were available for all non-UK born cases. The largest proportion were born in India (19, 20.4%) followed by Somalia (9, 9.7%), see Table 1. Those born in Romania or Somalia were most frequently diagnosed less than 2 years after entry, with a median time between entry and diagnosis of 3.0 years (IQR: 0.0 to 15.0) and 0.5 years (IQR: 0.0 to 8.0) respectively. Cases born in India were the group most frequently diagnosed more than 10 years after entry to the UK (6, 31.6%), with a median time since entry of 7.0 years (IQR: 2.0 to 13.0). Cases born in Pakistan had the highest median time since entry (31.5 years (IQR: 8.0 to 52.0).

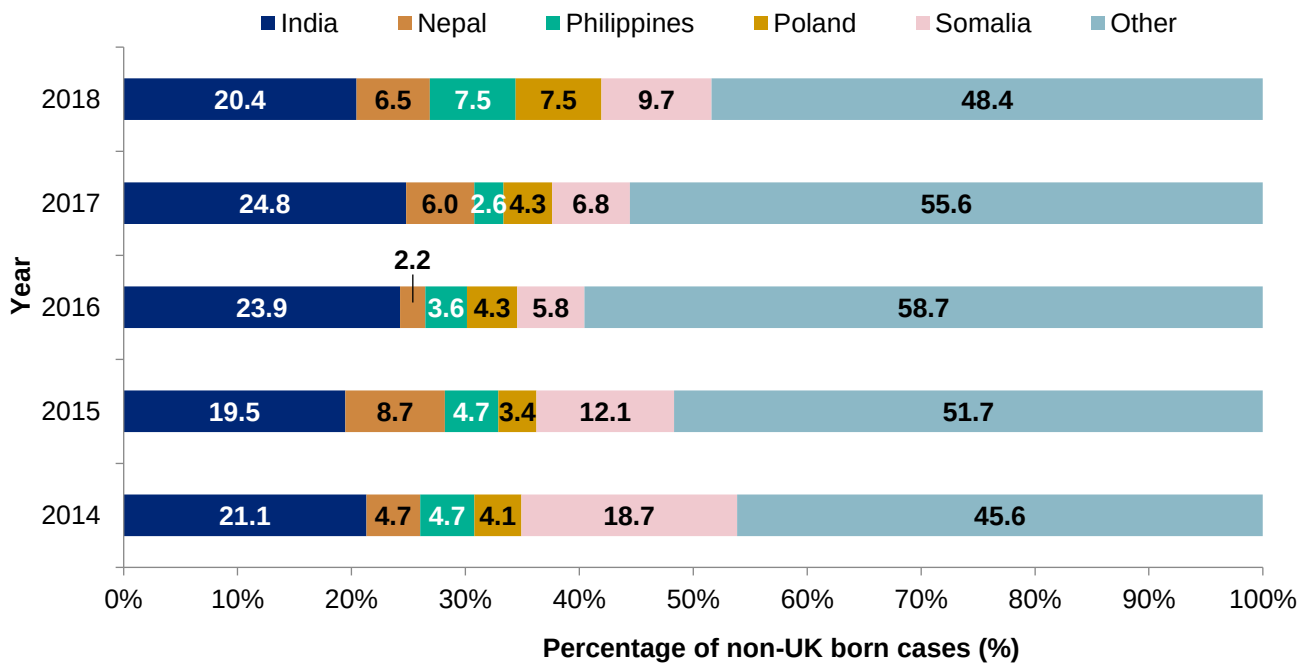
Over the past 5 years, people born in India have made up the highest proportion of non-UK born cases. The proportions from Somalia, Nepal, the Philippines and Poland all increased in 2018, see Figure 8.

Table 1. Most common countries of birth for non-UK born TB cases*, South West, 2018

Country of birth	Number of cases	Percentage of non-UK born cases (%)
India	19	20.4%
Somalia	9	9.7%
Philippines	7	7.5%
Poland	7	7.5%
Nepal	6	6.5%
Pakistan	6	6.5%
Romania	6	6.5%
Sudan	6	6.5%

* All countries with at least 5 notifications

Figure 8. Five-year trend in the percentage of non-UK born TB cases in the 5 most common countries of birth, South West, 2014-2018



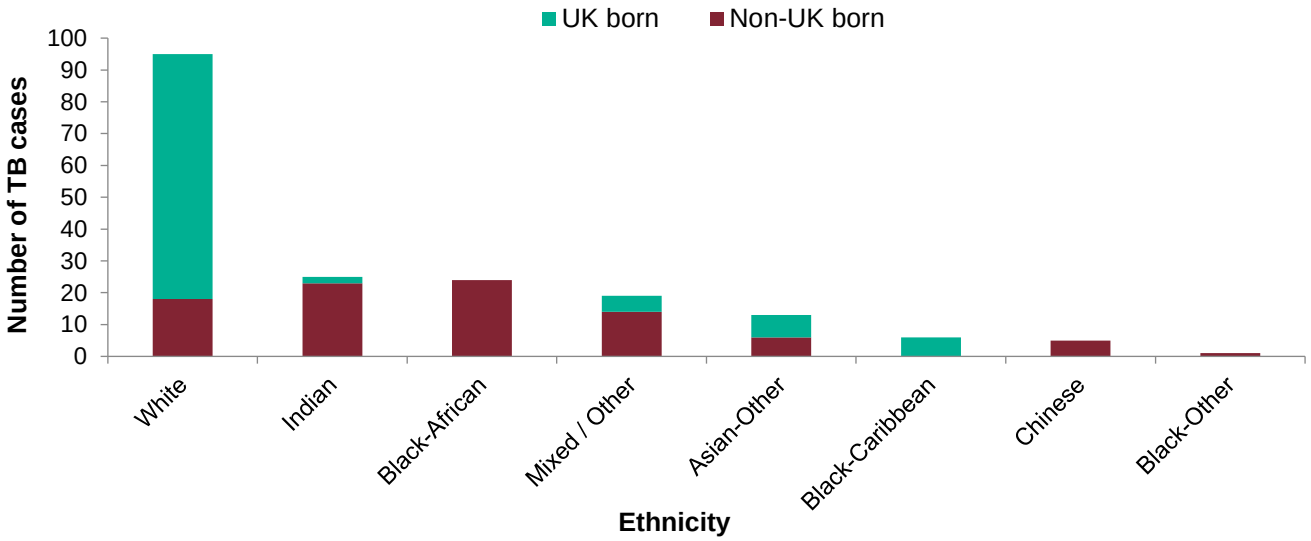
Most TB cases in 2018 were of White ethnicity (50.8%), though this proportion has decreased since 2017. The next most common ethnicities were Black-African (13.1%), Indian (13.1%) and Mixed-Other (9.9%). The proportion of cases in the Black-Caribbean and Asian-Other populations increased in 2018 compared to 2017, see Table 2.

Table 2. Percentage of TB cases by ethnicity and year, South West, 2014-2018

Ethnicity	2014	2015	2016	2017	2018
Asian-Other (%)	8.1	3.9	6.8	4.5	6.8
Black-African (%)	20.7	18.0	14.8	12.9	13.1
Black-Caribbean (%)	0.3	0.7	1.7	0.9	3.1
Black-Other (%)	1.3	0.7	1.7	0.4	0.5
Chinese (%)	1.6	1.4	1.3	2.2	2.6
Indian (%)	12.3	12.7	15.3	14.7	13.1
Mixed / Other (%)	9.7	10.2	10.6	11.2	9.9
White (%)	46.1	52.3	47.9	53.1	50.8

As in previous years, the majority of UK born cases in 2018 were of White ethnicity (79.4%). The next most common ethnicity among UK born cases was Asian-Other (7.2%), followed by Black-Caribbean (6.2%) whilst all other ethnicities each made up less than 6% of UK born cases. The majority of non-UK born cases were of Black-African ethnicity (24, 26.4%), followed by Indian (23, 25.3%). All cases of Black-Caribbean ethnicity were UK born and most cases with White ethnicity and Asian-Other ethnicity were UK born, see Figure 9.

Figure 9. Frequency of ethnicity by place of birth for TB cases, South West, 2018*



* Excludes cases with a missing place of birth

Occupation

In 2018, 136 (69.7%) cases were aged between 16 and 64 and therefore considered of working age[2]. Information on occupation was available for 132 (97.1%) of these cases. More cases

were reported among those in the ‘Education’ category (18, 13.6%) than among healthcare workers (16, 12.1%), see Table 3. The most common occupations in the ‘Other’ category were cleaner, software engineer, IT worker, lorry driver and taxi driver.

In the ‘None’ category people most frequently reported being unemployed (19, 50.0%) or a housewife/husband (12, 31.6%). The number of cases reported in the unemployed population has decreased since 2012. The majority of people in the ‘Education’ category were students (14, 77.8%). There were 7 cases (5.3%) in doctors and nurses.

Table 3. Occupational category of TB patients aged 16 to 64 years, South West, 2018

Occupational category	Number of TB Cases	Percentage of cases (%)
Agricultural/animal care worker	3	2.3%
Education	18	13.6%
Healthcare worker	16	12.1%
Social service/prison worker	1	0.8%
Other	56	42.4%
None	38	28.8%
Total	**132**	**100**

Clinical characteristics

Site of disease

Site of disease was known for all cases in 2018. The majority of cases were diagnosed with pulmonary disease only (101, 51.8%). 35 (17.9%) cases had both pulmonary and non-pulmonary disease. There were 59 (30.3%) cases with only non-pulmonary TB.

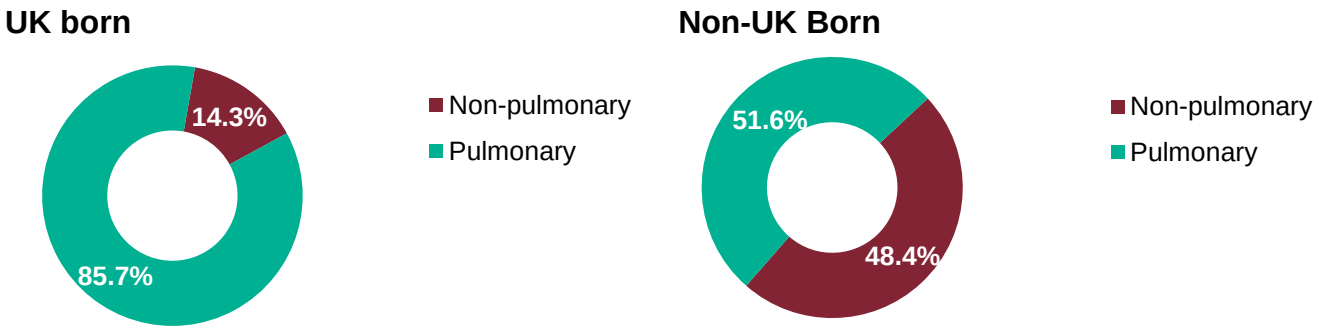
The distribution in site of disease has remained relatively stable over the last 10 years (the proportion of pulmonary cases has ranged from 61.9% to 70.9%). The most commonly recorded non-pulmonary site of disease was extra thoracic lymph nodes (35, 17.9%), see Table 4. There was a higher proportion of UK born cases with pulmonary disease (84, 85.7%) compared with non-UK born cases (48, 51.6%), see Figure 10.

Table 4. Site of disease for TB patients, South West, 2018*

Site of disease	Number of cases	Percentage of cases (%)
Pulmonary	**136**	**69.7%**
Miliary	5	2.6%
Laryngeal	3	1.5%
Non-Pulmonary	**59**	**30.3%**
ET Lymph nodes	35	17.9%
Unknown non-pulmonary site	32	16.4%
IT Lymph nodes	17	8.7%
Pleural	13	6.7%
Gastro-Intestinal	12	6.2%
Genitourinary	7	3.6%
Other non-pulmonary site	7	3.6%
Bone - Spine	6	3.1%
CNS - Other	6	3.1%
CNS - Meningitis	4	2.1%
Bone - Not Spine	3	1.5%
Cryptic	2	1.0%

* Patients may have disease at more than 1 site

Figure 10. Proportion of cases with pulmonary and non-pulmonary TB by place of birth, South West, 2018*



* For cases where place of birth is known. Pulmonary cases include those with both pulmonary and non-pulmonary TB

Previous diagnosis of tuberculosis

Data on whether a case had been previously diagnosed with TB were available for 184 (94.4%) notifications in 2018. A previous diagnosis of TB was recorded for 9 (4.9%) of these cases. Among UK born cases, 4.3% (4) had a previous TB diagnosis, compared with 5.6% (5) of non-UK born cases. Non-UK born cases with a previous diagnosis had a lower median age (29.0 years, IQR: 23.0 to 29.0) than UK born cases (62.0 years, IQR: 36.5 to 83.5) with a previous diagnosis. The median time since previous diagnosis

was 5.5 years (IQR: 2.5 to 20.0). Among cases who were provided with directly-observed therapy (DOT), 3 (27.3%) cases had a previous TB diagnosis.

BCG vaccination

BCG vaccination status was available for 103 (52.8%) cases in 2018. A total of 64 (62.1%) cases had received a BCG vaccination. There were 5 cases under 5 years old in 2018 and 3 of these patients were recorded as having received a BCG vaccination. Non-UK born cases were more likely to be vaccinated (35, 37.6%) than UK born cases (28, 28.6%), see Table 5. The rate of BCG vaccination in 2018 is the highest since 2008. Among those cases where vaccination status was known, the highest rate of vaccination was among those aged 40-49 (10, 83.3%) and 50-59 (5, 83.3%).

Table 5. Number and proportion of TB patients with BCG vaccination by place of birth, South West, 2018

Place of birth	Cases with BCG vaccination	Percentage of cases (%)
UK born	28	28.6
Non-UK born	35	37.6
Total*	**64**	**62.1**

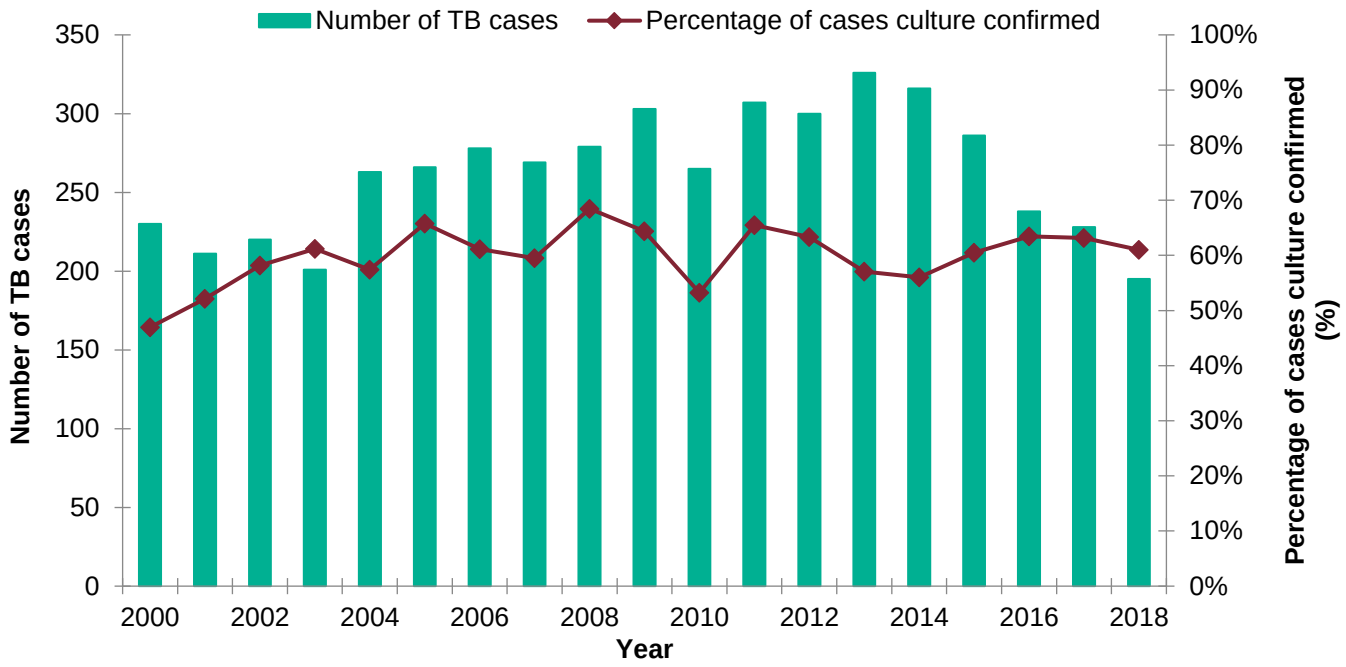
* Including cases with missing place of birth but with BCG vaccination recorded

Microbiological information

Culture confirmation and speciation

In 2018, data on culture confirmation were available for all cases. During this period there were 119 (61.0%) culture confirmed cases of TB in the South West. This proportion was lower than 2017 (144, 63.2%), see Figure 11. A total of 90 (66.2%) pulmonary cases were culture confirmed and 29 (49.2%) non-pulmonary cases were culture confirmed.

Figure 11. Number of TB cases and percentage of cases culture confirmed, 2000-2018



A greater proportion of non-UK born cases (61, 65.6%) were culture confirmed when compared with UK born cases (55, 56.1%).

Information on mycobacterial speciation was available for all culture confirmed cases. There were 109 (91.6%) cases of *Mycobacterium tuberculosis* and 9 (7.6%) cases of *Mycobacterium bovis*. The remaining case was reported as *Mycobacterium tuberculosis* complex (0.8%).

Sputum smear status

Data on sputum smear status were available for 67 (74.4%) pulmonary cases in 2018. Of all pulmonary cases with sputum smear information, 41 (61.2%) pulmonary cases were sputum smear positive. This is the largest proportion recorded since 2012.

TB transmission

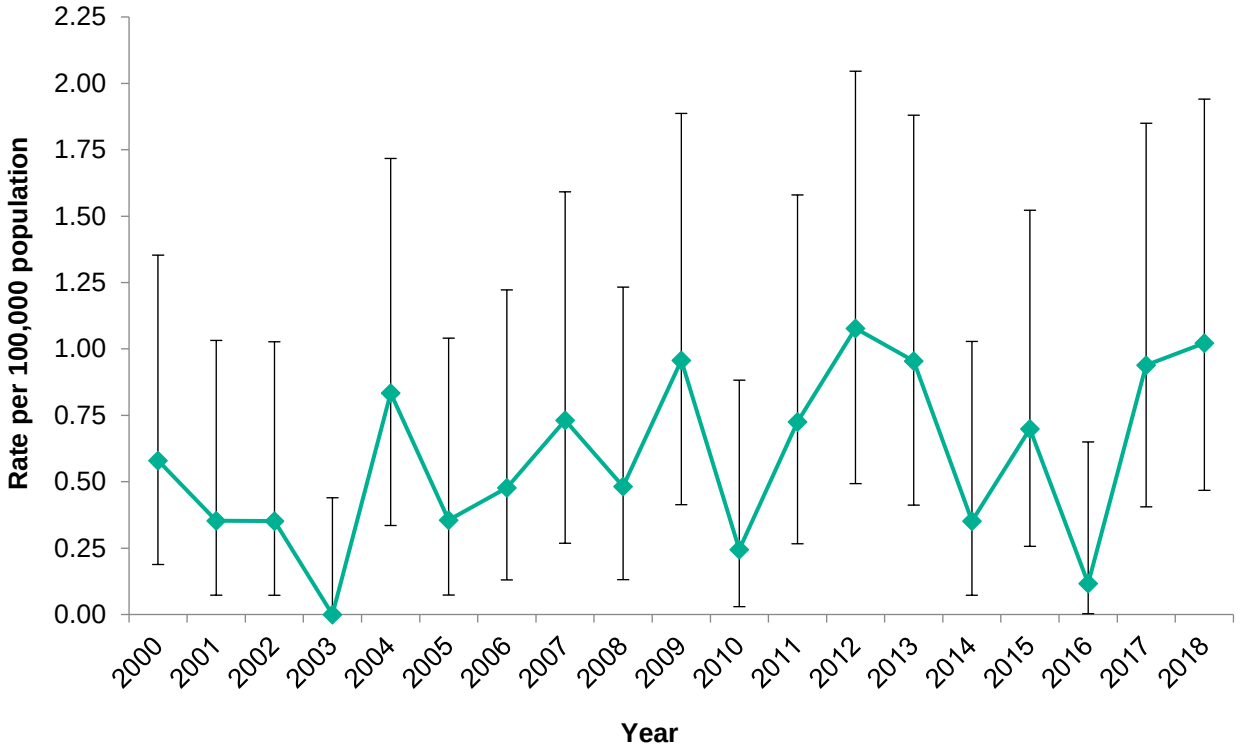
Rate of TB in UK born children

An indicator for ongoing local transmission is the rate of TB in UK born children under the age of 15. In 2018, the rate was 1.0 per 100,000 population, the highest rate reported since 2012, see Table 6.

Table 6. Number and rate of UK born TB cases by age, South West, 2000-2018

Year	Age < 15 years		All ages	
	TB Cases	Rate per 100,000 population	TB Cases	Rate per 100,000 population
2000	5	0.6	139	3.0
2001	3	0.4	123	2.7
2002	3	0.4	98	2.1
2003	0	0.0	87	1.9
2004	7	0.8	98	2.1
2005	3	0.4	123	2.6
2006	4	0.5	87	1.8
2007	6	0.7	97	2.1
2008	4	0.5	91	1.9
2009	8	1.0	99	2.1
2010	2	0.2	108	2.2
2011	6	0.7	127	2.6
2012	9	1.1	114	2.4
2013	8	1.0	151	3.1
2014	3	0.4	133	2.7
2015	6	0.7	123	2.5
2016	1	0.1	94	1.9
2017	8	0.9	106	2.2
2018	9	1.0	98	2.0

Figure 12. Rate of TB with 95% confidence intervals in UK born cases under 15, South West, 2000-2018



TB Monitoring Indicator 5: Incidence of TB in UK born children aged (<15 years) (England)

Whole genome sequencing

Whole genome sequencing (WGS) of *Mycobacterium tuberculosis* complex isolates was implemented in December 2016 in North and Central England and in January 2018 in the South of England. It replaced MIRU-VNTR strain typing. MIRU-VNTR refers to repetitive sequences of DNA located at specific loci (a particular position, point, or place in the genome) possessed by the *M. tuberculosis* genome. These repeats vary in number between different loci and different strains. The MIRU-VNTR profile used in England compares the number of repeats present at 24 specific loci across the genome.

WGS provides data on single nucleotide polymorphism (SNP) differences between the genomes of TB isolates, indicating how much the genome of the organism has mutated over time. The DNA sequence of Mycobacterium tuberculosis is estimated to change at the rate of approximately 1 SNP per genome every 2 years. Combined with clinical and epidemiological data, WGS offers greater understanding than MIRU-VNTR as to whether isolates belong to the same transmission chain and may also help determine the timing and direction of transmission between cases [3, 4, 5]. WGS can also enhance

diagnostic capability to identify *M. tuberculosis* complex and predict drug resistance using genotypic methods.

Although WGS was being performed routinely across England from January 2018, a number of TB services across the South West have agreed arrangements to refer clinical isolates for the Cardiff TB Reference Laboratory, which launched a routine WGS service in January 2019. Since MIRU-VNTR and WGS data are not directly comparable, it is not possible to report on clustering using a single method for cases notified in 2018. Some South West isolates underwent parallel MIRU-VNTR and WGS processing meaning both results will be available for future reporting on these isolates. WGS has also been carried out retrospectively on some isolates from TB cases epidemiologically and molecularly linked by MIRU-VNTR to support cluster investigation and to inform public health action going forward.

This report will explore the impact of WGS on public health investigation of TB cases and clusters during 2018.

Public health investigation and WGS

WGS is now utilised routinely to identify clusters in which cases are within 12 SNPs of each other. There is no currently consensus as to which SNP cut off is best utilised for public health investigation, although 12 SNPs represents the maximum SNP difference between 2 isolates for which epidemiological links have previously been identified[5] and is considered a conservative measure[6]. Cases and clusters are reviewed by the PHE South West Health Protection Team and Field Service South West to identify public health actions required to prevent ongoing transmission.

WGS has been used for public health management of clusters in the South West in:

- identification of new clusters
- identification of new cases within existing MIRU-VNTR clusters
- identification and confirmation of TB outbreaks

For example, in 2017, PHE was notified of an active case of TB in a prison in the South West. Following a second case notification, an outbreak investigation was undertaken which identified 2 further cases. WGS results showed that the clinical isolates from all 4 cases were closely related, with at most 5 SNP differences between them. 2 further cases were identified as part of this cluster during the latter stage of screening. Neither had epidemiological links to the prison and were not included in subsequent investigation of transmission within the prison.

Whole genome sequencing results

In 2018, isolates from 70 (58.8%) TB cases in the South West which were culture confirmed had WGS performed on them and isolates from 53 (44.5%) cases underwent MIRU-VNTR strain typing.

In 2018, 22.9% of cases were within 12 SNPs of at least 1 other TB case, compared to 24.9% nationally. The proportion of cases within 5 and 2 SNPs of at least 1 other TB case is shown in Table 7.

Table 7: Number and proportion of culture confirmed TB cases within specified SNP differences of at least 1 other case, 2018

SNP threshold	Number of cases	Percentage of cases (%)
12 SNP	16	22.9
5 SNP	13	18.6
2 SNP	10	14.3
Total cases with WGS result	70	100.0

Time delays from onset of symptoms to diagnosis and treatment

Delay from onset of symptoms to diagnosis

Data on the time between symptom onset and diagnosis were available for 174 (89.2%) cases in 2018, excluding those diagnosed post-mortem and asymptomatic cases. During this year, the median time between symptom onset and date of diagnosis was 88.0 days (IQR: 45.0 to 184.0), see Table 9. The minimum was 4 days and the maximum was 3847 days. However, there were exceptional circumstances surrounding the latter case and this case has been denotified since data was extracted for reporting. The median has not changed since 2017 however it should be noted that symptom onset date can be highly variable due to errors in reporting and difficulties in confirming a specific date when symptoms began.

In 2018, the median time between symptom onset and diagnosis for pulmonary cases was 92.0 days (IQR: 48.0 to 184.0). This median time was a substantial decrease since 2017 data (101.0 days (IQR: 39.0 to 183.0)). 43 (36.8%) pulmonary cases experienced a delay greater than 4 months. This proportion has increased substantially over recent years, from a minimum of 17.4% (15) in 2007.

Pulmonary sputum smear positive cases had a lower median delay (73.5 days, IQR: 38.0 to 170.0) than pulmonary sputum smear negative cases (87.5 days, IQR: 51.0 to

182.0). Non-pulmonary cases had a median delay of 70.5 days (IQR: 41.5 to 180.5), the second lowest recorded since 2001.

Table 9. Time between symptom onset and date of TB diagnosis*, South West, 2018

	Median days (IQR)	0-2 months		2-4 months		>4 months		All
		n	%	n	%	n	%	N
Pulmonary**	**92.0 (48.0-184.0)**	39	33.3	35	29.9	43	36.8	117
Non-pulmonary**	**70.5 (41.5-180.5)**	20	35.7	14	25.0	22	39.3	56
Pulmonary smear positive	**73.5 (38.0-170.0)**	15	37.5	10	25.0	15	37.5	40
Pulmonary smear negative	**87.5 (51.0-182.0)**	7	31.8	8	36.4	7	31.8	22
Total**	**88.0 (45.0-184.0)**	59	34.1	49	28.3	65	37.6	173

* Excluding asymptomatic cases, those with missing onset dates and those diagnosed post-mortem
** Including cases with missing sputum smear status information

Delay from onset of symptoms to treatment

In 2018, data on time between symptom onset and treatment start date were available for 174 (89.2%) cases, excluding those diagnosed post-mortem and asymptomatic cases. The median delay in 2018 was 92.5 days (IQR: 52.0 to 185.0). This is the second highest median delay recorded since 2000 but is a decrease since 2017. 53 (30.5%) cases started treatment within 2 months of symptom onset and 68 (39.1%) had a delay of greater than 4 months.

In 2018, the median delay for males decreased (80.5 days; IQR: 41.0 to 169.5) compared with 2017 (90.5 days; IQR: 39.0 to 186.0) but the median for females increased (112.5 days; IQR: 64.0 to 223.0) compared with 2017 (98.0 days; IQR: 61.0 to 202.0). The proportion of female cases with a delay from symptom onset to treatment of over 4 months was 44.6% (33) and for males was 35.0% (35).

The median delay for UK born cases was 100.0 days (IQR: 52.5 to 177.5) and for non-UK born cases was 90.0 days (IQR: 52.0 to 221.0).

The median delay for cases reporting at least 1 social risk factor was 80.0 days (IQR: 30.0 to 155.0). This is compared with a median delay of 103.0 days (IQR: 53.0 to 202.0) in those with no social risk factors. Among cases that did not report any social risk factors, 42.7% (56) experienced a delay of greater than 4 months compared with 33.3% (5) in cases reporting a social risk factor, see Table 10.

Table 10. Social risk factors and time between symptom onset and TB treatment, South West, 2018

	0-2 months		2-4 months		>4 months		Total
	n	%	n	%	n	%	N
No social risk factors	36	27.5	39	29.8	56	42.7	131
At least 1 social risk factor	5	33.3	5	33.3	5	33.3	15

TB Monitoring Indicator 6: Proportion of pulmonary TB cases starting treatment within 2 months of symptom onset (England, PHEC and Upper Tier Local Authority (UTLA) data shown on Fingertips)

TB Monitoring Indicator 7: Proportion of pulmonary TB cases starting treatment within 4 months of symptom onset (England, PHEC and Upper Tier Local Authority (UTLA) data shown on Fingertips)

Retrospective cohort study to identify risk factors associated with delays between TB symptom onset and treatment initiation in the South West, 2015-2018

Delays to treatment initiation amongst TB cases can lead to worse clinical and public health outcomes. In the South West in 2018 the proportion of TB cases with a delay of more than 4 months between symptom onset and treatment start was higher than the proportion observed nationally. This study therefore aims to identify risk factors associated with delays and to provide actionable recommendations to reduce these delays.

Two key delay periods will be measured and analysed in this study, the delay between onset of symptoms and presenting to healthcare ('presentation delay'), and the delay between presenting to healthcare and treatment initiation ('healthcare orientated delay'). Each delay period will have its own set of risk factors to be assessed including socio-demographic and clinical characteristics. This data will be collected from ETS between 2015 and 2018 inclusive. Cases will be described by time, place and person and outcomes ('presentation delay' and 'healthcare orientated delay') will be described using medians and interquartile ranges. The association between risk factors and outcomes will be measured using regression analysis.

TB outcomes in drug sensitive cohort

For the purposes of TB outcome reporting, the drug sensitive cohort excludes all TB cases with rifampicin resistant TB including MDR-TB, and non-culture confirmed cases treated as MDR-TB [7]. Treatment outcomes for the drug sensitive cohort are reported separately.

For cases with an expected duration of treatment less than 12 months, the outcomes at 12 months from treatment start date are reported. This group excludes cases with central nervous system (CNS) disease with an expected duration of treatment of 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.

For cases with CNS, spinal, cryptic disseminated or miliary disease, the last recorded treatment outcome is reported.

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

Outcomes in this section and the following section use a different dataset to the rest of the report. Cases in the dataset presented are based on the region where the last case manager was assigned to the case on ETS, that is, the treatment region. Therefore, the hospital variable may not correspond to the last case manager because of data validation rules on ETS. This data is therefore not comparable to the national annual report.

Treatment completion data were available for all drug sensitive cases notified in 2017. During this year, there were 17 (7.6%) drug sensitive cases that reported CNS TB and these were excluded from the following analysis.

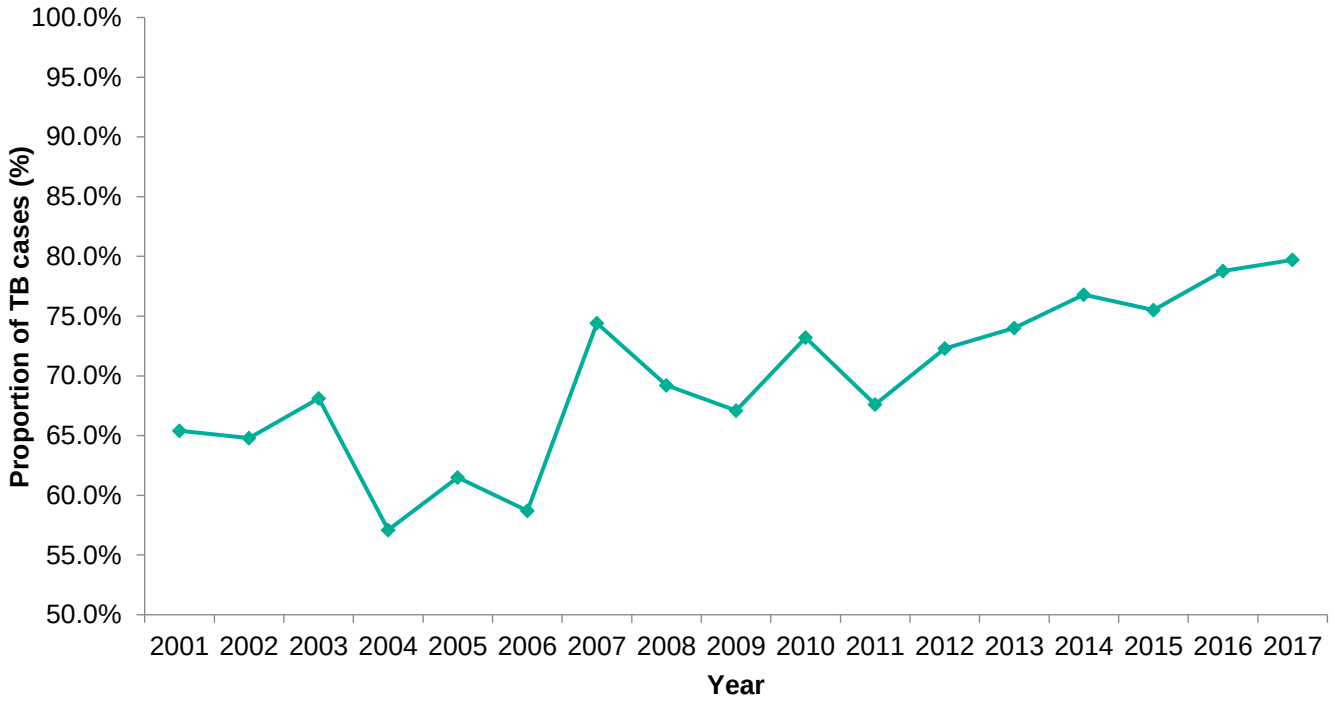
In the cohort without CNS disseminated disease and with TB infection sensitive to treatment using rifampicin, 165 (79.7%) cases completed treatment after a 12-month follow-up period, see Table 11. This is higher than the proportion of 2016 notifications which completed treatment within 12 months as reported in the previous annual report, see Figure 14. A higher proportion of cases notified in 2017 died or were still on treatment at 12 months when compared with cases notified in 2016, see Table 12.

Table 11. TB outcome at 12 months, South West, cases diagnosed in 2017*

Outcome at 12 months	Number of cases	Percentage of cases (%)
Completed	165	79.7
Died	17	8.2
Lost to follow up	7	3.4
Still on treatment	10	4.8
Treatment stopped	3	1.4
Not evaluated	5	2.4
Total	**207**	**100.0**

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

Figure 14. Proportion of TB cases completing treatment at 12 months, South West, 2001-2017*



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

Table 12. TB treatment outcomes at 12 months, 2001-2017*

Year	Completed (%)	Died (%)	Lost to follow up (%)	Still on treatment (%)	Treatment stopped (%)	Not evaluated (%)
2001	65.4	10.9	4.7	5.7	3.1	8.3
2002	64.8	11.8	6.4	7.4	2.9	10.3
2003	68.1	7.5	6.5	2.2	3.8	16.1
2004	57.1	8.3	7.1	5.4	1.3	18.3
2005	61.5	11.8	7.3	8.9	4.5	9.8
2006	58.7	8.1	7.8	7.4	3.1	24.0
2007	74.4	6.5	4.1	10.2	0.4	10.6
2008	69.2	9.3	6.6	14.8	1.2	5.8
2009	67.1	7.7	8.4	11.4	0.4	8.8
2010	73.2	7.0	3.3	7.4	0.8	7.4
2011	67.6	4.3	7.1	11.7	0.4	7.8
2012	72.3	7.7	5.1	8.4	0.4	8.0
2013	74.0	5.9	5.3	7.3	0.7	6.9
2014	76.8	7.6	6.5	7.6	1.0	1.4
2015	75.5	4.4	4.4	6.0	4.0	1.2
2016	78.8	3.8	5.2	3.3	1.9	2.9
2017	79.7	8.2	3.4	4.8	1.4	2.4

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

TB Monitoring Indicator 10: Number and proportion of drug sensitive TB cases that had completed a full course of treatment by 12 months (England, PHEC and UTLA data shown on Fingertips)

TB Monitoring Indicator 7: Number and proportion of drug sensitive TB cases that were lost to follow-up at last reported outcome (England, PHEC and UTLA data shown on Fingertips)

TB Monitoring Indicator 7: Number and proportion of drug sensitive TB cases that had died at last reported outcome (England, PHEC and UTLA data shown on Fingertips)

Of the notifications which were lost to follow-up, 3 (42.9%) left the UK whilst undergoing treatment and 2 (28.6%) were recorded as having other reasons for disengagement with TB services. Of the cases that died prior to treatment completion, 1 (5.9%) had death caused by TB and 3 (17.6%) were categorised as ‘TB incidental to death’. For 8 (47.1%) cases, it was recorded that ‘TB contributed to death’, and 5 (29.4%) had an unknown relationship between death and TB. 2 cases were diagnosed post-mortem in 2017. The median age of cases that died during their treatment for TB was 74.0 years (IQR: 69.0 to 78.0 years). For 6 (66.7%) cases which were still on treatment, a reason

for this was given. Treatment was extended for 5 (55.6%) cases and treatment was interrupted for 1 (11.1%) case.

A higher proportion of females (66, 84.6%) completed treatment than males (99, 76.7%). The remaining females most commonly were still on treatment (6, 7.7%). 2 (2.6%) female cases were not evaluated, 2 (2.6%) stopped treatment, 1 (1.3%) died and 1 (1.3%) was lost to follow-up. This is compared with male outcomes with 6 (4.7%) that were lost to follow-up, 16 (12.4%) died, 3 (2.3%) were not evaluated, 4 (3.1%) were still on treatment and 1 (0.8%) stopped treatment. All the 10 youngest cases in the cohort (0-14) completed treatment (100.0%). A substantially higher proportion of those in the oldest age group (≥65) died prior to treatment completion (15, 35.7%). Two cases (4.1%) aged 45-64 also died and 3 (6.1%) cases in this age group were still on treatment. Of those aged 15-44, 6 (5.7%) were lost to follow-up, 5 (4.7%) were still on treatment and 3 each (2.8%) had treatment stopped and were not evaluated.

There was a higher treatment completion rate among non-UK born patients (91, 85.0%) than UK born individuals (71, 74.0%), but there was also a higher proportion of non-UK born patients lost to follow-up (6, 5.6%) than UK born patients (1, 1.0%). However, a higher proportion of UK born cases died (14, 14.6%) compared with non-UK born cases where 2 (1.9%) cases died. A higher proportion of non-UK born cases were still on treatment (6, 5.6%) compared with UK born notifications (4, 4.2%).

The only case in the Black-Other group completed treatment (1, 100.0%). The ethnicity with the next highest treatment completion rate was Indian (29, 90.6%). The lowest treatment completion rates were observed in the Black-Caribbean (1, 50.0%), White (79, 73.8%) and Asian-Other (6, 75.0%) ethnicities. The highest proportion of notifications with deaths occurring during treatment was observed in the population with White ethnicity (15, 14.0%). The 2 remaining cases who died were of Asian-Other ethnicity (25.0%).

Treatment completion was reported for a slightly lower proportion of cases reporting at least 1 social risk factor (19, 79.2%) compared with cases reporting no social risk factors (122, 81.9%).

Upper tier local authorities with 5 or more cases that had a treatment completion rate of 70% or more were: Bournemouth, Christchurch and Poole (13, 81.3%), City of Bristol (47, 85.5%), Cornwall and Isles of Scilly (10, 71.4%), Devon (13, 72.2%), Dorset (7, 77.8%), Gloucestershire (14, 70.0%), Somerset (5, 71.4%), Swindon (22, 95.7%), Wiltshire (7, 77.8%). Plymouth had the lowest completion rate of areas with 5 or more cases (12, 66.7%). North Somerset had the highest proportion of cases whose outcome was not evaluated (1, 25.0%).

Outcomes: patients with CNS, spinal, miliary or cryptic disseminated disease

This section explores the outcomes of patients with CNS, spinal, miliary or cryptic disseminated TB that are sensitive to treatment with rifampicin.

There were 17 (7.6%) cases of TB sensitive to rifampicin treatment with CNS, spinal, miliary or cryptic dissemination notified in 2017. Of these cases 10 (58.8%) completed treatment and 4 (23.5%) were still on treatment, see Table 13. This is an increase in the proportion of cases completing treatment compared with 2016 when 50.0% (12) of cases completed treatment. There has been a decrease in the proportion of cases still on treatment compared with 2016.

Table 13. Outcome at 12 months for TB patients with rifampicin sensitive, CNS, spinal, miliary or cryptic disseminated disease, South West, cases diagnosed in 2017*

Outcome at 12 months	Number of cases	Percentage of cases (%)
Completed	10	58.8
Died	2	11.8
Lost to follow up	0	0.0
Still on treatment	4	23.5
Treatment stopped	0	0.0
Not evaluated	1	5.9
Total	**17**	**100.0**

* Excludes rifampicin resistant TB

Of the 2 people who died amongst 2017 notifications, 1 (50.0%) case was recorded as ‘TB caused death’ whilst for the other case (1, 50.0%) the relationship between TB and death was unknown. 1 case was diagnosed post-mortem. The majority of people (3, 75.0%) that were still on treatment had their treatment extended. Treatment was changed for 1 (25.0%) case.

Of the 17 cases with rifampicin sensitive CNS, spinal, miliary or cryptic disseminated disease 13 (76.5%) were male. A higher proportion of female cases completed treatment (3, 75.0%) than male (7, 53.8%). All the cases which were still on treatment were male. One case with drug sensitive CNS, spinal, miliary or cryptic TB was aged 0-14 and this case was still on treatment after 12 months. Of those cases aged 15-44, 3 (60.0%) completed treatment, 1 (20.0%) was still on treatment and 1 (20.0%) was not evaluated. Of the 8 cases aged 45-64 years, 6 (75.0%) cases completed treatment and 2 (25.0%) cases were still on treatment. Two (66.7%) cases aged ≥65 years died, whilst 1 (33.3%) case in this group completed treatment.

UK born cases had a higher treatment completion rate (7, 77.8%) than their non-UK born counterparts (3, 42.9%). 3 (42.9%) non-UK born cases were still on treatment and 1 (14.3%) was not evaluated. This compares to 1 (11.1%) UK born case still on treatment and 1 (11.1%) case who died.

No drug sensitive CNS, spinal, miliary or cryptic TB cases notified in 2017 reported any social risk factors.

The City of Bristol had the largest number of cases in this group of any South West upper tier local authority (6). Four (66.7%) completed treatment and 2 (33.3%) were still on treatment. North Somerset, Plymouth and Somerset all had 2 cases in this group. In North Somerset 1 (50.0%) case completed treatment and 1 (50.0%) was not evaluated. Both cases (100.0%) in Plymouth were still on treatment. 1 (50.0%) case in Somerset completed treatment and 1 (50.0%) case died.

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

The number and distribution of drug resistant cases notified in 2018 has been analysed. Outcomes related to drug resistant TB are presented for cases notified in 2016 due to the 24-month follow-up period. Unless otherwise stated, proportions in this section refer to the proportion of all culture confirmed cases excluding *M. bovis* cases as *M. bovis* is resistant to pyrazinamide.

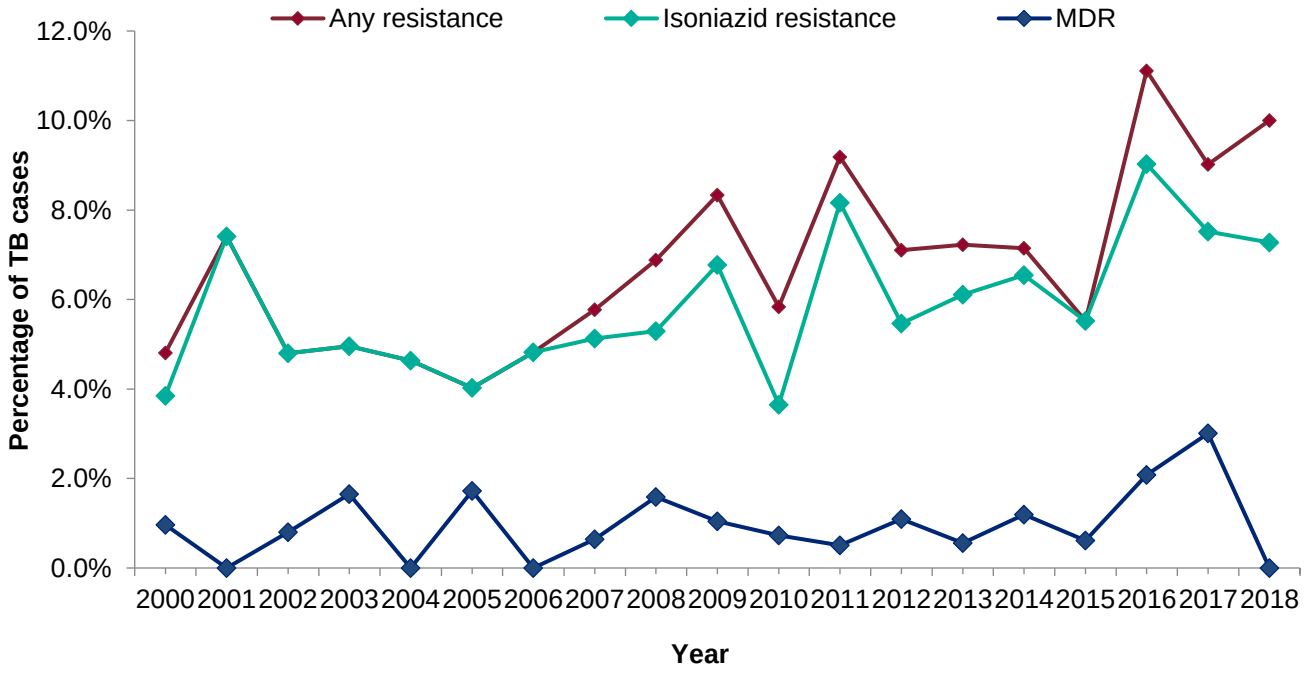
Overall drug resistance and geographical distribution

In 2018, 11 (10.0%) culture confirmed cases exhibited resistance to at least 1 first-line drug, see Figure 15. In 2018, 8 (7.3%) culture confirmed isolates had isoniazid resistance, 1 (0.9%) had ethambutol resistance and none had rifampicin resistance. 2 (1.8%) isolates had pyrazinamide resistance.

In addition to these cases, there was 1 M. bovis case which was resistant to isoniazid as well as pyrazinamide.

No culture confirmed TB cases were found to be multi-drug resistant (MDR) in 2018. In 2017, there were 4 MDR TB cases reported in the South West.

Figure 15. Percentage of culture confirmed TB cases with first-line drug resistance, South West, 2000-2018



TB Monitoring Indicator 9: Number and proportion of culture confirmed TB cases with drug susceptibility testing reported for the 4 first-line agents (England, PHEC and UTLA data shown on Fingertips)

TB Monitoring Indicator 18: Number and proportion of culture confirmed TB cases with any first-line drug resistance (England, PHEC and UTLA data shown on Fingertips)

TB Monitoring Indicator 19: Annual number and proportion of culture confirmed TB cases with MDR-TB (England, PHEC and UTLA data shown on Fingertips)

In 2018, the local authorities with the largest proportion of culture confirmed cases showing resistance to a first-line drug were Torbay, South Gloucestershire and City of Bristol. Seven local authorities in the South West had no cases in 2018 with resistance to a first-line drug.

Characteristics of patients with drug resistant TB

Of culture confirmed non-UK born cases, 7 (11.5%) cases were resistant to a first-line drug, compared with 4 (8.7%) of the UK born culture confirmed cases. 3 (75.0%) of the UK born notifications with drug resistance were found to be resistant to isoniazid.

The proportion of resistant isolates among culture confirmed female cases was 8.7% (4) compared with 10.9% (7) in males. The only case with Black-Caribbean ethnicity was drug resistant. The next highest proportion of resistant isolates were identified in cases with Black-African (3, 23.1%) ethnicity and Mixed/Other (2, 18.2%) ethnicities. The 15-44 age group had the highest proportion of culture confirmed cases exhibiting resistance (9, 15.0%). No cases with a drug resistant isolate had a previous diagnosis of TB recorded.

Of those cases which were culture confirmed reporting at least 1 social risk factor, 1 was resistant to at least 1 first-line drug (1, 7.7%). Of those not reporting social risk factors 9 (11.8%) cases were resistant to at least 1 first-line drug. A higher proportion of drug resistant notifications was reported amongst pulmonary cases (10, 12.2%) than non-pulmonary cases (1, 3.6%).

Second-line drug resistance and extensively drug resistant (XDR) TB

There were 4 (3.6%) culture confirmed notifications in 2018 with an infection resistant to second-line drugs. This is an increase of 1 from 2017. 3 (2.7%) of the cases with resistance to second-line drugs were male and 1 (0.9%) female. All 4 (3.6%) were UK

born and had pulmonary disease and 2 (1.8%) had White ethnicity. No cases had a previous TB diagnosis and no cases reported a social risk factor.

In 2018 no cases were found to be extensively drug resistant (XDR). Only 2 cases in the South West have ever been reported as XDR and these occurred in 2014 and 2017.

Outcomes: patients with rifampicin resistant TB at 24 months

Outcomes in this section of the report use a different dataset to the rest of the report. Cases in this dataset are based on the region where the last case manager assigned to the case on ETS operates, that is, the treatment region. Therefore, the hospital variable may not correspond to the last case manager because of data validation rules on ETS. This data is therefore not comparable to the national annual report.

Of culture confirmed cases notified in 2016, 4 (2.8%) were rifampicin resistant. 2 (1.4%) of these cases completed treatment within 24 months. 1 (0.7%) case was still on treatment at 24 months and 1 (0.7%) was lost to follow-up. 2 (1.4%) cases were male and 2 (1.4%) were female and all 4 cases were of different ethnicities. All 4 (2.8%) cases were non-UK born and had pulmonary disease and no social risk factors. 1 (0.7%) case was recorded as having a previous TB diagnosis.

TB Monitoring Indicator 13: Number and proportion of drug resistant TB cases that had completed treatment at 24 months (England, PHEC and UTLA data shown on Fingertips)

TB Monitoring Indicator 14: Number and proportion of drug resistant TB cases that were lost to follow-up at last reported outcome (England, PHEC and UTLA data shown on Fingertips)

TB Monitoring Indicator 15: Number and proportion of drug resistant TB cases that had died at last reported outcome (England, PHEC and UTLA data shown on Fingertips)

Spotlight on research: Retrospective cohort study to identify factors associated with treatment outcomes at 12 months in the drug sensitive cohort in the South West

Treatment completion among the drug sensitive cohort notified in 2017 across the South West is 79.7%. Although slowly increasing over the last five years, this remains below the Chief Medical Officer's target of 85%[8] and is one of the lowest rates in England. There is a limited evidence base for what factors are associated with TB treatment outcomes in low incidence areas and successful treatment completion is likely to be both complex and multifactorial. Untreated or incompletely treated TB represents a risk of onward transmission and may also contribute to the increasing number of drug-resistant cases and is therefore an important issue in the overall control and elimination of TB.

This study will investigate factors associated with treatment outcome with the aim to inform public health action to improve the proportion of cases with drug-sensitive TB resident in the South West who complete treatment within 12 months of initiating therapy. The study will use data from ETS to look at selected socio-demographic, clinical and service-level factors for TB notifications. Supplementary Information regarding service provision will also be sought directly from TB services, with support from NHS England and NHS Improvement. Data for the South East will also be included in the analysis, as representative of an area with a higher treatment completion rate (86.2%) and organisationally co-configured within the South of England TB Control Board.

Identification of factors associated with poor treatment completion will provide a better understanding of barriers, aid the development of recommendations to improve outcomes for individuals and reduce transmission risk for the wider population and support the introduction of evidence-based interventions.

TB in those with social risk factors and health inequalities

Social risk factors

In 2018, data on social risk factors were available for 151 (82.1%) notifications aged 15 and over. During this year, 16 (10.6%) cases reported at least 1 social risk factor (alcohol abuse, drug use, homelessness and/or imprisonment), see Table 14. The majority of these reported 1 of the social risk factors only (12, 75.0%), with 4 (25.0%) cases reporting 2 risk factors. In 2018, no cases reported more than 2 risk factors.

A higher proportion of people with pulmonary disease reported at least 1 social risk factor (14, 13.5%), than people with non-pulmonary disease (2, 4.3%).

At least 1 social risk factor was reported by 11 (14.3%) UK born cases while 5 (6.8%) non-UK born cases reported at least 1 social risk factor. Of all male TB cases aged 15 and over, 13 (14.6%) cases reported at least 1 risk factor, compared with 3 (4.8%) female cases.

Among people reporting at least 1 social risk factor, the most prevalent risk factor was drug use, reported by 7 (43.8%) of cases, see Table 15.

Table 14. TB cases reporting at least 1 social risk factor, South West, 2010-2018

Year	Any risk factor		Total
	Number of cases	Percentage of cases (%)	
2010	21	12.4	170
2011	23	11.3	204
2012	32	14.1	227
2013	36	13.8	260
2014	23	9.0	255
2015	32	13.7	233
2016	28	14.7	191
2017	24	13.8	174
2018	16	10.6	151

Table 15. Individual social risk factors among TB cases, South West, 2018

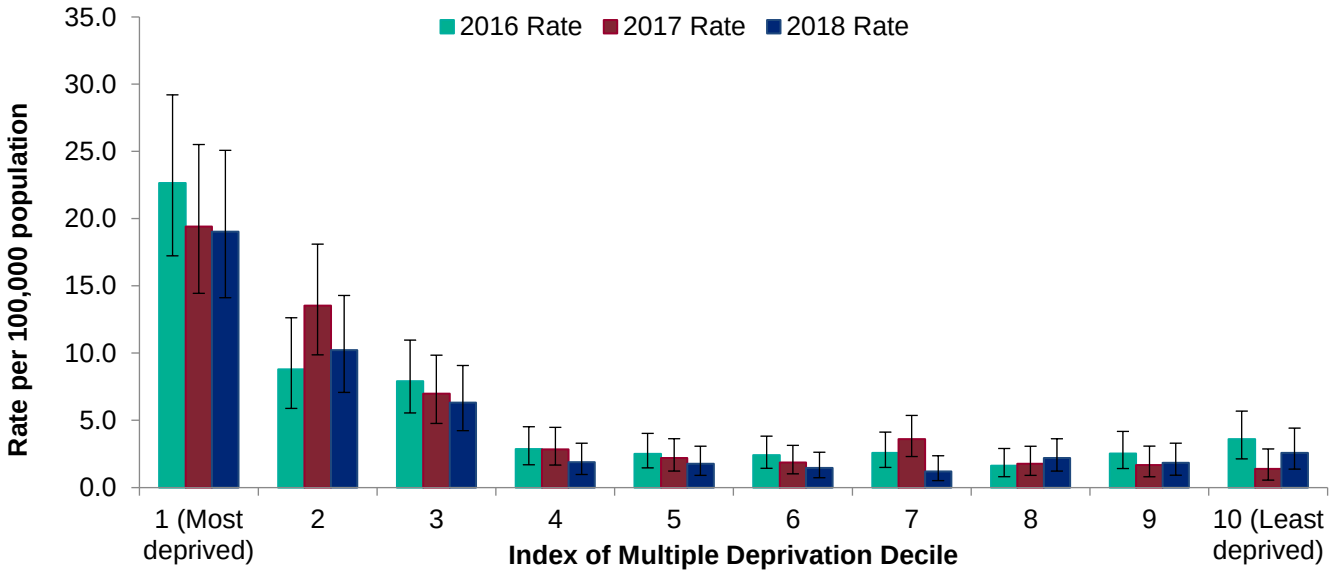
Social risk factor	Number of cases	Percentage of cases (%)
Homelessness	5	31.3
Drug use	7	43.8
Alcohol	5	31.3
Imprisonment	3	18.8

Deprivation

The Index of Multiple Deprivation (IMD), part of the English Indices of Deprivation, is an overall measure of deprivation experienced by people living in an area. It is measured at the level of lower super output areas and was last updated in 2015. The postcodes of cases were linked to an IMD score as an indicator of socio-economic status. In 2018, data on IMD were available for all notifications. During this year, the largest proportion of cases lived in areas from the most deprived IMD decile (50, 25.6%). The highest rate of TB was also observed in this decile, see Figure 16 where rates are calculated based on IMD rankings within the South West. However, in 2018 the rate in the most deprived decile was reduced when compared with the previous 2 years.

There appears to be a trend towards higher rates of TB with increasing socio-economic deprivation. In 2018, the highest rates are in deciles 1 to 3. The rate then remains low through deciles 4 to 6 but appears slightly elevated in decile 8 and 10. The lowest rate was seen in decile 7.

Figure 16. TB rate and 95% confidence intervals by Index of Multiple Deprivation decile, South West, 2016-2018



HIV testing, directly observed therapy (DOT), and Hospital admissions

HIV testing

In 2018, data on HIV testing were available for 175 (89.7%) cases. For some cases, HIV status was already known (8, 4.6%). Of those where status was unknown, most (164, 93.7%) were offered an HIV test and had this completed, see Table 16. 3 (1.7%) cases were not offered an HIV test.

Table 16. HIV testing for TB cases, South West, 2018*

HIV testing status	Number of cases	Percentage of cases (%)
HIV test offered and done	164	93.7%
HIV test offered but not done	0	0.0%
HIV test offered but refused	0	0.0%
HIV status already known	8	4.6%
HIV test not offered	3	1.7%
Total	**175**	**100.0%**

* Excludes cases diagnosed post-mortem

TB Monitoring Indicator 16: Number and proportion of TB cases offered an HIV test (England, PHEC and UTLA data shown on Fingertips)

Hospital inpatient and directly observed therapy (DOT)

In 2018, data on inpatient treatment for TB were available for 181 (92.8%) cases. A total of 45 (24.9%) cases were treated as an inpatient at some point during their care, see Table 17. Data on DOT were available for 177 (90.8%) cases. 11 (6.2%) patients received DOT as part of their care in 2018. This is less than half the number of cases receiving DOT in 2017 (32).

Table 17. Hospital inpatient and DOT use* for TB cases, South West, 2018

	Number of cases	Percentage of cases (%)	Total
Hospital inpatient	45	24.9%	181
DOT given	11	6.2%	177

* At any time during treatment

Comparison between South West and England

In 2018, the rate of TB in the South West (3.5 per 100,000 population) was less than half that observed nationally (8.3 per 100,000 population). The South West and North East both had the lowest regional rate, with the next lowest rate in East of England at 5.2 per 100,000 population. The highest rate nationally was in London with 19.0 per 100,000 population.

In 2018, the rate of TB in UK born children (<15 years) in the South West (1.0 per 100,000) was lower than in England (1.2 per 100,000). The national rate decreased in 2017 and 2018 but the South West rate increased marginally in 2018.

The South West had the lowest rate of disease in the non-UK born population (18.7 per 100,000 population). England as a whole experienced a non-UK born rate of 39.0 per 100,000 population and 2.8 per 100,000 population for UK born. Until 2016, there was a year on year increase in the proportion of non-UK born cases diagnosed ≥11 years after entry to the UK seen in the South West which also occurred at a national level. However, although at a national level this proportion remained stable in 2018, this was not reflected in the South West where this proportion dropped to 31.1% in 2017 and 27.9% in 2018.

In the South West the percentage of pulmonary cases (69.7%) was higher than recorded nationally (57.3%). In England 61.2% of all TB cases and 74.0% of pulmonary cases were culture confirmed in 2018. In the South West 61.0% of all cases and 66.2% of pulmonary cases were culture confirmed. In both 2016 and 2017, the South West had the lowest proportion of culture confirmed pulmonary cases but in 2018 the South West had the second lowest proportion of culture confirmed pulmonary cases.

The proportion of pulmonary notifications with a delay greater than 4 months between symptom onset and treatment start date in the South West was 38.1%. This was the highest proportion out of the regions in England, as was also the case in 2017.

In contrast to previous years, the South West region had the lowest proportion of cases reporting at least 1 social risk factor (10.6%). Nationally this figure was 13.3%, the largest proportion since data collection began in 2010, but the South West was 1 of 3 PHE Centre areas to observe a decrease in the proportion of cases reporting at least 1 social risk factor between 2017 and 2018.

Excluding cases where HIV status was known, 98.2% of cases in the South West had an HIV test offered and completed, which was the highest proportion of all PHE centre areas. This was also higher than the proportion in England. Nationally DOT was received in 13.7% of cases. In the South West it was used in 6.2% of cases.

The South West recorded 10.1% of culture confirmed cases exhibiting resistance to at least 1 first-line drug. Nationally 11.4% of cases displayed the same resistance in 2018, compared with 8.6% in 2017. In the South West between 2014 and 2018, 1.3% of cases were MDR compared with 1.4% nationally. In 2018, 4 cases nationally were XDR but none of these occurred in the South West.

In relation to outcome at 12 months for drug sensitive 2017 notifications, the South West had a treatment completion rate of 79.7% which was the second lowest of any region. The lowest rate was observed in North East (74.7%). Nationally the completion rate was 84.7% over the same period. This discrepancy between the England and South West completion rate was due to a comparatively high proportion of cases who died or were not evaluated at 12 months in the South West.

Latent TB infection testing and treatment

In January 2015, the 'Collaborative Tuberculosis Strategy for England' identified £10 million of funding to establish new migrant Latent TB infection (LTBI) testing and treatment services in areas with high TB incidence (>20.0 cases per 100,000 population). The only clinical commissioning group (CCG) to meet this threshold in the South West was Bristol.

The Bristol LTBI testing and treatment service is delivered through primary care and aims to prevent active TB by identifying and treating latent TB infection. Those eligible for the service are people registering with a GP practice in Bristol who:

- were born or spent more than 6 months in a high TB incidence country (>150.0 per 100,000 population or Sub-Saharan Africa)
- entered the UK within the last 5 years
- are aged between 16-35 years
- have no history of TB, either treated or untreated
- have never been screened for TB in the UK

Data on GP patient registrations were analysed to estimate the number of patients that would be eligible for LTBI screening. Based on an average of 3 years of data, the expected screening cohort for a full year was estimated as:

- number of new migrants eligible for screening: 1,025 to 1,324
- number requiring treatment for latent TB (20% positivity): 205 to 265
- number requiring treatment for active TB (<1%): <10

All new patients registering with a GP practice (or identified through The Haven[1]) that meet the eligibility criteria are offered LTBI screening, which comprises a single blood test. A positive result leads to a referral to the TB secondary care providers for treatment and support.

The service has been delivered in 2 phases. Phase 1 commenced in February/March 2016 and saw the service being delivered across 5 GP practices that had the highest need and The Haven. Phase 2 saw the service delivered to the next cohort of GP practices in Bristol CCG identified with high need.

[1] The Haven offers asylum seekers and refugees across Bristol a comprehensive health assessment

For phase 1, 3 practices (and the Haven) signed up to deliver the service. Approximately, 65 patients were invited to be tested for LTBI, 53 patients were tested and 11 found to be positive with LTBI. Two results were equivocal, and it was recommended that practices should re-test these patients. One patient was identified with active TB and was referred appropriately.

Phase 2 was launched on 27 September 2016 and offered to an additional 5 practices in Bristol. Two of these practices agreed to sign up to the service. From the start of phase 2 until November 2016 an additional 14 individuals were screened and 3 found to be positive for LTBI.

Phase 2 continued through to 2018 but uptake did not reach the anticipated levels seen in other parts of the country. Following a successful trial, a new model of delivery was agreed in 2019 which has seen provision change from General Practice to a community health service provider

Discussion

This report provides an epidemiological overview of TB in the South West. It uses notification data from 2018 and outcome data for cases notified in 2017 and 2016. There has been a year-on-year decrease in the incidence of TB in the South West since 2013 and the rate in 2018 was the lowest since 2003.

The England TB rate has also been decreasing in recent years. Between 2017 and 2018, the England TB rate decreased by 0.9 per 100,000, representing a 9.7% decrease in incidence. Comparatively, the South West rate decreased by 0.6 per 100,000, which is a 15.0% decrease in incidence between 2017 and 2018.

The age distribution of TB cases has remained largely similar throughout recent years, with variation generally reflecting changes in population-wide age distribution. The proportion of cases in people aged under 16 increased in 2018 compared with 2017 and 2016. Prevention of paediatric TB cases should be a focus for South West TB networks, particularly across the City of Bristol.

The rate of TB in both the UK born and non-UK born populations decreased compared with 2017. However, the rate in the non-UK born population was still much higher than the UK born rate, although the UK born population made up the majority of notified cases. The further decrease in TB rate in this population in 2018 could be a result of the UK pre-entry screening programme in high TB incidence countries. In addition, the number of migrants arriving in the UK from high TB burden countries has decreased in recent years and this may have affected the number of non-UK born cases in the South West.

For the second consecutive year there has been a decrease in the proportion of non-UK born cases diagnosed with TB ≥11 years after entering the country. This group accounted for 27.9% of non-UK born TB cases in 2018 compared to 31.1% in 2017, following a low of 10.2% in 2005. There has been a corresponding increase in the proportion of non-UK born cases diagnosed with TB less than 2 years after entry. Whether this reflects more rapid onset of active TB since entering the UK, earlier presentation to health services, re-activation of latent infection, exposure to an infectious case or another factor is unclear. However, in 2018 the proportion of those diagnosed between 6 and 10 years after entering the country increased and a corresponding decrease was observed in those diagnosed between 2 and 5 years after entering the country.

After a sustained decrease between 2013 and 2016, there was an increase in the rate of TB in the UK born population in 2017, but this rate decreased in 2018. The rate in UK

born children under the age of 15 also increased this year, though numbers of cases in this group are low. Although this rate remains slightly lower than the national rate, this should continue be a focus for improvement across the South West. Although, considering rates in this group, the 95% confidence intervals are wide and represent uncertainty in the measure due to small numbers of cases. Caution is therefore required when interpreting differences between annual rates in this group.

The geographical distribution of TB in the South West continues to show a concentration of cases within urban upper tier local authorities. This is similar to the distribution seen nationally. The highest rates of TB were observed in the City of Bristol, Swindon, Plymouth and Bournemouth, Christchurch and Poole. These local authorities contain some of the largest urban areas in the South West. The incidence rate for Bristol has now decreased in 5 consecutive years and is the lowest recorded since 2001. The rate in Plymouth increased between 2016 and 2017 but decreased in 2018. The rate in Swindon decreased substantially between 2017 and 2018 to the lowest rate recorded since 2005. Despite this, the City of Bristol contributed almost double the number of TB cases to the South West total reported in any other area.

High rates in urban areas may reflect the relative ease of transmission of respiratory infections in more densely populated areas. Also, these cities contain some of the most deprived areas in the South West, according to IMD ranking. As has been shown, TB rates are higher in more deprived areas. This may explain some of the geographic inequality in TB rate.

The proportion of cases which were resistant to at least 1 first-line drug decreased in 2016, 2017 and 2018 and there were no MDR or XDR TB cases reported in 2018. However, there was an increase in the proportion of cases with isoniazid resistance in 2018 compared with 2017 and 2016. Male cases were more likely to show first-line drug resistance than female cases and a higher proportion of pulmonary cases showed first-line drug resistance than non-pulmonary cases.

In 2017, the South West had the lowest culture confirmation rate for pulmonary cases (70.8%) of any PHE Centre area in England, joint with Yorkshire and Humber. In 2018, the South West had the second lowest culture confirmation rate (66.2%) but this rate was a decrease compared with the 2017 rate. Culture confirmation supports confirmation of clinical and radiological TB diagnosis, selection of appropriate treatment regimens, and microbiological reference typing for public health investigations. Culture confirmation will also support WGS typing of TB isolates in the future. TB services across the South West should target improvement in culture confirmation rates.

The proportion of cases in 2018 with a delay of more than 4 months between symptom onset and treatment start date decreased compared with 2017 but this was the highest

proportion out of all PHE Centre areas in England. The overall median delay between symptom onset and treatment start date decreased in 2018 compared with 2017 for all cases and for pulmonary cases. In contrast to previous years, groups reporting a social risk factor had a shorter median delay that those reporting no social risk factor, perhaps indicating the success of efforts to access these groups. Continuing to shorten treatment delays should be a priority for South West TB networks as this is likely to reduce transmission and ensure better treatment outcomes.

In 2018, the proportion of TB cases reporting 1 or more social risk factors was the lowest recorded since 2014. Cases reporting a risk factor were much more likely to be male, UK born and have pulmonary disease. Drug use continues to be the most frequently reported social risk factor among South West TB cases.

The South West continued to have the second lowest treatment completion rate for the drug sensitive cohort. The South West has regularly missed the recommended target for 12-month treatment completion of 85% of cases [8, 9]. The South West had the highest proportion of deaths among 2017 cases with drug sensitive TB of all PHE Centre areas. Of these, most cases were aged over 65.

Conclusion

The fifth consecutive annual reduction in the incidence of TB in the South West, although not necessarily part of a statistically significant downward trend, is promising. The data continues to suggest that TB control in the South West is improving.

However, a number of challenges remain which include:

- continued low rates of treatment completion and variation in these rates between different types of TB cases
- high proportion of cases experiencing a delay of more than 4 months between symptom onset and treatment start compared with other regions, despite improvements compared with 2017
- low and decreasing rates of culture confirmation
- increased proportion of cases among children in certain local authority areas
- concentration of TB cases in certain subgroups including the non-UK born population and deprived areas

It is expected that as cohort review continues to evolve it will facilitate services to improve TB detection, reduce healthcare associated delays and improve treatment outcomes. WGS is also expected to improve TB management and prevention. TB continues to present challenges for treatment completion which need to be taken into account when providing services.

References

1. Collaborative tuberculosis strategy for England: 2015-2020: www.gov.uk/government/publications/collaborative-tuberculosis-strategy-for-england

2. UK labour market: February 2019: www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/bulletins/uklabourmarket/february2019

3. Schurch AC, Kremer K, Daviena O, et al. *High-resolution typing by integration of genome sequencing data in a large tuberculosis cluster*. J Clin Microbiol. 2010; 48: 3403–06.

4. Gardy JL, Johnston JC, Sui SJH, et al. *Whole-genome sequencing and social-network analysis of a tuberculosis outbreak*. N Engl J Med. 2011; 364: 730–39.

5. Walker TM, Ip CL, Harrell RH, et al. *Whole-genome sequencing to delineate Mycobacterium tuberculosis outbreaks: a retrospective observational study*. The Lancet Infectious Diseases. 2013; 13(2): 137-46.

6. Tuberculosis in England 2019 report: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/821334/Tuberculosis_in_England-annual_report_2019.pdf

7. Walker, TM, Lalor MK, Broda A, et al. *Assessment of Mycobacterium tuberculosis transmission in Oxfordshire, UK, 2007–12, with whole pathogen genome sequences: an observational study*. The Lancet Respiratory Medicine. 2014; 2(4): 285-292.

8. Stopping tuberculosis in England: an action plan from the Chief Medical Officer: www.tbalert.org/wp-content/uploads/2011/04/images_pdf_stoppingtb_actionplan.pdf

9. Story, A and Cocksedge, M. *Tuberculosis case management and cohort review: guidance for health professionals.* 2012; London: Royal College of Nursing.

Appendix A: Methods, description of data sources and definitions

Methods

For a full description of the methods used to collect, manage, and clean the data see the national TB annual report:

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/821334/Tuberculosis_in_England-annual_report_2019.pdf

Data sources

Data on TB cases in the South West come from the national Enhanced TB Surveillance (ETS) system. Data collected includes notification, demographic, clinical and microbiological information, including drug resistance, strain type and WGS information, provided by the Cardiff Reference Laboratory and the National Mycobacterium Reference Laboratory.

Population denominators come from the Office for National Statistics (ONS) mid-year population estimates and the Labour Force Survey 2019.

Definitions

Amplified resistance: Amplified resistance is classed as resistance identified on repeat culture after 3 months of the first specimen date. Cases with a change from a sensitive to resistant result following treatment start are reclassified as amplified resistance, even if this is within the 3-month period.

BCG: Bacillus Calmette-Guérin vaccination.

Cluster: Clusters in this document refer to molecular clusters only. These are defined as a group of 2 or more patients that are infected with a strain of *Mycobacterium tuberculosis* complex with indistinguishable MIRU-VNTR profiles. Each cluster must have at least 1 notification with a full 24 MIRU-VNTR profile, and other members of the cluster may have a maximum of 1 missing loci.

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

Drug resistant cohort: The drug resistant cohort includes any cases with rifampicin resistant TB (initial or amplified), including MDR-TB (initial or amplified), as well as those without culture confirmation treated for MDR-TB.

Drug sensitive cohort: The drug sensitive cohort excludes all TB cases with rifampicin resistant TB (initial or amplified) including MDR-TB (initial or amplified), and non-culture confirmed cases treated as MDR-TB.

Extensively drug resistant TB (XDR-TB): XDR-TB is defined as resistance to isoniazid and rifampicin (MDR-TB), at least 1 injectable agent (capreomycin, kanamycin or amikacin) and at least 1 fluoroquinolone.

First-line drug resistance: First-line drug resistance is defined as resistance to at least 1 of the first-line drugs (isoniazid, rifampicin, ethambutol, pyrazinamide).

Initial resistance: Initial resistance is classed as resistance identified within 3 months of the first specimen date.

Interquartile range: A measure of statistical dispersion, being equal to the difference between the upper and lower quartiles (IQR = $Q_3 - Q_1$).

Latent TB infection (LTBI): LTBI is defined as a state of persistent immune response to stimulation by *Mycobacterium tuberculosis* antigens without evidence of active TB disease.

Last recorded outcome: Last known outcome, irrespective of when it occurred.

Median: Denoting or relating to a value or quantity lying at the midpoint of a frequency distribution of observed values or quantities, such that there is an equal probability of falling above or below it.

Multi-drug resistant TB (MDR-TB): MDR-TB is defined as resistance to at least isoniazid and rifampicin, with or without resistance to other drugs.

Multi-drug resistant / Rifampicin resistant TB (MDR/RR-TB): MDR/RR-TB is defined as resistance to rifampicin including MDR-TB cases.

Population denominator: Tuberculosis rates by geographical area, age, sex and place of birth were calculated using ONS mid-year population estimates (www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates). Rates by place of birth and by ethnic group were calculated using population estimates from the Labour Force Survey (www.esds.ac.uk/findingData/qlfs.asp). The Labour Force Survey is based on a population sample, so estimates are liable to sampling errors, particularly for small population subgroups, and should be interpreted with caution.

Post-mortem diagnosis: A post-mortem diagnosis is an unexpected diagnosis of TB made after death, usually during an autopsy examination.

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

Pulmonary tuberculosis: A pulmonary case is defined as a case with TB involving the lungs and/or tracheo-bronchial tree, with or without non-pulmonary TB diagnosis. In this report, in line with the World Health Organisation's recommendation and international reporting definitions, miliary TB is classified as pulmonary TB due to the presence of lesions in the lungs.

Social risk factor: Social risk factors for TB include current alcohol misuse, current or history of homelessness, current or history of imprisonment and current or history of drug misuse.

Treatment outcome: Information on outcomes were reported for all cases reported in the previous year, excluding those with known rifampicin resistant disease: outcomes for these cases were reported at 24 months. Definitions for outcomes are based on World Health Organisation and European Centre for Disease Control definitions but adapted to the UK context. In this report, all data was obtained from the ETS matched dataset provided in June 2019.

Appendix B: TB among South West residents

Table Bi. TB cases by local authority of residence (district level), South West, 2000-2018

Local authority	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Bath and North East Somerset	6	11	11	12	9	18	4	5	8	12	12	4	11	9	19	12	5	3	5
Bournemouth, Christchurch and Poole	17	12	17	13	13	24	23	13	18	14	15	24	16	11	13	13	9	13	11
Bristol, City of	48	40	63	51	75	66	81	81	71	84	81	82	88	97	98	79	66	61	49
Cheltenham	8	7	10	6	8	6	14	8	13	8	5	7	5	13	7	5	2	4	4
Christchurch	4	4	1	2	2	3	3	4	0	3	1	2	2	0	0	1	2	1	1
Cornwall	13	10	13	12	19	13	10	21	11	13	7	23	18	14	17	9	12	14	14
Cotswold	2	3	0	0	1	1	2	1	2	2	1	3	5	3	1	1	1	1	2
East Devon	8	2	5	1	6	5	1	3	2	5	4	3	1	0	1	4	2	1	4
East Dorset	3	6	2	2	3	1	1	2	2	5	1	1	2	3	3	1	2	7	3
Exeter	3	6	2	1	7	7	6	8	7	9	1	8	14	7	5	5	6	7	6
Forest of Dean	3	3	2	2	1	2	3	3	1	1	0	1	1	0	1	2	1	1	3
Gloucester	7	1	7	7	8	6	12	13	11	8	7	13	11	21	8	12	8	6	3
Isles of Scilly	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mendip	2	2	5	2	10	9	3	3	4	1	4	2	2	6	5	3	2	3	1
Mid Devon	2	0	0	1	0	2	1	0	4	0	2	2	3	1	3	2	1	5	2
North Devon	3	0	0	0	1	0	0	1	0	1	0	0	1	3	3	4	2	1	1
North Dorset	1	2	2	3	2	3	4	0	1	4	3	2	4	1	0	3	0	3	1
North Somerset	3	7	4	3	5	10	6	5	10	13	10	6	9	7	8	10	6	6	7
Plymouth	11	15	12	9	12	5	16	12	13	13	11	16	20	12	11	19	17	20	12
Poole	12	8	10	5	10	11	6	8	11	5	7	2	1	5	1	9	6	4	5
Purbeck	0	2	1	2	2	1	3	2	1	3	3	2	1	2	1	0	2	0	1
Sedgemoor	1	0	5	0	2	0	0	3	2	1	2	7	3	2	4	2	0	3	0
South Gloucestershire	8	11	5	12	12	10	9	8	16	25	13	18	13	17	21	16	18	9	11
South Hams	2	6	0	0	1	1	2	2	2	1	6	3	1	2	4	3	1	2	1
South Somerset	2	2	4	2	2	9	5	5	2	3	5	2	5	5	8	0	1	2	2
Stroud	6	3	0	6	3	4	4	3	7	4	2	2	5	7	5	5	1	3	3
Swindon	11	9	8	12	11	10	21	24	13	18	21	23	18	30	18	22	30	25	14
Taunton Deane	4	2	4	1	3	2	0	1	4	2	1	6	6	3	2	0	3	2	1
Teignbridge	11	12	5	8	2	2	5	4	8	8	5	9	4	9	7	13	7	3	6

Tewkesbury	5	1	1	2	3	4	2	2	1	1	2	4	2	4	4	4	3	6	4
Torbay	9	8	6	3	8	12	10	4	11	14	12	11	5	10	6	8	6	3	5
Torridge	1	1	0	0	1	0	0	1	0	0	0	1	1	0	2	1	1	0	1
West Devon	1	1	1	2	3	0	2	1	2	1	2	0	5	5	4	1	0	0	4
West Dorset	3	1	2	3	2	5	3	2	4	2	2	2	2	2	4	0	0	0	2
West Somerset	0	0	1	1	0	1	0	1	1	0	2	0	0	0	0	0	1	0	0
Weymouth and Portland	4	2	0	1	3	4	4	6	0	6	0	1	1	3	5	1	3	0	0
Wiltshire	6	11	11	14	12	9	12	9	16	13	15	15	14	12	17	16	11	9	6

Table Bii. TB rate per 100,000 population by lower tier local authority of residence, South West, 2000-2018

Local authority	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Bath and North East Somerset	3.6	6.5	6.5	7.0	5.3	10.5	2.3	2.9	4.6	6.9	6.9	2.3	6.2	5.0	10.5	6.5	2.7	1.6	2.6
Bournemouth, Christchurch and Po	9.5	6.9	8.0	5.7	7.2	10.8	9.0	7.0	8.0	6.0	6.2	7.4	5.0	4.2	3.6	5.9	4.3	4.5	4.3
Bristol, City of	12.3	10.3	16.2	13.0	19.0	16.3	19.8	19.7	17.1	20.0	19.1	19.2	20.3	22.1	22.1	17.5	14.5	13.3	10.6
Cheltenham	7.3	6.4	9.1	5.5	7.3	5.4	12.5	7.1	11.5	7.0	4.4	6.1	4.3	11.2	6.0	4.3	1.7	3.4	3.4
Cornwall	2.6	2.0	2.6	2.4	3.7	2.5	1.9	4.0	2.1	2.5	1.3	4.3	3.3	2.6	3.1	1.6	2.2	2.5	2.5
Cotswold	2.5	3.7	0.0	0.0	1.2	1.2	2.4	1.2	2.4	2.4	1.2	3.6	6.0	3.6	1.2	1.2	1.2	1.1	2.2
Dorset	3.2	3.8	2.0	3.1	3.4	3.9	4.2	3.3	2.2	5.5	2.5	2.2	2.7	3.0	3.5	1.3	1.9	2.7	1.9
East Devon	6.4	1.6	4.0	0.8	4.7	3.9	0.8	2.3	1.5	3.8	3.0	2.3	0.7	0.0	0.7	2.9	1.4	0.7	2.8
Exeter	2.7	5.4	1.8	0.9	6.3	6.2	5.3	7.0	6.1	7.9	0.9	6.8	11.8	5.8	4.1	4.0	4.7	5.4	4.6
Forest of Dean	3.8	3.7	2.5	2.5	1.2	2.5	3.7	3.7	1.2	1.2	0.0	1.2	1.2	0.0	1.2	2.4	1.2	1.2	3.5
Gloucester	6.3	0.9	6.3	6.3	7.1	5.3	10.4	11.1	9.3	6.7	5.8	10.7	8.9	16.9	6.4	9.4	6.2	4.6	2.3
Isles of Scilly	0.0	0.0	0.0	0.0	45.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mendip	1.9	1.9	4.8	1.9	9.5	8.5	2.8	2.8	3.7	0.9	3.7	1.8	1.8	5.4	4.5	2.7	1.8	2.6	0.9
Mid Devon	2.9	0.0	0.0	1.4	0.0	2.7	1.3	0.0	5.2	0.0	2.6	2.6	3.8	1.3	3.8	2.5	1.3	6.2	2.4
North Devon	3.4	0.0	0.0	0.0	1.1	0.0	0.0	1.1	0.0	1.1	0.0	0.0	1.1	3.2	3.2	4.2	2.1	1.0	1.0
North Somerset	1.6	3.7	2.1	1.6	2.6	5.1	3.0	2.5	5.0	6.4	4.9	3.0	4.4	3.4	3.8	4.8	2.8	2.8	3.3
Plymouth	4.6	6.2	4.9	3.7	4.9	2.0	6.4	4.8	5.1	5.1	4.3	6.2	7.8	4.6	4.2	7.3	6.5	7.6	4.6
Sedgemoor	1.0	0.0	4.7	0.0	1.8	0.0	0.0	2.7	1.8	0.9	1.8	6.1	2.6	1.7	3.4	1.7	0.0	2.5	0.0
Somerset West and Taunton	3.0	1.5	3.6	1.4	2.1	2.1	0.0	1.4	3.5	1.4	2.1	4.1	4.1	2.0	1.4	0.0	2.7	1.3	0.6
South Gloucestershire	3.3	4.5	2.0	4.8	4.8	3.9	3.5	3.1	6.2	9.6	5.0	6.8	4.9	6.3	7.7	5.8	6.5	3.2	3.9
South Hams	2.4	7.3	0.0	0.0	1.2	1.2	2.4	2.4	2.4	1.2	7.2	3.6	1.2	2.4	4.7	3.5	1.2	2.3	1.2
South Somerset	1.3	1.3	2.6	1.3	1.3	5.8	3.2	3.1	1.2	1.9	3.1	1.2	3.1	3.0	4.9	0.0	0.6	1.2	1.2
Stroud	5.6	2.8	0.0	5.5	2.7	3.6	3.6	2.7	6.3	3.6	1.8	1.8	4.4	6.1	4.3	4.3	0.9	2.5	2.5
Swindon	6.1	5.0	4.4	6.5	5.9	5.3	10.9	12.2	6.5	8.8	10.1	11.0	8.5	14.0	8.3	10.1	13.7	11.3	6.3
Teignbridge	9.1	9.9	4.1	6.5	1.6	1.6	4.0	3.2	6.4	6.4	4.0	7.2	3.2	7.1	5.5	10.1	5.4	2.3	4.5
Tewkesbury	6.5	1.3	1.3	2.6	3.8	5.1	2.5	2.5	1.3	1.2	2.5	4.9	2.4	4.7	4.7	4.6	3.4	6.6	4.3
Torbay	7.0	6.2	4.6	2.3	6.1	9.1	7.6	3.0	8.3	10.6	9.1	8.4	3.8	7.6	4.5	6.0	4.5	2.2	3.7
Torridge	1.7	1.7	0.0	0.0	1.6	0.0	0.0	1.6	0.0	0.0	0.0	1.6	1.5	0.0	3.0	1.5	1.5	0.0	1.5
West Devon	2.1	2.0	2.0	4.0	6.0	0.0	3.9	1.9	3.8	1.9	3.8	0.0	9.3	9.3	7.4	1.8	0.0	0.0	7.2
Wiltshire	1.4	2.5	2.5	3.2	2.7	2.0	2.6	2.0	3.4	2.8	3.2	3.2	2.9	2.5	3.5	3.3	2.2	1.8	1.2

Table Biii. TB rate per 100,000 population by clinical commissioning group (CCG), South West, 2000-2018

CCG	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
NHS Bath and North East Somerset CCG	3.6	6.5	6.5	7.0	5.3	9.9	2.3	2.9	4.6	6.9	6.9	2.3	6.2	5.0	10.5	6.5	2.7	1.6	2.7
NHS Bristol, North Somerset and South Gloucestershire CCG	7.2	7.0	8.7	7.9	11.0	10.1	11.2	10.8	10.9	13.7	11.7	11.8	12.2	13.2	13.8	11.2	9.5	8.0	7.0
NHS Devon CCG	4.8	4.7	2.9	2.3	3.7	3.1	3.8	3.2	4.2	4.6	3.8	4.7	4.7	4.3	4.0	5.1	3.7	3.5	3.5
NHS Dorset CCG	6.4	5.3	5.0	4.4	5.3	7.3	6.6	5.1	5.1	5.7	4.3	4.8	3.9	3.6	3.6	3.7	3.1	3.6	3.1
NHS Gloucestershire CCG	5.5	3.2	3.4	4.0	4.2	4.0	6.4	5.1	6.0	4.1	2.9	5.0	4.8	7.9	4.3	4.7	2.6	3.3	3.0
NHS Kernow CCG	2.6	2.0	2.6	2.3	3.9	2.5	1.9	4.0	2.1	2.5	1.3	4.3	3.3	2.6	3.1	1.6	2.2	2.5	2.5
NHS Somerset CCG	1.8	1.2	3.8	1.2	3.3	4.1	1.5	2.5	2.5	1.3	2.6	3.2	3.0	3.0	3.5	0.9	1.3	1.8	0.7
NHS Swindon CCG	5.9	4.8	4.3	6.3	5.7	5.1	10.1	11.9	6.3	8.6	9.9	10.7	8.3	13.7	8.1	9.9	13.4	11.0	6.2
NHS Wiltshire CCG	1.4	2.5	2.5	3.2	2.7	2.0	2.6	2.0	3.4	2.8	3.2	3.2	2.9	2.5	3.3	3.3	2.2	1.8	1.2

Table Biv. TB rate per 100,000 population by sustainability and transformation partnership (STP), South West, 2000-2018*

STP	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Bath, Swindon and Wiltshire	13.7	18.3	17.7	21.7	18.2	21.0	20.4	22.0	21.3	24.8	27.5	23.9	24.3	28.4	29.2	27.1	24.1	19.6	13.3
Bristol, North Somerset and South Gloucestershire	8.5	8.4	10.2	9.4	12.9	12.1	13.5	13.0	13.1	16.3	14.1	14.2	14.7	16.1	16.8	13.6	11.5	9.7	8.7
Cornwall and Isles of Scilly	2.3	1.8	2.3	2.1	3.5	2.1	1.7	3.6	1.9	2.2	1.2	3.8	3.0	2.1	2.8	1.5	1.9	2.2	2.2
Devon	10.3	10.2	6.1	4.9	8.0	6.2	8.1	6.9	8.9	9.8	8.1	9.9	10.0	8.8	8.4	10.9	7.7	7.5	7.5
Dorset	8.9	7.4	6.6	6.1	7.2	10.1	9.1	7.1	7.0	8.0	6.1	6.8	5.4	5.0	4.8	5.1	4.4	5.0	4.1
Gloucestershire	16.8	9.7	10.1	12.1	12.5	11.8	18.7	14.8	16.9	11.0	8.0	14.0	13.4	21.4	11.8	13.0	7.1	9.3	8.4
Somerset	2.1	1.4	4.3	1.4	3.8	4.7	1.8	2.8	2.8	1.5	3.0	3.6	3.4	3.3	3.9	1.0	1.4	2.0	0.8

* Excludes cases with a missing postcode

Table Bv. TB cases and rate by age and sex, South West, 2000-2018

Age Group	Male		Female	
(years)	Count	Rate	Count	Rate
0-9	5	1.6	4	1.3
10-19	10	3.2	6	2.0
20-29	17	4.9	11	3.4
30-39	24	7.4	17	5.2
40-49	13	3.9	12	3.4
50-59	14	3.6	9	2.3
60-69	14	4.3	10	2.9
≥70	18	4.5	11	2.2

Table Bvi. Drug resistance among TB patients with culture confirmed disease*, South West, 2000-2018

Year	Any resistance		Isoniazid resistant		Multi-drug resistant		Ethambutol		Rifampicin		Total	Pyrazinamide		Total excluding M. bovis
	n	%	n	%	n	%	n	%	n	%	N	n	%	n
2000	5	4.6	4	3.7	1	0.9	0	0.0	2	1.9	108	0	0.0	104
2001	9	8.2	9	8.2	0	0.0	0	0.0	0	0.0	110	0	0.0	108
2002	7	5.5	7	5.5	1	0.8	0	0.0	1	0.8	128	0	0.0	125
2003	7	5.7	7	5.7	2	1.6	0	0.0	2	1.6	123	0	0.0	121
2004	7	4.6	7	4.6	0	0.0	0	0.0	0	0.0	151	0	0.0	151
2005	8	4.6	8	4.6	3	1.7	1	0.6	3	1.7	175	0	0.0	174
2006	10	5.9	10	5.9	0	0.0	0	0.0	0	0.0	170	0	0.0	166
2007	9	5.6	8	5.0	1	0.6	1	0.6	1	0.6	160	2	1.3	156
2008	14	7.3	11	5.8	3	1.6	2	1.0	4	2.1	191	3	1.6	189
2009	17	8.7	14	7.2	2	1.0	2	1.0	3	1.5	195	4	2.1	192
2010	8	5.7	5	3.5	1	0.7	1	0.7	2	1.4	141	2	1.4	137
2011	19	9.5	17	8.5	1	0.5	2	1.0	1	0.5	201	1	0.5	196
2012	14	7.4	11	5.8	2	1.1	1	0.5	3	1.6	190	3	1.6	183
2013	16	8.6	14	7.5	1	0.5	1	0.5	1	0.5	186	2	1.1	180
2014	12	6.8	11	6.2	2	1.1	2	1.1	2	1.1	177	0	0.0	168
2015	10	5.8	10	5.8	1	0.6	0	0.0	1	0.6	173	1	0.6	163
2016	17	11.3	14	9.3	3	2.0	3	2.0	4	2.6	151	1	0.7	144
2017	15	10.4	13	9.0	4	2.8	2	1.4	4	2.8	144	6	4.2	133
2018	12	10.1	9	7.6	0	0.0	1	0.8	0	0.0	119	2	1.7	110

* Culture confirmed cases, Pyrazinamide resistance excluding *M. bovis* case