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Tuberculosis in East of England: Annual review (2017 data)

Data from 2000 to 2017

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Lay summary

Tuberculosis (TB) is an infectious disease of public health concern, which infected 10 million people and caused 1.6 million deaths worldwide in 2017. In September 2018, the United Nations General Assembly held its first-ever meeting on TB to co-ordinate "an urgent global response to a global epidemic". The Public Health England (PHE) and NHS England Collaborative TB Strategy aims to reduce national TB incidence via 10 areas for action. These include improving access to diagnosis, improving treatment, tackling TB in hard to reach populations (such as people with drug and alcohol misuse, homelessness or prison issues), as well as rolling out screening for long-term migrants to the UK.

This report focuses on TB in the East of England, and enables everyone involved (from GPs to local government) to use the latest data to design public health strategies and clinical care to control TB and drive towards elimination by 2035.

TB case reports peaked at 560 in the East of England in 2011. Since then, the number of people diagnosed with TB has fallen by 27% to 409 people in 2017. In general, the East of England has lower rates of TB than England overall (6.4 cases per 100,000 population compared to 9.2 per 100,000).

The recent declines are not experienced by all groups of people, and there are still significant inequalities to be addressed. The largest reductions occurred among people born outside the UK; however an increasing proportion of TB cases are among people from Central and Eastern European countries. Over one-third of people experience a long delay between the onset of TB symptoms and starting antibiotic treatment, and this proportion remains stubbornly high.

More than 10% of people with TB also have social risk factors such as drug and alcohol misuse, homelessness, or a history of imprisonment. These individuals are twice as likely to die following their TB diagnosis, and therefore need additional social support to help them successfully complete their antibiotic treatment in a stable environment.

Encouragingly, 84% of people with TB complete antibiotic treatment within 12 months, which is the second-highest rate of completion in the East of England since recording began in 2000. Also, antibiotic resistant TB is still relatively rare.

Positive steps have been made towards the elimination of TB in the East of England. Although this is a very challenging target, everyone should continue to work together in integrated and co-ordinate ways to achieve TB control through effective clinical care, surveillance and public health action.

Executive summary

In 2017, there were 409 tuberculosis (TB) case reports to the Public Health England (PHE) Enhanced Tuberculosis Surveillance system (ETS) for individuals resident in the East of England. The East of England has lower rates of TB than England as a whole. In 2017, the 409 cases equated to a rate of 6.4 cases per 100,000 population (95% confidence interval [CI] 5.8-7.0), compared to 9.2 per 100,000 (95% CI 8.9-9.4) in England overall [1].

In the East of England, both the number of cases and rate of TB decreased in 2017 compared to 2016, and the rate of TB in 2017 was statistically significantly lower than the rate in 2012 (8.1 per 100,000, 95% CI 7.4-8.8). Case numbers increased marginally in 6 out of 12 local authorities, but encouraging reductions were observed in Hertfordshire (74 cases versus 99 in 2016), Norfolk (28 versus 37 in 2016) and Suffolk (19 versus 30 in 2016).

As in previous years, Luton and Peterborough continued to experience the highest rates of TB in the East of England (27.5 per 100,000 and 22.1 per 100,000 respectively). Peterborough, Southend-on-Sea and Thurrock all recorded an increasing trend in rate between 2016 and 2017.

The highest age and sex specific rates of TB in the East of England were recorded among men aged 30-39 years (11.1 per 100,000) and women aged 20-29 years (12.2 per 100,000), with very few paediatric cases reported. TB rates declined in every age group except among people aged 65+ years whose rate remained stable.

A country of birth outside of the UK was recorded for 69.2% of people with TB in 2017 (278/402). This largely reflects the high incidence of TB in the communities from which migrants have originated. The rate of TB among people born outside the UK (36.6 per 100,000) was 16 times higher than the rate among UK born individuals (2.3 per 100,000). The decline in rate for the East of England is largely driven by changes in TB among people born outside the UK.

In accordance with England overall, people with TB are 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 East of England is white (41.9%, 169/403), approximately half of whom were born outside of the UK, most commonly in Romania and Lithuania. As in previous years, the majority of TB cases among people born

[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.

outside the UK occurred among settled migrants who entered the UK 11 or more years prior to their TB diagnosis.

In 2017 one-quarter of people with TB aged 18-65 years were not in employment or education (26.1%, 86/329). Where occupation was recorded, 10.6% of people with TB were healthcare workers (35/329), and 10.3% were in the education sector as either staff or students (34/329).

As in previous years, over half (63.3%, 259/409) of people had pulmonary TB, one-quarter were inpatients at the time of diagnosis (23.3%, 93/395), and 6.2% had previously been diagnosed with TB (24/387). Furthermore, 77.6% of pulmonary TB cases were confirmed by culture (201/259), which is approaching the national target of 80%. Between 2013 and 2017, 35.9% of people with TB (443/1,235) had a strain related to at least 1 other person in the East of England by MIRU-VNTR typing,[2] making 183 new or expanding clusters of cases. Overall, 15.8% of clusters comprised of 5 or more linked people (29/183).

In 2016, 83.6% of people with pulmonary TB (158/189) identified household and close contacts to be screened for latent or active TB. Only 34.9% of people with TB identified 5 or more contacts (66/189). In total, 984 contacts were identified, of whom 76.1% were assessed (749/984). These contact screening activities diagnosed 17 new cases of active TB, and 169 individuals with latent TB infection.

Among people with pulmonary TB in 2017, 31.6% started TB treatment within 2 months of symptom onset (71/225), representing a gradually increasing delay in treatment start since 2015 (41.2%). Additionally, 36.9% of people with pulmonary TB started treatment more than 4 months after symptom onset, consistent with a prolonged period of infectiousness. Extra-pulmonary cases of TB took on average 27 days longer to diagnose than pulmonary cases.

Treatment was completed within 12 months for 84.0% (320/381) of people with rifampicin sensitive TB reported in 2016 whose expected treatment duration was less than 12 months.[3] The most common outcome category for people who did not complete treatment was death (5.8%, 22/381). TB was recorded to be the cause or to have contributed to death in one-third of these individuals. The proportion of people who were lost to follow up declined compared to those reported in 2015.

[2] Mycobacterial Interspersed Repetitive Unit – Variable Number Tandem Repeats: a measure of TB strain relatedness. Further detail can be found in Appendix B.

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

TB antibiotic sensitivity was known for 62.1% of cases in 2017 (254/409), of which 10.0% were resistant to at least 1 first line drug (26/354), and 3.4% had multidrug-resistant or rifampicin resistant TB (MDR/RR-TB, 9/254). One of these cases had extensively drug-resistant TB (XDR-TB).[4]

People with 1 or more social risk factors for TB, including drug and alcohol misuse, homelessness and prison were less frequent in 2017 (11.3%, 40/404) compared to 2016 (15.4%, 57/423). In previous years, the East of England has had one of the highest proportions of people with risk factors, but now falls slightly below average for England overall (12.6%) [1]. This may reflect a real change in the characteristics of people with TB, but also depends on their willingness to disclose such information to TB services. Individuals with risk factors were more likely to be male (85.4%, 274/321), UK born (49.8%, 152/321), white (59.8%, 192/307), have pulmonary TB (81.3%, 261/320) which is sputum smear positive (71.0%, 115/162), have had a previous diagnosis of TB (10.9%, 32/293), and first line drug resistance (13.4%, 33/247). 78.9% of individuals with risk factors (194/246) completed treatment at their last recorded outcome, compared to 89.4% of individuals with no risk factors (2,214/2,476).

In 2017 almost half (43.8%, 179/409) of people with TB were resident in the most deprived areas of the East of England,[5] and an unusually large proportion of people were resident in the second-least deprived areas (16.4%, 67/409), which may reflect screening or awareness-raising initiatives in these areas.

HIV tests were not offered to 5.0% of people with TB in 2017 that were eligible to be tested (18/360).[6] Having offered a test to the other 95.0% of individuals, follow up to complete the test varied substantially by upper tier local authority, with just 32.7% of Luton residents having a test both offered and received (16/49). A low proportion of people had TB-HIV co-infection in the East of England in 2017 (3.5%), reflecting a declining trend since peak rates in 2004 (15.9%).

In conclusion, the epidemiology of TB in the East of England is changing. Although the overall number of TB notifications has declined in the East of England, an increasing proportion of people with TB originate from Central and Eastern European countries. Additionally, the majority of people with TB born outside the UK are diagnosed with TB 11 or more years after their entry to the UK. New focuses for TB control should include reducing the average time from symptom onset to treatment start for people with

[4] 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).

[5] Most deprived quintile of lower super output areas based on Index of Multiple Deprivation (IMD 2015) rank.

[6] Excludes TB cases diagnosed post-mortem and patients whose HIV status was already known.

pulmonary TB in order to reduce their infectiousness and the possibility of TB transmission.

People with TB should have access to high-quality diagnostics, and therefore the rate of culture confirmation should be improved slightly to attain the national target of 80%, and the implementation of Whole Genome Sequencing technology for TB diagnosis should be monitored. Ongoing attention should be paid to people with social risk factors who represent a core population of socially disadvantaged individuals who required continued effort and investment to deliver effective packages of TB care.

1. TB notifications and incidence

Overall numbers, rates and geographical distribution

In 2017, 409 cases of tuberculosis (TB) were reported among residents of the Public Health England (PHE) East of England area (Figure 1), a crude rate of 6.4 cases per 100,000 population (95% confidence interval [CI] 5.8-7.0). The rate of TB in the East of England remains significantly lower than the overall rate for England (9.2 per 100,000) [1]. Case numbers have been gradually declining in the East of England since their peak in 2011, with an unusually low rate of notifications in 2015 (6.1 per 100,000). The rate of TB in 2017 was statistically significantly lower than the rate in 2012 (8.1 per 100,000, 95% CI 7.4-8.8).

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

Figure 1: TB case reports and rates, East of England, 2000 to 2017

Whilst rates take into account the size of the population from which cases arise, the actual number of cases also need to be considered. Hertfordshire notified the largest number of cases in 2017 (74), while Central Bedfordshire reported the fewest (6, Appendix C). Case numbers increased in 6 out of 12 local authorities, with the largest

change seen in Southend-on-Sea (14 cases vs 6 in 2016). Substantial reductions in case numbers were observed in 3 local authorities: Hertfordshire (74 cases vs 99 in 2016), Norfolk (28 vs 37 in 2016) and Suffolk (19 vs 30 in 2016).

TB cases rates for upper tier local authorities (UTLAs) are presented in Figure 2. In general, rates are stable below 20 cases per 100,000 for all UTLAs with the exception of Luton (27.5 per 100,000) and Peterborough (22.1 per 100,000). Peterborough, Southend-on-Sea and Thurrock all saw an increase in rate in 2017 compared to 2016. The case rates for 2017 are also presented as a map in Figure 3.

Figure 2: TB case rates, by upper tier local authority of residence, East of England, 2000 to 2017

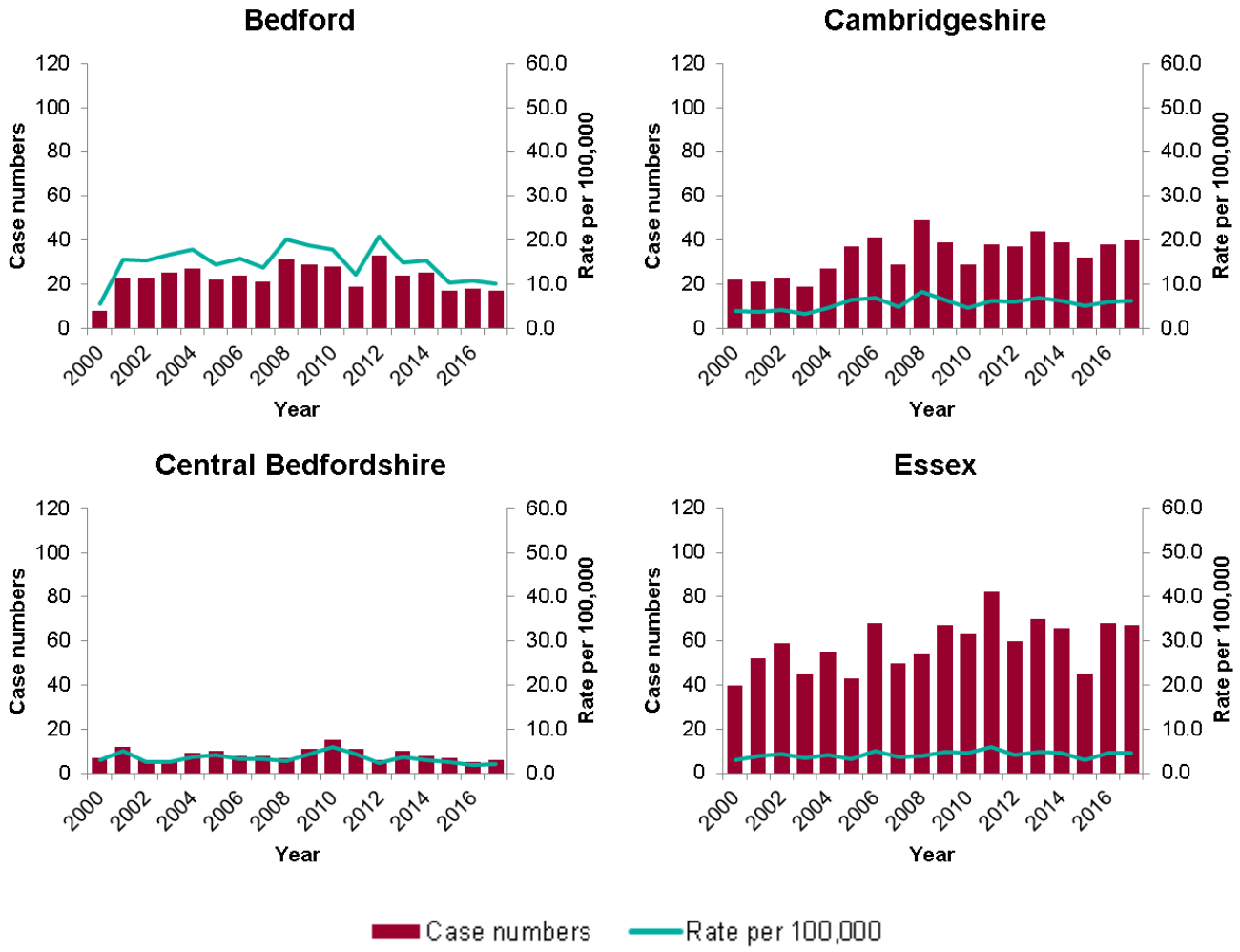


Figure 2: TB case rates, by upper tier local authority of residence, East of England, 2000 to 2017 (continued)

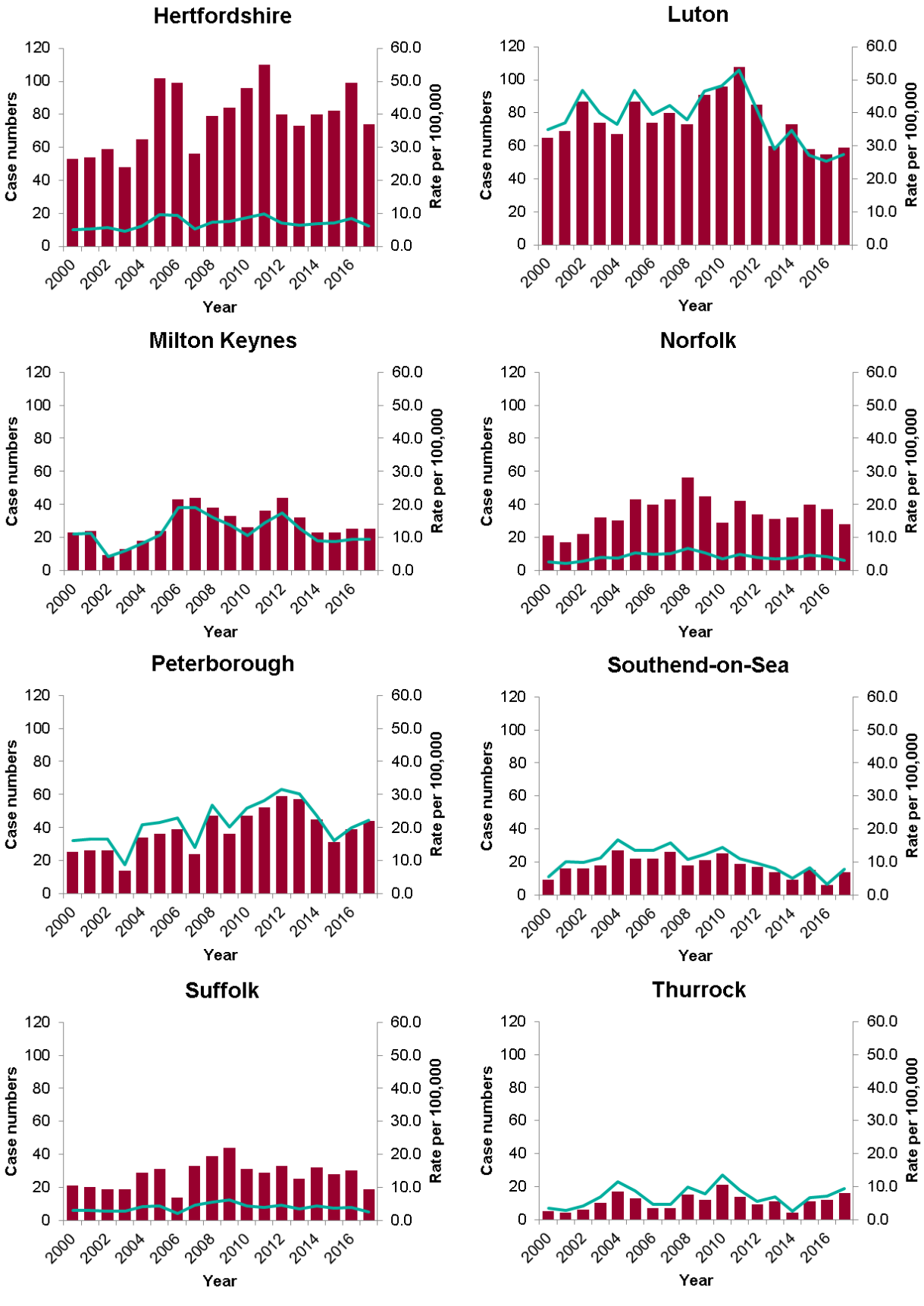
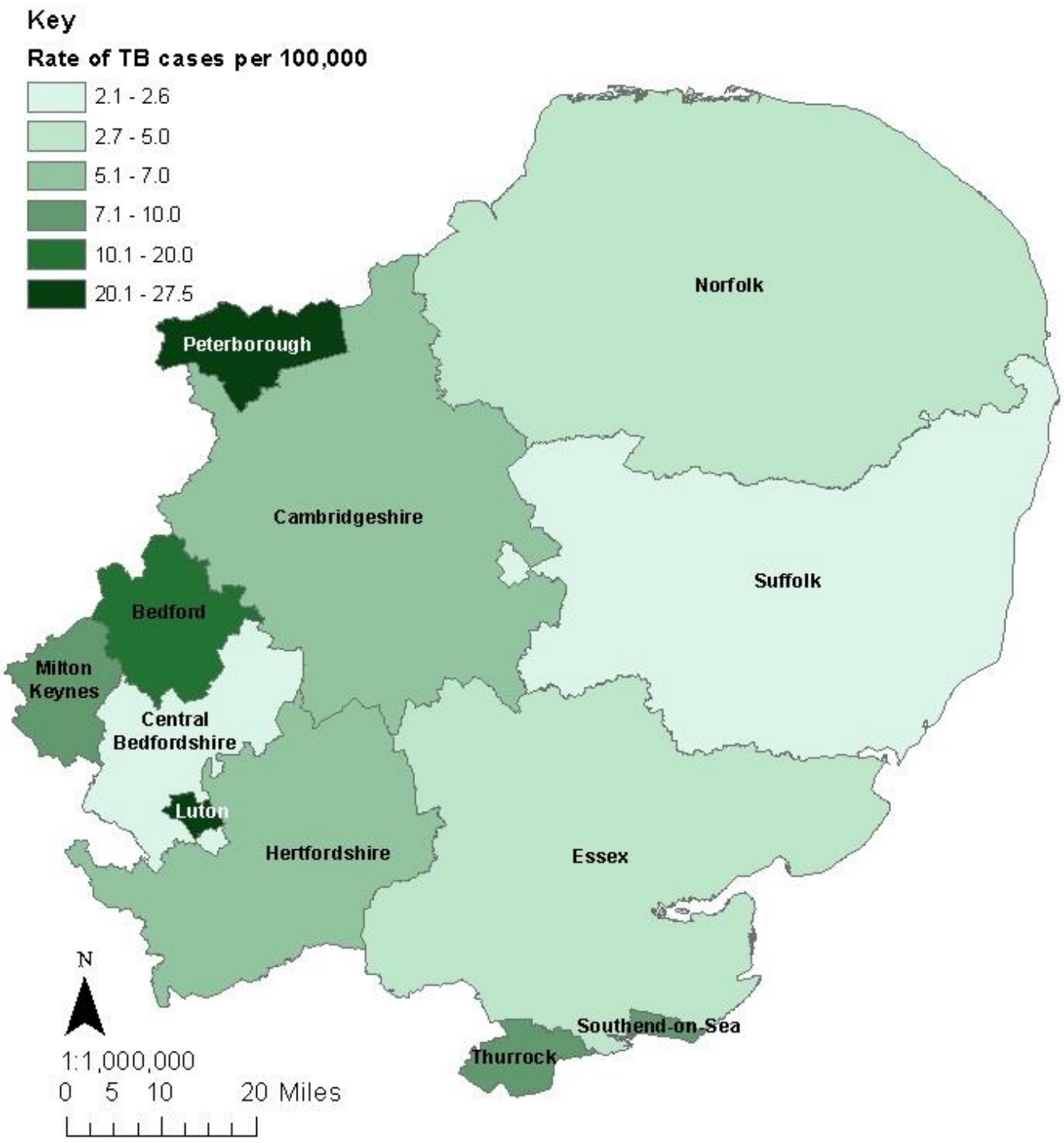


Figure 3: TB case rate by upper tier local authority of residence, East of England, 2017

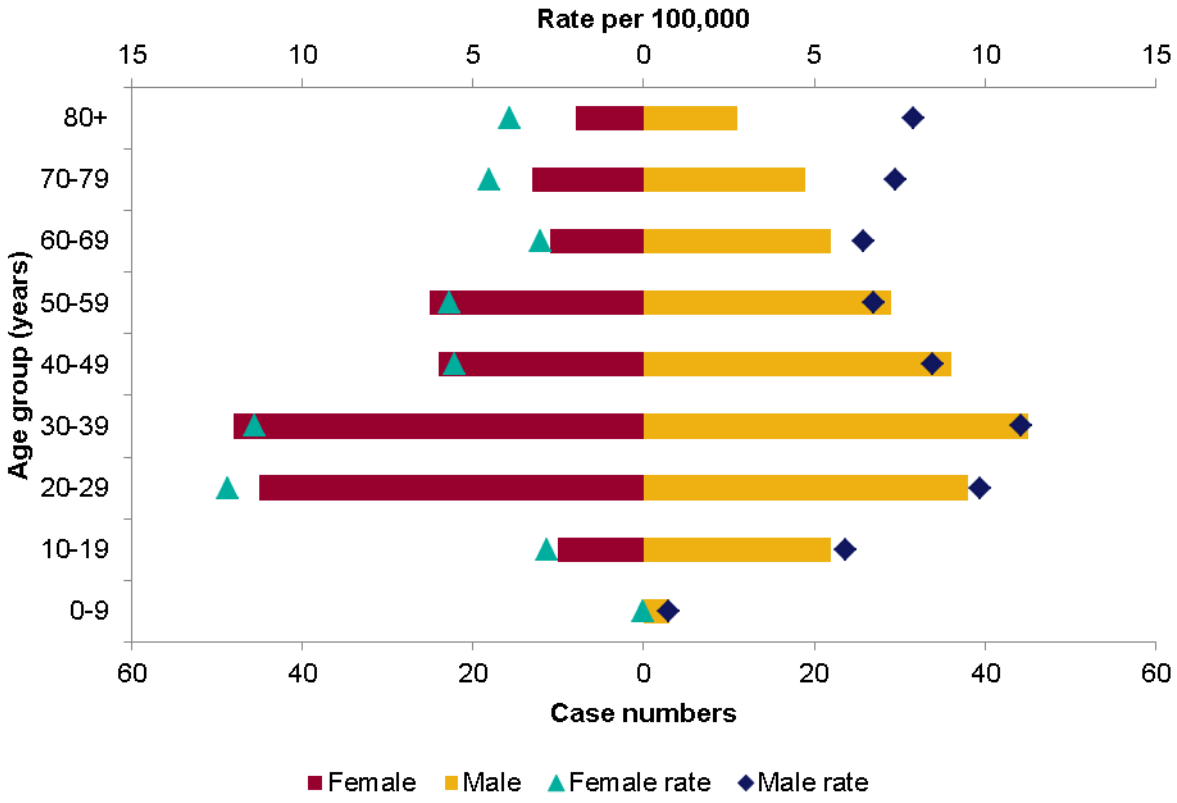


Demographic characteristics

Age and sex

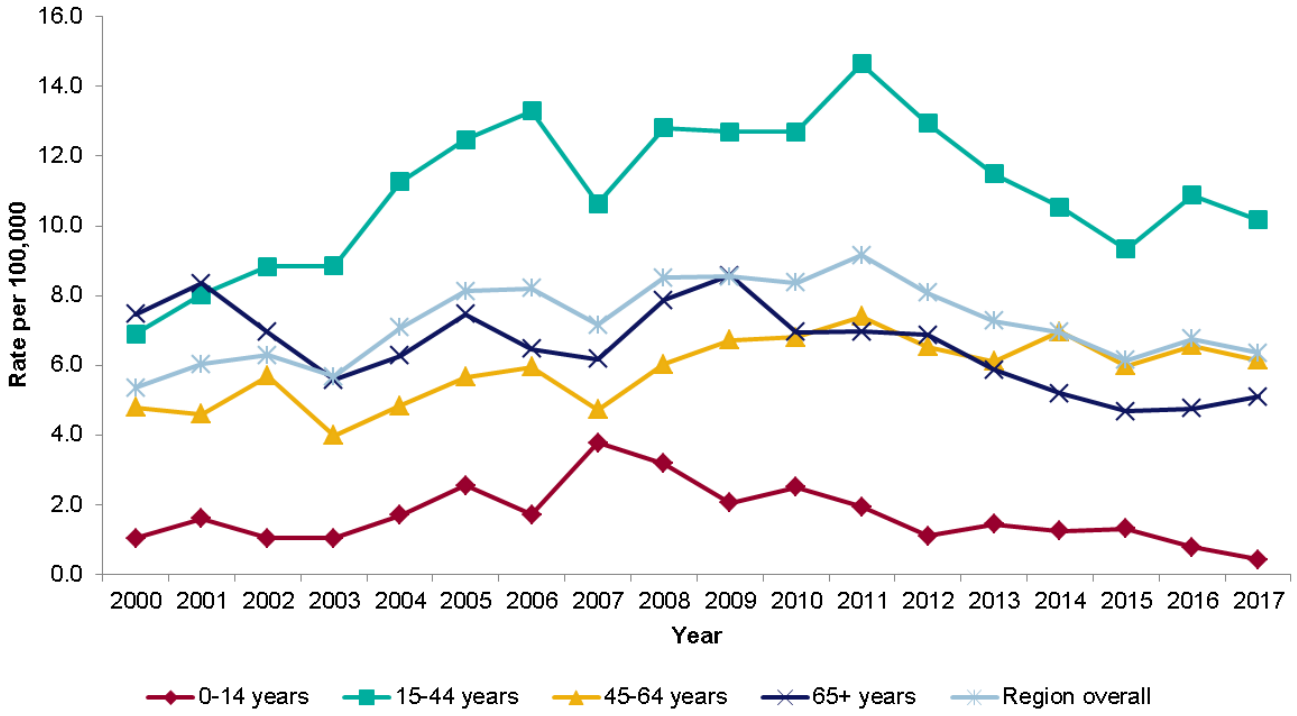
The age sex pyramid for people with TB in 2017 was similar to previous years, with more males (55.0%) than females, and the same mean age at notification (42.8 years) compared to 2016. Crude rates of TB among males were highest for those aged 30-39 years (11.1 per 100,000), which is lower than the rate in 2016 (17.1 per 100,000). And for females, the highest rate was among those aged 20-29 years (12.2 per 100,000). This is a change compared to 2016, in which the highest rates of TB were among females aged 30-39 years (11.6 per 100,000). In 2017 there were 3 paediatric TB cases in children aged less than 5 years, compared to 4 in 2016 (Figure 4).

Figure 4: TB case reports and rate by age and sex, East of England, 2017



The overall rate of TB in the East of England is primarily driven by the rate of TB among people aged 15-44 years. The rate of TB declined for the majority of age groups compared to 2016, except among people aged 65+ years whose rate remained stable (Figure 5).

Figure 5: TB case rates by age group, East of England, 2000 to 2017



Place of birth and time since entry

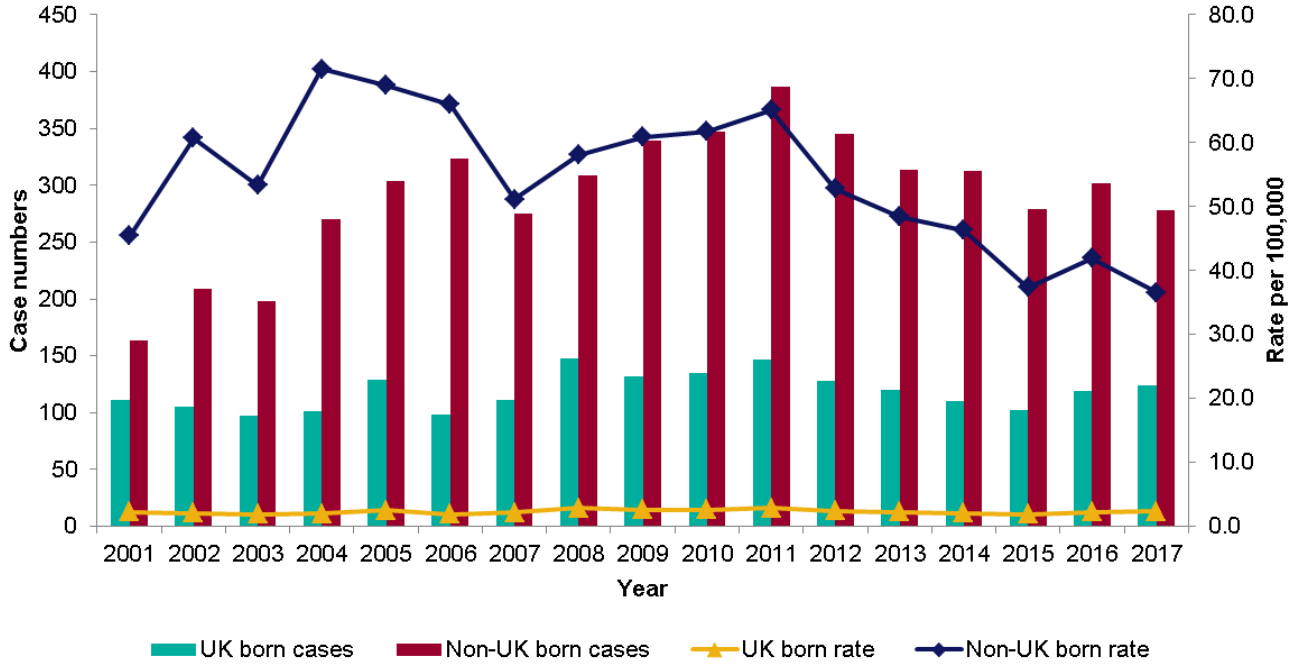
The rates of TB among people born outside the UK should be interpreted in the context of changes to the pre-UK entry screening policies. In 2005 the UK piloted the pre-entry screening of long term migrants to the UK for active pulmonary TB in 15 high TB incidence countries. In 2012 this pre-entry screening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

In 2017 98.3% of people with TB had recorded a country of birth (402/409), and of these, 69.2% (278/402) were born outside the UK. The rate of TB was 16 times higher among these people (36.6 per 100,000) compared to UK born people with TB (2.3 per 100,000). These rates should be interpreted with caution, as population estimates, used as the 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.[7] 2017 saw a slight increase in the number of UK born cases (124 vs 119), but a notable reduction in the number of non-UK born cases (278 vs 302) compared to 2016 (Figure 6).

[7] 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. The LFS data are based on the East of England Government Office Region, which excludes the Milton Keynes area. However, Milton Keynes cases have not been excluded from the numerator due to the large population over which the rate by place of birth has been calculated.

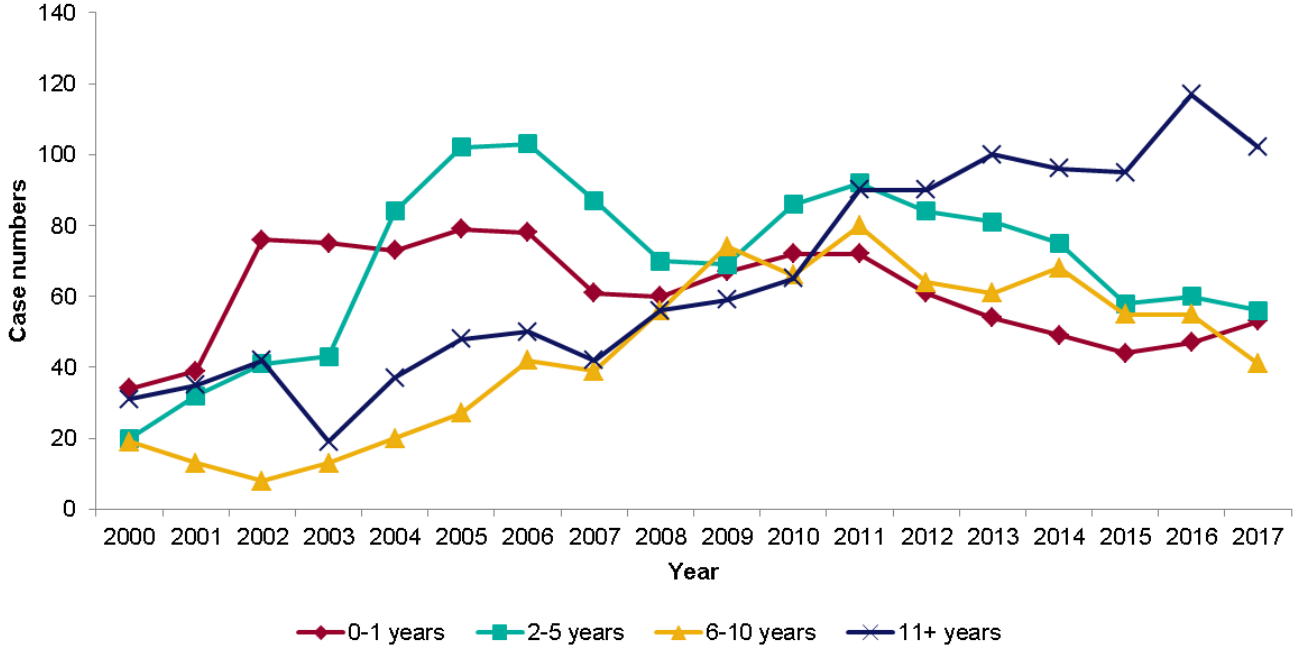
TB Monitoring Indicator 2: TB incidence in UK born and non-UK born populations

Figure 6: TB case reports and rate by place of birth, East of England, 2001 to 2017



In 2017 the year of entry to the UK was reported for 90.6% (252/278) of TB patients born outside the UK. Among those with a reported date of entry, 40.5% (102/252) had arrived in the UK 11 or more years prior to their TB diagnosis – a similar proportion compared to 2016 (41.9%, 117/279, Figure 7).

Figure 7: Time between entry to the UK and TB notification for non-UK born patients by year, East of England, 2000 to 2017



The 10 most common countries of birth for TB patients born outside the UK and notified in 2017 were India (accounting for 21.6% of non-UK born TB patients), Pakistan (11.9%) and Romania (11.2%), followed by Lithuania, Zimbabwe, Philippines, Eritrea, Nigeria, Poland and Portugal (each <10.0%, Table 1). Eritrea was reported as one of the most common countries of birth due to a single large screening event held in 2017.

Table 1: 10 most common countries of birth of non-UK born TB patients, East of England, 2017

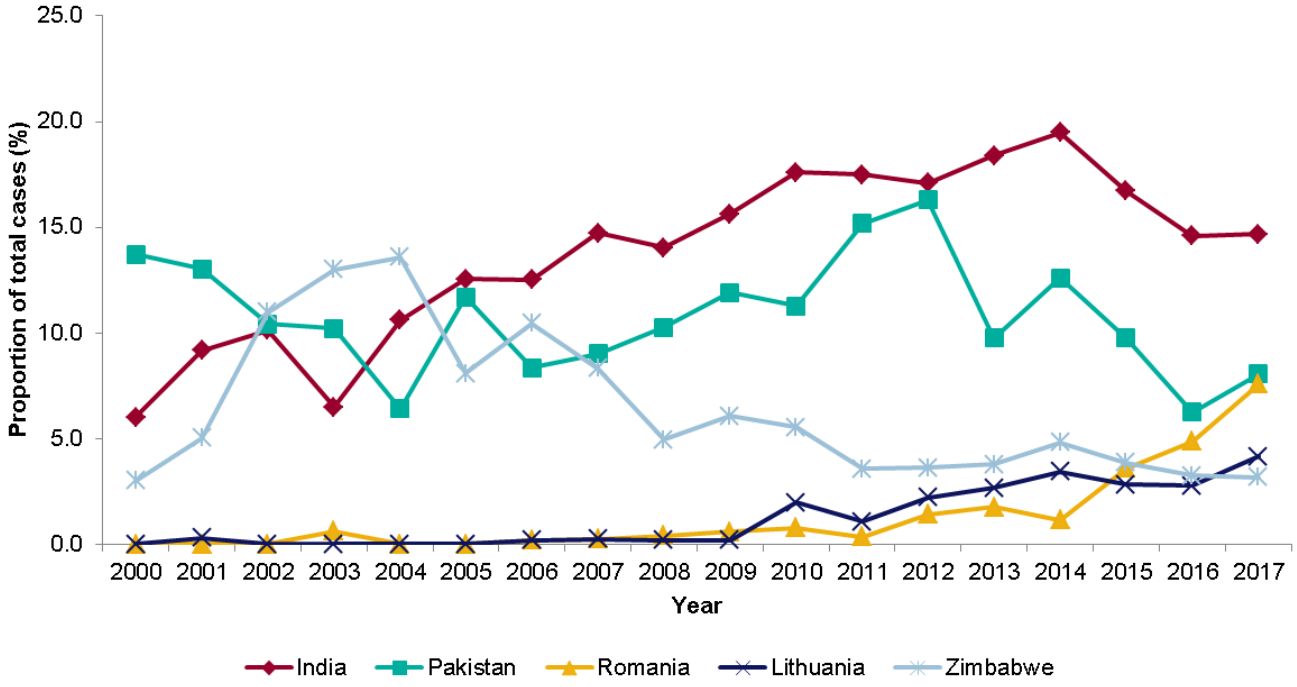
Country of origin	Number of patients	Proportion of non-UK born (%)	Time since entry (years)		
			Median	IQR*	
India	60	21.6	9	3	14
Pakistan	33	11.9	13.5	5	37
Romania	31	11.2	2	0	3
Lithuania	17	6.1	5	2	6
Zimbabwe	13	4.7	15	13	16
Philippines	9	3.2	11	9	13
Eritrea	8	2.9	1	0.5	1.5
Nigeria	7	2.5	10.5	4	14
Poland	7	2.5	11	5	13
Portugal	7	2.5	13	12	13
Total	**192**				

*IQR: Interquartile range

Among the 5 most common countries of birth for TB patients born outside the UK, there has been an ongoing increase in the proportion of patients from Romania and Lithuania (Figure 8). There is also an increasing trend of patients from Central and Eastern European countries[8] overall: in 2017 23.7% of non-UK born patients (66/278) originated from these countries, compared to 16.9% in 2016 (51/302) and 16.5% in 2015 (46/279). There has also been a decline in the proportion of patients originating from India. Compared to 2016 in 2017 there was an increase in the proportion of patients from Pakistan.

[8] 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.

Figure 8: TB case reports by country of birth from the 5 most common countries of birth outside the UK, East of England, 2000 to 2017



The age distribution of TB cases differs between patients born within and outside the UK. Both groups experience a low rate of TB among children aged less than 15 years. UK born patients are relatively evenly distributed across the remaining age groups (49 cases aged 15-44 years, 38 aged 45-64 years, 33 aged 65 years or more). However, among those born outside the UK, the majority of cases are aged 15-44 years (67.3%, 187/278).

Although the majority of TB cases in the East of England occur among patients born outside the UK, some UTLAs record a large proportion of UK born cases. The UTLAs where 30% or more of all TB cases were among UK born patients include Suffolk (63.2%, 12/19), Thurrock (43.8%, 7/16), Hertfordshire (43.7%, 31/71), Norfolk (33.3%, 9/27), Central Bedfordshire (33.3%, 2/6) and Essex (31.3%, 21/67).

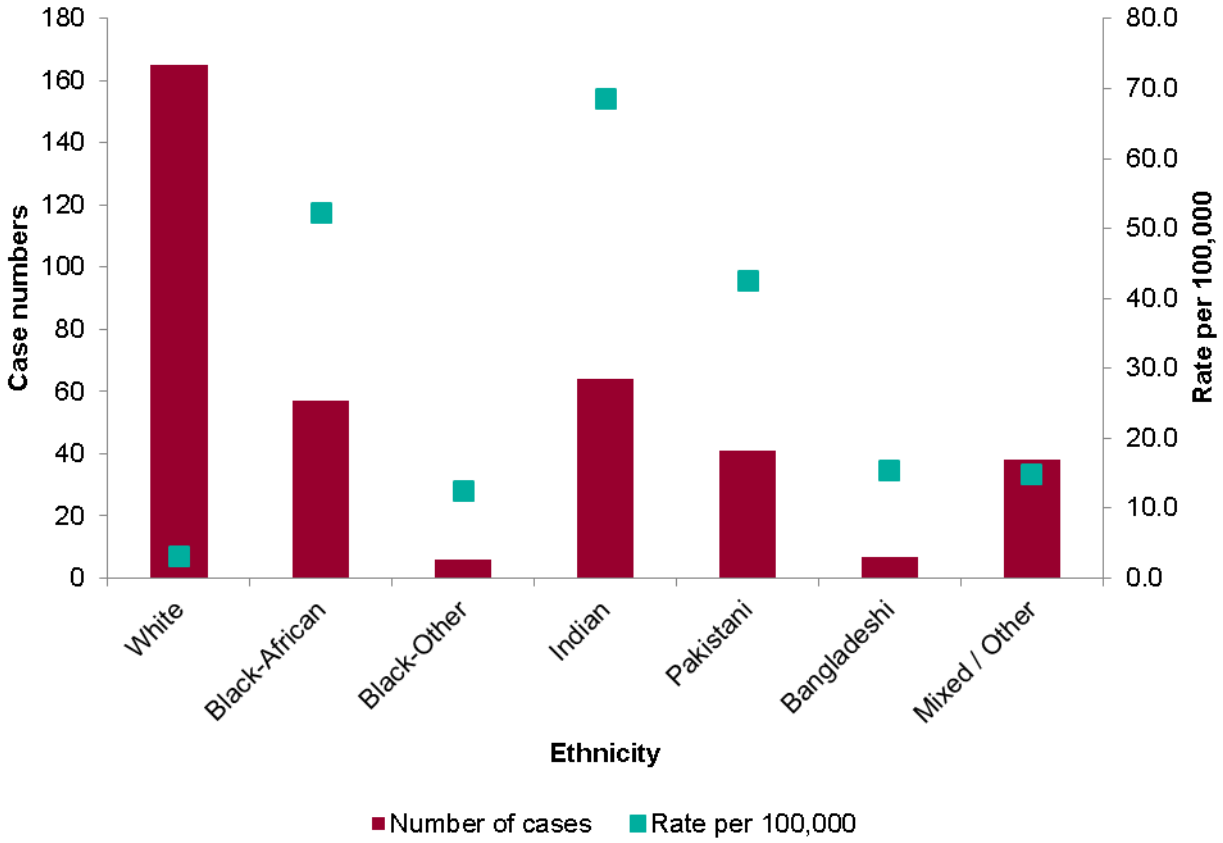
Ethnicity

In 2017 98.5% of patients with TB reported their ethnicity. Excluding cases resident in Milton Keynes,[9] the majority of cases were white (43.7%, 165/378), equating to a rate of 3.0 cases per 100,000, similar to the rate recorded for white individuals in 2016 (2.9 per

[9] 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. Cases resident in Milton Keynes are excluded from rate calculations (Figure 9) because the LFS data are based on the East of England Government Office Region, which excludes the Milton Keynes area.

100,000). The highest rates of TB were seen for Indian (68.5 per 100,000), black-African (52.2 per 100,000) and Pakistani (42.6 per 100,000) ethnic groups (Figure 9). 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.[10]

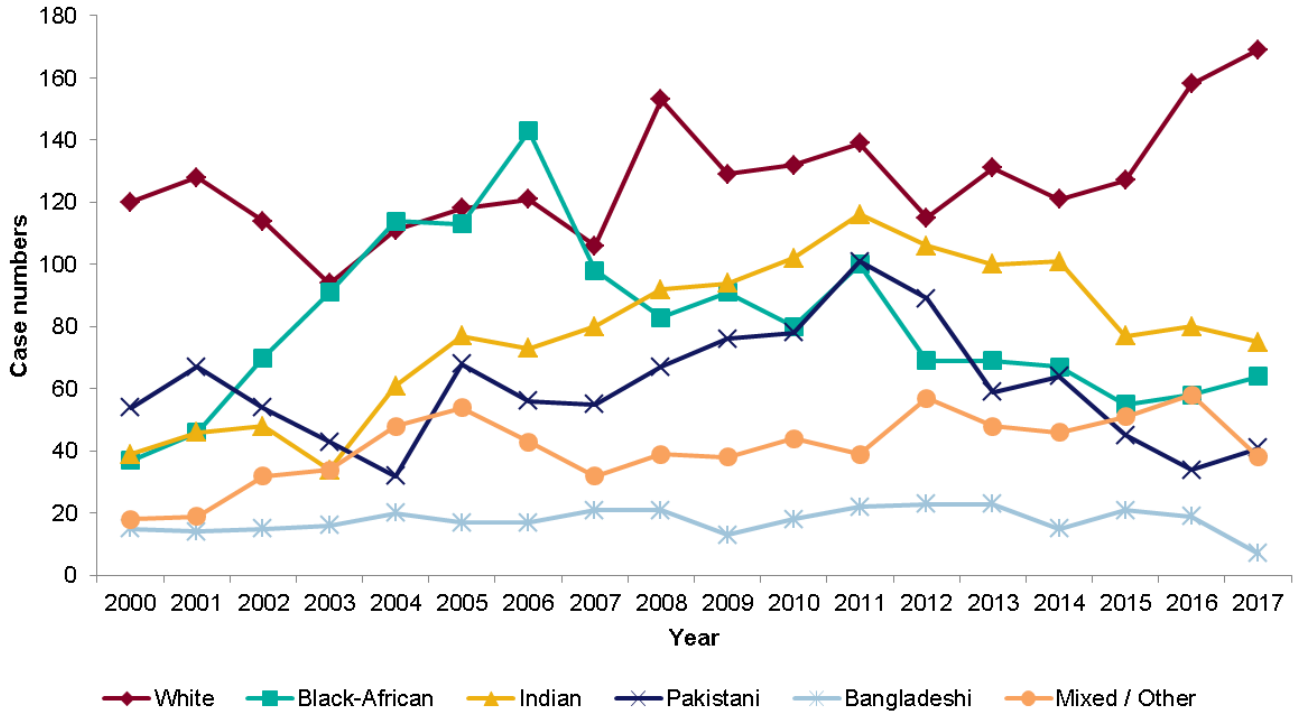
Figure 9: TB case number and rate by ethnic group, East of England, 2017



For most ethnic groups case numbers remained stable between 2016 and 2017. However, there was a continued increase in the number of white TB patients, climbing by nearly 40% between 2014 and 2017 (169 vs 121 cases, Figure 10).

[10] 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, East of England, 2000 to 2017



As in 2016 approximately half of white TB patients in 2017 were born in the UK (52.7%, 89/169, Table 2). The most common countries of birth for non-UK born white TB patients were Romania (27 cases) and Lithuania (17 cases).

Table 2: Proportion of UK born TB patients by ethnic group, East of England, 2017

Ethnic group	Number of patients	Number UK born	Proportion (%)
White	169	89	52.7
Black-African	64	8	12.5
Black-Other	8	4	50.0
Indian	75	8	10.7
Pakistani	41	6	14.6
Bangladeshi	7	2	28.6
Mixed / Other	39	7	17.9

Occupation

As in previous years, in 2017 approximately one-quarter of TB patients aged 18-65 years (26.1%, 86/329) were not in employment or education. This occupational category was largely comprised of housewives/husbands, retired and unemployed individuals (90.7%, 78/86), as well as a few asylum seekers, prisoners and others. Overall, 10.6% of cases were among healthcare workers (35/329) and 10.3% were in the education sector as either students or staff (34/329). The majority of cases reported working in another occupation (45.3%, 149/329) and 6.7% did not report an occupation (Table 3).

Table 3: Occupational category of TB patients aged 18 to 65 years, East of England, 2017

Occupational category	Number of patients	Proportion (%)
Other	149	45.3
None*	86	26.1
Health care worker	35	10.6
Education	34	10.3
Social service/prison worker	3	0.9
Occupation not recorded	22	6.7
Total	**329**	

*Includes housewives/husbands, retired, unemployed, asylum seekers and prisoners

Clinical characteristics

Site of disease

In 2017 63.3% of patients (259/409) had pulmonary TB disease (with or without extra-pulmonary sites). The next most common site of disease, as in 2015 and 2016, was extra-thoracic lymph nodes, present in 17.8% of cases (73/409, Table 4).

Table 4: Site of disease of TB patients, East of England, 2017

Site of disease	Number of cases	Proportion (%)*
Pulmonary ONLY	201	49.1
Pulmonary with extra-pulmonary sites	58	14.2
Lymph nodes (extra-thoracic)	73	17.8
Intra-thoracic lymph nodes	51	12.5
Pleural	40	9.8
Unknown extra-pulmonary site	28	6.8
Other (extra-pulmonary)	19	4.6
Gastrointestinal	16	3.9
Miliary	10	2.4
Bone/joint (spine)	9	2.2
CNS (other)†	9	2.2
CNS (meningitis)†	8	2.0
Bone/joint (other)	5	1.2
Genitourinary	3	0.7
Laryngeal	2	0.5
Cryptic	1	0.2
Unknown	0	0.0

*patients may have disease at more than 1 site, so the total proportion will not equal 100%
†CNS: Central nervous system

In 2017 UK born patients were more likely to have pulmonary disease (71.0%, 88/124) compared to non-UK born patients (59.7%, 166/278). Furthermore, 80.0% of patients who reported at least 1 social risk factor[11] (32/40) had pulmonary TB, compared to 60.9% of patients who reported no risk factors (193/317).

Previous history of tuberculosis

In 2017 among patients who reported their clinical history, 6.2% of cases (24/387) had a previous diagnosis of TB at least 12 months prior to their most recent notification, which is not substantially different to the rate of previous diagnosis in previous years in the East of England. These patients had a median of 4.5 years since their previous diagnosis (IQR 2-9.5 years). This is similar to the proportion of cases reporting a previous diagnosis of TB in England overall (5.9%), although these individuals had a longer median time since previous diagnosis (7 years, IQR 3-25 years) [1]. Nine of these patients were recorded as having at least 1 previous episode of TB after the year 2000 whilst resident in the East of England, all of whom completed treatment for their previous episode.

Hospital inpatient and directly observed therapy

Nearly one-quarter of patients (23.3%, 92/395) were inpatients at the time of diagnosis with TB. Hospitalisation was more common among those with sputum smear positive TB (50.7%, 38/75) or multidrug-resistant[12] or rifampicin resistant TB (MDR/RR-TB, 66.7%, 6/9). Hospitalisation was also more common among those with at least 1 social risk factor (37.5%, 15/40).

Since 2015 the proportion of patients who received directly observed therapy (DOT) has steadily declined from its peak of 9.8% (38/389) to 7.1% of patients diagnosed with TB in 2017 (29/409). A large proportion of children aged 0-14 years received DOT (40.0%, 2/5), as did patients with 1 or more social risk factors (32.4%, 12/37) and nearly half of patients with MDR/RR-TB (42.9%, 3/7).

[11] Social risk factors for TB include: prison, homelessness, alcohol and substance misuse.
[12] 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 2017 as in previous years, 63.8% of all cases (261/409) were confirmed by culture of a TB isolate. Among pulmonary cases, 77.6% of cases (201/259) were culture confirmed.

Of the 261 culture confirmed cases in 2017, 97.3% were *M. tuberculosis* (254/261), 1.5% were *M. africanum* (4/261) and the small number remaining were either *M. bovis* or undifferentiated isolates of *M. tuberculosis complex*.

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

Sputum smear

As described in the last chapter, 63.3% of TB cases reported in 2017 were pulmonary. Among these individuals, 49.0% (127/259) had a sputum smear test, of which 61.4% were smear positive (78/127). These findings compare closely with previous years for the East of England. The rate of sputum smear testing for pulmonary cases was lower in the East of England compared to England overall (63%), although the smear positivity rate for those tested was higher than for England (53%) [1].

Other laboratory test results

Between 2015 and 2017 the 22.2% (100/450) 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 (13.8%, 62/450). A substantial proportion of cases not culture confirmed did not have any other positive test result reported (77.8%, 350/450), and therefore we interpret that these cases were diagnosed on the basis of imaging or clinical judgement. Overall, 28.5% of cases notified between 2015 and 2017 (350/1,230) 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, East of England, 2015 to 2017

Laboratory test result*	Pulmonary		Extra-pulmonary		All cases†	
	n	%	n	%	n	%
Sputum smear positive	18	10.0	0	0.0	18	4.0
Smear positive (any specimen type)	8	4.4	8	3.0	16	3.6
Histology positive	25	13.9	37	13.8	62	13.8
PCR positive	6	3.3	2	0.7	8	1.8
No known positive lab result	125	69.4	224	83.3	350	77.8
Total	**180**		**269**		**450**	

*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 2017 the rate of TB in the East of England among children aged 0-14 years was 0.4 cases per 100,000 population, remaining at a low level since 2011, and substantially lower than the peak rate (3.1 per 100,000) in 2007, and also lower than the rate for England overall (1.4 per 100,000) in 2017 [1].

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

Strain typing and clustering

The National TB Strain Typing Service in England, established in 2010, prospectively typed TB isolates using 24 loci MIRU-VNTR.[13] Clustered cases (with indistinguishable MIRU-VNTR strain types) may reflect people with TB that are part of the same chain of transmission, but could also reflect common endemic strains circulating either within England or abroad. MIRU-VNTR strain typing can be used to refute transmission between individuals who have distinguishable strain types, but an indistinguishable strain type does not confirm transmission. Additional epidemiological information is required to assess whether patients with indistinguishable strain types reflect recent transmission.

In 2017 strain typing in the East of England continued to be by MIRU-VNTR. However, in January 2018, NMRS-South (covering the East of England) moved to Whole Genome Sequencing (WGS), at which time MIRU-VNTR typing was discontinued. WGS strain typing will be reported in the next regional TB annual report. Work is ongoing to reconcile the inferences from the 2 typing methods.

Proportion of patients in clusters and geographical distribution

Between 2013 and 2017 1,348 cases of TB were culture confirmed in the East of England, of which 91.6% (1,235/1,348) were MIRU-VNTR strain typed with at least 23 complete loci. Since 2013, there have been 443 patients whose strain of TB was related

[13] Mycobacterial Interspersed Repetitive Unit – Variable Number Tandem Repeats: a measure of TB strain relatedness. Further detail can be found in Appendix B.

to least 1 other patient in the East of England (comprising 183 separate new or expanding clusters),[14] giving a clustering proportion of 35.9%.[15]

Size of clusters

Between 2013 and 2017 183 new or expanding MIRU-VNTR clusters were identified in the East of England. Of these clusters, 50.3% (92/183) included just 2 linked patients, and 15.8% (23/183) comprised of 5 or more linked patients. The largest cluster had 37 new related patients added during this time period.

Cluster Lineage

Between 2013 and 2017, 443 patients with TB were linked to a MIRU-VNTR cluster in the East of England. Half of these clusters (49.7%, 91/183) were Euro-American lineage, 18.6% Delhi Central Asian lineage (34/183), 9.8% East African Indian lineage (18/183), 8.7% Beijing lineage (16/183). One cluster comprised *M. africanum* cases of TB, and the remaining 12.6% of clusters could have had multiple possible lineages (23/183).

Characteristics of patients in clusters

The majority of clustered patients (notified between 2013 and 2017) were male (63.0%, 279/443) and were most commonly white (43.8%, 194/443). As could be expected, three-quarters of clustered patients had pulmonary TB (76.7%, 340/443) and 32.5% (144/443) were sputum smear positive. Only 7.9% (35/443) of clustered patients had previously been diagnosed with TB. Patients with at least 1 social risk factor were likely to form part of a local MIRU-VNTR cluster (40.1%, 79/197). In fact, half of patients who reported alcohol misuse were clustered with at least 1 other patient (50.9%, 27/53).

Contact tracing

Screening of people exposed to a patient with active TB is a key strategy to find and treat active and latent TB, and prevent further transmission. The outcomes of contact tracing activities are part of the regular systematic review of the clinical and public health management of individual active TB cases by the team caring for them, which is termed cohort review [3]. Cohort reviews are supported in the East of England by the

[14] Clusters are valid if there are a minimum of 2 cases within the East of England notified within the time period of analysis with indistinguishable MIRU-VNTR profiles. Consequently, clusters reported here represent new or expanding clusters in the PHE East of England area. Cases must have at least 23 loci typed to be considered part of a cluster. At least 1 case in the cluster must have 24 typed loci, otherwise all cases in the cluster must have the same untypeable locus.

[15] The proportion of culture confirmed, strain typed cases which form part of a cluster.

PHE Health Protection Team and Field Service. Data are reported for TB cases notified in 2016, which were reviewed in 2017. This represents a baseline for the East of England as this is the first year in which it was possible to summarise data across the region.

In 2016 392 cases of TB were treated by clinics in the East of England. 92.9% of these patients (364/392) were presented at a subsequent cohort review meeting, of which 51.9% had pulmonary TB (189/364). Overall, pulmonary TB patients identified a median of 3 close contacts for screening and only 34.9% of patients (66/189) identified 5 or more close contacts. 16.4% of pulmonary TB patients (31/189) did not identify any close contacts. In total 984 contacts of pulmonary TB patients were identified, of whom 76.1% were assessed (749/984). These contact screening activities identified 17 new cases of active TB, and 169 individuals with latent TB infection (LTBI).

BCG vaccination status of TB patients

In 2017 Bacillus Calmette-Guérin (BCG) vaccination status was known for 68.0% of patients (278/409), 74.5% of whom (207/278) had previously been vaccinated. All non-UK born children aged 0-14 years had received a BCG vaccination, as well as 75.0% of UK born paediatric patients. Overall, receipt of BCG vaccination was similar among non-UK born patients (77.8%, 144/185) and UK born patients (67.7%, 63/93).

4. Delay from onset of symptoms to start of treatment

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

Overall 399 patients started on TB treatment in 2017. Among patients with pulmonary TB who reported both date of symptom onset and date of treatment start, 31.6% (71/225) started treatment within 2 months of symptom onset (Table 6). This demonstrates a gradually increasing delay in treatment start for pulmonary cases since 2015, when 41.2% started treatment within 2 months of symptom onset (33.3% in 2016). In 2017, more than one-third of patients with pulmonary TB started treatment more than 4 months (120 days) after symptom onset (36.9%, 83/225), indicating a prolonged period of infectiousness.

More than half of patients with extra-pulmonary TB started treatment more than 4 months after symptom onset (51.2%, 66/129). These long treatment delays are often thought to relate to difficulties in diagnosing cases of extra-pulmonary disease, which is supported by the longer median time from symptom onset to diagnosis for extra-pulmonary cases (119.5 days) compared to pulmonary cases (92.5 days).

Table 6: Time between symptom onset and treatment start*, East of England, 2017

Time delay	Pulmonary		Extra-pulmonary only		Overall	
	n	%	n	%	n	%
<2 months	71	31.6	39	30.2	110	31.1
2-4 months	71	31.6	24	18.6	95	26.8
Over 4 months	83	36.9	66	51.2	149	42.1
Total	**225**		**129**		**354**	

*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 2017 53.0% of pulmonary TB patients (44/83) who experienced a treatment delay exceeding 4 months were male and 49.4% (41/83) were aged 15-44 years. The majority of these patients were non-UK born (60.2%, 50/83), among whom 26.0% (13/50) entered the UK 2-5 years prior to their TB diagnosis, and 40.0% (20/50) entered the UK 11 or more years previously. Only 28.9% of these pulmonary cases (24/83) were sputum smear positive, and 7.2% (6/83) had previously been diagnosed with TB. Overall 9.0% (7/83) of patients with a treatment delay exceeding 4 months had at least 1 social risk factor and 4.8% (4/83) had MDR/RR-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 [4]. 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 the following groups:

- 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
- for 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

84.0% of patients (320/381) diagnosed in 2016 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 a substantial improvement on the treatment completion rates seen in recent years in the East of England (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, East of England, 2002 to 2016*

Year of diagnosis	Patients completing treatment at 12 months		
	Rifampicin sensitive cases	n	Proportion (%)
2002	318	223	70.1
2003	292	218	74.7
2004	380	276	72.6
2005	427	310	72.6
2006	433	328	75.8
2007	375	294	78.4
2008	452	325	71.9
2009	453	353	77.9
2010	462	373	80.7
2011	494	406	82.2
2012	443	351	79.2
2013	403	340	84.4
2014	393	318	80.9
2015	348	274	78.7
2016	381	320	84.0

*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 (5.8%, 22/381), continuation of treatment (4.2%, 16/381) and loss to follow up (3.7%, 14/381, Table 8). The proportion of patients notified in 2016 who died within 12 months of treatment start was similar to those notified in 2015 (6.3%). However, 2016 saw a reduction in the proportion of patients lost to follow up (3.7%) compared to those diagnosed in 2015 (5.5%).

Table 8: TB outcome at 12 months, East of England, patients diagnosed in 2016*

Outcome at 12 months	Number of patients	Proportion (%)
Treatment completed	320	84.0
Died	22	5.8
Still on treatment	16	4.2
Lost to follow up	14	3.7
Treatment stopped	7	1.8
Not Evaluated	2	0.5
Total	**381**	

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

Patients aged 65 years or older had substantially worse treatment outcomes than average. In this age group, just 61.8% completed treatment within 12 months (34/55), and 23.6% died within 12 months (13/55) compared to 2.8% of patients aged under 65 years (9/319). Deaths were also higher than average among UK born patients (10.2%,

11/108), patients with at least 1 social risk factor (7.5%, 4/53) and patients with pulmonary TB (7.3%, 16/219).

There was a substantial difference in loss to follow up between UK born (0.9%, 1/108) and non-UK born patients (4.9%, 13/264). In particular, non-UK born patients who entered the UK 0-1 years prior to their TB diagnosis were highly likely to be lost to follow up (12.5%, 5/40). For 42.9% of all patients lost to follow up (6/14), the reason recorded was because they had left the UK. The median age of patients lost to follow up was 32.5 years.

In 2016 18.2% of deaths (4/22) recorded among the 381 patients with rifampicin sensitive TB without CNS involvement were diagnosed post-mortem. Causes of death reported by clinicians to ETS[16] indicated that TB cause the death of 13.6% of patients (3/22) and contributed to the death of 18.2% of patients (4/22). TB was incidental to the death of 27.3% of patients who died (6/22) and the relationship between TB and death was unknown for 40.9% of patients (9/22). 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 2016 with rifampicin sensitive TB and possible CNS involvement (which is no more than 24 months after starting treatment), 74.4% (32/43) had completed treatment (Table 9). The median treatment duration for these individuals was 279 days (IQR 194.5-364.5 days). This is a higher rate of treatment completion compared to similar patients diagnosed in 2015 (64.9%, 24/37).

Table 9: TB outcome for patients with rifampicin sensitive, CNS, spinal, miliary or cryptic disseminated disease, East of England, patients diagnosed in 2016 *

Outcome	Number of patients	Proportion (%)
Treatment completed	32	74.4
Still on treatment	<5	<11.6
Died	<5	<11.6
Lost to follow up	<5	<11.6
Not Evaluated	<5	<11.6
Total	**43**	

*excludes rifampicin resistant TB

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

Fewer than 5 patients with rifampicin sensitive TB and possible CNS involvement died (median age 47 years), of whom 1 was diagnosed post-mortem. TB contributed to the death of 1 of these patients.

Overall fewer than 5 patients with rifampicin sensitive TB and possible CNS involvement were lost to follow up (median age 22 years), among whom 1 infant left the UK. The reason for loss to follow up was unknown for the remaining cases.

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

Drug resistance

Anti-TB antibiotic drugs are a large family and resistance may occur to 1 or more of these antibiotics and may be in complex combinations. A distinction is made between first, second and third line TB antibiotic drugs depending upon their clinical effectiveness [5]. 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].[17]

Overall initial drug resistance and geographical distribution

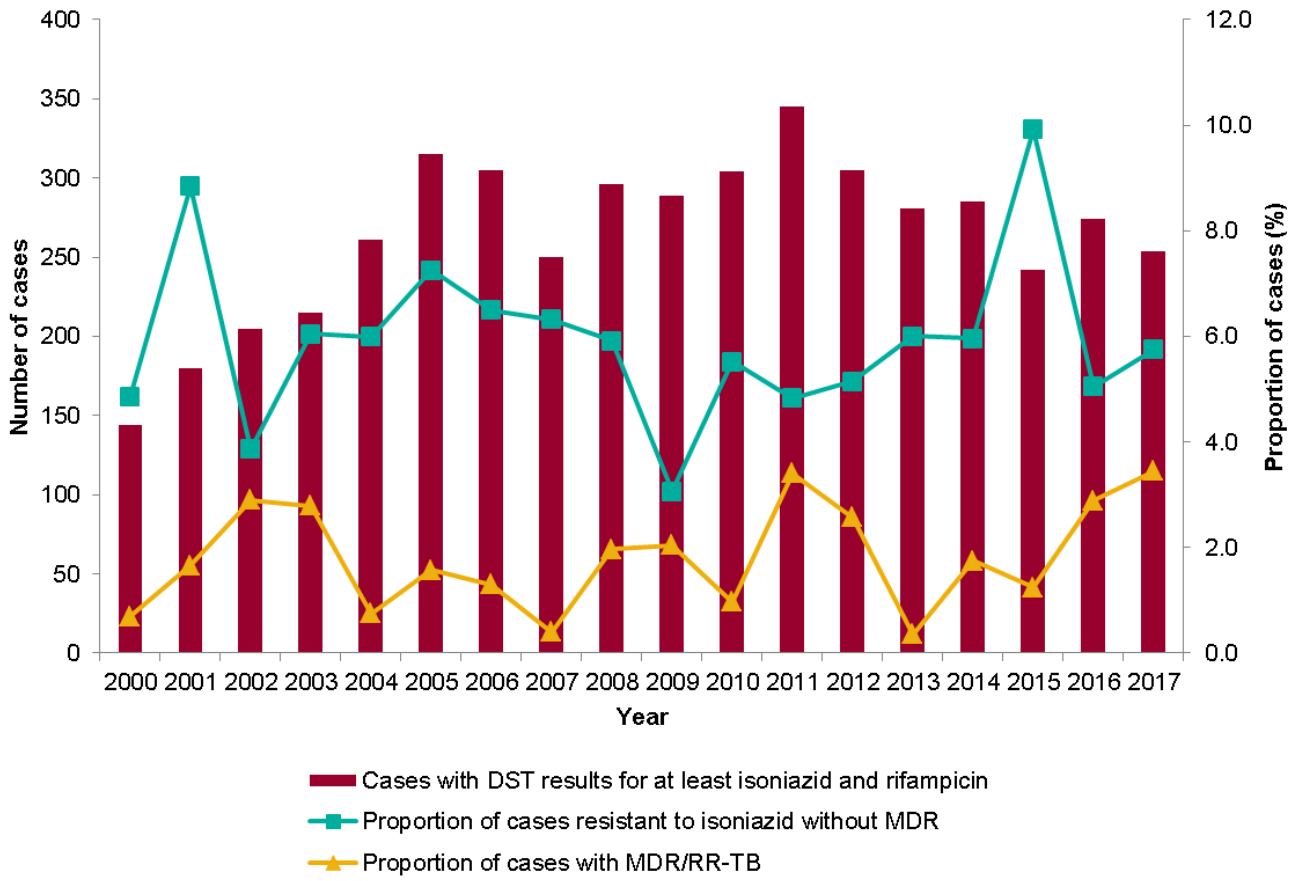
In 2017 among 254 culture confirmed cases of TB with phenotypic drug sensitivity testing (DST) for at least isoniazid and rifampicin, 10.0% (26/254) had first line drug resistance. The majority of these cases (5.7%, 15/254) were resistant to isoniazid but not rifampicin (INH-R), however 3.4% (9/254) had MDR/rifampicin resistant TB (RR-TB) (Figure 11). Two cases notified in 2017 were pre-XDR[18] and 1 case was XDR-TB. No cases were treated with a second line regimen for MDR/RR-TB in the absence of resistant DST results.

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

[17] Injectable agents: amikacin, capreomycin or kanamycin. Fluoroquinolones: moxifloxacin, ofloxacin or ciprofloxacin.
[18] Pre-XDR-TB: cases initially MDR and resistant to either at least 1 injectable agent or at least 1 fluoroquinolone.

Figure 11: Proportion of TB cases with initial first line drug resistance, East of England, 2000 to 2017



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

Of the 26 cases with any first line drug resistance, a high proportion occurred among patients aged 65 years or older (34.6%, 9/26), non-UK born patients (72.0%, 18/26), or white patients (42.3%, 11/26). The majority of patients had pulmonary TB (80.8%, 21/26), one-fifth had previously been diagnosed with TB (19.2%, 5/26) and a small proportion also recorded a social risk factor (13.6%, 3/26). Among the subset of patients who had MDR/RR-TB, the majority were aged 15-44 years (66.7%, 6/9), non-UK born (77.8%, 7/9) and all had pulmonary TB (100.0%, 9/9).

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 1 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.

There have been 7 cases of acquired drug resistance in the East of England between 2008 and 2017 (0.2%, 7/2,875), typically 1 case per year. The median time to development of first acquired drug resistance was 221 days after treatment start (IQR 177-440 days).

TB outcome at 24 months for patients with rifampicin resistant disease

In 2015 4 cases of MDR/RR-TB were notified in the East of England. Patients had either completed treatment, or were still on treatment at 24 months after treatment start.

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 404 patients with TB aged 15 years or older in 2017, risk factors including homelessness, drug and alcohol misuse, and prison were recorded for 87.4% (353/404). Among those individuals, 11.3% (40/353) had at least 1 risk factor, which was a substantial decline in both number and proportion compared to 2016 (15.4%, 57/370, Table 10).

Table 10: Social risk factors among TB patients, East of England, 2009 to 2017

Year	Total recorded	Any social risk factor	
		Number of patients	Proportion (%)
2009	324	35	10.8
2010	375	23	6.1
2011	462	35	7.6
2012	438	32	7.3
2013	388	26	6.7
2014	372	34	9.1
2015	307	39	12.7
2016	370	57	15.4
2017	353	40	11.3

The most common risk factor reported in 2017 was drug misuse (4.6%, 17/371, Table 11)[19] followed by imprisonment (4.4% (16/362), homelessness (4.0%, 15/371) and alcohol misuse (2.4%, 9/372). Almost one-third of patients with at least 1 social risk factor had multiple factors (30.0%, 12/40).

Table 11: Social risk factors among TB patients, East of England, 2017

Risk factor	Total recorded	Number of patients	Proportion (%)
Drug use	371	17	4.6
Prison	362	16	4.4
Homelessness	371	15	4.0
Alcohol misuse	372	9	2.4

Among all cases notified between 2009 and 2017 with at least 1 risk factor, the majority of patients were male (85.4%, 274/321, Table 12). Compared to patients with no risk

[19] Problem drug use is defined as illicit injecting drug use or long duration/regular use of illicit opiates, cocaine and/or amphetamines.

factors, those with social risk factors were more likely to be UK born (49.8%, 152/321 vs 23.9%, 721/3,011), white (59.8%, 192/307 vs 26.0%, 798/2,999), have pulmonary disease (81.6%, 261/320 vs 52.8%, 1,616/3,061) which is sputum smear positive (71.0%, 115/162 vs 52.4%, 408/779), a previous diagnosis of TB (10.9%, 32/293 vs 6.0%, 180/3,006), and first line drug resistance (13.4%, 33/247 vs 7.9%, 150/1,902).

Table 12: Characteristics of patients aged 15 years or older in relation to social risk factors, East of England, patients diagnosed between 2009 and 2017

Characteristic		Patients with risk factors		Patients with no risk factors	
		Number of patients	Proportion (%)	Number of patients	Proportion (%)
Sex	Female	47	14.6	1,455	47.6
	Male	274	85.4	1,604	52.4
Age	15-44	202	62.9	1,908	62.2
	45-64	102	31.8	682	22.2
	65+	17	5.3	478	15.6
Country of birth	Non-UK born	153	50.2	2,290	76.1
	UK born	152	49.8	721	23.9
Ethnicity	White	192	59.8	798	26.0
	Black-Caribbean	14	4.4	19	0.6
	Black-African	49	15.3	470	15.3
	Indian	12	3.7	709	23.1
	Pakistani	11	3.4	488	15.9
	Mixed / Other	22	6.9	315	10.3
Clinical characteristics	Pulmonary	261	81.6	1,616	52.8
	Sputum smear positive	115	71.0	408	52.4
	Previous TB diagnosis	32	10.6	180	6.0
First line drug resistance		33	13.4	150	7.9
HIV test	Offered	166	96.0	1,498	94.1

Overall, 34.8% (87/250) of patients between 2009 and 2017 aged 15 years or older with at least 1 risk factor started treatment more than 4 months after symptom onset. This is smaller than the proportion of all patients in 2017 (42.1%, 149/354) who started treatment more than 4 months after symptom onset (Chapter 4). Delays of this length were more common among patients with risk factors and extra-pulmonary TB (52.3%, 23/44) compared to pulmonary TB (31.1%, 64/206). The median time from symptom onset to diagnosis was generally shorter for patients with risk factors (79 days, IQR 37-180 days) compared to patients with no risk factors (93 days, IQR 48-179 days).

Outcomes for patients aged 15 years or older with rifampicin sensitive TB with no CNS involvement with risk factors (notified between 2009 and 2017) were less favourable than patients with no risk factors (Table 13). Treatment was completed by 78.9% (194/246) of patients with social risk factors at their last recorded outcome, compared to

89.4% (2,214/2,476) of patients with no risk factors. Additionally, patients with risk factors were more likely to die (8.9%, 22/246 vs 4.2%, 103/2,476) or be lost to follow up (8.5%, 21/246 vs 3.9%, 97/2,476).

Table 13: Last recorded TB outcome for patients aged 15 years or older, East of England, 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	194	78.9	2,214	89.4
Died	22	8.9	103	4.2
Lost to follow up	21	8.5	97	3.9
Still on treatment	2	0.8	5	0.2
Not Evaluated	7	2.8	27	1.1
Treatment stopped	0	0.0	30	1.2
Total	**246**		**2,476**	

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

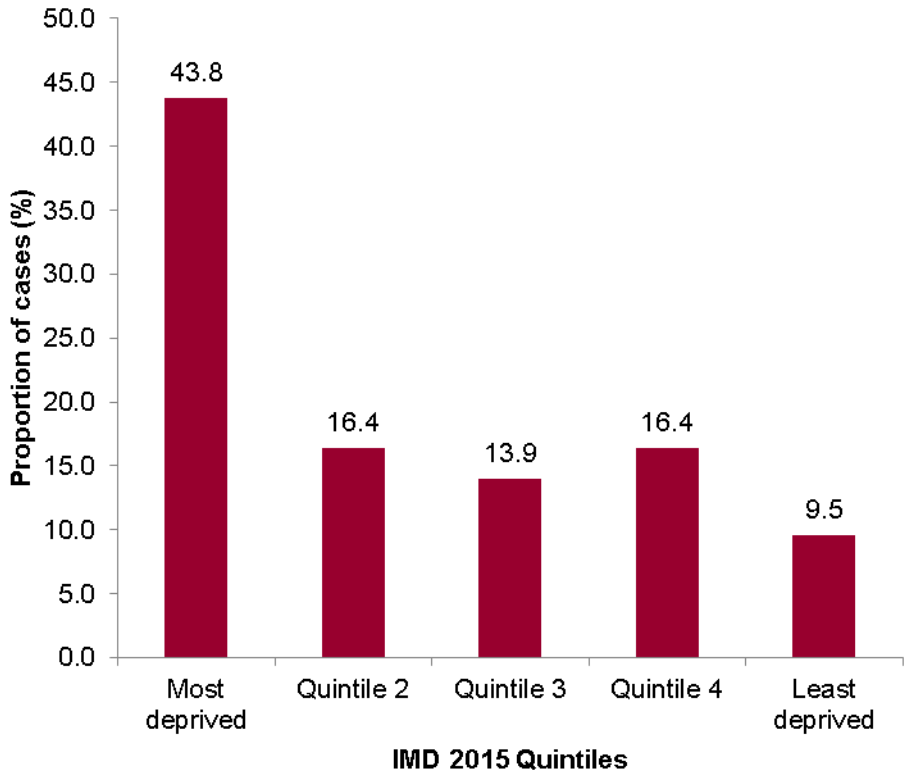
TB Monitoring Indicator 17: Proportion of patients with drug sensitive TB with at least 1 social risk factor who completed treatment within 12 months

Among all individuals with social risk factors, only 34.6% (85/246) were known to have started on DOT. The proportion of rifampicin sensitive patients on DOT who completed treatment (77.6%, 66/85) was marginally worse than patients who did not receive DOT (84.4%, 92/109).

Deprivation

Based on the Index of Multiple Deprivation (IMD 2015) rank assigned to different geographical areas in the East of England,[20] 43.8% (179/409) of patients were resident in the most deprived quintile, compared to other areas in the East of England (Figure 12). A substantial proportion of patients living in these areas (14.4%, 22/179) also had at least 1 social risk factor. In previous years, TB case rate has had a linear association with deprivation, so it is unusual that 16.4% of TB patients reported in 2017 (67/409) resided in the second-least deprived quintile.

Figure 12: TB case rate by deprivation, East of England, 2017



[20] The Index of Multiple Deprivation 2015 rank for each lower super output area (LSOA), based on deprivation score assigned, relative to other LSOAs in the PHE East of England area.

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

HIV testing

TB complicating HIV infection is a well-recognised and particularly lethal clinical state, but is successfully treated with a combination of highly active antiretroviral therapy (HAART) and appropriate TB antibiotic treatment [6]. For this reason, it is essential that all patients with TB should undergo HIV testing so that if they are diagnosed as having TB-HIV co-infection they have the opportunity to start curative TB treatment and HAART as soon as possible, and in so doing preserve their life expectancy and reduce the risk of TB and HIV transmission to others.

Of the 407 TB patients diagnosed in 2017 who were not diagnosed post-mortem and had a previously unknown HIV status, HIV testing information was known for 93.5% (360/385). HIV status was already known for 5.4% of patients (22/407). HIV tests were offered to 95.0% of patients with TB (342/360): 83.3% were offered and received a test (300/360), 0.3% were offered but declined a test (1/360), and 11.4% were offered but did not receive this testing (41/360). HIV tests were not offered to 5.0% of patients (18/360). There were no notable characteristics of patients not offered an HIV test (ie not predominantly paediatric or elderly, no specific ethnicity).

With the exception of Luton local authority, in most areas of the East of England 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, East of England, 2017

UTLA name	Total number of patients	Offered		Offered and received	
		Number of patients	Proportion (%)	Number of patients	Proportion (%)
Bedford	17	16	94.1	15	93.8
Cambridgeshire	36	35	97.2	35	100.0
Central Bedfordshire	4	4	100.0	3	75.0
Essex	61	60	98.4	58	96.7
Hertfordshire	67	58	86.6	57	98.3
Luton	50	49	98.0	16	32.7
Milton Keynes	22	20	90.9	19	95.0
Norfolk	24	23	95.8	23	100.0
Peterborough	40	40	100.0	40	100.0
Southend-on-Sea	12	12	100.0	12	100.0
Suffolk	14	13	92.9	12	92.3
Thurrock	13	12	92.3	10	83.3
East of England	**360**	**342**	**95.0**	**300**	**83.3**

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[21] for patients aged 15 years and older (see Tuberculosis in England: 2017 for methods) [1].

In 2017, 3.5% of TB cases were also co-infected with HIV, which is slightly higher than for England (2.8%) but reflects low level of co-infection overall. In general, over the past decade, there has been a declining trend in the proportion of co-infected cases since its peak in 2004 (15.9% for East of England, 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].

[21] 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, East of England, 2001 to 2017

Year	TB-HIV co-infection	
	n	%
2001	26	7.9
2002	47	13.6
2003	47	15.0
2004	62	15.9
2005	45	10.0
2006	55	11.9
2007	42	11.0
2008	45	9.5
2009	39	7.9
2010	35	7.3
2011	32	5.9
2012	20	4.1
2013	22	5.1
2014	22	5.2
2015	12	3.2
2016	11	2.6
2017	14	3.5

*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 deal with the issue of 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 [3].

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[22] following a national NHS procurement process and establishing a laboratory provider framework [7]. 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 [8].

In the East of England, the LTBI screening programme was commenced in a limited number of GP practices in Cambridgeshire and Peterborough, Hertfordshire Valley, Milton Keynes, Luton and Bedfordshire CCGs in May 2016. Analysis of local data for 2017 has found a positivity rate of 12.9% (70/544 IGRA tests), which is slightly lower than the rate found in the first 8 months' screening activity which occurred in 2016 (13.7%, 64/468). This is also lower than the rate found for England overall in 2017 (16.8%) [1]. For more information, please refer to Tuberculosis in England: 2018 [1].

[22] 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 East of England in 2017 was 6.4 cases per 100,000 population, representing a gradual decline which is statistically significantly lower than the rate of TB in 2012 (8.1 per 100,000). Rates of TB increased marginally in half of East of England local authorities, most notably in Peterborough and Southend-on-Sea. 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 East of England, with 20-30 cases of first line resistance per year. Rifampicin and multidrug-resistance remains rare, with 9 MDR/RR-TB cases notified in 2017, and 1 case of XDR-TB.

Delays to treatment start remain unacceptably long, with over one-third of patients with pulmonary TB having symptoms for more than 4 months. In contrast, culture confirmation of pulmonary TB is approaching the national target of 80%.

Treatment completion improved markedly, with 84.0% of patients notified in 2016 completing treatment within the expected duration of 12 months, compared to 77.9% in 2015. The proportion of patients who were lost to follow up also reduced.

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

An increasing proportion of people with TB originate from Central and Eastern European countries. Additionally, the majority of people with TB born outside the UK are diagnosed with TB 11 or more years after their entry to the UK. The impact of these changes in the epidemiology on existing TB control measures should be considered.

Focus 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.

Ensure that all diagnostic specimens are submitted for TB culture.

Strengthen outreach to hard-to-reach populations in the urban centres and ensure equity of diagnosis and access to care regardless of social deprivation, with emphasis on the homeless, those in contact with the criminal justice system, and others with complex psychological and social needs.

Continue to support and monitor the implementation of Whole Genome Sequencing technology for TB diagnosis in the East of England.

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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 East of England TB Control Board and local health protection forums.

Aim of report

This report describes the recent epidemiology of TB in the East of England. 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 2017, 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 2017. This is available at: gov.uk/government/collections/tuberculosis-and-other-mycobacterial-diseases-diagnosis-screening-management-and-data

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 2017 on 2 October 2018.

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 2017. 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.

Screening of people exposed to a patient with active TB is a key strategy to find and treat active and latent TB, and prevent further transmission. The outcomes of contact tracing activities are discussed by cohort reviews undertaken in all areas of the East of England [3]. All patients are reviewed by 1 of 4 TB Networks which meet on a quarterly basis. Standardised data collection for the 4 TB Networks was commenced for patients notified during 2016 (and discussed in 2017). Occasionally it is not possible to collect adequate information for every patient, and patients resident in the East of England but treated by a clinic in another area are reviewed elsewhere. Consequently, the number of patients presented to cohort review does not necessarily equal the number of patients summarised in the rest of this report. When considering the outcomes of contact tracing activities, TB Services are asked to report the results of routine (close) contact screening, however they do occasionally include the results of larger incident screening.

Definitions

BCG	Bacillus Calmette-Guérin vaccination
CI	Confidence interval
CCG	Clinical commissioning group
Cluster	Two 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)
HAART	Highly active antiretroviral therapy
IGRA	Interferon-gamma release assay – blood test for TB infection which does not differentiate between active disease and LTBI
IMD 2015	The Index of Multiple Deprivation 2010 rank for each LSOA, based on deprivation score assigned, relative to other LSOAs in the PHE East of England 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)
VOT	Video observed therapy
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 East of England was carried out on cases that clustered in the East of England and notified between 2013 and 2017.

Appendix C: TB among East of England residents

Table Bi: TB case numbers by upper tier local authority of residence, East of England, 2000 to 2017

UTLA name	Year																	
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Bedford	8	23	23	25	27	22	24	21	31	29	28	19	33	24	25	17	18	17
Cambridgeshire	22	21	23	19	27	37	41	29	49	39	29	38	37	44	39	32	38	40
Central Bedfordshire	7	12	6	6	9	10	8	8	7	11	15	11	6	10	8	7	5	6
Essex	40	52	59	45	55	43	68	50	54	67	63	82	60	70	66	45	68	67
Hertfordshire	53	54	59	48	65	102	99	56	79	84	96	110	80	73	80	82	99	74
Luton	65	69	87	74	67	87	74	80	73	91	96	108	85	60	73	58	55	59
Milton Keynes	23	24	9	13	18	24	43	44	38	33	26	36	44	32	23	23	25	25
Norfolk	21	17	22	32	30	43	40	43	56	45	29	42	34	31	32	40	37	28
Peterborough	25	26	26	14	34	36	39	24	47	36	47	52	59	57	45	31	39	44
Southend-on-Sea	9	16	16	18	27	22	22	26	18	21	25	19	17	14	9	15	6	14
Suffolk	21	20	19	19	29	31	14	33	39	44	31	29	33	25	32	28	30	19
Thurrock	5	4	6	10	17	13	7	7	15	12	21	14	9	11	4	11	12	16
East of England	**299**	**338**	**355**	**323**	**405**	**470**	**479**	**421**	**506**	**512**	**506**	**560**	**497**	**451**	**436**	**389**	**432**	**409**

Table Bii: 3 year average TB rate* per 100,000 by lower tier local authority of residence, East of England, 2000 to 2017

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
Bedford																
Bedford	12.2	15.8	16.6	16.3	16.0	14.7	16.5	17.5	18.9	16.2	16.9	15.9	16.9	13.4	12.0	10.3
Cambridgeshire																
Cambridge	7.6	7.3	6.9	8.5	13.6	14.3	15.8	11.2	12.5	10.6	12.0	12.5	11.4	10.2	10.4	11.7
East Cambridgeshire	2.3	1.3	2.6	2.6	3.5	2.5	3.3	2.9	2.8	3.2	2.8	2.7	3.1	2.7	3.0	2.3
Fenland	4.0	2.0	2.3	2.3	3.0	2.2	4.3	4.6	4.2	3.9	4.2	7.3	8.3	7.8	5.4	3.3
Huntingdonshire	2.3	3.8	3.7	5.2	4.1	4.1	3.4	5.6	5.6	5.9	4.1	4.5	4.4	5.0	4.6	4.5
South Cambridgeshire	3.8	3.3	4.0	4.2	5.3	6.0	6.4	7.0	5.9	4.3	4.5	4.9	5.1	4.6	4.7	5.6
Central Bedfordshire																
Central Bedfordshire	3.6	3.4	2.9	3.5	3.7	3.5	3.1	3.5	4.4	4.9	4.2	3.5	3.0	3.1	2.4	2.2
Essex																
Basildon	4.2	4.6	4.4	5.2	6.5	7.1	7.8	7.2	8.3	8.0	6.5	6.2	6.0	7.2	7.3	6.7
Braintree	1.8	1.2	1.5	1.9	2.9	2.1	1.6	0.9	1.8	2.7	3.8	3.4	3.4	2.0	2.0	1.5
Brentwood	7.3	5.8	3.8	3.3	4.3	4.2	6.5	7.4	7.3	5.5	3.6	4.5	6.2	7.9	7.4	5.2
Castle Point	4.2	3.5	4.6	3.4	3.1	3.0	3.0	3.4	1.9	2.6	2.3	3.4	3.0	3.7	2.6	2.2
Chelmsford	3.4	4.8	6.2	5.1	5.1	3.9	4.7	4.2	3.6	4.0	3.4	3.0	3.1	3.3	3.5	3.1
Colchester	4.5	3.8	3.6	3.3	3.5	4.7	4.0	4.4	4.5	7.0	6.5	5.5	3.4	3.3	3.6	4.1
Epping Forest	6.1	4.9	4.9	3.8	4.9	3.5	3.5	3.8	5.7	6.2	7.2	8.5	8.4	6.5	4.1	3.8
Harlow	5.9	8.5	9.0	6.4	7.7	7.6	10.1	8.8	8.7	10.6	16.6	19.3	16.7	9.1	9.0	12.4
Maldon	1.1	1.1	2.2	2.2	1.6	0.5	1.1	1.6	2.2	2.7	2.2	2.2	1.6	1.6	2.6	3.2
Rochford	3.4	3.4	3.3	2.5	3.7	4.1	4.1	4.4	3.6	3.2	1.6	1.6	1.2	0.8	2.0	1.9
Tendring	2.4	3.3	2.6	2.4	1.9	1.4	0.7	1.0	1.7	2.9	2.2	2.4	2.4	2.1	2.3	2.3
Uttlesford	1.9	1.9	0.9	1.4	2.8	4.1	3.6	4.0	3.9	3.8	1.7	1.2	1.2	3.2	3.5	4.2
Hertfordshire																
Broxbourne	4.2	4.6	7.2	7.6	9.4	6.3	5.9	4.7	5.1	4.3	5.0	7.1	7.7	7.0	6.9	8.3
Dacorum	1.9	1.9	2.9	3.4	4.6	5.3	5.2	4.0	5.2	5.8	7.6	6.1	4.7	3.8	4.2	4.8

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
East Hertfordshire	1.8	1.8	2.0	2.3	3.6	2.8	2.2	1.5	1.7	2.7	2.9	2.6	2.4	3.3	4.4	4.3
Hertsmere	10.6	10.9	9.2	8.8	8.8	8.7	7.6	7.5	11.5	12.1	13.0	10.6	10.5	8.5	11.0	10.6
North Hertfordshire	6.0	4.0	3.6	4.7	7.2	7.4	7.0	8.3	8.0	7.7	5.2	6.0	5.1	6.1	5.3	6.3
St Albans	3.6	3.1	5.3	6.3	8.3	6.0	5.0	4.2	7.3	7.2	7.3	5.2	5.3	4.6	4.8	4.3
Stevenage	6.7	5.4	5.8	11.2	15.0	13.7	13.2	10.2	13.8	12.4	10.7	9.4	8.6	10.1	8.9	8.0
Three Rivers	6.4	5.6	5.2	5.9	6.3	8.3	6.3	5.4	4.2	6.5	7.6	7.9	8.6	6.3	6.9	5.4
Watford	16.6	19.5	16.1	20.1	22.0	24.3	18.0	14.6	14.6	19.6	18.4	15.9	12.4	15.7	17.7	16.2
Welwyn Hatfield	1.0	1.0	2.4	4.6	5.8	5.4	8.1	11.5	12.0	14.3	12.0	11.6	7.3	7.5	9.6	8.3
Luton																
Luton	39.7	41.3	41.1	41.2	41.0	42.8	39.9	42.3	44.3	49.3	47.5	41.0	35.0	30.3	29.1	26.7
Milton Keynes																
Milton Keynes	8.8	7.1	6.1	8.3	12.7	16.3	18.0	16.3	13.4	12.9	14.2	14.8	12.9	10.0	9.0	9.2
Norfolk																
Breckland	1.1	1.9	2.7	4.0	4.3	3.7	3.7	3.6	3.9	3.1	2.5	3.0	2.3	2.0	1.7	1.9
Broadland	1.7	1.4	1.4	1.7	2.2	3.3	3.0	2.7	1.6	1.6	1.9	2.7	2.1	1.6	0.5	0.3
Great Yarmouth	2.2	4.0	5.4	5.4	4.6	6.0	10.5	13.6	12.8	11.0	9.2	8.5	8.9	8.8	11.8	11.4
King's Lynn and West Norfolk	2.9	3.7	3.4	3.3	3.3	3.3	4.4	4.4	4.6	3.2	2.7	2.5	3.3	3.8	4.6	4.2
North Norfolk	2.0	0.7	0.7	1.3	2.3	7.0	7.3	7.6	3.6	3.6	2.3	3.3	2.0	2.3	1.0	1.0
Norwich	4.9	6.0	8.4	10.7	11.2	9.2	8.9	7.8	8.8	8.7	9.3	8.7	7.2	7.8	8.0	7.9
South Norfolk	2.4	2.7	2.1	3.2	3.8	3.7	2.6	2.5	1.9	1.9	1.3	1.1	1.0	1.8	2.0	1.8
Peterborough																
Peterborough	16.3	13.8	15.3	17.1	21.8	19.4	21.2	20.3	24.2	24.8	28.6	30.0	28.5	23.2	19.8	19.3
Southend-on-Sea																
Southend-on-Sea	8.5	10.4	12.6	13.8	14.6	14.2	13.3	12.9	12.5	12.6	11.7	9.5	7.6	7.1	5.6	6.5
Suffolk																
Babergh	1.6	1.2	1.6	1.9	1.5	0.4	1.1	1.9	3.1	2.7	2.3	1.5	1.5	1.9	2.6	2.6
Forest Heath	0.6	0.6	0.6	1.7	3.5	5.2	6.4	6.9	5.7	4.0	2.8	4.5	4.9	4.8	3.7	4.2
Ipswich	7.4	6.8	8.9	6.3	5.7	5.6	6.4	9.4	9.3	8.6	6.5	4.7	5.6	6.3	7.5	5.5

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
Mid Suffolk	1.2	1.5	1.5	1.9	1.5	2.2	1.4	1.8	1.0	1.7	2.1	2.0	2.0	2.3	3.0	2.0
St Edmundsbury	1.4	1.7	2.6	4.6	4.8	5.4	3.8	5.6	5.2	5.8	5.4	5.7	6.3	5.0	5.0	3.5
Suffolk Coastal	0.9	1.2	2.0	3.4	2.8	2.2	2.2	3.0	3.8	3.8	4.8	4.0	2.9	2.1	1.6	1.6
Waveney	5.6	5.0	3.2	4.9	4.0	4.6	6.9	8.3	7.5	5.2	4.0	4.6	4.6	3.7	3.7	4.3
Thurrock																
Thurrock	3.5	4.6	7.5	9.1	8.3	6.0	6.4	7.4	10.3	10.0	9.3	7.1	4.9	5.3	5.4	7.7
East of England	**5.9**	**6.0**	**6.3**	**7.0**	**7.8**	**7.8**	**8.0**	**8.1**	**8.5**	**8.7**	**8.5**	**8.2**	**7.4**	**6.8**	**6.6**	**6.4**

*rates calculated using ONS mid-year population estimates

Table Biii: TB case numbers and rate by age and sex, East of England, 2017

Age group (years)	Male			Female			Overall		
	Number	Rate	95% CI	Number	Rate	95% CI	Number	Rate	95% CI
0-14	4	0.7	0.2 - 1.7	1	0.2	0.0 – 1.0	5	0.2	0.1 - 0.5
15-44	120	10.2	8.5 - 12.2	118	10.1	8.4 - 12.1	238	5.1	4.5 - 5.8
45-64	62	7.5	5.7 - 9.6	41	4.8	3.5 - 6.5	103	3.1	2.5 - 3.7
65+	39	6.9	4.9 - 9.4	24	3.6	2.3 - 5.3	63	2.5	2.0 - 3.3
All ages	**225**	**7.1**	**6.2-8.1**	**184**	**5.6**	**4.9 - 6.5**	**409**	**6.4**	**5.8 – 7.0**

*rates calculated using ONS mid-year population estimates

Table Biv: Drug resistance among TB patients with culture confirmed disease*, East of England, 2000 to 2017

Year	DST results	First line drug resistance		INH-R without MDR-TB		MDR/RR-TB		Pre-XDR		XDR	
	Number	Number	Proportion (%)	Number	Proportion (%)	Number	Proportion (%)	Number	Proportion (%)	Number	Proportion (%)
2000	144	9	6.3	7	4.9	1	0.7	0	0.0	0	0.0
2001	180	19	10.5	16	8.8	3	1.7	0	0.0	0	0.0
2002	205	16	7.7	8	3.9	6	2.9	0	0.0	0	0.0
2003	215	19	8.8	13	6.0	6	2.8	0	0.0	0	0.0
2004	261	18	6.7	16	6.0	2	0.7	0	0.0	0	0.0
2005	315	29	9.1	23	7.3	5	1.6	0	0.0	0	0.0
2006	305	24	7.8	20	6.5	4	1.3	0	0.0	0	0.0
2007	250	17	6.7	16	6.3	1	0.4	0	0.0	0	0.0
2008	296	25	8.2	18	5.9	6	2.0	0	0.0	1	0.3
2009	289	20	6.8	9	3.1	6	2.0	0	0.0	0	0.0
2010	304	22	7.1	17	5.5	3	1.0	0	0.0	0	0.0
2011	345	30	8.5	17	4.8	12	3.4	0	0.0	2	0.6
2012	305	28	9.0	16	5.1	8	2.6	0	0.0	2	0.6
2013	281	19	6.7	17	6.0	1	0.4	0	0.0	0	0.0
2014	285	24	8.4	17	6.0	5	1.8	0	0.0	0	0.0
2015	242	27	11.2	24	9.9	3	1.2	0	0.0	1	0.4
2016	274	23	8.3	14	5.1	8	2.9	0	0.0	0	0.0
2017	254	26	10.0	15	5.7	9	3.4	2	0.8	1	0.4

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

Appendix D: All TB patients notified by East of England clinics

Tables of further information about TB cases treated by hospital clinics and TB services based on the East of England are available for public health and clinical stakeholders from your local FS team.

Appendix E: Local authority TB epidemiological summaries

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