Feidhmeannacht na Seirbhíse Sláinte
Health Service Executive

Health Protection Surveillance Centre

Report on the Epidemiology of Tuberculosis in Ireland 2015

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Epidemiology of Tuberculosis in Ireland 2015

A Report by the
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Acknowledgements

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Report prepared by Sarah Jackson and Joan O'Donnell, HPSC.

Summary of 2015 TB notifications

- TB case notifications decreased in 2015 (n=303, rate 6.6/100,000) compared to 2014 (n=313, rate 6.8/100,000). This is the lowest crude notification rate* recorded since TB enhanced surveillance began in 1998.
- Regional variation was noted in TB notification rates ranging from 3.0 in HSE South East to 10.4 in HSE South.
- The highest rates were reported by North Cork (13.4) and South Lee (14.1) in HSE South and Dublin West (13.0) in HSE East.
- The highest age-specific rate occurred among those aged 65 years and older (11.8).
- Rates were higher in males for all age groups and the highest rates among both sexes were in those aged 65 years and older.
- Foreign-born cases accounted for 42.6% of notifications.
- There was a notable difference in age between cases born in Ireland (median age 56.5 years) and foreign-born cases (median age 32.0 years).
- Pulmonary cases accounted for 66.3% of total TB cases, 70.1% were culture positive and 42.1% were smear positive.
- There were two cases of TB meningitis notified.
- Treatment outcome data were provided for 80.2% of cases in 2014. Treatment was reported as completed for 66.5% of total cases and for 70.3% of sputum smear positive cases notified. Treatment outcome data for 2015 is not currently available.
- There were 21 deaths reported, four (19.0%) of which were attributable to TB.
- There were 13 drug-resistant cases, including one MDR-TB case.

* All rates in this report are per 100,00 population unless otherwise specified

Introduction

In 2015, 6.4 million cases of TB were notified by national TB control programmes and reported to the World Health Organization (WHO) (83.0 per 100,000 population). Of these, 85% were new pulmonary sputum smear positive cases. Approximately 1.8 million TB deaths occurred globally in 2015. [1]

In 2015, 307,202 cases of TB were reported by 51 of the 53 countries of the WHO European Region. The overall notification rate averaged at 34.5 cases per 100,000, with a wide variation between countries and an incremental west-to-east gradient.[2] Figure 1 displays a map of TB notification rates in 2015 in the WHO European region.

The lowest rate in the region occurred in Western Europe (EU countries plus Iceland and Norway) at 11.7 per 100,000 population, with rates lower than 10 per 100,000 reported in 22 countries and higher than 20 per 100,000 in Bulgaria, Latvia, Lithuania, Portugal and Romania.

In 2015, 29.8% of reported TB cases in Western Europe were foreign born. This proportion ranged from 0.2% to 89.5% across 29 countries of the EU/EEA. Multidrug-resistance (MDR) remained most frequent in the Baltic States (11.1-21.2%). Other countries reported lower levels of multidrug-resistant TB (MDR-TB) ranging from 0.0-6.0%.

In 2015, 251,715 notifications were reported from 23 of the 25 non-EU European and central Asian countries of which 52% were from the Russian Federation. The highest rates per 100,000 population in this region were reported by Kyrgyzstan (131.9.0), Moldova (103.5), Russia (91.2) and Georgia (90.3), while the lowest rates were reported by Monaco (0.0), Andorra (5.7) and Switzerland (6.8). The highest burden of MDR-TB cases in the WHO European region is in the non-EU European and central Asian countries where the prevalence is 31.4% in culture confirmed pulmonary cases. This is seven times higher than the proportion reported in the EU/EEA countries (4.5%). Overall, the proportion of culture confirmed pulmonary cases with MDR-TB across the entire WHO European region was 25.0%.

In Ireland, national epidemiological data on TB have been collated by the Health Protection Surveillance Centre (HPSC) since 1998. From January 2000, this information has included enhanced surveillance data items based on the minimum dataset reported to the European Centre for Disease Prevention and Control (ECDC). The resulting National Tuberculosis Surveillance System (NTBSS) was set up following consultation with the eight former health boards and the National TB Advisory Committee. The National TB Advisory Committee was reconvened in October 2004 and updated guidelines for TB prevention and control in Ireland were published in April 2010.[3]

This report presents an epidemiological review of all TB cases notified in Ireland in 2015. Data for 2015 have been validated.

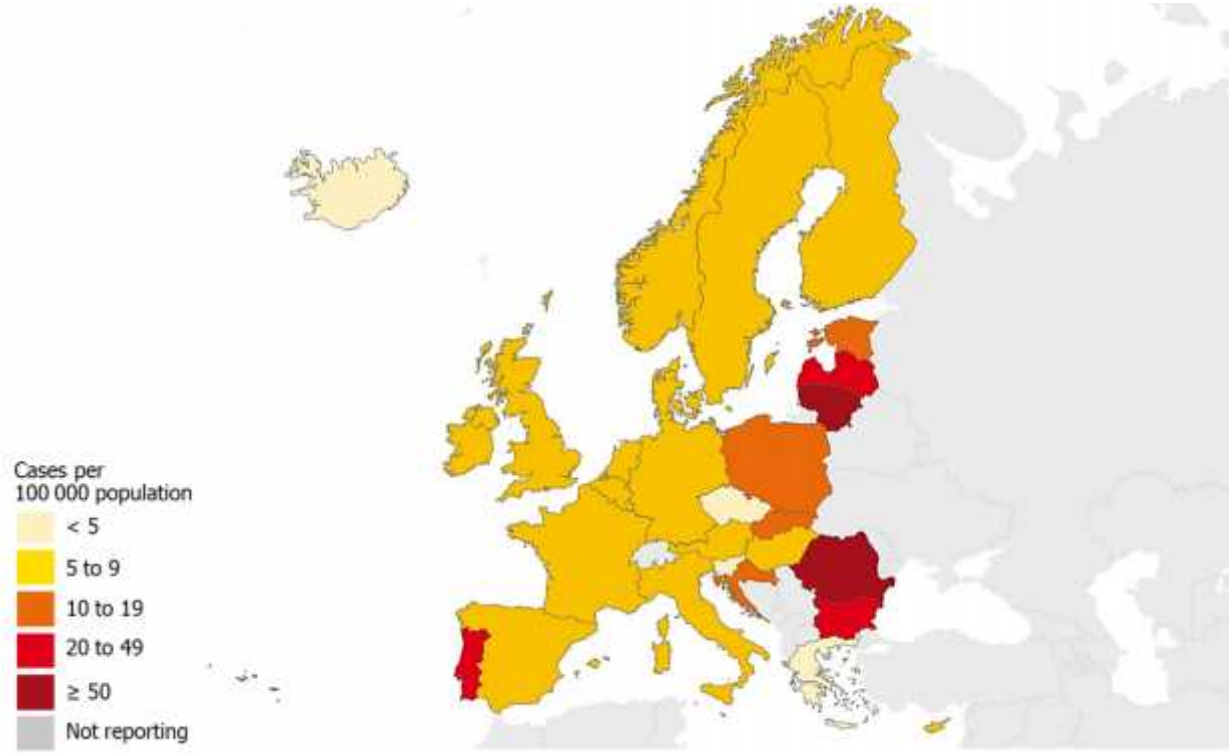

Figure 1: Tuberculosis notification rates per 100,000 population, EU and EEA, 2015[2]

Case Definition

The case definition used for the analyses in this report is the Irish TB case definition under SI No. 452/2011 Infectious Diseases (Amendment) Regulations 2011.[4] This case definition is also in harmony with the 2012 EU case definition.

Tuberculosis: (*Mycobacterium tuberculosis* complex including *M*. *tuberculosis, M*. *africanum*, *M*. *bovis*, *M*. *canetti*, *M*. *caprae*, *M*. *microti* and *M*. *pinnipedii*)

Clinical Criteria – Any person with:

- Signs, symptoms and/or radiological findings consistent with active tuberculosis in any site
  AND
- A clinician's decision to treat the person with a full course of anti-tuberculosis therapy

  OR
- A case discovered post-mortem with pathological findings consistent with active tuberculosis that would have indicated anti-tuberculosis antibiotic treatment had the patient been diagnosed before dying

Confirmed case – A person meeting the clinical criteria and at least one of the following two:

- Isolation of *M. tuberculosis* complex (excluding *Mycobacterium. bovis*-BCG) from a clinical specimen

OR

- Detection of *M. tuberculosis* nucleic acid in a clinical specimen
  AND
- Positive microscopy for acid-fast bacilli or equivalent fluorescent staining bacilli on light microscopy

Probable case – A person meeting the clinical criteria and at least one of the following three:

- Microscopy positive for acid-fast bacilli or equivalent fluorescent staining bacilli on light microscopy

OR

- Detection of *Mycobacterium tuberculosis* nucleic acid in a clinical specimen

OR

- Histological appearance of granulomata

Possible case: A person meeting the clinical criteria without laboratory confirmation

Definitions

Pulmonary TB: TB of the lung parenchyma or the tracheo-bronchial tree or the larynx. WHO defines pulmonary TB, for the purpose of analysis, as any case that has a pulmonary disease component.

Extra-pulmonary TB: TB affecting any site other than pulmonary as defined above. Pleural TB and intra-thoracic lymphatic TB by themselves are considered as extrapulmonary.

Pulmonary and extra-pulmonary TB is a case of TB that meets the previous two definitions.

Smear positive case[5]: A patient with the presence of at least one acid-fast bacillus (AFB+) in at least one sputum sample in countries with a well functioning external quality assurance (EQA) system.

A new case is defined as a patient where no previous history of TB was reported.

A recurrent case is defined as a patient with a documented history of TB prior to their 2015 notification.

Multidrug-resistant (MDR-TB) is defined as a TB case resistant to at least isoniazid and rifampicin with or without resistance to ethambutol and streptomycin.

Extensively drug-resistant TB (XDR-TB) is defined as a TB strain resistant to any fluoroquinolone (such as levofloxacin or moxifloxacin) and at least one of three injectable second-line drugs (capreomycin, kanamycin and amikacin), in addition to MDR-TB. This definition of XDR-TB was agreed by the WHO Global Task Force on XDR-TB in October 2006.[6]

TB Outbreak

In general an outbreak is defined as the occurrence of cases of active TB disease[†] above the expected level usually over a given period of time[‡] in a geographic area, facility or within a specific population group.[3]

The following are examples of situations to report:

- An unexpected increase (significantly above baseline) of newly identified TB[§] cases in any setting
- Two or more TB cases[†] on treatment from a congregate (e.g. school or prison) or high risk setting (e.g. HIV positive individuals occurring within a relatively short space of time).
- Three or more TB cases[†] on treatment from a community setting (outside a household) occurring within a relatively short period of time that may be related.
- Three or more TB cases[†] on treatment in a household
- Two or more cases of MDR-TB (multidrug-resistant TB) or XDR-TB (extensively drug-resistant) that may be related and occur outside a household

When assessing whether a cluster of TB cases represents an outbreak, indicators to consider include:

- Epidemiological links between cases
- Similar unique characteristics among cases
- Matching drug resistance patterns of isolates
- Matching DNA fingerprint patterns of isolates

[†] This definition of a TB outbreak relates to cases of TB disease only and not to cases of latent TB infection (LTBI).

[‡] In general, within 6 months but outbreaks over longer periods may also be considered where epidemiological/microbiological evidence suggests that cases are linked. This should be based on local risk assessment or in consultation with HPSC if deemed appropriate.

[§] TB cases as defined by the Irish case definition, see http://www.hpsc.ie/NotifiableDiseases/CaseDefinitions/

Methods

Data collection

An enhanced TB notification form was completed by public health doctors for each case of TB notified. These forms summarise all available clinical, microbiological, histological and epidemiological data. Forms were then collated in the regional departments of public health, where data were entered onto the Computerised Infectious Disease Reporting (CIDR) system. Finalised 2015 data (with outcome information) were extracted from CIDR during August 2016.

The introduction of the amendment to the Infectious Disease Regulations 1981 on January 1st 2004, made outbreaks, unusual clusters or changing patterns of illness statutorily notifiable by medical practitioners and clinical directors of laboratories to the medical officer of health. Standard reporting procedures for the surveillance of TB outbreaks were formally agreed in 2007. Outbreak data are collated on the CIDR system.

Data analysis

National TB data from 1992 to 1997 were provided by the Department of Health (DoH). National TB data from 1998 to 2010 were obtained from the NTBSS system. Data for 2011 onwards are taken from the CIDR system.

Rates for 1991 to 1993 are based on the 1991 population census; rates for 1994, to 1999 are based on the 1996 population census; rates for 2000 to 2003 are based on the 2002 population census; rates for 2004 to 2008 are based on the 2006 population census and rates for 2009 to 2015 are based on the 2011 census.

For the calculation of rates in the Irish-born and foreign-born population, denominator data represent persons usually resident in each province and county, and present in the state on census night. The Irish-born population was defined as those persons who were born in Ireland.[7]

Direct methods of standardisation were used to allow comparison of rates between geographical areas using the 2011 Irish population as the standard population. In order to compare rates between groups of interest, 95% confidence intervals were used.

Three-year moving averages were calculated by applying the formula (a+2b+c)/4 to each three successive points a, b and c (each letter representing a year) in the series. They are useful for smoothing irregularities in trend data and make it easier to discern long-term trends that otherwise might be obscured by short-term fluctuations.

Local health offices (LHOs) came into operation on 1st September 2005, replacing Community Care Areas. LHO denominators are used in this report rather than community care area (CCA) denominators. LHO rates were calculated using Census 2011 LHO denominator data extracted from Health Atlas[8] for all LHOs except HSE-SE, who supplied regionally calculated Census 2011 LHO denominator data.

Data completeness

For the case based dataset, 16 key variables from CIDR were analysed for completeness. Appendix 1 shows the completeness of reporting for these variables during 2015.

Results: TB cases in Ireland, 2015

Overall cases and rates

There were 303 cases of TB notified in 2015, corresponding to rate of 6.6 per 100,000 population respectively. A summary of the 2015 data is shown in table 1.

Table 1: Summary of the epidemiology of TB in Ireland, 2015

Parameter	Number of cases	CIR	% of total
Total number of cases	303	6.6	n/a
Cases in indigenous population	152	4.0	*50.2*
Cases in foreign-born persons	129	16.8	*42.6*
Culture positive cases	198	4.3	*65.3*
Pulmonary cases	197	4.3	*65.0*
Smear positive pulmonary cases	83	1.8	*27.4*
Multi-drug resistant cases	1	0.02	*0.3*
Extensively drug-resistant cases	0	0.00	*0.0*
Mono-resistant to isoniazid	6	0.1	*2.0*
Deaths attributable to TB	4	0.1	*1.3*
TB meningitis cases	2	0.4	*0.7*

The number and rates of TB cases notified for each of the years from 2006-2015 are shown in table 2. Three-year moving averages for the years 2006-2014 are also shown.

Table 2: Number and rates of notified cases of TB in Ireland, 2006-2015 with 3-year moving averages, 2006-2014

Year	Number of cases	Crude rate per 100,000 population	3-year moving average
2006	463	10.9	464
2007	481	11.3	473
2008	467	11.0	474
2009	479	10.4	461
2010	420	9.2	433
2011	413	9.0	401
2012	359	7.8	376
2013	372	8.1	354
2014	313	6.8	325
2015	303	6.6	

Crude incidence rates by HSE area

The highest crude rate for 2015 was reported in HSE South (10.4/100,000) while the lowest rate was reported in HSE South East (3.0/100,000).

The crude incidence rates seen in each HSE area from 2006 to 2015 are shown in table 3 while the 3-year moving average TB notification rates for each HSE area from 2006 to 2014 are shown in table 4.

Table 3: Crude TB incidence rates per 100,000 population by HSE area, 2006-2015

Year	HSE E	HSE M	HSE MW	HSE NE	HSE NW	HSE SE	HSE S	HSE W	National
2006	12.7	6.0	10.2	8.4	3.8	11.1	15.3	7.7	**10.9**
2007	14.6	6.4	8.3	6.1	7.2	6.3	16.4	10.6	**11.3**
2008	15.9	9.5	6.9	4.6	5.9	6.5	14.0	7.5	**11.0**
2009	14.5	8.9	7.1	6.1	9.7	7.4	12.3	4.7	**10.4**
2010	11.1	8.5	7.6	6.8	7.4	5.4	13.5	4.7	**9.2**
2011	11.6	6.4	6.3	5.7	5.0	6.0	12.6	7.0	**9.0**
2012	9.1	9.6	5.5	5.4	5.4	5.0	10.2	7.2	**7.8**
2013	9.1	5.7	8.4	6.1	6.2	6.4	9.9	8.1	**8.1**
2014	8.2	5.7	4.0	5.0	6.6	5.8	9.8	3.6	**6.8**
2015	8.1	5.0	4.0	3.6	7.0	3.0	10.4	5.6	**6.6**

Table 4: 3-year moving average TB notification rate per 100,000 population by HSE area, 2006-2014

Year	HSE E	HSE M	HSE MW	HSE NE	HSE NW	HSE SE	HSE S	HSE W	National
2006	13.2	6.2	10.9	6.5	5.3	9.1	14.8	9.2	**10.9**
2007	14.5	7.1	8.4	6.3	6.0	7.5	15.5	9.1	**11.2**
2008	15.2	8.6	7.3	5.3	7.2	6.7	14.2	7.6	**11.0**
2009	14.0	8.9	7.2	5.9	8.2	6.7	13.1	5.4	**10.3**
2010	12.1	8.1	7.2	6.4	7.4	6.1	13.0	5.3	**9.4**
2011	10.9	7.7	6.5	5.9	5.7	5.6	12.3	6.5	**8.7**
2012	9.7	7.8	6.5	5.7	5.5	5.6	10.8	7.4	**8.2**
2013	8.9	6.6	6.6	5.7	6.1	5.9	10.0	6.7	**7.7**
2014	8.4	5.5	5.1	4.9	6.6	5.3	10.0	5.2	**7.2**

Age and sex distribution

There were 121 (39.9%) cases of TB notified in females and 182 (60.1%) cases of TB notified in males, giving a male to female ratio of 1.5:1 in 2015. Table 5 gives the breakdown of notified TB cases by sex and HSE area.

Table 5: TB cases by HSE area and sex, 2015

HSE area	Female	Male	M:F ratio	Total
HSE E	56	75	1.3	**131**
HSE M	5	9	1.8	**14**
HSE MW	7	8	1.1	**15**
HSE NE	6	10	1.7	**16**
HSE NW	13	5	0.4	**18**
HSE SE	4	11	2.8	**15**
HSE S	18	51	2.8	**69**
HSE W	12	13	1.1	**25**
Total	**121**	**182**	**1.5**	**303**

Table 6 shows the number of cases and the age-specific rates for males and females. The highest age-specific rates occurred in those aged 65 years and older (11.8/100,000) and the median age was 40 years (range: 2-90 years).

Rates in males were higher than in females in all age groups. The highest rate among both females (9.9) and males (14.0) occurred in those aged 65 years and older. Figure 2 shows the age-specific rates of TB in Ireland from 2006 to 2015.

Table 6: TB cases and age-specific rates per 100,000 population by sex, 2015

Age group (years)	Female		Male		Total	
	Cases	Rates	Cases	Rates	Cases	Rate
0-14	6	*1.3*	8	*1.6*	**14**	***1.4***
15-24	10	*3.5*	16	*5.5*	**26**	***4.5***
25-34	27	*7.0*	50	*13.6*	**77**	***10.2***
35-44	24	*6.9*	28	*8.0*	**52**	***7.5***
45-54	10	*3.4*	22	*7.6*	**32**	***5.5***
55-64	15	*6.5*	24	*10.3*	**39**	***8.4***
65+	29	*9.9*	34	*14.0*	**63**	***11.8***
Total	**121**	**5.2**	**182**	**8.0**	**303**	**6.6**

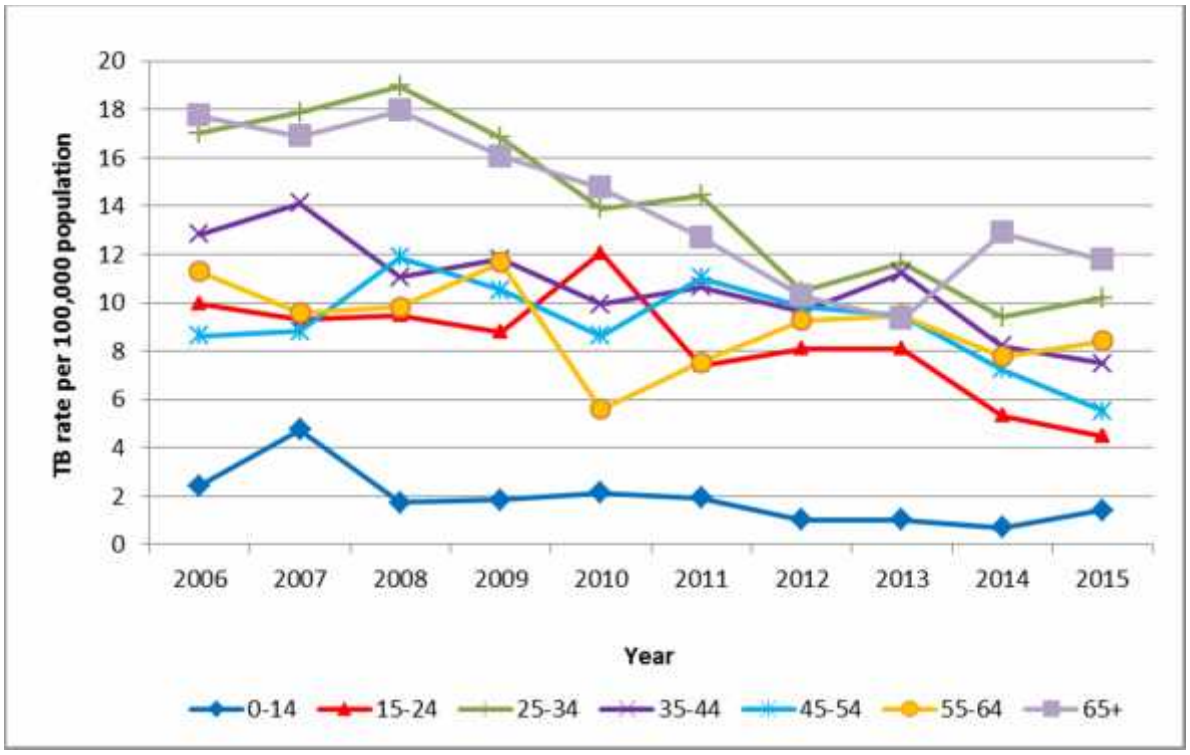

Figure 2: Age-specific rates of TB by year, 2006-2015

Crude incidence rates by Local Health Office (LHO)

Crude incidence rates for each local health office (LHO)** in 2015 are shown in table 7. Three-year moving averages for the crude incidence rates are presented in table 8. The highest crude rates (per 100,000 population) were reported by South Lee (14.1) and North Cork (13.4) in HSE South, and Dublin West (13.0) in HSE East.

** Note: Local Health Offices (LHOs) came into operation on 1st September 2005, taking over operations from Community Care Areas (CCAs)

Table 7: TB crude incidence rate per 100,000 population by LHO[††], 2006-2015

HSE area	LHO	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
HSE-E	**Total**	**12.7**	**14.6**	**15.9**	**14.5**	**11.1**	**11.6**	**9.1**	**9.1**	**8.2**	**8.1**
	Dublin South	5.5	8.7	4.7	6.9	4.6	6.1	6.9	6.9	4.6	5.4
	Dublin South East	5.4	10.0	15.4	8.7	6.9	8.7	8.7	5.2	8.7	4.3
	Dublin South City	19.4	29.8	29.8	20.0	17.3	16.6	13.8	12.4	8.3	9.0
	Dublin South West	5.4	14.9	6.8	17.5	12.3	9.1	7.1	8.4	9.1	7.1
	Dublin West	17.9	16.4	28.4	17.8	14.4	28.0	10.9	11.6	10.3	13.0
	Dublin Nth West	21.0	24.7	21.5	25.3	16.4	14.9	16.4	10.9	11.4	9.4
	Dublin Nth Central	26.1	23.7	24.5	22.2	22.9	14.0	15.5	17.7	19.2	12.6
	Dublin Nth	11.7	8.6	9.5	11.5	9.0	8.6	4.9	6.5	4.9	7.8
	Kildare/W Wicklow	6.9	7.4	14.3	6.1	4.8	4.8	5.3	7.0	5.7	6.1
	Wicklow	7.3	2.7	5.5	9.3	3.4	8.4	3.4	5.1	1.7	5.9
HSE-M	**Total**	**6.0**	**6.4**	**9.5**	**8.9**	**8.5**	**6.4**	**9.6**	**5.7**	**5.7**	**5.0**
	LD/WH	5.3	6.2	14.1	8.8	15.2	5.6	9.6	7.2	9.6	5.6
	LS/OY	6.5	6.5	5.8	8.9	3.2	7.0	9.5	4.5	2.5	4.5
HSE-MW	**Total**	**10.2**	**8.3**	**6.9**	**7.1**	**7.6**	**6.3**	**5.5**	**8.4**	**4.0**	**4.0**
	Clare	8.1	7.2	3.6	6.8	8.5	6.8	5.1	8.5	6.0	4.3
	Limerick	14.5	9.3	11.2	8.3	7.8	6.8	6.3	9.4	4.2	5.2
	Tipp Nth/E Limerick	6.1	8.1	4.0	4.3	5.7	4.3	4.3	5.7	0.0	0.0
HSE-NE	**Total**	**8.4**	**6.1**	**4.6**	**6.1**	**6.8**	**5.7**	**5.4**	**6.1**	**5.0**	**3.6**
	Cavan/Monaghan	8.4	5.1	6.7	6.0	6.7	3.7	5.2	3.7	5.2	4.5
	Louth/Sth Monaghan	7.2	8.1	5.4	5.7	7.3	9.0	6.5	9.8	5.7	4.1
	Meath	9.2	5.5	2.5	6.5	6.5	4.9	4.9	5.4	4.3	2.7
HSE-NW	**Total**	**3.8**	**7.2**	**5.9**	**9.7**	**7.4**	**5.0**	**5.4**	**6.2**	**6.6**	**7.0**
	Donegal	2.7	6.8	4.8	8.1	5.6	7.4	5.6	5.6	6.2	4.3
	Sligo/Leitrim	5.5	7.7	7.7	12.3	10.3	1.0	5.1	7.2	7.2	11.3
HSE-SE	**Total**	**11.1**	**6.3**	**6.5**	**7.4**	**5.4**	**6.0**	**5.0**	**6.4**	**5.8**	**3.0**
	Carlow/Kilkenny	7.5	5.8	5.0	3.8	5.4	5.4	6.1	10.7	6.9	5.4
	Tipperary South	20.4	9.0	6.8	9.6	7.4	5.3	4.2	6.4	6.4	3.2
	Waterford	13.3	8.3	9.2	14.9	7.8	8.6	6.3	5.5	7.0	2.3
	Wexford	6.1	3.0	5.3	2.8	2.1	4.8	3.4	3.4	3.4	1.4
HSE-S	**Total**	**15.3**	**16.4**	**14.0**	**12.3**	**13.5**	**12.6**	**10.2**	**9.9**	**9.8**	**10.4**
	Kerry	6.4	6.4	7.2	5.5	4.8	7.6	8.9	6.2	9.6	6.2
	North Cork	8.7	7.4	8.7	13.4	19.0	14.5	10.1	14.5	10.1	13.4
	North Lee	28.0	19.7	22.1	13.8	16.5	16.0	12.7	9.4	9.4	9.4
	South Lee	16.2	30.1	15.6	16.2	18.8	15.2	11.0	14.1	14.1	14.1
	West Cork	5.6	0.0	9.3	10.6	0.0	3.5	3.5	5.3	5.3	5.3
HSE-W	**Total**	**7.7**	**10.6**	**7.5**	**4.7**	**4.7**	**7.0**	**7.2**	**8.1**	**3.6**	**5.6**
	Galway	8.2	13.4	7.8	6.4	6.0	7.6	8.4	9.6	3.2	5.2
	Mayo	7.3	4.8	6.5	2.3	3.1	4.6	7.7	9.2	3.1	5.4
	Roscommon	6.8	11.9	8.5	3.1	3.1	9.4	1.6	0.0	6.2	7.8
Ireland		**10.9**	**11.3**	**11.0**	**10.4**	**9.2**	**9.0**	**7.8**	**8.1**	**6.8**	**6.6**

[††] In some areas, LHO does not correspond to county

Table 8: TB 3 year moving average rates (per 100,000 population) by local health office[‡‡], 2005-2014

HSE area	LHO	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
HSE-E	**Total**	**12.8**	**13.2**	**14.5**	**15.2**	**14.0**	**12.1**	**10.9**	**9.7**	**8.9**	**8.4**
	Dublin South	5.7	5.9	6.9	6.3	5.8	5.6	5.9	6.7	6.3	5.4
	Dublin South East	7.5	7.0	10.2	12.3	9.9	7.8	8.2	7.8	6.9	6.7
	Dublin South City	20.7	22.1	27.2	27.3	21.8	17.8	16.1	14.2	11.7	9.5
	Dublin South West	9.5	9.5	10.5	11.5	13.5	12.8	9.4	7.9	8.3	8.4
	Dublin West	18.8	17.7	19.8	22.7	19.6	18.6	20.3	15.4	11.1	11.3
	Dublin Nth West	18.2	21.5	23.0	23.3	22.1	18.2	15.6	14.6	12.4	10.8
	Dublin Nth Central	25.1	24.9	24.5	23.7	22.9	20.5	16.6	15.7	17.5	17.2
	Dublin Nth	10.8	10.5	9.6	9.7	10.3	9.5	7.8	6.2	5.7	6.0
	Kildare/W Wicklow	7.0	7.3	9.0	10.5	7.8	5.1	4.9	5.6	6.2	6.1
	Wicklow	5.3	5.7	4.6	5.8	6.9	6.1	5.9	5.1	3.8	3.6
HSE-M	**Total**	**5.6**	**6.2**	**7.1**	**8.6**	**8.9**	**8.1**	**7.7**	**7.8**	**6.6**	**5.5**
	LD/WH	6.8	6.4	7.9	10.8	11.7	11.2	9.0	8.0	8.4	8.0
	LS/OY	4.5	6.0	6.3	6.8	6.7	5.6	6.7	7.6	5.2	3.5
HSE-MW	**Total**	**12.9**	**10.9**	**8.4**	**7.3**	**7.2**	**7.2**	**6.5**	**6.5**	**6.6**	**5.1**
	Clare	14.6	10.8	6.5	5.3	6.4	7.7	6.8	6.4	7.0	6.2
	Limerick	13.2	12.9	11.1	10.0	8.9	7.7	6.9	7.2	7.3	5.7
	Tipp Nth/E Limerick	10.6	7.8	6.6	5.1	4.6	5.0	4.6	4.6	3.9	1.4
HSE-NE	**Total**	**5.2**	**6.5**	**6.3**	**5.3**	**5.9**	**6.4**	**5.9**	**5.7**	**5.7**	**4.9**
	Cavan/Monaghan	6.7	7.2	6.3	6.1	6.4	5.8	4.9	4.5	4.5	4.7
	Louth/Sth Monaghan	4.7	6.1	7.2	6.1	6.0	7.3	7.9	7.9	7.9	6.3
	Meath	4.5	6.4	5.7	4.2	5.5	6.1	5.3	5.0	5.0	4.2
HSE-NW	**Total**	**5.8**	**5.3**	**6.0**	**7.2**	**8.2**	**7.4**	**5.7**	**5.5**	**6.1**	**6.6**
	Donegal	4.4	4.1	5.3	6.1	6.6	6.7	6.5	6.1	5.7	5.6
	Sligo/Leitrim	8.0	7.1	7.1	8.9	10.7	8.5	4.4	4.6	6.7	8.2
HSE-SE	**Total**	**8.6**	**9.1**	**7.5**	**6.7**	**6.7**	**6.1**	**5.6**	**5.6**	**5.9**	**5.3**
	Carlow/Kilkenny	7.0	6.8	6.0	4.9	4.5	5.0	5.6	7.1	8.6	7.5
	Tipperary South	13.9	15.8	11.3	8.0	8.3	7.4	5.6	5.0	5.8	5.6
	Waterford	11.2	11.0	9.8	10.4	11.7	9.8	7.8	6.7	6.1	5.5
	Wexford	4.2	4.9	4.4	4.1	3.2	2.9	3.8	3.8	3.4	2.9
HSE-S	**Total**	**13.1**	**14.8**	**15.5**	**14.2**	**13.1**	**13.0**	**12.3**	**10.8**	**10.0**	**10.0**
	Kerry	7.3	6.4	6.6	6.6	5.7	5.7	7.2	7.9	7.7	7.9
	North Cork	8.4	7.7	8.0	9.5	13.6	16.5	14.5	12.3	12.3	12.0
	North Lee	21.5	24.3	22.4	19.4	16.5	15.7	15.3	12.7	10.2	9.4
	South Lee	12.7	18.5	23.0	19.4	16.7	17.3	15.0	12.8	13.3	14.1
	West Cork	7.9	5.1	3.7	7.3	7.6	3.5	2.7	4.0	4.9	5.3
HSE-W	**Total**	**10.0**	**9.2**	**9.1**	**7.6**	**5.4**	**5.3**	**6.5**	**7.4**	**6.7**	**5.2**
	Galway	10.0	10.3	10.7	8.8	6.6	6.5	7.4	8.5	7.7	5.3
	Mayo	8.5	7.3	5.9	5.0	3.5	3.3	5.0	7.3	7.3	5.2
	Roscommon	12.8	9.4	9.8	8.0	4.5	4.7	5.9	3.1	2.0	5.1
Ireland		**10.6**	**10.9**	**10.9**	**10.5**	**10.1**	**9.4**	**8.7**	**8.2**	**7.8**	**7.2**

[‡‡] In some areas, LHO does not correspond to county

Geographic origin

In 2015, 152 (50.2%) cases were born in Ireland, 129 (42.6%) were born outside Ireland and for the remaining 22 cases (7.3%), the country of birth was unknown. The crude TB rate in the Irish-born population was 4.0 per 100,000 population while the crude rate in the foreign-born population was 16.8 per 100,000 population. Figure 3 shows TB cases and rate per 100,000 population by geographic origin, compared to the national rate from 2006 to 2015 while table 9 shows the breakdown of TB cases by HSE area and geographic origin for 2015.

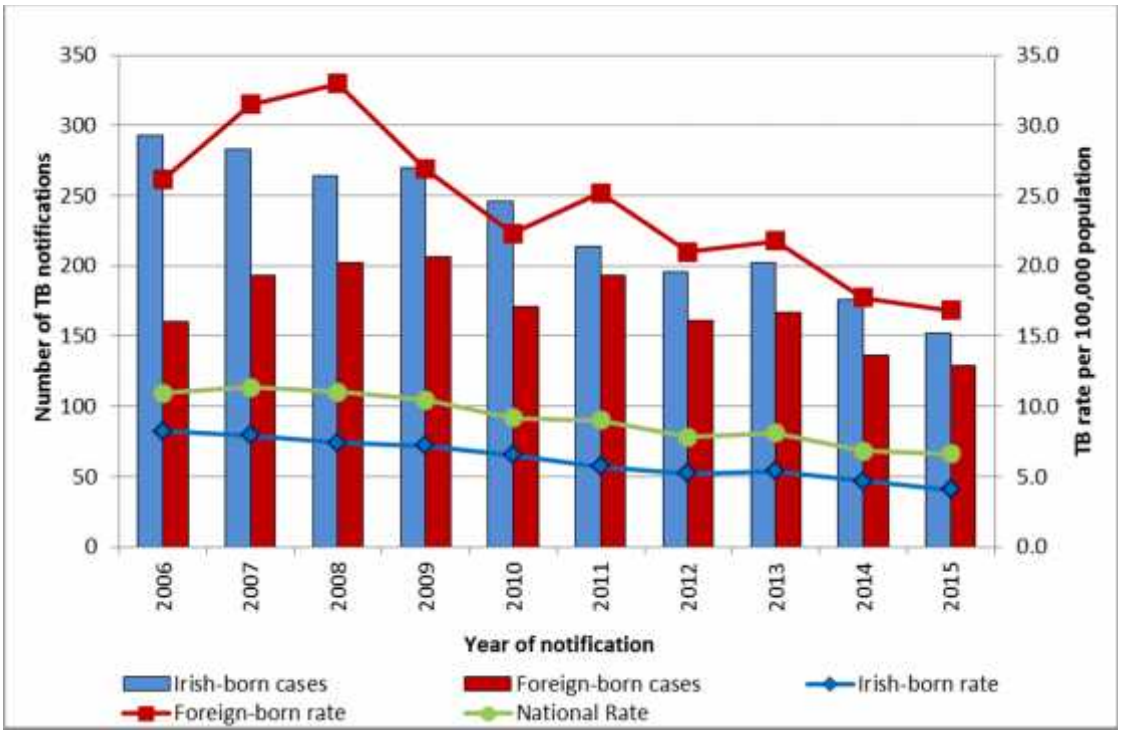

Figure 3: TB cases and rate per 100,000 by geographic origin, 2006-2015

Table 9: TB cases and rates per 100,000 population by HSE area and geographic origin, 2015

HSE area	Irish-born			Foreign-born			Unk	Total
	N	*%*	*CIR*	*N*	*%*	*CIR*		
HSE-E	49	*37.4*	***3.8***	62	*47.3*	***20.5***	20	**131**
HSE-M	6	*42.9*	***2.5***	8	*57.1*	***19.3***	0	**14**
HSE-MW	7	*46.7*	***2.2***	8	*53.3*	***15.1***	0	**15**
HSE-NE	10	*62.5*	***2.7***	6	*37.5*	***7.9***	0	**16**
HSE-NW	9	*50.0*	***4.4***	8	*44.4*	***15.6***	1	**18**
HSE-SE	6	*40.0*	***1.4***	9	*60.0*	***13.4***	0	**15**
HSE-S	50	*72.5*	***9.0***	19	*27.5*	***18.9***	0	**69**
HSE-W	15	*60.0*	***4.2***	9	*36.0*	***11.8***	1	**25**
Total	**152**	***50.2***	***4.0***	**129**	***42.6***	***16.8***	**22**	**303**

Figure 4 illustrates the interval between arrival and notification for foreign-born TB cases with year of arrival reported between 2006 and 2015. Just over half of foreign born cases are notified within five years of their arrival in Ireland (53.4%). Data completeness levels varied during this time period with a marked increase in data completeness from 2011 onwards (range of data completeness: 39.8% in 2012 to 79.1% in 2015, mean: 60.5%).

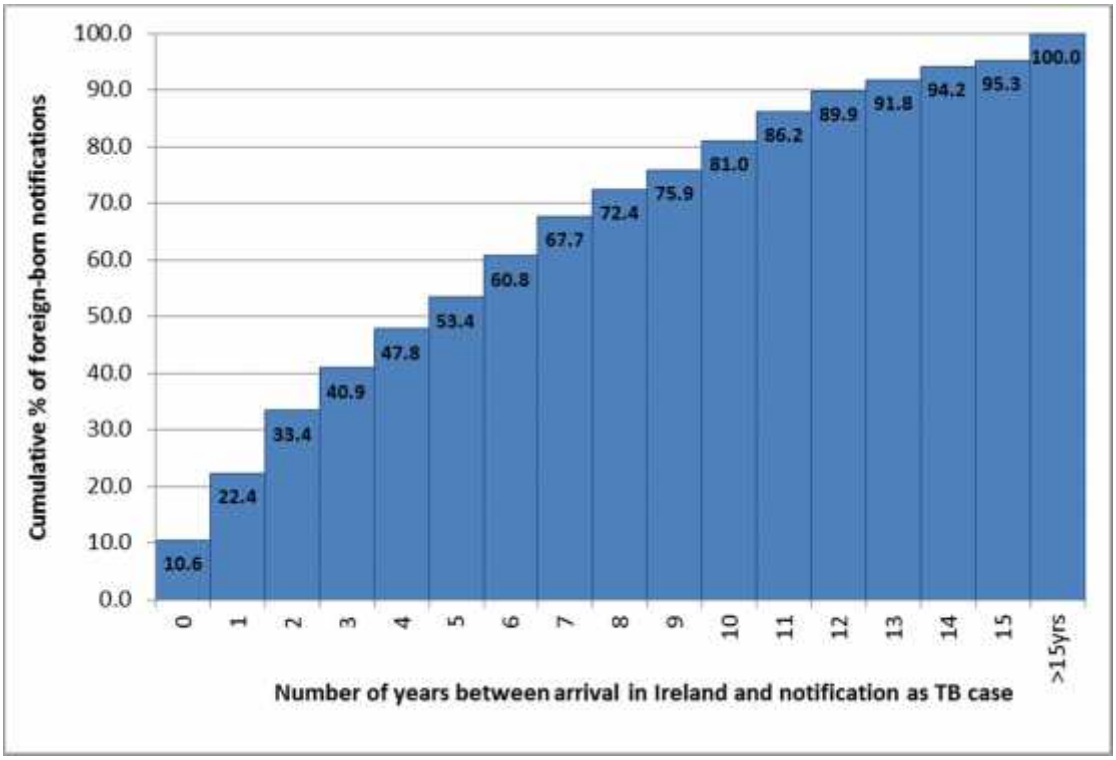

Figure 4: Interval between arrival & notification for foreign-born cases with year of arrival reported: 2002-2015

The highest age-specific rates in foreign-born cases were in the 25-34 year age group (26.7) while the highest age-specific rates in Irish-born cases were in those aged 65 years and older (10.2). The median age for Irish-born cases was 56.5 years and 32.0 years for foreign-born cases. Table 10 shows number of cases and age-specific rates by geographic origin during 2015.

Table 10: TB cases and age-specific rates by geographic origin, 2015

Age group (years)	Irish-born		Foreign-born	
	cases	rate	cases	rate
0-14	9	*1.0*	5	*5.3*
15-19	4	*1.7*	5	*11.2*
20-24	4	*1.8*	10	*16.8*
25-34	15	*2.8*	56	*26.7*
35-44	16	*3.1*	34	*19.7*
45-54	24	*5.1*	7	*6.7*
55-64	30	*7.3*	6	*13.2*
65+	50	*10.2*	6	*16.5*
Total	**152**	***4.0***	**129**	***16.8***

Cases born outside Ireland originated from at least 34 countries in 2015. Of the 129 cases born outside Ireland, 57.4% were born in Asia, 20.2% in Africa, 20.2% in Europe and 2.3% in America. Table 11 shows the breakdown of these cases by country of birth and corresponding continent.

Table 11: Countries of origin of foreign-born cases with TB, 2015

Continent	2015	Country	2015
Africa	26	Algeria	2
		Burundi	1
		Congo	1
		Congo, the Democratic Republic of the	1
		Eritrea	1
		Lesotho	1
		Malawi	3
		Niger	1
		Nigeria	3
		Somalia	1
		South Africa	5
		Sudan	2
		Zambia	1
		Zimbabwe	3
America	3	Brazil	3
Asia	74	Afghanistan	2
		Bangladesh	3
		China	1
		Hong Kong	1
		India	26
		Indonesia	2
		Iraq	1
		Myanmar	1
		Pakistan	22
		Philippines	10
		Sri Lanka	1
		Syrian Arab Republic	1
		Thailand	1
		Viet Nam	2
Europe	26	Latvia	2
		Lithuania	2
		Poland	8
		Romania	12
		United Kingdom	2
Total			**129**

Site of disease

In 2015, diagnostic type was reported for 297 cases. Of these, 174 (58.6%) were pulmonary, 100 (33.7%) were extrapulmonary and 23 (7.7%) were pulmonary and extrapulmonary. Six cases did not have site of infection reported. TB cases by site of disease and HSE area are shown in table 12.

Table 12: TB cases by site of disease and HSE area, 2015

HSE area	Pulmonary		Extrapulmonary		P+E		Diagnostic type not reported		Total	
	Number	%	Number	%	Number	%	Number	%		
HSE-E	77	*58.8*	42	*32.1*	7	*5.3*	5	*3.8*	**131**	*96.2*
HSE-M	6	*42.9*	7	*50.0*	1	*7.1*	0	*0.0*	**14**	*100.0*
HSE-MW	9	*60.0*	4	*26.7*	2	*13.3*	0	*0.0*	**15**	*100.0*
HSE-NE	13	*81.3*	2	*12.5*	1	*6.3*	0	*0.0*	**16**	*100.0*
HSE-NW	9	*50.0*	6	*33.3*	3	*16.7*	0	*0.0*	**18**	*100.0*
HSE-SE	4	*26.7*	10	*66.7*	1	*6.7*	0	*0.0*	**15**	*100.0*
HSE-S	40	*58.0*	24	*34.8*	5	*7.2*	0	*0.0*	**69**	*100.0*
HSE-W	16	*64.0*	5	*20.0*	3	*12.0*	1	*4.0*	**25**	*96.0*
Total	**174**	***57.4***	**100**	***33.0***	**23**	***7.6***	**6**	***2.0***	**303**	***98.0***

Pulmonary TB cases

WHO defines pulmonary TB, for the purpose of analysis, as any case that has a pulmonary disease component. There were 197 cases reported with a pulmonary disease component (66.3% of cases with site reported). Sputum microscopy results were available for 124 (62.9%) of pulmonary cases, 81 (41.1%) of which were sputum positive by microscopy while 138 (70.1%) were culture positive. Sputum smear and culture results for these cases are shown in table 13.

The proportion of pulmonary cases (with or without an extrapulmonary site) was higher in persons born in Ireland (72.4%) compared to those born abroad (56.6%).

Table 13: Sputum smear and culture status for pulmonary TB cases, 2015

Culture	Sputum smear result				Total
	Sputum smear positive	Sputum smear negative	Sputum smear not done	Sputum smear unknown	
Culture positive	71	31	22	14	**138**
Culture negative	0	8	6	0	**14**
Culture not done	0	0	12	0	**12**
Culture not known	10	4	3	16	**33**
Total	**81**	**43**	**43**	**30**	**197**

Extra-pulmonary TB cases

In 2015, 100 cases (33.7%) had exclusively extrapulmonary TB. Of these 58 (58.0%) were culture confirmed and 34 (34.0%) were histology positive. Extrapulmonary disease components were reported in 123 cases (40.6%). The extrapulmonary sites reported are shown in table 14. The most frequent sites of extrapulmonary disease reported were extrathoracic lymph nodes and pleural. There were two cases of TB meningitis in 2015.

Table 14: Extrapulmonary disease sites in notified cases, 2015[§§]

Site	Number	%
Lymphatic extrathoracic	40	32.5
Pleural	19	15.4
Other	15	12.2
Lymphatic intrathoracic	12	9.8
Peritoneal/digestive	11	8.9
Spine	7	5.7
Bone/joint other than spine	6	4.9
Disseminated	5	4.1
Genitourinary	4	3.3
Meningitis	2	1.6
Site not reported	2	1.6
Total	**123**	**100.0**

TB meningitis

There were two cases of TB meningitis reported, giving an incidence rate of 0.04 per 100,000 population. One case was exclusively extrapulmonary in a foreign-born case. One case was culture confirmed as *M. bovis* in an Irish-born case. Both cases were in adults, neither of whom had BCG status reported. A profile of these cases is provided in table 15.

Table 15: TB meningitis cases in Ireland, 2015

Year	HSE Area	Age group (years)	History of BCG	Culture Status	Species	Case classification
2015	HSE-E	35-44	Unknown	Negative	Unknown	Possible
2015	HSE-W	65+	Unknown	Positive	*M. bovis*	Confirmed

Between 1998 and 2015, a total of 98 cases of TB meningitis have been reported (figure 5). The cumulative incidence rates of TB meningitis in each HSE area and in Ireland for 1998-2015 are shown in table 16. The highest cumulative rate of TB meningitis between 1998 and 2015 is in HSE South (4.0 per 100,000).

[§§] Includes extrapulmonary (E) and pulmonary plus extrapulmonary cases (P + E)

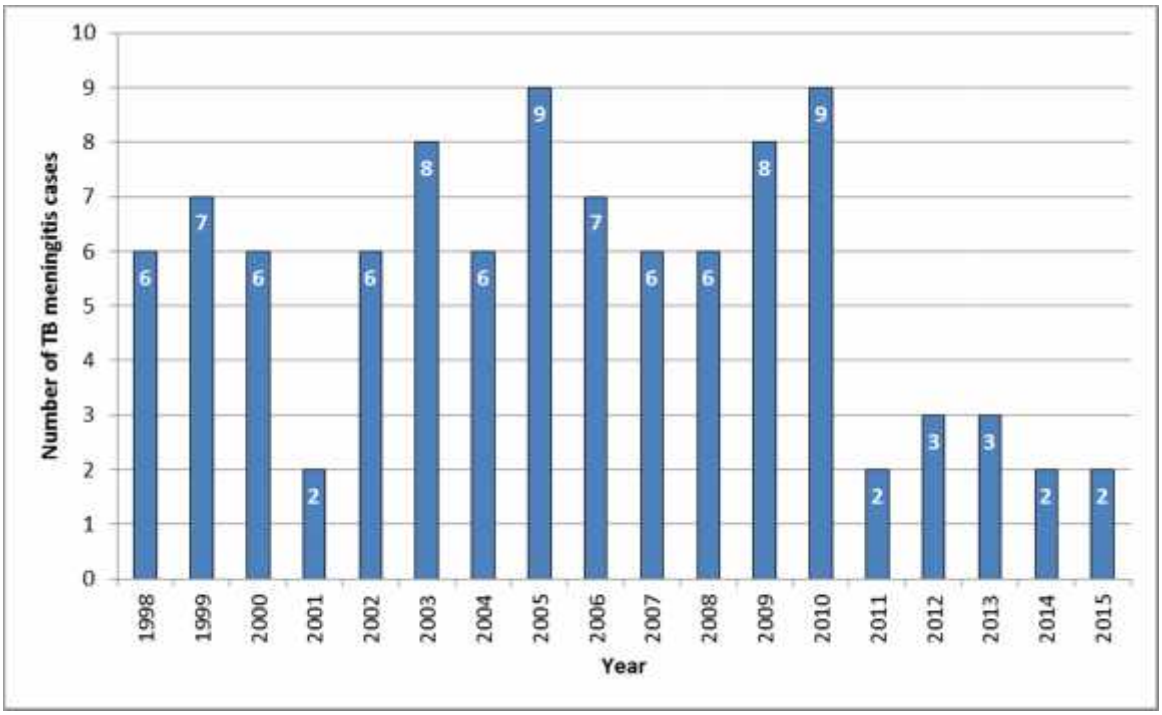

Figure 5: Number of TB meningitis cases, 1998-2015

Table 16: Cumulative incidence rate of TB meningitis in Ireland, 1998-2015

HSE area	Cases 1998 to 2015	Cumulative incidence rate (per 100,000)***	95% CI
HSE-E	35	2.3	1.6 - 3.1
HSE-M	0	0.0	0 - 0
HSE-MW	8	2.2	0.7 - 3.8
HSE-NE	12	3.0	1.3 - 4.8
HSE-NW	4	1.7	0 - 3.3
HSE-SE	7	1.5	0.4 - 2.6
HSE-S	25	4.0	2.4 - 5.6
HSE-W	7	1.7	0.4 - 2.9
Ireland	**98**	**2.3**	**1.9 - 2.8**

The highest cumulative age specific rates of TB meningitis between 1998 and 2015 were reported in the 25-34 year age group (3.6/100,000) followed by those aged 65 years and older (3.2/100,000) while the lowest rates were reported in the 45-54 year age group (1.0/100,000) and the 5-9 year age group (1.0/100,000). Figure 6 shows the number of TB meningitis cases by age group and cumulative age specific rate between 1998 and 2015.

*** *Note: Calculations based on 2006 census figures*

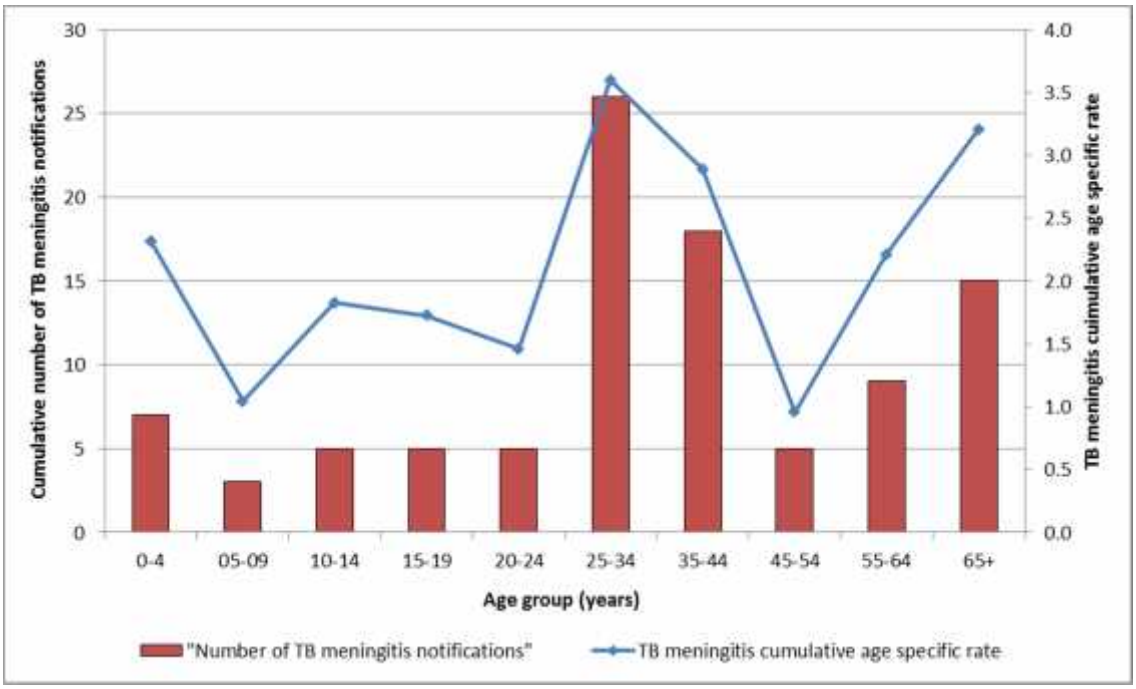

Figure 6: Cumulative number of TB meningitis notifications by age group and cumulative age specific rate, 1998-2014

Bacteriological results

Cases are reported as being laboratory confirmed where culture, PCR, microscopy or histology was reported as positive.

In 2015, 243 (80.2%) were laboratory confirmed by culture, PCR, microscopy or histology. Of cases with a pulmonary component, 161 (81.7%) were laboratory confirmed while 79 (79.0%) of cases with exclusively extrapulmonary disease were laboratory confirmed.

Culture

In 2015, 198 (65.3%) of all TB cases notified were culture positive. Table 17 shows a breakdown by culture status and HSE area of TB cases notified in 2015 while figure 7 shows the number and percentage culture positive TB notifications by year.

Of cases with a pulmonary component, 138 (70.1%) were culture confirmed while new[†††] cases with a pulmonary component, 96 (78.7%) were culture confirmed. Of the cases with exclusive extrapulmonary disease 58 (58.0%) were culture confirmed in 2015.

[†††] "New" cases are defined as cases where previous history of TB was reported as "No"

Table 17: Culture status of TB cases by HSE area, 2015

HSE area	Positive	Negative	Not done	Unknown	Total	%
HSE-E	82	5	3	41	**131**	62.6
HSE-M	11	2	1	0	**14**	78.6
HSE-MW	12	2	0	1	**15**	80
HSE-NE	13	0	0	3	**16**	81.3
HSE-NW	13	1	4	0	**18**	72.2
HSE-SE	8	2	2	3	**15**	53.3
HSE-S	40	21	7	1	**69**	58
HSE-W	19	2	1	3	**25**	76
Ireland	**198**	**35**	**18**	**52**	**303**	**65.3**

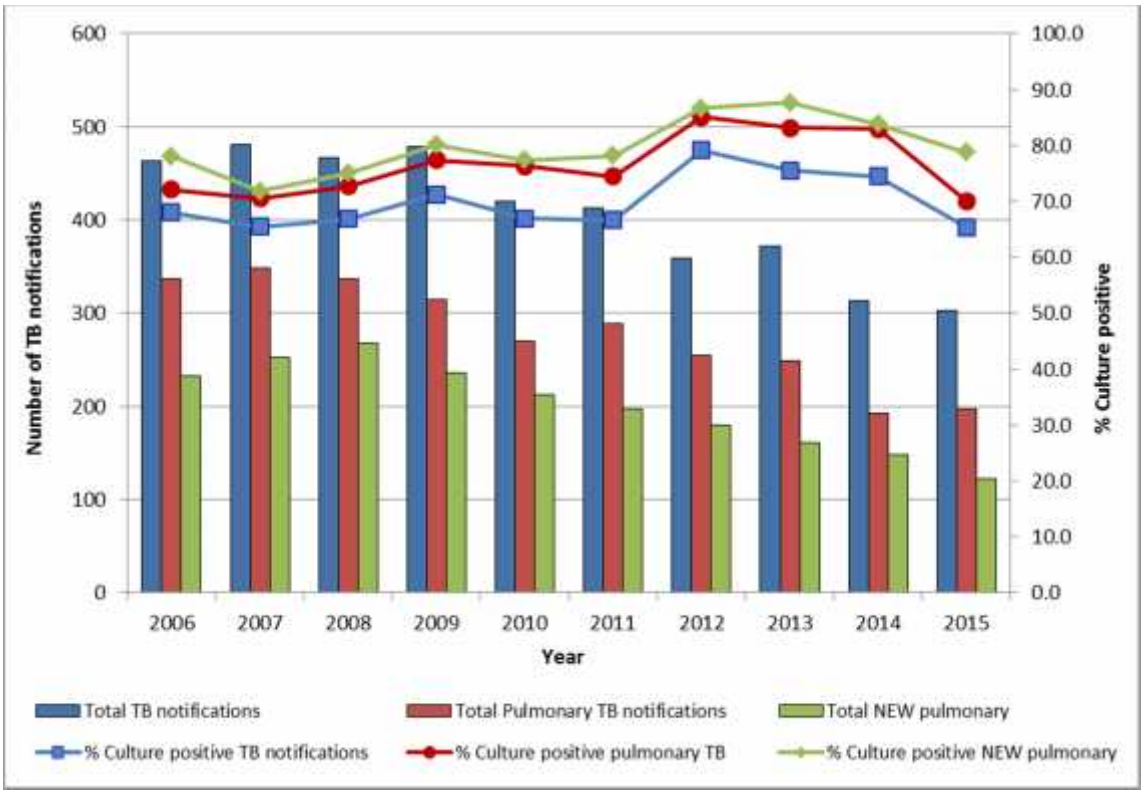

Figure 7: Number of TB notifications and percentage culture positive by year, 2006-2015

Species

Table 18 shows the number and percentage of culture positive TB cases by species and year.

Of the four *M. bovis* cases notified during 2015, none had a previous history of TB reported and three were born in Ireland. All cases reported having one or more risk factors for TB. One case reported having received BCG vaccination. Cases were aged between 28-77 years. All cases were pansensitive.

Table 18: Number and percentage of culture positive TB notifications by species 2006-2015

Year	*M. africanum*		*M. bovis*		*M. canettii*		*M. tuberculosis*		*M. tuberculosis* complex		Species unknown	
	N	%	N	%	N	%	N	%			N	%
2006	1	*0.3*	5	*1.6*			307	*97.5*			2	*0.6*
2007	2	*0.6*	6	*1.9*			305	*96.8*			2	*0.6*
2008	0	*0.0*	12	*3.8*			295	*94.6*			5	*1.6*
2009	1	*0.3*	8	*2.3*			328	*96.2*			4	*1.2*
2010	3	*1.1*	12	*4.3*			265	*94.3*			1	*0.4*
2011	0	*0.0*	6	*2.2*	0	*0.0*	254	*88.2*	14	*4.9*	-	-
2012	4	*1.4*	4	*1.4*	1	*0.4*	272	*94.8*	3	*1.0*	-	-
2013	4	*1.4*	6	*2.1*	0	*0.0*	270	*96.1*	1	*0.4*	-	-
2014	3	*1.3*	3	*1.3*	0	*0.0*	226	*97.4*	0	*0.0*	0	*0.0*
2015	0	*0.0*	4	*2.0*	0	*0.0*	186	*93.9*	6	*3.0*	2	*1.0*

Anti-TB drug resistance[‡‡‡]

Information on the results of drug sensitivity testing (DST) was reported for 190 (96.0%) of the 198 culture confirmed cases in 2015. The proportion of culture confirmed cases with DST results reported was 99.0% for new pulmonary cases and 84.6% for cases with a previous history of TB. Table 19 details the percentage of culture positive TB notifications with DST results available by previous history of TB and year.

Of the 190 cases where sensitivity results were reported, resistance was documented in 13 (6.8%) cases, including one case of MDR-TB. Mono-resistance to isoniazid was recorded in six cases (table 20). No cases of XDR-TB were reported in Ireland during 2015.

Of the drug resistant cases, including MDR-TB cases, nine (69.2%) were foreign-born (figure 8) and three (23.1%) had a previous history of TB (figure 9).

A summary of drug resistance in 2015 is shown in table 20 and the drug sensitivity results of the MDR-TB cases are shown in table 21 while figure 10 shows the number and percentage (of cases with DST results) of MDR-TB and XDR-TB notifications by year, 2006-2015.

‡‡‡ Resistance to pyrazinamide has not been reported in *M. bovis* cases as *M. bovis* is innately resistant to pyrazinamide.

Table 19: Percentage of culture positive TB notifications with DST results available by previous history of TB and year 2006-2015

Year	% Culture pos with DST results – Total notifications	% Culture pos with DST results - New pulmonary	% Culture pos with DST results - Previous history of TB reported	% Culture pos with DST results - Previous TB treatment reported
2006	94.3	96.7	89.3	100.0
2007	95.2	93.9	100.0	100.0
2008	96.8	97.5	100.0	100.0
2009	96.8	95.2	97.0	100.0
2010	98.6	100.0	100.0	100.0
2011	91.3	94.2	93.3	87.5
2012	98.2	98.1	100.0	100.0
2013	96.8	99.3	87.5	88.9
2014	99.6	100.0	93.3	87.5
2015	96.0	99.0	84.6	100.0
Mean	**96.4**	**97.4**	**94.5**	**96.4**

Table 20: Summary of drug resistant TB cases in Ireland, 2015

DST results	Number	% of culture confirmed cases
Cases with DST results	190	*96.0*
Resistant cases	13	*6.6*
MDR-TB	1	*0.5*
XDR-TB	0	*0.0*
Mono-resistance to isoniazid	6	*3.0*
Mono-resistance to rifampicin	0	*0.0*
Mono-resistance to pyrazinamide	1	*0.5*
Mono-resistance to ethambutol	0	*0.0*
Mono-resistance to streptomycin	4	*2.0*
Cases resistant to isoniazid and streptomycin	1	*0.5*

Table 21: Sensitivity results of MDR cases, 2015

Diagnosis	Isolate	Isoniazid	Rifampicin	Pyrazinamide	Ethambutol	Streptomycin
Pulmonary	M.TB	**R**	**R**	S	S	S

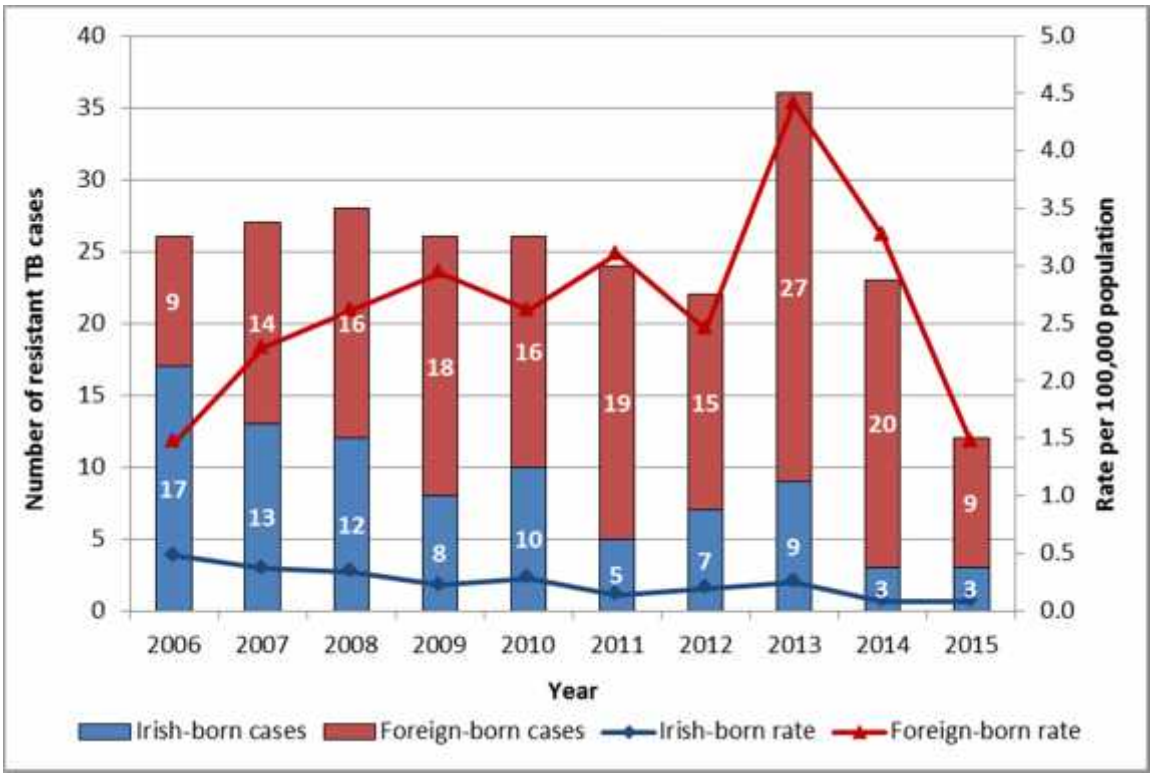

Figure 8: Number and rate of TB notifications with resistance to any first line anti-TB drug by geographic origin[§§§] and year 2006-2015

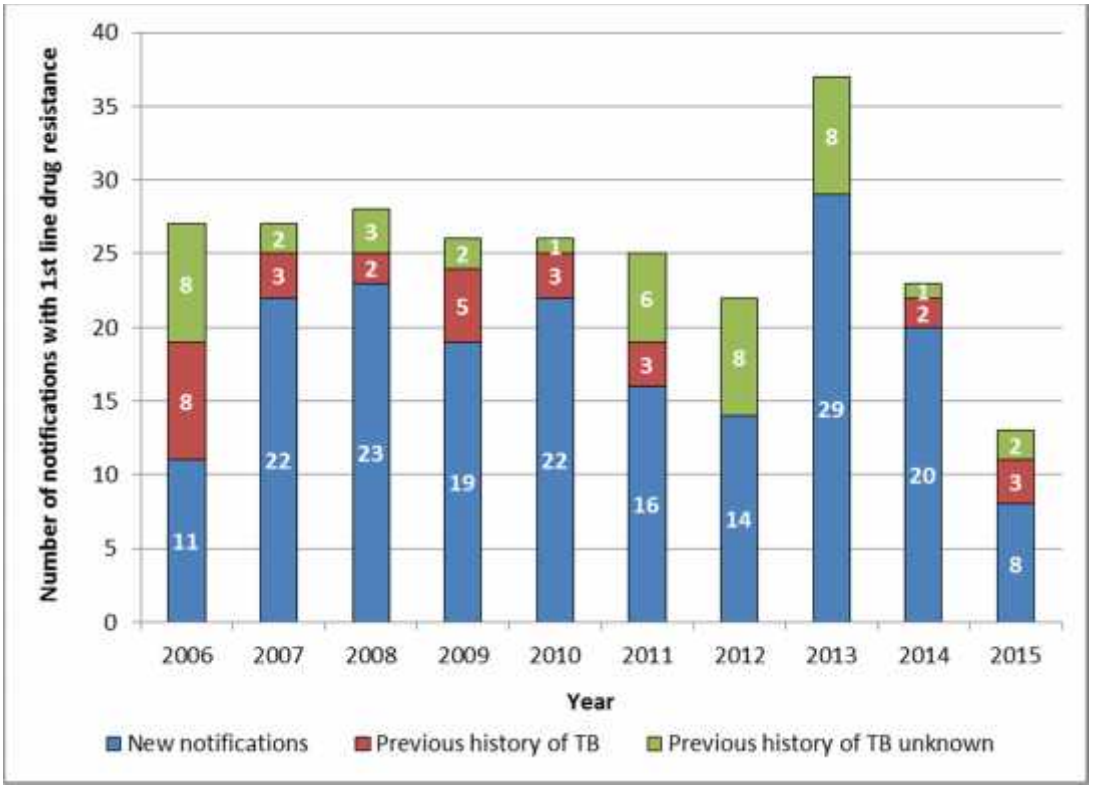

Figure 9: Number of TB notifications with resistance to any first line anti-TB drug by previous history of TB and year 2006-2015

[§§§] Country of birth missing for 1 resistant case in 2015.

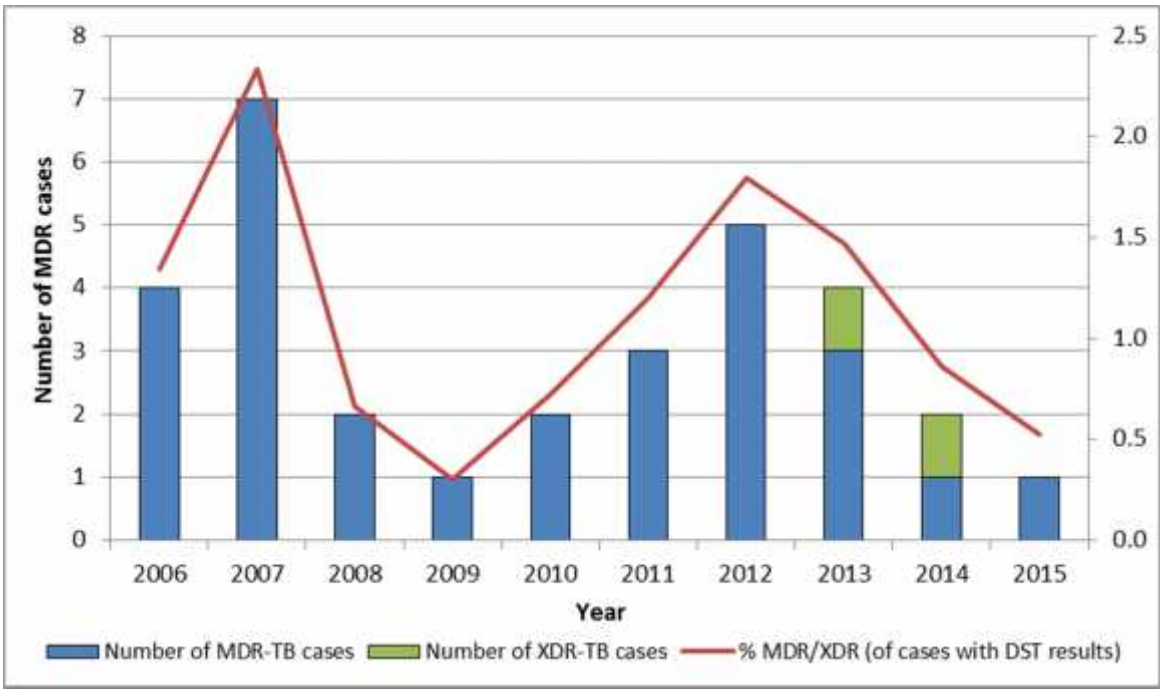

Figure 10: Number of MDR-TB and XDR-TB cases and percentage MDR/XDR-TB cases by year: 2006-2015

Case classification

Using the case definitions (described in the Methods section), TB cases notified can be classified into confirmed, probable and possible cases as outlined in Table 22.

Table 22: Case classification of TB cases by site of disease, 2015

Site of disease	Confirmed		Probable		Possible		Total
	Cases	%	Cases	%	Cases	%	
Pulmonary	124	71.3	19	10.9	31	17.8	**174**
Pulmonary + Extrapulmonary	16	69.6	2	8.7	5	21.7	**23**
Extrapulmonary	60	60.0	19	19.0	21	21.0	**100**
Diagnostic type not reported	3	50.0	0	0.0	3	50.0	**6**
Total	**203**	**67.0**	**40**	**13.2**	**60**	**19.8**	**303**

Treatment outcome: 2014 cases[****]

Outcome was recorded for 251 (80.2%) of the 313 cases notified in 2014 (table 23, figure 11). Treatment was reported as completed for 208 cases, 21 cases died, four were recorded as being lost to follow up, nine cases were transferred, treatment was interrupted in three cases and six cases were still on treatment at the time of reporting. Treatment outcome was not reported for the remaining 62 cases. Of the 21 deaths reported, four (1.3% of total cases) were attributed to TB.

Outcome was reported for 77 (84.6%) of the 91 smear positive cases. Of the 77, 64 completed treatment, seven died, one case had treatment interrupted, one was lost to follow up and three cases were transferred while one was still on treatment at the time of reporting. Treatment outcome was unknown for the remaining 14 smear positive cases. Of the seven deaths among smear positive cases, one was attributed to TB.

Details on treatment outcome for all cases and for smear positive cases only are shown in table 23 while treatment outcome by HSE area is shown in table 24.

Of the 23 drug-resistant cases, 14 (60.9%) were reported as having completed treatment, two died, one case was transferred and one case was lost to follow up. Treatment outcome was not reported for the remaining five resistant cases.

Of the four MDR-TB cases reported in 2013, three cases completed treatment and one case was reported as still being on treatment at the time of report production. Treatment outcomes for the MDR-TB cases reported during 2014 are not yet available, due to the extended treatment period.

Figure 12 shows TB notifications by treatment success and year while figure 13 shows the number of MDR-TB notifications by treatment outcome and percentage treatment success by year.

[****] Treatment outcome for 2015 not available at the time of publication.

Table 23: Treatment outcome for all cases and smear positive cases, 2014

Treatment outcome	Total		Smear Positive	
	Number	%	Number	%
Completed - cured	51	16.3	48	52.7
Completed - failed	0	0.0	0	0.0
Completed - status unknown	157	50.2	16	17.6
Died (attributed to TB)	4	1.3	1	1.1
Died (cause unknown)	4	1.3	0	0.0
Died (not attributed to TB)	13	4.2	6	6.6
Lost to follow up	4	1.3	1	1.1
Still on treatment	6	1.9	1	1.1
Transferred	9	2.9	3	3.3
Treatment interrupted	3	1.0	1	1.1
Unknown	62	19.8	14	15.4
Total	**313**	**100.0**	**91**	**100.0**

Table 24: Treatment outcome by HSE area, 2014

		Outcome known	Outcome unknown	Lost to follow up	Total
HSE E	**Number**	76	54	3	**133**
	%	*57.1*	*40.6*	*2.3*	*100.0*
HSE M	**Number**	16	0	0	**16**
	%	*100.0*	*0.0*	*0.0*	*100.0*
HSE MW	**Number**	15	0	0	**15**
	%	*100.0*	*0.0*	*0.0*	*100.0*
HSE NE	**Number**	20	2	0	**22**
	%	*90.9*	*9.1*	*0.0*	*100.0*
HSE NW	**Number**	17	0	0	**17**
	%	*100.0*	*0.0*	*0.0*	*100.0*
HSE SE	**Number**	29	0	0	**29**
	%	*100.0*	*0.0*	*0.0*	*100.0*
HSE S	**Number**	61	4	0	**65**
	%	*93.8*	*6.2*	*0.0*	*100.0*
HSE W	**Number**	13	2	1	**16**
	%	*81.3*	*12.5*	*6.3*	*100.0*
National	**Number**	**247**	**62**	**4**	**313**
	%	***78.9***	***19.8***	***1.3***	***100.0***

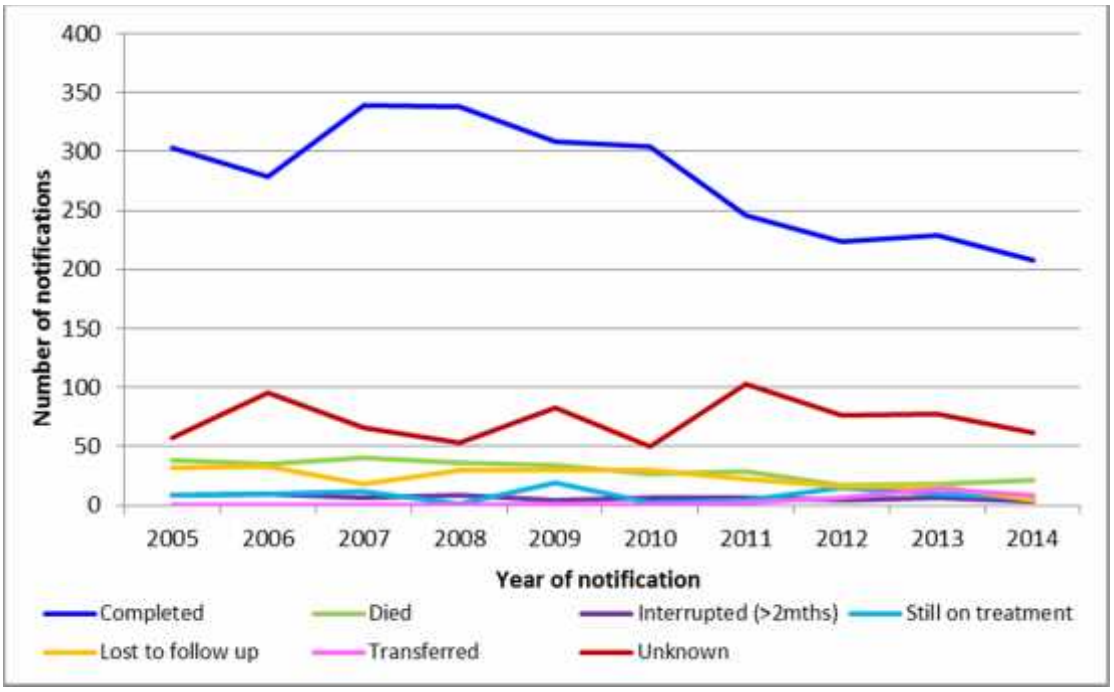

Figure 11: TB notifications by treatment outcome and year 2005-2014

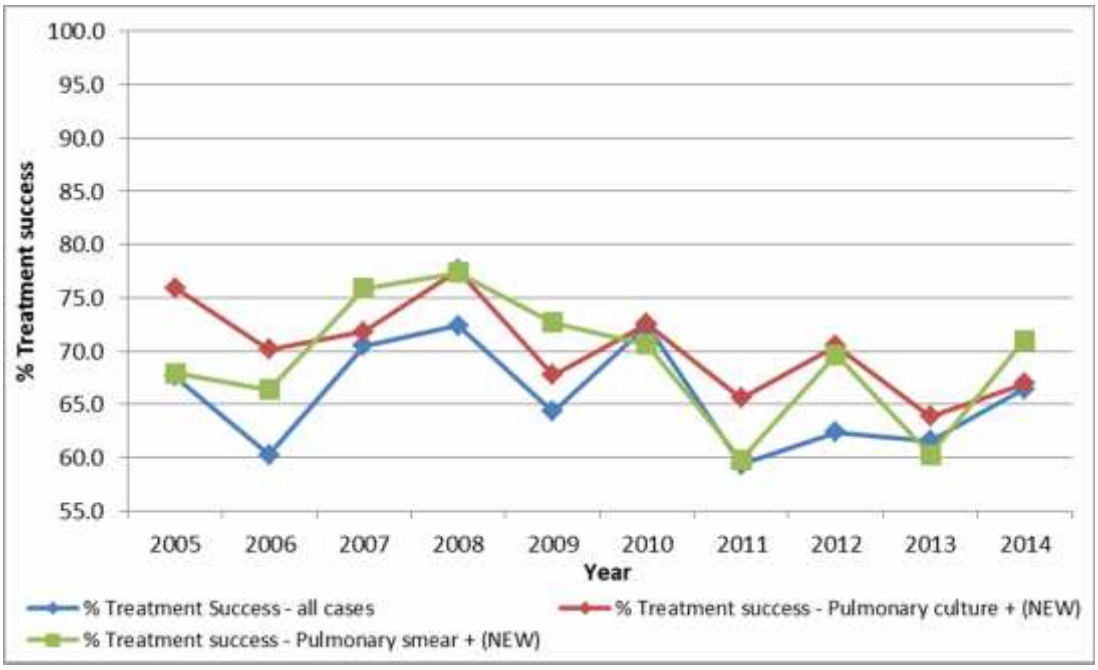

Figure 12: TB notifications by treatment success and year 2005-2014

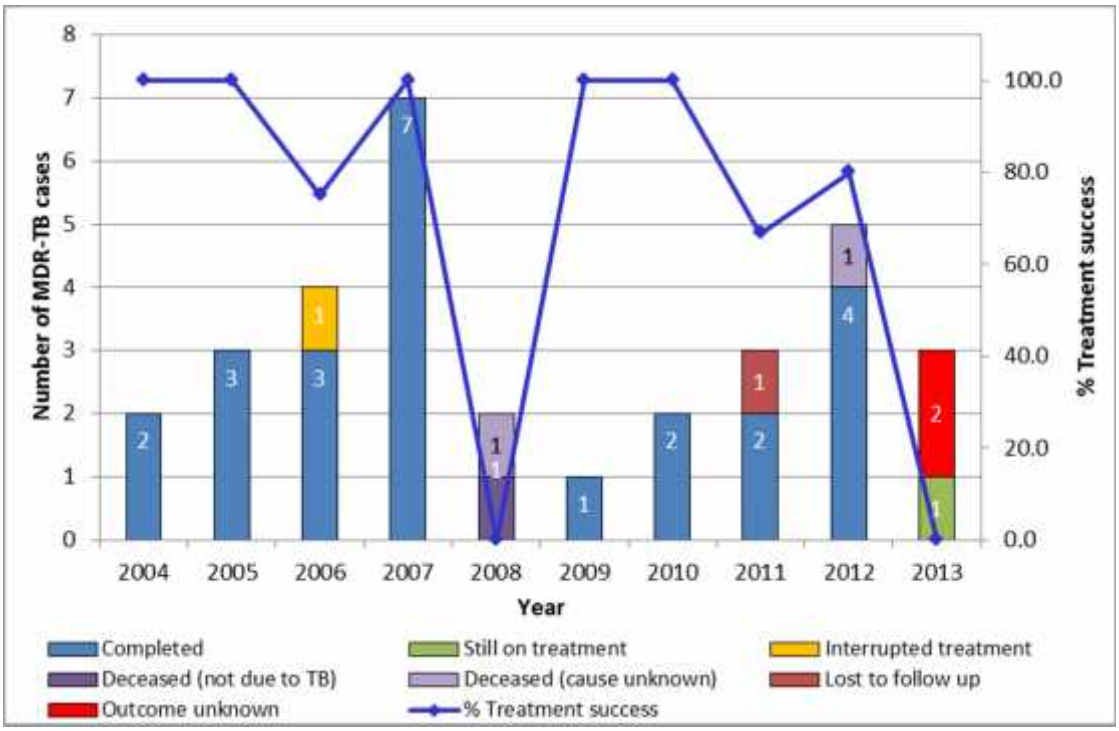

Figure 13: Number of MDR-TB notifications by treatment outcome and percentage treatment success by year, 2004-2013

Case ascertainment

Table 25 summarises the method by which cases notified in 2015 were found. The majority of cases presented as a case.

Table 25: Method of case finding, 2015

Case found by	Number	Percentage
Presenting as case	233	76.9
Not reported	30	9.9
Contact tracing	22	7.3
Other	15	5.0
Immigrant screening	1	0.3
Post-mortem diagnosis	1	0.3
Pre-employment screening	1	0.3
Total	**303**	**100.0**

Previous history of TB

During 2015, 17 (5.6%) of cases were reported to have a previous history of TB. The previous year of diagnosis was provided for nine (52.9%) cases, with year of previous diagnosis ranging from 1950 to 2014. Five cases (29.4%) were reported to have had TB in the previous ten years.

Of previously diagnosed cases, previous treatment was reported for 11 (64.7%) cases. Of the cases who were previously treated for TB, 10 (90.9%) cases were reported as having completed treatment. Figure 14 shows the number of TB notifications by previous history of TB disease and year.

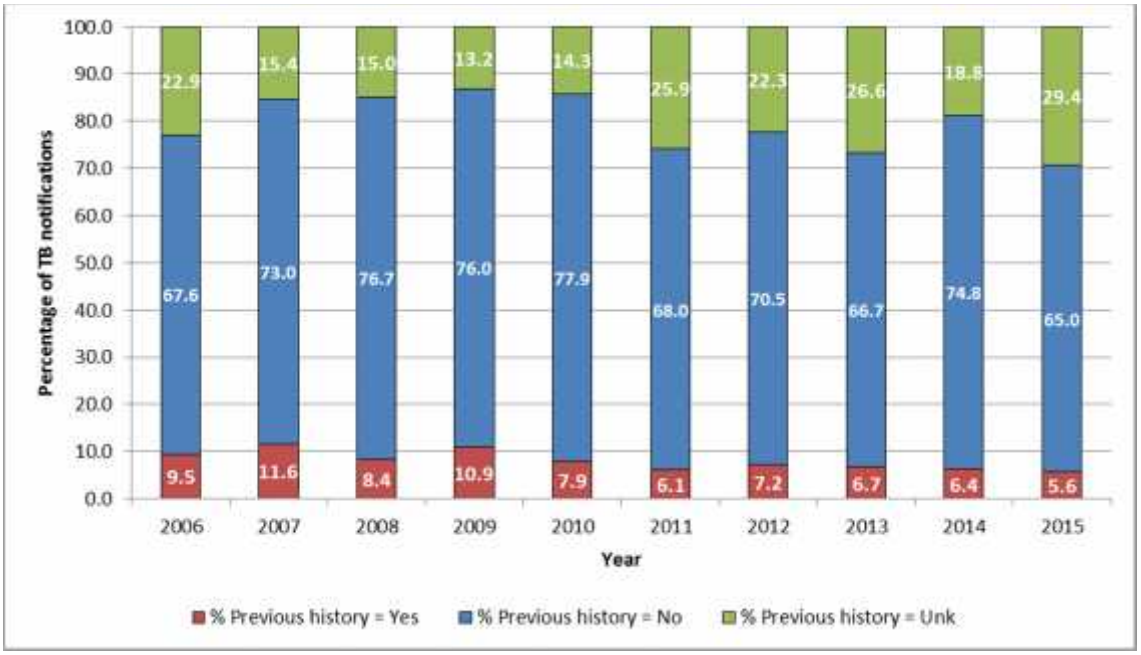

Figure 14: TB notifications by previous history of TB disease and year 2006-2015

TB risk groups

Figure 15 shows the breakdown of TB cases with a reported risk factor by type of risk factor and year.

Information on TB risk factors was reported for 250 (82.5%) cases in 2015. Of these, 67.7% of cases reported one or more risk factor for TB. The most commonly reported risk factors were being from a country of high TB endemicity[††††], followed by residence in an area of high endemicity and contact with a case of TB.

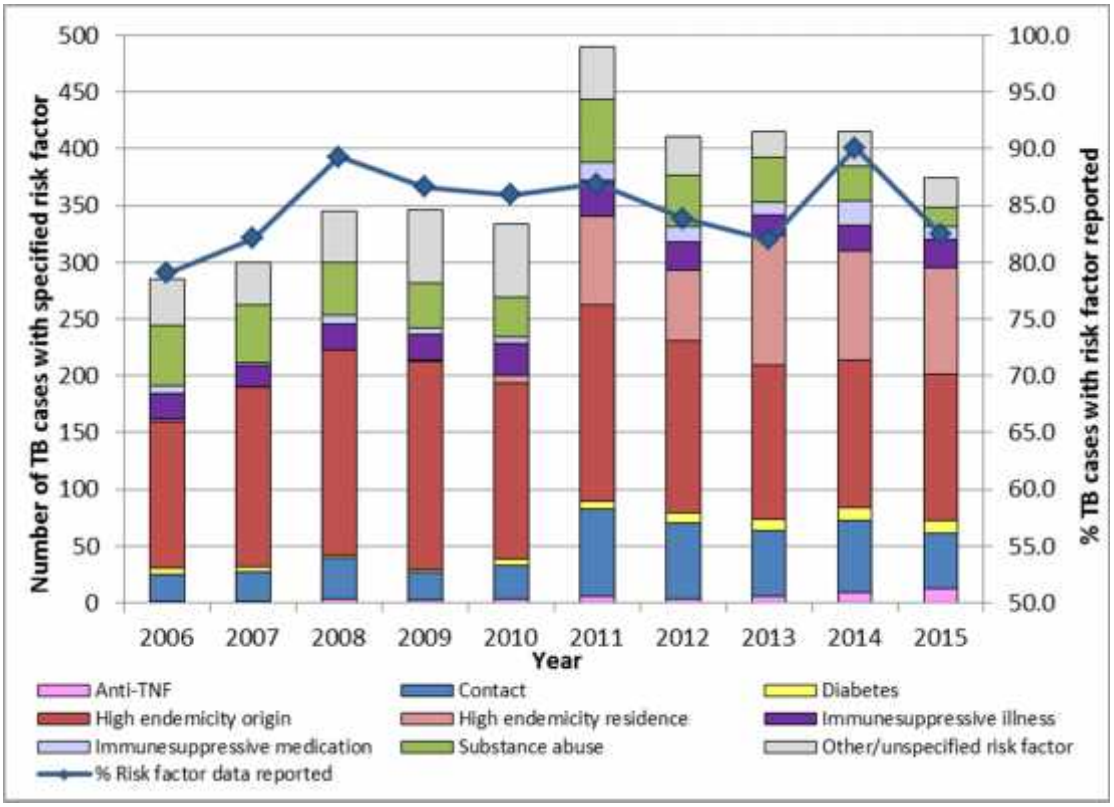

Figure 15: Number of TB notifications with a TB risk factor reported and percentage of TB cases with risk factor data reported, 2006-2015

[††††] Countries with an annual TB notification rate of ≥ 40 cases per 100,000 population are considered areas of high endemicity.

HIV status

HIV status was reported for 105 (34.7%) cases, eight of whom (7.6%) were reported as HIV positive in 2015. Figure 16 illustrates the trends in the percentage of TB notifications by HIV status and year, 2006-2015.

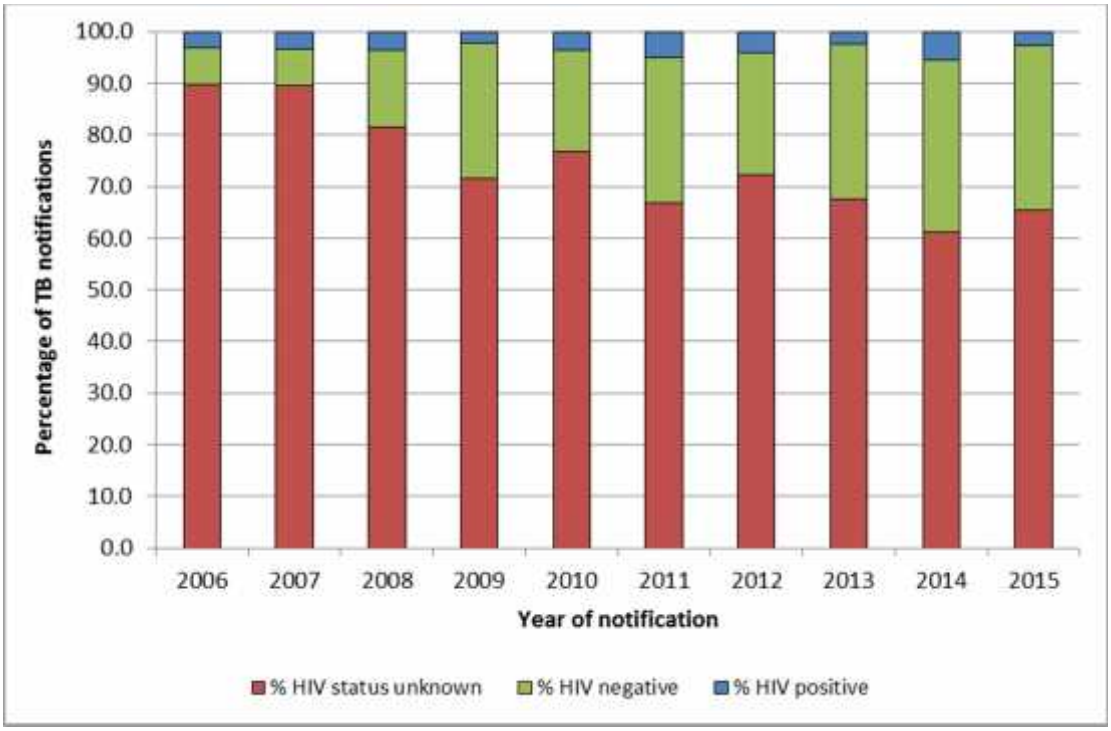

Figure 16: Percentage of TB notifications by HIV status and year, 2006-2015

Outbreaks

The introduction of the amendment to the Infectious Disease Regulations 1981 on January 1st 2004‡‡‡‡, made outbreaks, unusual clusters or changing patterns of illness statutorily notifiable by medical practitioners and clinical directors of laboratories to the medical officer of health. Standard reporting procedures for surveillance of TB outbreaks were formally agreed in 2007.

During 2015, five outbreaks were reported, comprising 18 cases of active TB and 35 cases of latent TB infection (LTBI) and 15 cases hospitalised due to TB (figure 17). Three outbreaks were reported by HSE-S and one each was reported by HSE-NW and -W (figure 18). There was one general outbreak in a workplace and four family outbreaks, one of which occurred across an extended family and three were in private houses (figure 19).

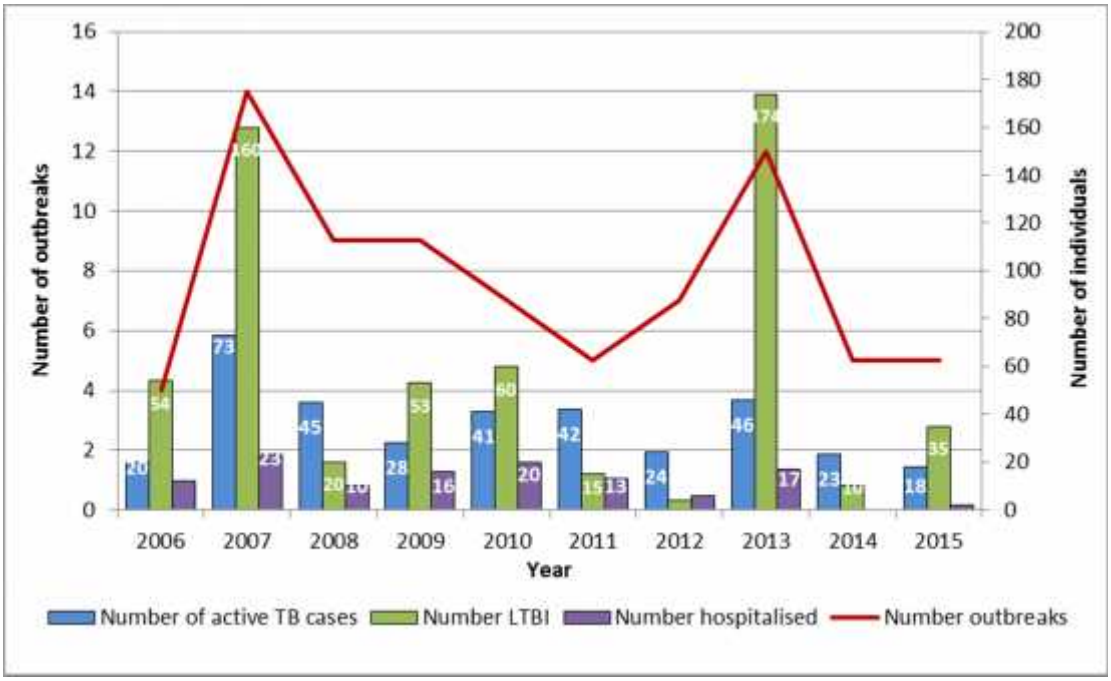

Figure 17: TB outbreak summary by year, 2006-2015

‡‡‡‡ http://www.irishstatutebook.ie/eli/2003/si/707/made/en/print

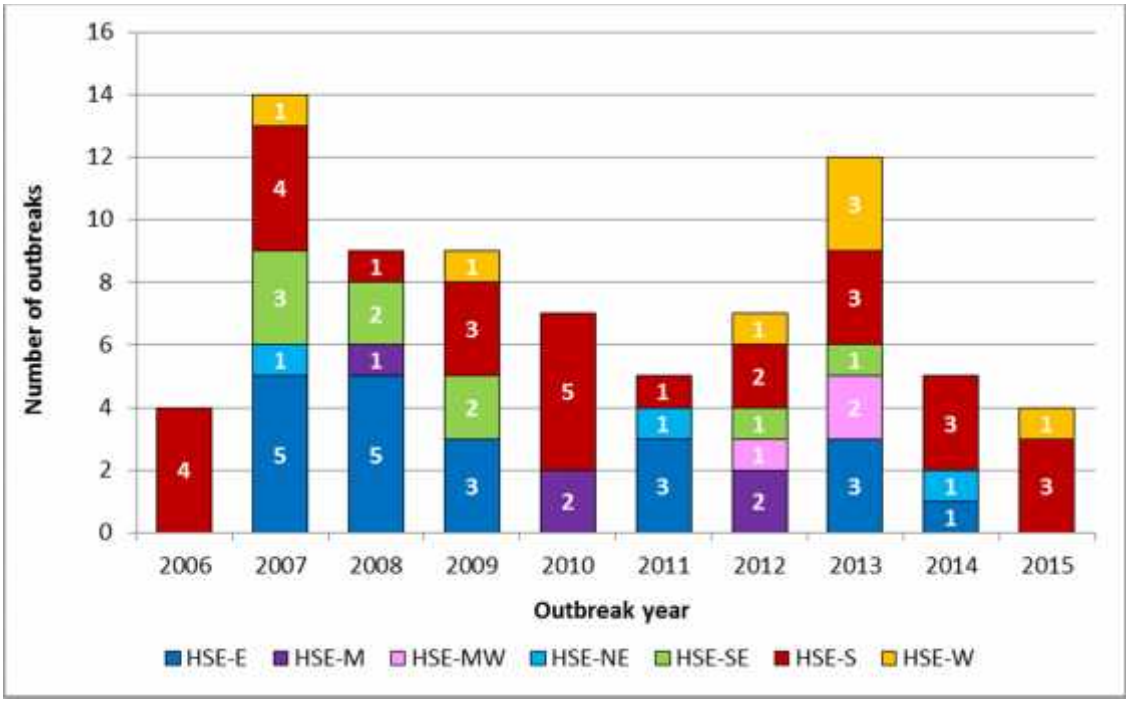

Figure 18: Number of TB outbreaks by HSE area and year, 2006-2015

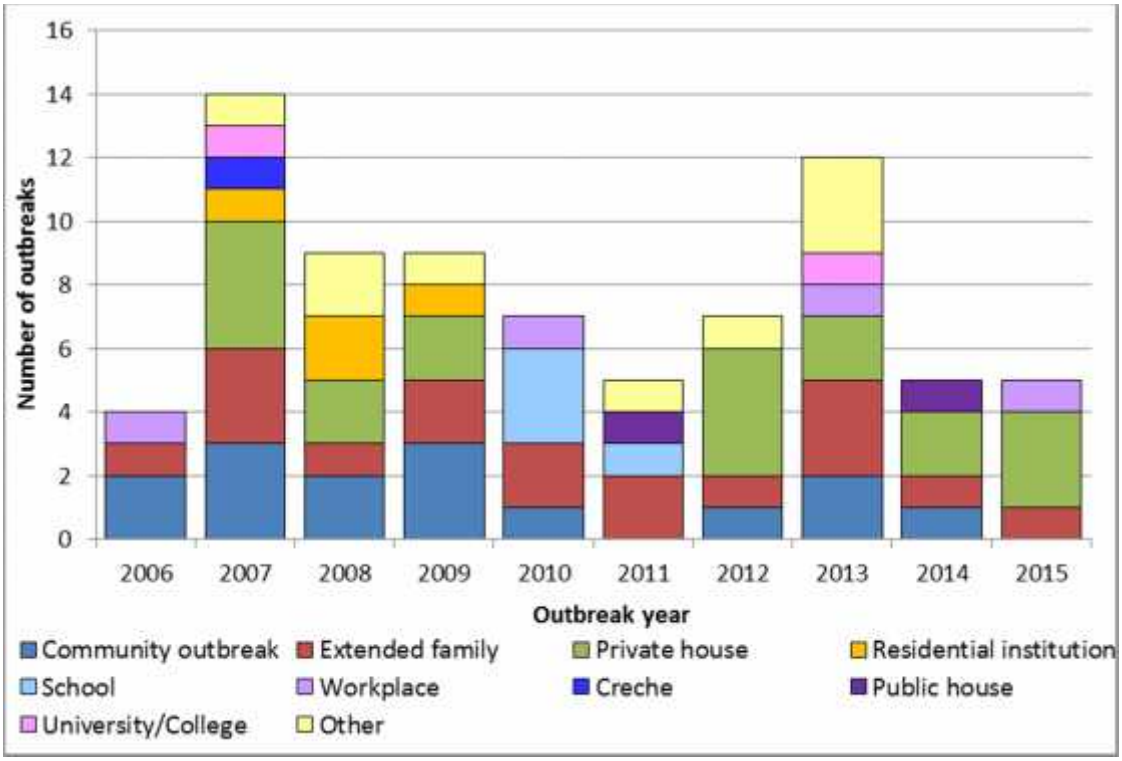

Figure 19: Number of TB outbreaks by location and year, 2006-2015

Discussion

In 2015, 303 cases of TB were notified to HPSC, a national crude incidence rate of 6.6 per 100,000 population, which is the lowest crude incidence rate recorded since TB surveillance began in 1998. This rate remains stable in comparison to 2014 (6.8 per 100,000) and the crude incidence rate between 2011 and 2015 shows a statistically significant declining trend. This trend remained significant even when stratified by country of birth.

Ireland is classified as a low incidence country by WHO criteria, i.e. TB notification rate of less than 10 per 100,000.[9] The overall notification rate in countries of the EU and Western Europe who report to ECDC was 11.7 per 100,000 population in 2015, ranging from 2.1 per 100,000 population in Iceland to 76.5 per 100,000 in Romania.[2]

Differences in crude incidence rates persist between HSE areas, with the highest rate observed in HSE South and the lowest rate reported by HSE South East. This is the sixth consecutive year that HSE South had the highest regional incidence rate.

Certain local health offices (LHOs) were found to have particularly high rates of TB incidence during 2015, including South Lee and North Cork in HSE South and Dublin West in HSE East. According to the 2011 Census, 31% of the population in Cork City and 27% of the population in Dublin City belong to social class 6 and 7 (see Appendix 2 for descriptions of social class).[7] This shows that the main burden of TB disease remains concentrated in large urban areas in Ireland, which is also observed elsewhere in Europe where large cities have notification rates twice as high as rates seen in other parts of the country.[10]

During 2015, there was a sharp increase in the proportion of cases where country of birth was not reported (7.3%). This is the highest number of cases with unknown country of birth since enhanced surveillance started in 2002. Where country of birth was known, 45.9% of TB cases notified were foreign born. In 2015, among countries in the EU and Western Europe who reported data to ECDC, 29.8% of notifications were in foreign-born patients. In France and Germany, where crude incidence rates are similar to those reported in Ireland, the percentage of cases of foreign origin in 2015 ranged from 55-68%.[2]

The crude rate of TB notifications in the Irish-born population was 4.0 and represents a decrease for the third consecutive year. The crude rate in foreign-born cases also continued to decrease during 2015 for the fourth year in a row. However, birth country specific rates for 2015 should be interpreted with caution as 7.3% of cases did not have country of birth reported.

The highest age-specific rates (ASIRs) in 2015 occurred among those aged 65 years and older and were closely followed by the 25-34 year age group. These age groups also had the highest ASIRs when stratified by sex. The male to female ratio (1.5:1) reported in 2015 was consistent with the mean ratio observed between 2010 and 2014. Males are predominant among TB cases in nearly all European countries with an overall M:F ratio of 1.5:1 in 2015.[2]

There was a notable difference in age between Irish and foreign-born cases of TB. The highest ASIRs in foreign-born cases were in the 25-34 year age group and the 35-44 year age group while the highest ASIRs in Irish-born cases were in those aged 65 years and older and in the 55-64 years age group. Consistent with the ASIRs stratified by country of birth, the median age continued to be lower in foreign-born cases (33 years) than for Irish-born cases (56 years). The mean age of foreign-born cases between 2006 and 2015 continues to show a

statistically significant increasing trend but the reasons for this increase are unclear. The mean age of Irish-born cases however remains stable. The majority of foreign-born cases in 2015 were from Asia (54.3%) and Africa (18.6%) which is also consistent with previous years.

Two cases of TB meningitis were reported in 2015, corresponding to a crude rate of 0.4 per million population respectively. Both cases were adults. Between 1998 and 2015, seven cases of TB meningitis were reported among 0-4 year olds, with the most recent case being reported in 2009.

The Health Protection Surveillance Centre *Guidelines on the prevention and control of tuberculosis in Ireland 2010* recommends that the cessation of neonatal BCG vaccination should be considered if certain criteria are met.[3] In this context the Health Information and Quality Authority (HIQA) undertook a Health Technology Assessment (HTA) of a selective BCG vaccination programme in 2015 at the request of the Chief Medical Officer in the Department of Health on foot of a recommendation from the National Immunisation Advisory Committee and the National Tuberculosis Advisory Committee to move to a selective BCG vaccination programme. In Europe, only Ireland and Portugal continue to have universal BCG vaccination programmes. [11]

The HTA recommended moving from a universal to selective BCG vaccination programme in Ireland. This recommendation was based on evidence in relation to declining TB incidence in Ireland, International Union Against TB and Lung Disease criteria for discontinuing universal BCG vaccination, and the incidence of BCG reactions reported. Between 2002 and 2015 there were no TB deaths reported in Ireland in children aged less than 15 years.

Selective BCG vaccination will focus resources on those who are at higher risk of contracting TB. The HTA indicated that one in eight newborns will continue to be eligible for the vaccine. This includes infants born in, or whose parents are from, a country with a high incidence of TB (≥40 TB cases per 100,000 per annum), those in contact with patients with active respiratory TB, and members of an at-risk group, such as the Traveller community in Ireland. It would be important to consult with groups at higher risk to determine the most acceptable and efficient way to identify those eligible for vaccination.

The HTA also states that any change of vaccination strategy should be supported by a clear commitment of sufficient resources for TB control. A change in emphasis from protection to prevention requires a coherent plan for changes to other TB control measures. That plan must clearly outline the requirements, resources, and steps to ensure that TB control in Ireland is consistent with the requirements for TB elimination.

During 2016, WHO reported eight new TB vaccines in Phase II and Phase III trials. These vaccines included recombinant BCGs, whole-cell derived vaccines, recombinant viral-vectored platforms, protein and adjuvant combinations and mycobacterial extracts. These vaccines aim either to prevent infection (pre-exposure) or to prevent primary progression to disease or reactivation of LTBI (post-exposure).[1]

Cases with a pulmonary component accounted for 65.0% of total TB cases in 2015, slightly less than the mean proportion (66.8%) between 2010 and 2014. In 2015, sputum microscopy results were available for 67.4% of pulmonary cases, an increase compared to the mean proportion of 66.1% between 2010 and 2014. Sputum smear positivity was 41.1% in 2015

(1.8/100,000), a decrease compared to 45.4% of pulmonary cases between 2010 and 2014 (2.3/100,000).

Culture confirmation of specimens and identification of *Mycobacterium tuberculosis* complex (MTC) is the most accurate method of confirming active tuberculosis. Trends in the proportion of culture confirmed pulmonary TB cases are an indicator of the performance of a TB control programme. During 2015, 65.5% of all cases were culture positive and 70.4% of all pulmonary cases. This compares to a mean of 72.5% culture positive cases between 2010 and 2014 and 80.4% for pulmonary cases.

The proportion of new pulmonary cases that were culture confirmed in 2015 decreased for the third year in a row to 70.1%, from a mean of 80.4% between 2010 and 2014. This falls short of the EU monitoring framework target of ≥ 80% culture confirmation among new pulmonary TB cases and every effort must be maintained to achieve this once again.[12] Among countries in the EU and Western Europe who reported data to ECDC, the culture confirmed proportion of new pulmonary cases ranged from 41.4% (Italy) to 96.7% (Slovenia).[2]

During 2015, 17.2% of all TB cases reported to HPSC were either culture unknown (52 cases) or culture not done (18 cases). This is the second highest number of cases missing culture results since enhanced surveillance began in 2002. It is crucial that we endeavour to improve the quality of data relating to the culture status of TB cases in the coming years as this assists in measuring the performance of the TB control programme.

The proportion of new culture confirmed pulmonary cases with reported drug sensitivity testing (DST) results were 99.3% in 2015, almost meeting the EU monitoring framework action plan target of 100% of new culture confirmed pulmonary cases with DST results for the first time.[12] ECDC has adopted the culture and DST monitoring targets as a measurement to assess both diagnostic laboratories' and physicians' capabilities to correctly diagnose TB. They recommend that Member States also use these to monitor progress towards TB elimination. The WHO End TB strategy also includes a target of 100% DST results for all previously treated cases irrespective of culture status.[13] Ireland achieved this target in 2015, with 100% of culture positive cases that were previously treated for TB having DST results. It is important that we continue to improve the quality of data relating to DST results in order to accurately assess the performance of the TB control programme.

Of the resistant cases reported, one (0.5% of cases with DST results available) was MDR-TB in 2015. This is the lowest number of MDR cases reported since 2009 giving a mean number of 2.5 MDR-cases per year reported between 2010 and 2014. MDR-TB cases represented 0.3% of total cases in 2015. In 2014 the proportion of cases with MDR-TB was 4.5%, ranging from 0% (Cyprus, Iceland, Luxembourg, Malta and Slovenia)-21.4% (Estonia) in the EU and Western Europe.[2] MDR-TB or XDR-TB is more likely to be reported in patients previously treated for TB or in immigrants from countries with a high burden of MDR-TB.

The rate of resistance was higher in foreign-born than in Irish-born cases, with a mean proportion of 73.1% of resistant cases occurring in foreign-born individuals between 2010 and 2014. The rate of resistance in foreign-born cases has steadily increased since 2006, while the rate of resistance in Irish-born cases has remained stable during the same period. The majority of resistant cases in Ireland in 2015 had no previous history of TB disease reported.

In October 2006, WHO expressed concern over the emergence of XDR-TB and called on countries to strengthen and implement measures to prevent the global spread of these drug resistant strains of TB.[6] In this context, focus on the surveillance, prevention and treatment of drug resistance needs to be strengthened in all countries.

In 2014 treatment outcome was provided for only 80.2% of total cases notified. This compares to a mean of 82.6% with treatment outcome reported since 2002. This may be explained by the fact that information on treatment outcome was unavailable for 42.9% of cases within one region and for 18.8% in another region. It is extremely important to maintain and improve on the provision of treatment outcome data. A concerted effort is required by clinicians and Public Health involved in TB treatment and control to prioritise the provision of these data.

As part of the WHO End TB strategy and the ECDC Framework Action Plan to Fight TB in the EU, three TB treatment outcome monitoring targets are currently in place. WHO have set a target of 90% treatment success rate in all TB cases and a treatment success rate of 75% for MDR-TB cases while ECDC have set a target of 85% treatment success for new pulmonary culture confirmed cases.[9 12 13]

The proportion of total cases where outcome was reported as completed (66.5%) increased during 2014 compared to 2013 (61.6%) (range: 59.6%-72.4%). This also falls short of the WHO End TB target of above 90% reported treatment success for all TB cases.[13]

The proportion of new culture confirmed pulmonary TB cases where outcome was reported as treatment completed was 66.9%, which was also an increase compared to 2013 (63.8%). This is also below the ECDC EU target of successfully treating 85% or more of all new culture confirmed pulmonary TB cases.[12] The scope of this indicator is to measure the ability of a TB control programme's ability to retain patients through a complete course of chemotherapy with a favourable clinical result.

Treatment outcome was reported for 78.3% of resistant cases in 2014. However, none of the MDR cases in the 2013 cohort of four cases was reported to have successfully completed treatment. One MDR case was reported as still on treatment, one was transferred out and the remaining two MDR cases did not have treatment outcome reported. This further reiterates the importance of more complete outcome data to actively monitor the significant threat of MDR/XDR-TB cases and to guide effective TB control in Ireland. Between 2003 and 2012, 83.3% of MDR-TB cases successfully completed treatment, meeting the WHO End TB target of 75% treatment success for MDR-TB cases.[13] We must endeavour to reach this target.

It is important that every endeavour is made to improve the completeness and timeliness of submission of reports of treatment completion which are essential for efficient TB programme management.

Information on risk factors was reported by 82.5% of cases in 2015. Where risk factor information was reported, 82.0% of the cases reported having one or more TB risk factors, a slight increase compared to 80.9% in 2014. The three most commonly reported risk factor(s) were being from a country of high TB endemicity (annual TB notification rate of ≥ 40 cases per 100,000 population), followed by residence in a country of high TB endemicity and contact with a TB case. These data are important as they provide information to guide policy

for targeting prevention and control interventions in relation to TB disease and latent TB infection in the relevant groups.

The proportion of TB cases where HIV status was reported remains notably low at 34.7% of cases during 2015, a decrease on the proportion reported in 2014 (39.0%). This percentage has steadily increased since 2003 when HIV status was reported for only 2.5% of total cases. Both the WHO End TB strategy and the ECDC Framework Action Plan to Fight TB in the EU have set targets of 100% of all TB cases having HIV status reported.[12 13] The objective of this indicator is to reduce the burden of TB/HIV co-infection by strengthening the collaboration between TB and HIV/AIDS programmes within a health service. The scope of this indicator is to measure the extent to which HIV-positive TB patients are identified and to demonstrate the extent to which HIV testing has been incorporated into the national TB control programme. We must strive to improve the completeness of TB-HIV data in the coming years, particularly as HIV became notifiable in 2012.

Outbreak reporting assists in the assessment of the burden of TB disease and latent TB infection and also assists in guiding the appropriate use of resources for the TB control programme. Data on LTBI cases identified during outbreak investigation was not well completed in 2015, with only one out of five outbreaks reporting this information.

Application of the ECDC epidemiological monitoring indicators to the Irish TB data demonstrates that Ireland has not yet achieved all of the ECDC targets. This highlights the need to adopt a focused approach to reduce TB transmission in order to reach the "***The Stop TB Partnership"*** TB elimination goal of less than one case per million population by 2050. However, regarding the MDR-TB indicator, data for 2015 indicate that the numbers of MDR-TB cases have stabilised since 2008 to a low level with approximately three cases per annum. Due to the very small numbers involved, these data should be interpreted with caution.

Ireland now meets the criterion (TB notification of < 10 cases per 100,000) as set out by the WHO for a low incidence TB country.[9] In November 2014 the WHO published an action framework for low incidence countries towards TB elimination which includes targets and a strategy.[9] The framework states that low incidence countries need to progress further towards "pre-elimination" (< 1 case per 100,000) by 2035 and to elimination (< 1 case per million) by 2050. Close collaboration will be needed between countries with high and low incidences of TB in order to reach these targets. To achieve the aforementioned goals, a multi-sectoral approach is required. This will include better access to high-quality diagnosis and TB care and more effective TB prevention including addressing the social determinants of TB with special attention to groups at highest risk of TB.

In addition to the action framework for low incidence countries, WHO have also introduced additional indicators as part of the End TB Strategy. These indicators will aim to monitor LTBI screening and treatment in risk groups such as household TB contacts aged less than five years old, people living with HIV, people on anti-TNF treatment, dialysis or transplant recipients.[1, 13]

The importance of good surveillance data cannot be underestimated in this context. Such data will help guide where resources should be directed e.g. identification of risk groups, areas with high TB notification rates in order to implement effective TB prevention and control strategies in Ireland and to reach the global "pre-elimination" and elimination targets by 2035 and 2050 respectively.

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Appendix 1: Completeness of data, 2015

Completeness of data reported for 2015 notifications ranged from 100.0% (age and sex positive cases) to 34.7% (HIV status) depending on the variable analysed. Of the 16 key variables analysed, eight had completeness levels of 90% or more in 2015. Table A1 shows the completeness of reporting for 16 key variables during 2015.

Table A1: Completeness of reported data by variable

Variable	% Complete 2015
Age	100.0
Sex	100.0
Diagnostic type	98.0
Country of birth (all notifications)	92.7
Sputum smear result (pulmonary cases)	64.0
Culture result	76.9
Isolate (Culture positive cases)	99.0
Drug susceptibility result (Culture positive cases)	96.0
Case finding method	90.1
Treatment outcome	80.2
Risk group	82.5
Previous history of TB (all cases)	70.6
Previous year of TB diagnosis (previously diagnosed cases)	52.9
Previous TB treatment history (previously diagnosed cases)	76.5
Previous TB treatment outcome (previously treated cases)	90.9
HIV status	34.7

Appendix 2: Social Class (Source: CSO 2011)

Social Class

The entire population is classified into one of the following social class groups (introduced in 1996) which are defined on the basis of occupation:

1 Professional workers
2 Managerial and technical
3 Non-manual
4 Skilled manual
5 Semi-skilled
6 Unskilled
7 All others gainfully occupied and unknown

The occupations included in each of these groups have been selected in such a way as to bring together, as far as possible, people with similar levels of occupational skill. In determining social class no account is taken of the differences between individuals on the basis of other characteristics such as education. Accordingly social class ranks occupations by the level of skill required on a social class scale ranging from one (highest) to seven (lowest). This scale combines occupations into six groups by occupation and employment status following procedures similar to those outlined above for the allocation of socio-economic group. A residual category “All others gainfully occupied and unknown” is used where no precise allocation is possible.

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