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ANNUAL EPIDEMIOLOGICAL REPORT

Building a Better Health Service | Seirbhís Sláinte Níos Fearr á Forbairt

hpsc

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01

VACCINE PREVENTABLE DISEASES

1.1 *Haemophilus influenzae* (invasive)

Summary

Number of cases, 2016: 58
Number of cases, 2015: 52
Number of cases, 2014: 61
Crude incidence rate, 2016: 1.2/100,000

In 2016, 58 cases of invasive *Haemophilus influenzae* disease were notified in Ireland (1.22 cases per 100,000 total population). This is a 15.4% increase on the number reported in 2015, which was a decrease of 14.8% in 2014. In 2004 the incidence rate was 0.89 cases/100,000. No imported cases or outbreaks were reported in 2016.

The main change in 2016, when compared to 2015, is the increase in the number of non-typeable/non-capsular strains from 24 to 34 and the decrease in untyped cases from 21 to 13 (Figure 1).

Non-typeable/non-capsular cases accounted for the majority of the invasive *H. influenzae* cases notified in 2016 (58.6%, n=34/58). The remaining cases were due to *H. influenzae* type f (10.3%; n=6), type b (5.2%; n=3), types e and 'not b' (1.7%, n=1 each) and isolates that were not typed (22.4%; n=13), of which 6 (10.3%) were diagnosed by PCR testing only. The median age of cases was 47 years (range 11 days to 91 years). The incidence rates were highest in infants <1 year (11.2/100,000) and those aged 65+ years (3.3/100,000) (Table 1).

Cases occurring in children <10 years of age (n=12) and in elderly adults (65 years of age and older (n=21)) accounted for 56.9% of all invasive *H. influenzae* notifications in 2016 (Table 1). One notable trend since 2004 is the increase in the overall proportion of cases 65+ years of age from 26.3% to 36.2% in 2016.

In 2016, the highest frequency of cases occurs in the 0-4 year age group (19.0%; n=11), after which it falls sharply before increasing again among those aged 65+ years (34.6%; n=21) (Table 1), a pattern consistent with what has been observed since 2004 (Figure 2).

In 2016 the number of male cases (n=18) was less than half that of females (n=39) giving a male to female ratio of 0.46:1.

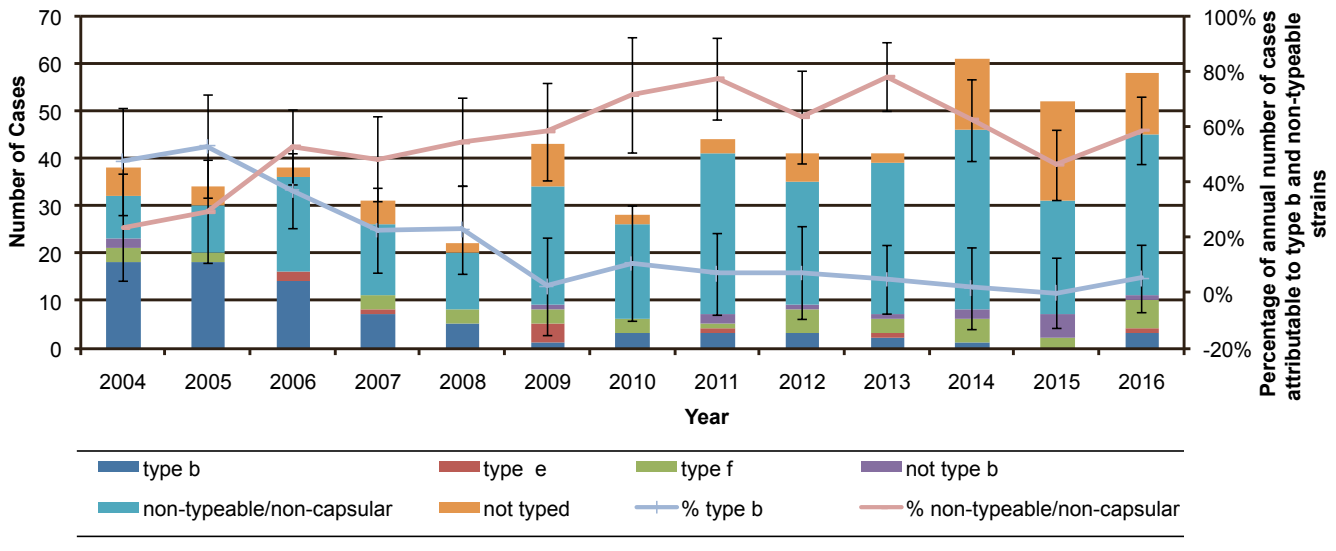

Figure 1. Number of invasive H. influenzae cases and proportion of cases attributable to type b and non-typeable strains with 95% confidence intervals, Ireland, 2004-2015

The M:F ratio has been observed to vary considerably in recent years with a 1:1 ratio recorded in 2015 and 1.8:1 in 2014 (Figure 3).

Between 2004 and 2016, a period of 13 years, the fewest quarterly number of cases has been in the third quarter on eight occasions (Figure 3).

Incidence of disease in 2016 was highest in the HSE M area (2.1/100,000) with the lowest in the HSE SE area (0.98/100,000) (Table 2). No HSE area had an incidence rate that was significantly different from the national rate (Figure 4).

A breakdown by clinical diagnosis for all cases by age group between 2004 and 2016 is presented in Table 3. In 2016, 17.2% (n=10/58) of cases did not have a clinical diagnosis recorded.

Two deaths were reported among the 58 cases in 2016; both aged 80-84 years. The cause of death in one was not caused by the *H. influenzae* infection itself and in the other, it was not known. Both had a confirmed non-typeable infection with pneumonia.

In 2016, there were three cases of *H. influenzae* type b (Hib) reported compared to none in 2015. In 2014, only one case of Hib occurred, with two cases in 2013 and 18 cases notified in both 2004 and 2005. Between Q3-2007 and Q4-2016, a nine and a half year period, only one true Hib vaccine failure was reported, highlighting the continuing positive impact that the Hib booster catch up campaign has had in Ireland.

Since September 2008, the Hib booster dose has been administered at 13 months of age as part of the routine childhood immunisation schedule in addition to the three doses given during infancy (at 2, 4 and 6 months of age). Furthermore, vaccination is routinely recommended for those at increased risk of Hib disease due to underlying medical conditions or treatments.

Table 1. Number and incidence rates of invasive H. influenzae cases by serotype and age group, Ireland, 2016

Age Group	type b	type e	type f	not type b	non-typeable/ non-capsular	not typed (all)	not typed, PCR only diagnosis	not typed	Total	ASIR
<1	1	0	0	1	2	3	3	0	7	11.24
1-4	0	0	0	0	3	1	1	0	4	1.49
5-9	0	0	0	0	0	1	1	0	1	0.28
10-14	0	0	1	0	0	0	0	0	1	0.31
15-19	0	0	0	0	1	0	0	0	1	0.33
20-24	0	0	0	0	3	0	0	0	3	1.10
25-34	0	0	0	0	5	1	0	1	6	0.91
35-44	0	1	0	0	5	0	0	0	6	0.80
45-54	0	0	2	0	2	0	0	0	4	0.64
55-64	2	0	1	0	1	0	0	0	4	0.79
65+	0	0	2	0	12	7	1	6	21	3.29
Total	3	1	6	1	34	13	6	7	58	1.22
CIR	0.06	0.02	0.13	0.02	0.71	0.27	0.13	0.15	1.22	-

CIR, crude incidence rate per 100,000 total population; ASIR, age specific incidence rate per 100,000 population; ASIR values calculated using Census 2016 data

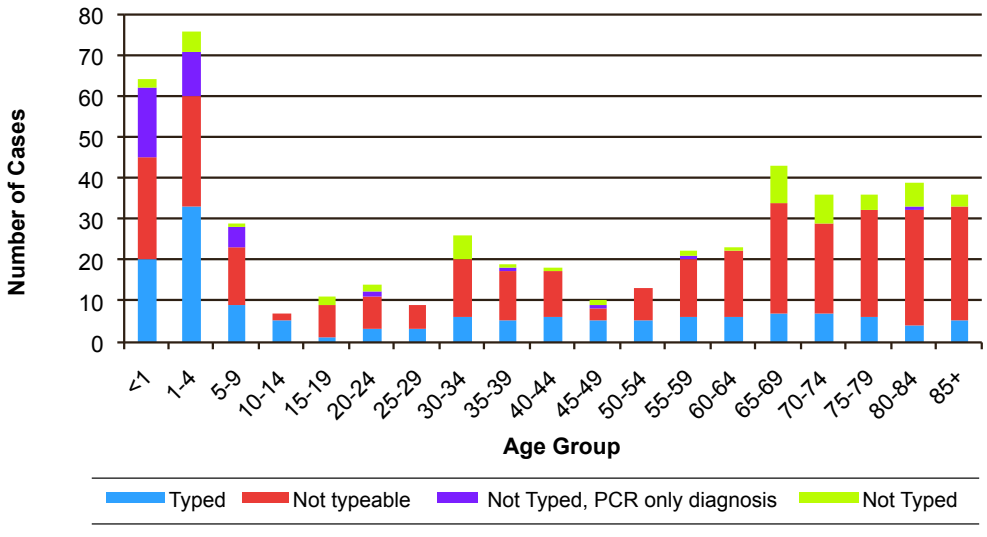

Figure 2. Number of H. influenzae cases by agegroup and type, Ireland, 2004-2016*
** Typed includes b, e, f, not-b*

Table 2. Incidence rates per 100,000 population of invasive H. influenzae by HSE area, Ireland, 2004-2016

HSE Area	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
E	1.07	1.00	0.87	0.80	0.53	0.74	0.56	1.11	1.11	0.62	0.93	1.52	1.11
M	1.19	1.19	0.40	1.19	0.79	1.06	0.35	1.06	0.35	1.42	1.71	0.34	2.05
MW	0.83	0.28	0.83	0.55	0.83	2.11	0.53	0.53	1.05	0.79	2.08	1.04	1.30
NE	0.25	1.27	0.25	0.00	0.00	0.23	0.45	1.59	0.91	1.36	1.52	0.87	1.08
NW	0.42	0.00	2.11	0.42	0.00	0.39	0.39	0.77	0.77	1.16	0.39	0.78	1.95
SE	1.08	0.43	0.87	1.08	0.65	1.00	1.00	0.80	1.21	1.00	2.35	1.18	0.98
S	1.13	0.32	1.29	0.32	0.64	1.20	1.05	0.30	0.60	0.90	1.16	0.72	1.01
W	0.48	1.45	0.72	1.45	0.48	1.12	0.22	1.35	0.45	0.90	0.88	0.88	1.32
Ireland	0.90	0.80	0.90	0.73	0.52	0.94	0.61	0.96	0.89	0.89	1.28	1.09	1.22

Table 3. Number of invasive H. influenzae cases by clinical diagnosis, Ireland, 2004-2016

Clinical diagnosis	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Septicaemia	8	14	13	6	3	9	9	11	11	14	15	14	18
Pneumonia	5	0	3	6	3	8	5	12	12	4	12	8	12
Other	1	2	1	0	0	0	0	3	4	7	7	3	9
Bacteraemia (without focus)	1	0	1	1	2	0	0	3	5	6	9	8	6
Meningitis	3	9	3	2	2	2	1	3	2	2	7	3	1
Epiglottitis	1	3	3	1	1	0	2	0	0	3	1	1	1
Cellulitis	1	1	2	1	1	0	0	1	0	0	0	1	1
Meningitis & septicaemia	1	0	1	0	1	1	1	1	1	0	0	2	0
Septic arthritis	0	1	0	0	1	0	0	0	0	0	0	0	0
Osteomyelitis	1	0	0	0	0	0	0	0	0	0	0	0	0
Not specified	16	4	11	14	8	23	10	10	6	5	10	12	10
Total	38	34	38	31	22	43	28	44	41	41	61	52	58
% Not specified	42.1%	11.8%	28.9%	45.2%	36.4%	53.5%	35.7%	22.7%	14.6%	12.2%	16.4%	23.1%	17.2%

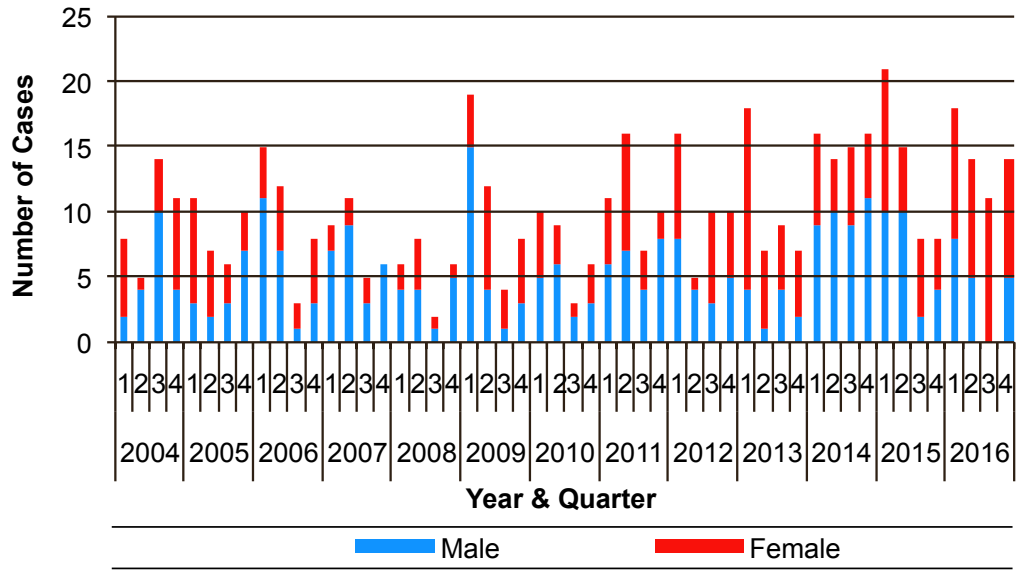

Figure 3. Number of H. influenzae cases by year/quarter and gender, Ireland, 2004-2016

The figures presented in this summary are based on data extracted from the Computerised Infectious Disease Reporting (CIDR) system on 9th November, 2017. These figures may differ from those published previously due to on-going updating of notification data on CIDR.

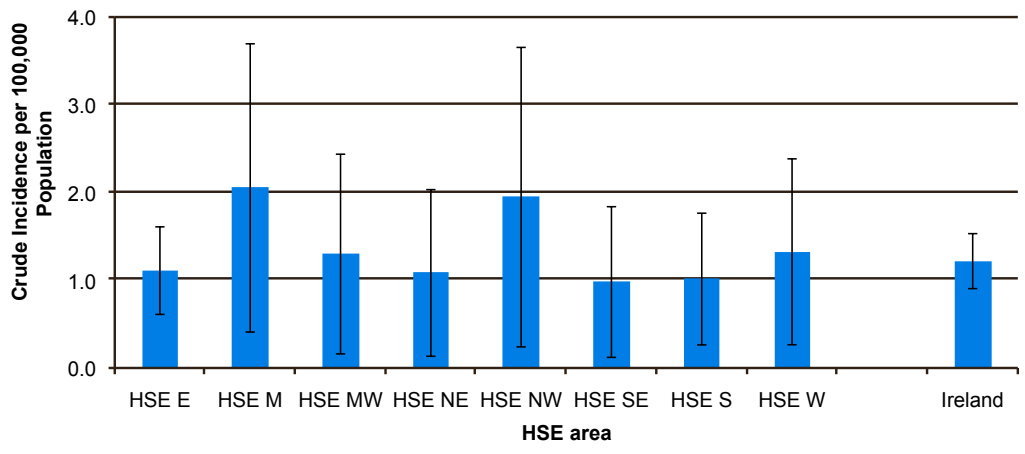

Figure 4. Crude incidence rates per 100,000 population with 95% confidence intervals for H. influenzae notifications by HSE area, Ireland, 2016 (Incidence rates based on Census 2016 data)

1.2 Measles

Summary

Number of cases, 2016: 43
Number of confirmed cases, 2016: 43
Crude incidence rate, 2016: 0.9/100,000

There were 43 measles cases (0.9/100,000) in 2016 compared to two cases in 2015 (figure 1). All cases in 2016 were classified as confirmed.

Forty (93%) of the cases in 2016 were part of a national measles outbreak which occurred following importation of measles virus from Romania. One further case in a resident of Slovenia, exposed on a flight, was linked to the outbreak. This confirmed case is not included in the Irish data but was reported by Slovenian national public health authorities. Of the 40 cases, 27 (68%) were in the HSE S, five (13%) were in the HSE SE, four (10%) were in the HSE MW, three (8%) were in the HSE E and one (3%) was in the HSE NE. The cases ranged in age from three months to 40 years with a median age of eight years and a mean age of 12 years. Thirty (75%, n=30/40) of the cases were unvaccinated; eight of these were less than one year of age. One case (3%, n=1/40) had received one dose of MMR, three cases (8%, n=3/40) were reported to have received two doses while vaccination status was unknown for the remainder (15%, n=6/40). Of the cases reported to have received MMR vaccine only one had vaccination dates reported. Nineteen cases (48%, n=19/40) were hospitalised. Length of hospitalisation was reported for 18 cases with a median duration of stay of four days (range two to eight days). Reported complications of measles included pneumonia (3%, n=1/33) and shortness of breath (n=1). Measles virus from 33 of the cases were genotyped by the NVRL and all were genotype B3. Information on the outbreak investigation was published in Eurosurveillance.[1]

Two of the 43 cases were part of a separate localised outbreak. Genotype D8 was identified in this outbreak. The index case had arrived from the United Kingdom but reported exposure to a hospitalised measles in Germany 8-17 days before rash onset. The secondary case in Ireland was a health care student and had contact with the index case in an Emergency Department in Ireland. The index case was in the age group 20-24 years and the secondary case was in the age group 25-34 years. The index case was unvaccinated and the secondary case had one dose of MMR, however, the date of vaccination was not available.

One of the 43 cases was reported as exposed to measles cases in Pakistan. No secondary cases were identified. The case was genotyped by the NVRL and was genotype B3. The case was less than one year of age and was unvaccinated. The total 43 cases by age group and the age specific incidence rates are shown in figures 2 and 3. Nineteen of the 43 cases (44%) were hospitalised. The country of birth was recorded as Ireland for 27 cases; country of birth was

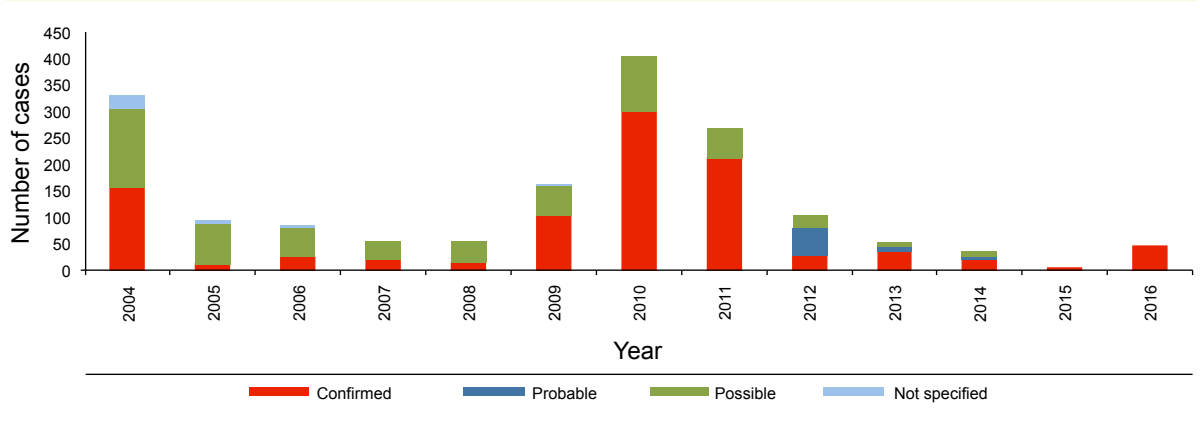

Figure 1. Number of measles cases by year and case classification, 2004-2016

outside of Ireland for twelve cases and was unknown for four cases. Of the 43 cases, the setting where the case most likely acquired measles was reported as home (42%, n=18), hospital in-patient (12%, n=5), overseas (7%, n=3), hospital out-patient (5%, n=2), work (5%, n=2), other healthcare facility (2%, n=1) and was unreported for the remainder (28%, n=12). Twenty four (56%) of the cases were male and 19 (44%) were female. A breakdown of the total cases and the crude incidence rate per 100,000 population by HSE Area is given in table 1.

The figures presented above are based on data extracted from the Computerised Infectious Disease Reporting (CIDR) system on 25th July 2017. These figures may differ slightly from those published previously due to ongoing updating of notification data on CIDR. The 2016 census data was used here to calculate rates.
WHO require information on discarded measles cases ie measles cases investigated and who were found not to meet the case definition. The HSE Areas reported the number of discarded CIDR cases to HPSC. For 2016, 154 cases were discarded from CIDR as following investigation as they were not considered to be measles cases. Discarded cases are not available in CIDR for reporting and are not included in the analysis above.

The Regional Verification Commission for Measles and Rubella Elimination (RVC) was established in the WHO European Region in 2011 to evaluate the documentation submitted by Member States with a view to verifying the elimination of measles and rubella at the regional level. The RVC has recommended establishment of national verification committees (NVC) in all Member States and suggested a standard format for annual status reports from countries.

These reports include information on measles and rubella epidemiology, virologic surveillance supported by molecular epidemiology, the analysis of vaccinated population cohorts and the quality of surveillance, and the sustainability of the country's National Immunisation Programme. The review and evaluation of annual national reports will continue for at least three years after the RVC confirms that, according to established criteria, endemic measles and rubella transmission have been interrupted in all Member States of the Region. Only then can Regional elimination be declared.[2] The WHO European RVC concluded at the sixth meeting of the European RVC for measles and rubella elimination in June 2017 that Ireland provided evidence for interrupted transmission of measles virus for 24 months.[3]

The NVRL is the WHO accredited National Measles Rubella laboratory for Ireland. Laboratories that perform measles/ rubella investigations in their own laboratories are requested to send all positive samples for measles or rubella to the NVRL for confirmatory testing. In addition, a selection of negative specimens should also be referred. Genotyping is undertaken in the NVRL on a selection of specimens.

Table 1. Number of measles cases and the crude incidence rate per 100,000 population (CIR) by HSE Area in 2016

HSE Area	Number	CIR
HSE E	4	0.2
HSE M	0	0.0
HSE MW	4	1.0
HSE NE	1	0.2
HSE NW	0	0.0
HSE SE	5	1.0
HSE S	27	3.9
HSE W	2	0.4
Total	43	0.9

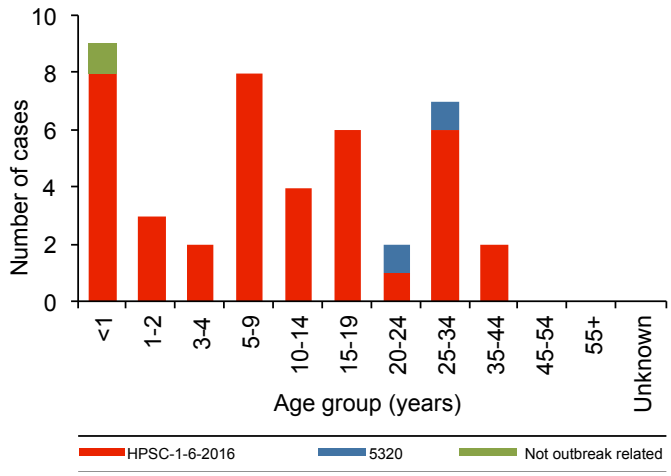

Figure 2. Number of measles cases in 2016 by age group and outbreak identifier

HPSC-1-6-2016 is the outbreak identifier for the 2016 national measles outbreak
5320 is the outbreak identifier for a 2016 localised measles outbreak with two cases
One case in 2016 was not related to an outbreak in Ireland

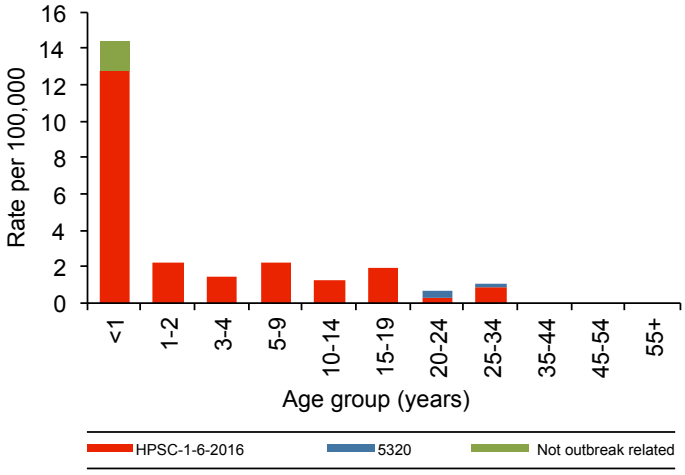

Figure 3. The age specific incidence rate (per 100,000) of measles cases in 2016 by age group and outbreak identifier

HPSC-1-6-2016 is the outbreak identifier for the 2016 national measles outbreak
5320 is the outbreak identifier for a 2016 localised measles outbreak with two cases
One case in 2016 was not related to an outbreak in Ireland

Acknowledgements
HPSC would like to thank all those who provided data for this report – Departments of Public Health, laboratories and clinicians.

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1.3 Meningococcal Disease (*Neisseria meningitidis*) (invasive)

Summary

Number of cases, 2016: 87
Number of cases, 2015: 74
Number of cases, 2014: 82
Crude incidence rate, 2016: 1.8/100,0000

Between 1999 and 2012, a marked downward trend in invasive meningococcal disease (IMD) incidence was observed: in 1999 there were 536 cases (14.8/100,000) and in 2012 there were 66 cases (1.4/100,000), a decline of almost 88%. In 2016, however, 87 cases (1.8/100,000) of IMD were notified, 13 more reported than in the previous year (n=74).

Typically, most cases in 2016 were diagnosed by blood/CSF culture testing, blood/CSF PCR testing or by detection of Gram negative diplococci in skin lesions/culture or in CSF specimens. Isolation of the organism from non-sterile sites (such as the eye, nose or throat) in clinically compatible cases is considered a possible case.

Of the 87 cases notified in 2016, 85 (97.7%) were case classified as confirmed and two (2.3%) as possible. Of the 85 confirmed cases, 37 (43.5%) were confirmed by PCR testing alone and another 17 confirmed cases (20.0%) were diagnosed by culture of sterile specimens alone. Of the remaining 31 (36.4%) confirmed cases, all were diagnosed by both culture and PCR testing of sterile specimens. Additional laboratory testing was done on the 85 confirmed cases: six had positive CSF microscopy test results and one had a positive skin lesion culture. Of the two possible cases reported in 2016, one had a positive a bronchial lavage test result.

In 2015, male cases (n=49) exceeded female cases (n=38), resulting in a male to female ratio of 1.28:1, following a consistent pattern observed since 2001. IMD cases in 2016 ranged in age from one week to 93 years (median age of 14.2 years).

Overall incidence in Ireland was 1.8/100,000 population in 2016. Age specific incidence rate (ASIR) was highest among infants <1 year of age (28.9/100,000; n=18), followed by children in the 1 to 4 years (5.9/100,000; n=16), and 15 to 19 year age groups (4.6/100,000; n=14) (Table 1, Figure 1).

Figure 2 presents the number of IMD cases by gender and age group between 1999 and 2016 and shows the decline in numbers across all of the age groups, with the steepest declines observed in the <1, 5-9 and 10-24 year age groups following the introduction of the meningococcal C conjugate (MCC) vaccine in late 2000.

At regional level, incidence was highest in the HSE NW area (4.7/100,000) and lowest in the HSE MW area (1.3/100,000) (Table 2). No area had an incidence rate that was significantly different from the national rate (Figure 3). There was one imported case identified in 2016, (from the United Kingdom with a menB infection (aged 20-24 years)). In December 2016, a cluster of two cases was reported in HSE NW in Donegal, both aged 10-14 with a serogroup B infection; both cases recovered.

Table 1. Number of cases, deaths, age-group specific incidence rates per 100,000 population and case fatality ratios of IMD, Ireland, 2016

Age Group	No. Cases	ASIR	No. Deaths	%CFR
<1	18	28.9	0	0.0%
1-4	16	5.9	0	0.0%
5-9	4	1.1	0	0.0%
10-14	8	2.5	0	0.0%
15-19	14	4.6	1	7.1%
20-24	6	2.2	0	0.0%
25+	21	0.7	4	19.0%
All ages	87	1.8	5	5.7%

ASIR, age specific incidence rate per 100,000 population calculated using Census 2016 data; %CFR, case fatality ratio,

Apart from the years 2003, 2013, 2014 and 2016, IMD cases have tended to occur most frequently in the first quarter of each calendar year (Figure 4).

Most cases of IMD occurred in cases whose ethnic background was described as 'White' (51.7%; n=45/87) followed by 'Irish Traveller' (12.6%; n=11), 'Indian Subcontinent' (3.4%; n=3) 'Other' (2.3%; n=2) and 'not known'/not specified (29.9%; n=26).

Neisseria meningitidis serogroup B was the pathogen most commonly associated with IMD in 2016 and accounted for 48 of the 87 (55.2%) notifications. However, this is a marked decline on what was previously reported between 2002 and 2015 when serogroup B accounted for more than 80% (n=1746/2105) of all IMD notifications (Figure 5).

There were five IMD related notified deaths in 2016 (case fatality ratio of 5.8%) (age range 17 months to 81 years)

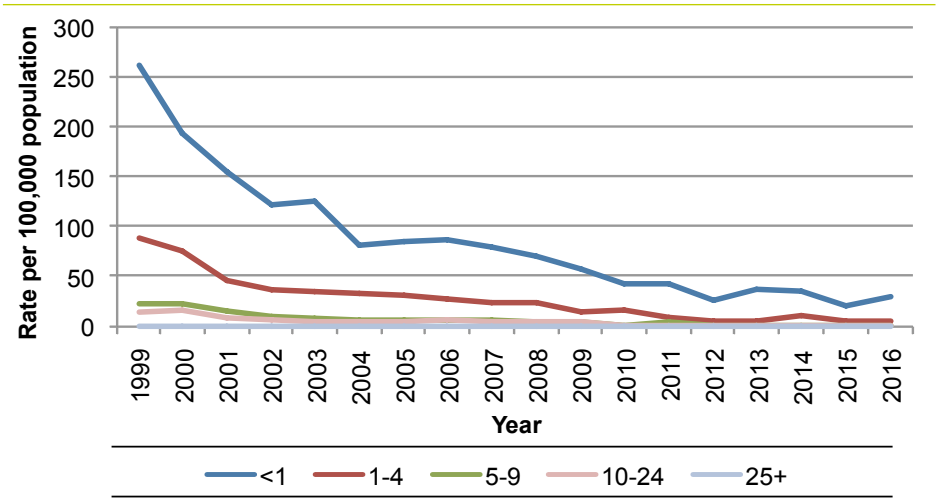

Figure 1. Age-specific rates per 100,000 population for invasive meningococcal disease (IMD), Ireland, 1999-2016

Table 2. Age specific incidence rates per 100,000 population of IMD by HSE area and age group, Ireland, 2016

HSE Area	<1	1-4	5-9	10-14	15-19	20-24	25+	Total
HSE E	26.4	4.2	0.8	0.0	3.9	1.8	0.6	1.4
HSE M	0.0	5.6	0.0	0.0	15.5	0.0	1.1	2.1
HSE MW	20.3	0.0	0.0	3.8	3.9	4.6	0.4	1.3
HSE NE	15.4	0.0	2.5	0.0	9.7	4.4	0.7	1.7
HSE NW	94.6	14.2	5.1	21.7	5.8	0.0	0.6	4.7
HSE SE	15.4	17.5	2.6	0.0	3.0	0.0	0.0	1.6
HSE S	34.0	7.9	0.0	4.4	2.3	5.1	1.5	2.6
HSE W	52.3	4.0	0.0	3.3	0.0	0.0	0.3	1.3
Ireland	28.9	5.9	1.1	2.5	4.6	2.2	0.7	1.8

ASIR, age specific incidence rate per 100,000 population calculated using Census 2016 data

Table 3. Number of cases, deaths and case fatality ratios (%CFR) by year for meningococcal B and C disease, Ireland, 1999-2016

	Meningococcal B			Meningococcal C		
Year	No. Cases	No. Deaths	%CFR	No. Cases	No. Deaths	%CFR
1999	292	12	4.1	135	5	3.7
2000	258	13	5.0	139	11	7.9
2001	245	8	3.3	35	3	8.6
2002	199	8	4.0	14	0	0.0
2003	206	11	5.3	5	1	20.0
2004	163	7	4.3	5	1	20.0
2005	169	5	3.0	5	0	0.0
2006	168	5	3.0	4	0	0.0
2007	158	6	3.8	2	0	0.0
2008	149	6	4.0	4	1	25.0
2009	119	6	5.0	5	0	0.0
2010	93	4	4.3	4	0	0.0
2011	84	2	2.4	2	0	0.0
2012	58	1	1.7	0	0	0.0
2013	68	4	5.9	1	0	0.0
2014	69	3	4.3	6	1	16.7
2015	43	2	4.7	11	0	0.0
2016	48	2	4.2	22	1	4.5

%CFR, case fatality ratio

(Table 1). Two of the deaths were attributable to a serogroup B infection, one to a serogroup W135 infection, one case had a serogroup C infection at the time of death, but the cause of death was not known and another, with no serogroup reported, is awaiting a coroner's report at the time of writing.

IMD due to serogroup C (MenC) had remained at low levels between 2003 and 2014 with an average of 3.4 cases occurring annually. However, since then, numbers have risen with 11 cases in 2015 and 22 in 2016 (Table 3). Of the cases in 2016, 11 were unvaccinated (aged between 1 month and 69 years), six were complete vaccine failure failures (aged 8 to 17 years), two were incomplete vaccine failures (aged 12-14 years) and the vaccination status of the remaining three cases were either unknown or not specified (aged 30-81 years) (Table 4).

The recent increase in MenC cases, which began in 2014, may be attributable to waning population herd immunity. Recent studies undertaken in the United Kingdom have reported waning immunity to serogroup C disease following infant vaccination in early childhood. Furthermore, protection given by vaccination at 12 months also wanes by the teenage years, but vaccination later in childhood provides higher levels of antibody that persist for longer.[1-4] Evidence shows that MCC vaccination significantly reduces nasopharyngeal carriage of the serogroup C meningococcus, providing indirect protection through herd immunity.[5-6] The

Table 4. Details of the MenC cases notified in 2016 including age group, outcome and age at vaccination

Case No.	Age Grp	Outcome	Vaccination Status	No. MenC doses given	Age at (Last) Vaccination
1	<1	Not known	Unvaccinated	0	.
2	<1	Not known	Unvaccinated	0	.
3	<1	Recovering	Unvaccinated	0	.
4	<1	Recovering	Unvaccinated	0	.
5	5-9	Recovering	Complete	3	6 months
6	10-14	Recovering	Complete	3	6 months
7	10-14	Recovered	Incomplete	1	6 months
8	10-14	Recovering	Incomplete	3	5 months
9	15-19	Recovering	Complete	1	3.5 years
10	15-19	Recovered	Complete	1	3.3 years
11	15-19	Recovered	Complete	1	3.3 years
12	15-19	Recovering	Complete	1	2.5 years
13	15-19	Recovered	Unvaccinated	0	.
14	20-24	Recovering	Unvaccinated	0	.
15	30-34	Recovering	Unknown	.	.
16	45-49	Recovering	Unknown	.	.
17	50-54	Recovering	Unvaccinated	0	.
18	55-59	Recovering	Unvaccinated	0	.
19	60-64	Not known	Unvaccinated	0	.
20	65-69	Recovered	Unvaccinated	0	.
21	65-69	Recovering	Unvaccinated	0	.
22	80-84	Died	Not specified	.	.

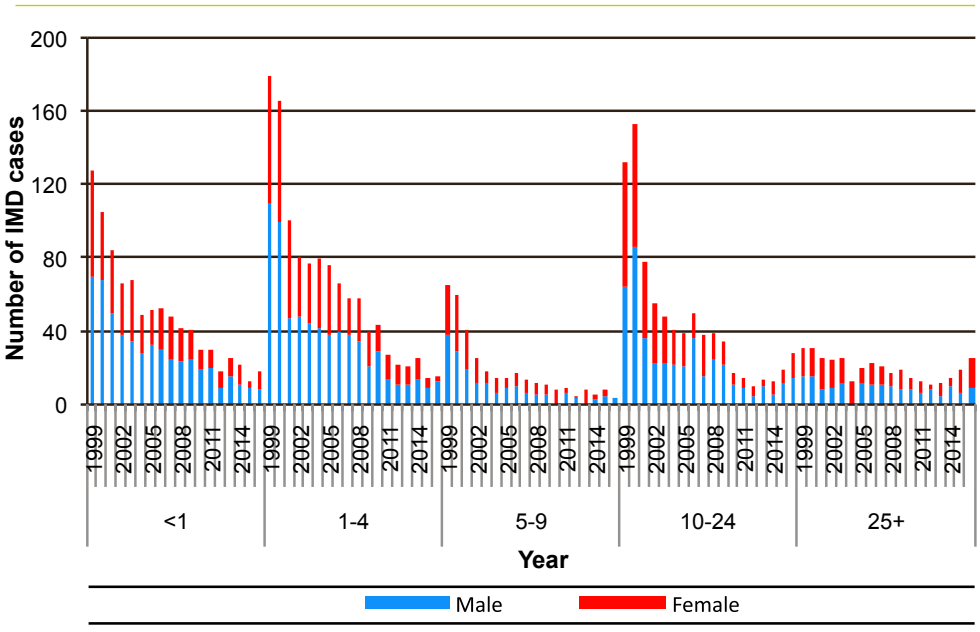

Figure 2. Number of IMD cases by gender and age group in Ireland, 1999-2016 (excludes one case with unknown gender details in 2009)

continuing increase in MenC cases in Ireland in 2016 may reflect a decline in this herd immunity.

The routine meningococcal C conjugate (MCC) vaccination programme in Ireland has recently changed in response to the recent increase in MenC cases and the emerging evidence of waning immunity. Instead of three doses of the MCC vaccine being administered to children at 4, 6 and 13 months of age, from July 2015 a single dose is given at 4 months, 13 months and at 12-13 years (if not previously vaccinated at >10 years of age) (http://www.hse.ie/eng/health/immunisation/hcpinfo/guidelines/chapter13.pdf).

The National Immunisation Advisory Committee (NIAC) also recommended a booster dose of the MCC vaccine for those considered at increased risk of MenC disease, and since 2011, the MCC vaccine booster has been recommended for close contacts of cases if their last dose was more than one year before. In August 2014, NIAC recommended an adolescent booster at 12-13 years to be offered in the first year of secondary level school. The adolescent booster MenC programme commenced in January 2015.

Despite the marked reduction in the overall incidence in the past decade, IMD is still an important public health concern due to its associated severity, high mortality rate and serious adverse sequelae. Complete IMD prevention and control requires effective vaccination. Effective vaccines are now available against serogroups A, B, C, W135 and Y forms of the disease. In 2012, Bexsero®, a recombinant multicomponent vaccine (4CMenB) against serogroup B disease was approved by the European Medicines Agency. In March 2014, the United Kingdom's Joint Committee on Vaccination and Immunisation (JCVI) recommended the vaccination of infants against serogroup B[7]. In Ireland, the primary childhood immunisation (PCI) schedule were updated in July 2016 so that all babies born on or after 1st October 2016 are now offered the MenB vaccine at 2, 4 and 12 months of age (https://www.hse.ie/eng/health/immunisation/infomaterials/newsletter/newsletter23.pdf). The MenB vaccine cannot be given at same time as MenC vaccine, which is given at 6 and 13 months of age.

The figures presented in this summary are based on data extracted from the Computerised Infectious Disease

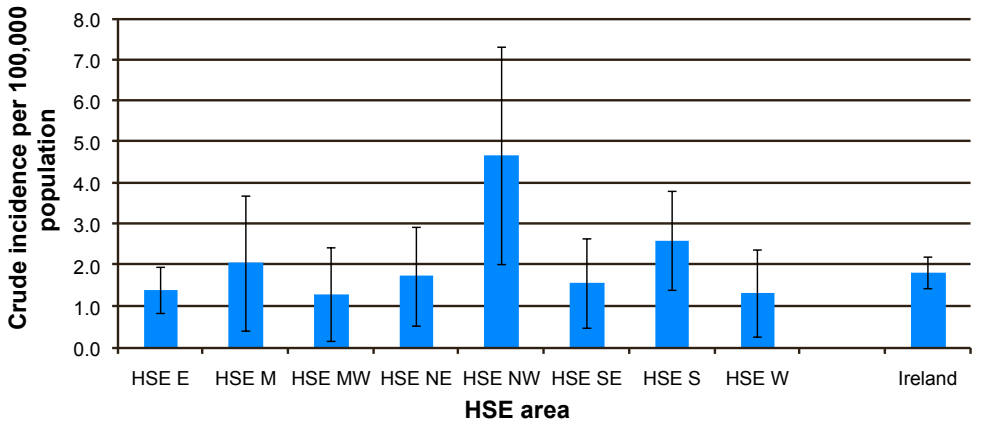

Figure 3. Crude incidence rates per 100,000 population with 95% confidence intervals for IMD notifications by HSE area, Ireland, 2016

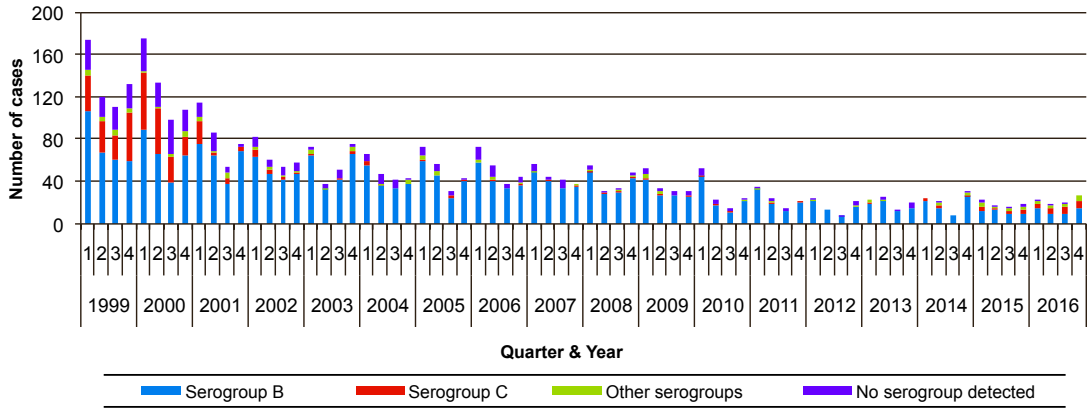

Figure 4. Number of IMD cases by quarter and serogroup, Ireland, 1999-2016

Reporting (CIDR) system on 9th November, 2017. These figures may differ from those published previously due to on-going updating of notification data on CIDR.

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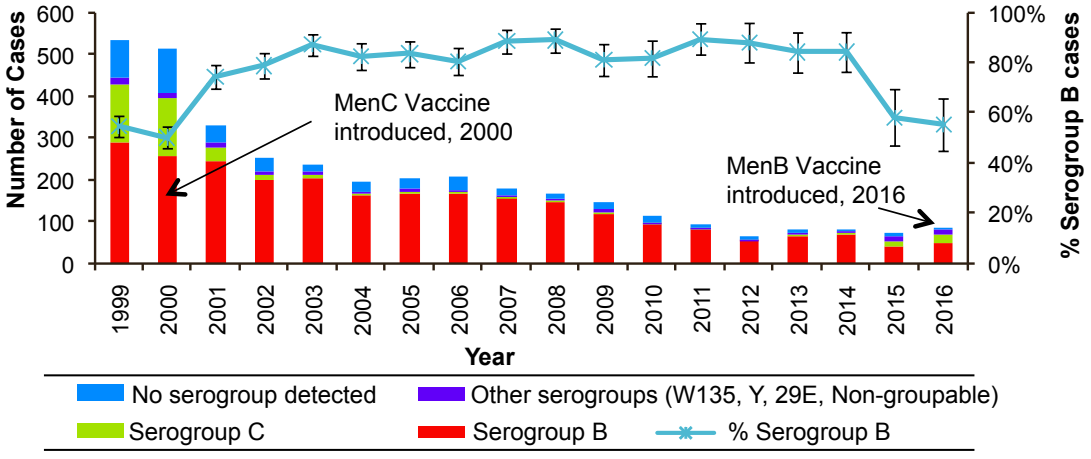

Figure 5. Number of IMD notifications in Ireland by serogroup and proportion of cases attributable to serogroup B with 95% confidence intervals, Ireland, 1999-2016

1.4 Mumps

Summary

Number of cases, 2016: 488
Number of cases, 2015: 2,014
Crude incidence rate, 2016: 10.2/100,000

There was a decrease in mumps in 2016 with 488 (10.2/100,000) mumps cases notified compared to 2015 when 2,014 cases were notified (figure 1). Sixty three percent (n=305) of the cases in 2016 were notified between January and May (figure 2).

In 2016, the largest number of cases was notified in the HSE E while the highest crude incidence rate was in the HSE S (table 1).

Of the 488 mumps cases notified 52% (n=252) were classified as confirmed, eight percent (n=41) as probable and 40% (n=195) were classified as possible.

The median age of cases was 22 years (mean age was 27 years) with cases ranging in age from one to 87 years (age was unknown for one case). The highest age specific incidence rates were in those aged 15-19 years and 20-24 years (figure 3). Fifty one per cent (n=247) of cases were female and 48% (n=235) were male while gender was not reported for one percent (n=6).

Mumps vaccine in Ireland is available as part of the combined measles mumps rubella (MMR) vaccine. In Ireland, vaccination with the first dose of MMR is routinely recommended at twelve months of age and the second dose at four to five years of age. A MMR vaccination campaign started in April 2009 for students in fourth, fifth and sixth year of second level schools. A MMR catch up campaign started during the academic year 2012/2013 and continued during the academic year 2013/2014 for children/students attending primary schools, second level schools and special schools and home-schooled students who had not completed (or were not sure they had) their two dose MMR

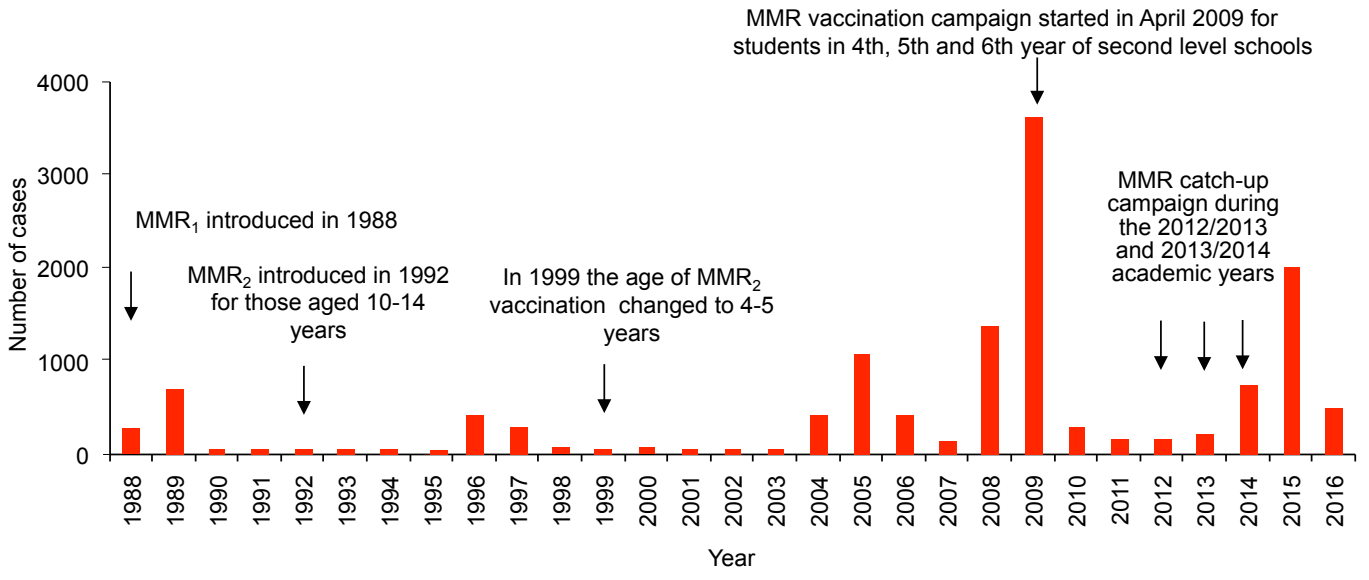

Figure 1. Number of mumps cases by year
A MMR catch-up campaign was conducted during the 2012/2013 and 2013/2014 academic years for children/students attending primary schools, second level schools and special schools and home-schooled students who had not completed (or were not sure they had) their two dose MMR vaccination schedule
MMR_1- first dose of MMR
MMR_2- second dose of MMR
1988-June 2000 data collated by DoHC
July 2000-2016 data collated by HPSC

vaccination schedule. Additionally, MMR vaccine continued to be recommended for students in college or universities if not previously vaccinated.

Of the 488 mumps cases, 11% (n=53) were unvaccinated, 11% (n=54) had one dose of MMR, 23% (n=111) were reported to have received two doses of MMR while for 55% (n=270) of cases the number of doses of MMR were not reported. The vaccination date was reported for 74% (n=40/54) of cases reported to have received one dose of MMR. Both vaccination dates were reported for 55% (n=61/111) of cases vaccinated with two doses of MMR. Forty per cent (n=44/111) of the cases reported to have received two doses of MMR were classified as confirmed; 45% (n=20/44) of these cases had both MMR vaccination dates reported.

The country of birth was recorded as Ireland for 15% (n=71) of cases, was recorded as being a country other than Ireland for 7% (n=32) of cases and was unknown or not specified for the remainder.

Twenty three cases were hospitalised, representing five per cent (n=23/488) of all cases and nine per cent (n=23/266) of cases where hospitalisation data was known. The number of days hospitalised was reported for five of the hospitalised cases; the median number of days hospitalised was two days (range two to five days).

The most commonly reported complications of mumps included orchitis (8%, n=8/99), pancreatitis (0.5%, n=1/185) and deafness (0.5%, n=1/185).

The setting where the case most likely acquired mumps was reported for 23% (n=111/488) of cases. The identified settings were: university/college (7%, n=36), social setting (6%, n=28), secondary school (5%, n=24), family/household (3%, n=14), work (1%, n=5), international travel (0.4%, n=2), day-care/pre-school (0.2%, n=1) and primary school (0.2%, n=1).

The probable countries of infection were recorded as Ireland (n=142), Spain (n=1), United Kingdom (n=1), Vietnam (n=1) and was unknown or not specified for the remainder.

Ten localised outbreaks of mumps were notified during 2016 with a total of 58 associated cases of illness. The outbreak locations included one university/college outbreak (with 31 ill), seven private houses (with 18 ill), one school outbreak (with 7 ill), and one outbreak reported as an outbreak among close social contacts (with two ill).

The figures presented in this summary are based on data extracted from the Computerised Infectious Disease Reporting (CIDR) system on 4th September 2017. These figures may differ slightly from those published previously due to ongoing updating of notification data on CIDR. The 2016 census data was used here to calculate rates.

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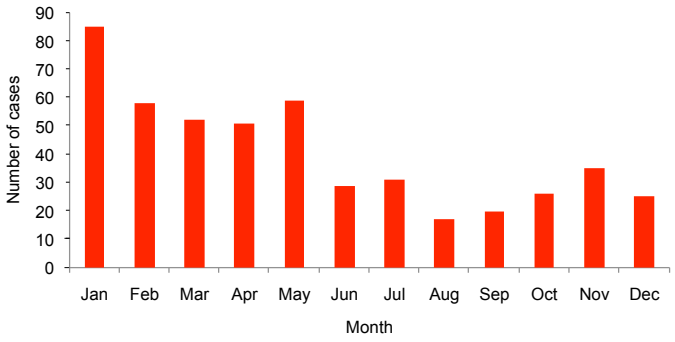

Figure 2. Number of mumps cases in 2016 by month

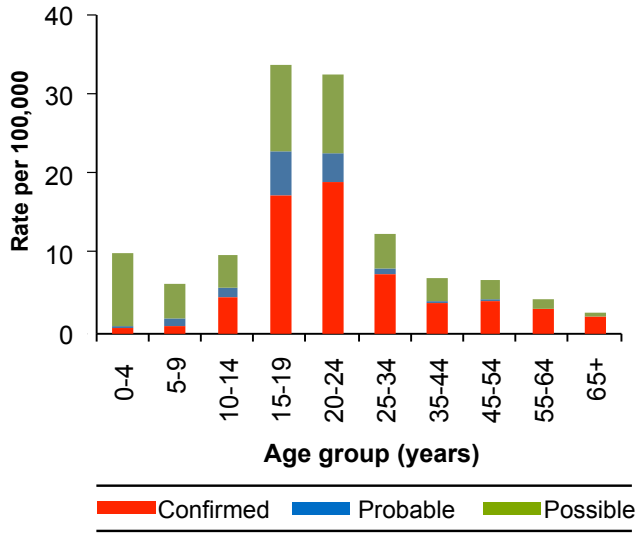

Figure 3. The age specific incidence rates (per 100,000 population) of mumps cases in 2016 by case classification

Table 1. Number of mumps cases and the crude incidence rate per 100,000 population (CIR) by HSE Area in 2016

HSE Area	Number	CIR
HSE E	140	8.2
HSE M	42	14.4
HSE MW	31	8.1
HSE NE	21	4.6
HSE NW	19	7.4
HSE SE	66	12.9
HSE S	111	16.1
HSE W	58	12.8
Total	**488**	**10.2**

1.5 Other forms of Bacterial Meningitis*
(*excluding meningococcal disease)

Summary

Number of cases, 2016: 15
Number of cases, 2015: 32
Number of cases, 2014: 23
Crude incidence rate, 2016: 0.31/100,000

Apart from *Neisseria meningitidis*, which is the most common cause of bacterial meningitis in Ireland, other pathogens cause this disease, including those caused by non-notifiable organisms. For information on invasive meningococcal disease (*Neisseria meningitidis*), see that chapter within this report. Information on bacterial meningitis caused by specified notifiable diseases is summarised below and further pathogen-specific data are available in the relevant chapter. The figures presented in this chapter are based on data extracted from the Computerised Infectious Disease Reporting (CIDR) system on 9th November, 2017. Census data from 2016 were used to calculate 2016 incidence rates. These figures may differ from those published previously due to on-going updating of notification data on CIDR.

Bacterial meningitis caused by diseases not otherwise specified (NOS):
In total, 15 cases of meningitis under this disease category were notified in 2016, none of whom died. Five each (33.3%) of the 15 cases were case classified as confirmed, probable and possible (Table 1). The causative pathogens were identified in five (33.3%) of cases (Table 2).

Prior to 1st January 2012, all cases of Group B streptococcus, also known as *S. agalactiae*, were notifiable under the 'Bacterial Meningitis (NOS)' disease category. In 2012, this changed when *Streptococcus agalactiae* in children < 90 days of age was notifiable in its own right, including those which were meningitis-related. This has meant that the overall number of bacterial meningitis (NOS) cases has, as a result, declined between 2012 and 2016 compared to previous years. In other words, without this change there would have been 27 extra cases reported under the bacterial meningitis (NOS) category between 2012 and 2016. Furthermore, there is evidence of an additional 54 possible meningitis-related cases of this disease in this same age group during this same five year period where *S. agalactiae* was either isolated from or detected in CSF specimens from patients that were not clinically categorised as having 'meningitis'. These 54 cases have been excluded from Table 3, which is a summary breakdown of all bacterial meningitis cases by their causative pathogen (both specified and not specified types except for meningococcal disease) between 2011 and 2016.
Among the bacterial meningitis (NOS) cases notified in 2016 were five caused by *Escherichia coli* (age range two weeks to 87 years; three were confirmed and none of which had serotype details reported). There were 10 other cases whose causative organism was not identified.

Bacterial meningitis caused by specified notifiable diseases: Haemophilus influenzae
One case of meningitis related *H. influenzae* was notified in 2016, aged 6-11 months old with a non-typeable/non-capsular strain. See Table 3 and the chapter on invasive *H. influenzae* disease for further details.

Listeria species
Four cases of listeriosis meningitis were notified in 2016 (age range 1 week to 74 years), none of whom died from their infections. All serotypes were identified, two were type 4b and one each of type 1/2a and 1/2b. Of the four cases, three had an underlying medical condition reported. See Table 3 and the chapter on listeriosis disease for further details.

Streptococcus pneumoniae
In 2016, 37 cases of pneumococcal meningitis were notified, compared to 32 in the previous year (Table 3). The median age was 56 years (range two months to 83 years). Five pneumococcal meningitis-related deaths were reported during 2016. Of the 37 cases, nine were vaccinated with either the PCV13 (three cases aged <10 years) or PPV23 vaccine (seven cases aged between 34-83 years), 19 were not vaccinated with either vaccine and nine had a vaccination status that was either unknown or not specified. Table 4

Table 1. Number and percentage of bacterial meningitis (NOS) cases reported by case classification, Ireland, 2011-2016

Case Classification	2011	2012	2013	2014	2015	2016	2011-2016
Confirmed	18	12	6	13	16	5	70
Probable	4	5	5	8	9	5	36
Possible	13	12	10	2	7	5	49
Total	35	29	21	23	32	15	155
% Confirmed	51.4%	41.4%	28.6%	56.5%	50.0%	33.3%	45.2%

Note: Meningitis related-Streptococcus agalactiae < 90 days of age excluded from 2012, 2013, 2014, 2015 and 2016 figures

Table 2. Number and percentage of bacterial meningitis (NOS) cases reported with and without an identified causative organism, Ireland, 2011-2016

Causative Organism	2011	2012	2013	2014	2015	2016	2011-2016
Known	20	11	6	13	17	5	72
Unknown/Not specified	15	18	15	10	15	10	83
Total	35	29	21	23	32	15	155
% Known	57.1%	37.9%	28.6%	56.5%	53.1%	33.3%	46.5%

Note: Meningitis related-Streptococcus agalactiae < 90 days of age excluded from 2012, 2013, 2014, 2015 and 2016 figures

Table 3. Annual notifications of bacterial meningitis (specified and NOS) except invasive meningococcal disease, Ireland, 2011-2016

Notified under	Causative organism	2011	2012	2013	2014	2015	2016	2011-2016
Haemophilus influenzae disease (invasive)	*Haemophilus influenzae*	4	3	2	7	5	1	**22**
Leptospirosis	*Leptospira* spp.	1	1	0	0	0	0	**2**
Listerosis	*Listeria* spp.	2	2	2	1	6	4	**17**
Streptococcus pneumoniae infection (invasive)	*Streptococcus pneumoniae*	23	37	33	39	32	37	**201**
Streptococcus Group A infection (invasive) (iGAS)	*Streptococcus pyogenes*	0	1	3	0	4	0	**8**
Streptococcus Group B infection (invasive) (Group B Strep) < 90 days of age	*Streptococcus agalactiae*†	NA	11	5	5	4	2	**27**
Tuberculosis*	*Mycobacterium* spp.*	2	3	3	1	2	0	**11**
Total Bacterial Meningitis, specified		**32**	**58**	**48**	**53**	**53**	**44**	**288**
Bacterial Meningitis, not otherwise specified	*Enterococcus faecium*	0	1	0	0	0	0	1
	Enterococcus spp	0	0	0	1	0	0	1
	Escherichia coli	1	7	4	8	15	5	40
	Group C Streptococcus	0	1	0	0	0	0	1
	Klebsiella oxytoca	1	0	0	0	0	0	1
	Klebsiella pneumoniae	0	0	0	1	0	0	1
	Micrococcus luteus	0	0	0	1	0	0	1
	Pasteurella multocida	0	0	0	0	1	0	1
	Staphylococcus aureus	2	1	0	0	1	0	4
	Staphylococcus aureus & *Staphylococcus capitis*	0	1	0	0	0	0	1
	*Streptococcus agalactiae***	16	0	1	1	0	0	18
	Streptococcus salivarius	0	0	1	0	0	0	1
	Streptococcus suis	0	0	0	1	0	0	1
	Unknown	1	2	2	1	4	3	13
	Not specified	14	16	13	9	11	7	70
Total Bacterial Meningitis, not otherwise specified		**35**	**29**	**21**	**23**	**32**	**15**	**155**
Total Bacterial Meningitis, specified and not otherwise specified		**67**	**87**	**69**	**76**	**85**	**59**	**443**

*Tuberculosis meningitis figure for 2016 is provisional
†*Streptococcus agalactiae* < 90 days of age in 2012 to 2016-these figures do not include 54 meningitis-related cases where the causative organism was isolated from or detected in CSF specimens from patients that were not clinically categorised as having 'meningitis'
***Streptococcus agalactiae* for all ages only in 2011 and for cases > 90 days of age only in 2012 to 2016
NA not applicable

presents the vaccination status, serotype and additional risk factor, if any, for each case. See chapter on pneumococcal disease for further details.

Streptococcus Group B infection (invasive) (Group B Strep) < 90 days of age

Two cases of *Streptococcus agalactiae* under 90 days of age were notified to CIDR during 2016, compared to four in 2015 (Table 3). Both cases in 2016 were male and one week old.

Table 4. Details of the 37 pneumococcal meningitis cases reported, Ireland, 2016

Age Group (years)	Died	Vaccination Status	No. of PCV13 / Prevenar 13 Doses	No. of PPV23 / Pneumovax 23 Doses	Serotype of Infection	Serotype Covered by Vaccine Type	Additional Risk Factors (excluding age 65+ years)
<1		N	0	0	38	Not covered	NA
		NA	NA	NA	NA	.	NA
1-4		Y	3	0	10A	PPV23	N
		Y	3	0	NA	.	N
5-9		Y	3	NA	NA	.	N
30-34		N	0	0	19A	PCV13, PPV23	Y
		Y	0	1	NA	.	Y
		Y	0	1	NA	.	Y
		N	0	0	6C	Not covered	Y
40-44		N	0	0	NA	.	N
		N	0	0	15C	Not covered	N
		NA	0	NA	19F	PCV13, PPV23	Y
45-49		N	0	0	3	PCV13, PPV23	N
		N	0	0	10A	PPV23	Y
55-59		NA	0	NA	12F	PPV23	N
		N	0	0	NA	.	Y
		N	0	0	15B/C	Undetermined	Y
		N	0	0	15B/C	Undetermined	Y
		N	0	0	9N	PPV23	Y
		NA	0	NA	11A	PPV23	Y
		N	0	0	20	PPV23	Y
		N	0	0	NA	.	N
		NA	0	NA	NA	.	Y
60-64		N	0	0	NA	.	N
		NA	NA	NA	15A	Not covered	N
	Died	N	0	0	NA	.	N
	Died	U	U	U	19A	PCV13, PPV23	N
	Died	NA	NA	NA	3	PCV13, PPV23	NA
		N	0	0	35B	Not covered	N
	Died	U	U	0	NA	.	Y
65+		N	0	0	NA	.	NA
		N	0	0	7F	PCV13, PPV23	Y
		Y	0	1	23B	Not covered	Y
		N	0	0	15B/C	Undetermined	Y
	Died	Y	0	1	12F	PPV23	Y
		Y	0	1	22F	PPV23	Y
		Y	0	1	11A	PPV23	Y

Vaccinated: Y=Yes, N=No; U=Unknown; NA=not applicable or not available

1.6 Pertussis

Summary

Number of cases, 2016: 213
Number of cases, 2015: 117
Crude incidence rate, 2016: 4.5/100,000

Pertussis increased 1.8 fold in 2016 compared to 2015 with 213 cases notified in 2016 (4.5/100,000) and 117 cases (2.5/100,000) notified in 2015 (figures 1 and 2).

Of the 213 cases in 2016, 79% (n=169) were classified as confirmed, seven percent (n=14) were classified as probable and 14% (n=30) were classified as possible.

The largest number of cases notified and the highest crude incidence rate was in the HSE E (table 1).

Fifty-four per cent of cases (n=114) were female and 46% (n=99) were male.

The largest number of cases and the highest age-specific incidence rate were in children aged less than one year followed by those in the age group 1-4 years (figures 3 and 4). Thirty five percent (n=74/213) of all cases were aged less than six months of age. Fourteen percent (n=30/213) of all cases were aged less than two months of age.

Maternal antibodies from women immunised before pregnancy wane quickly and the concentration of pertussis

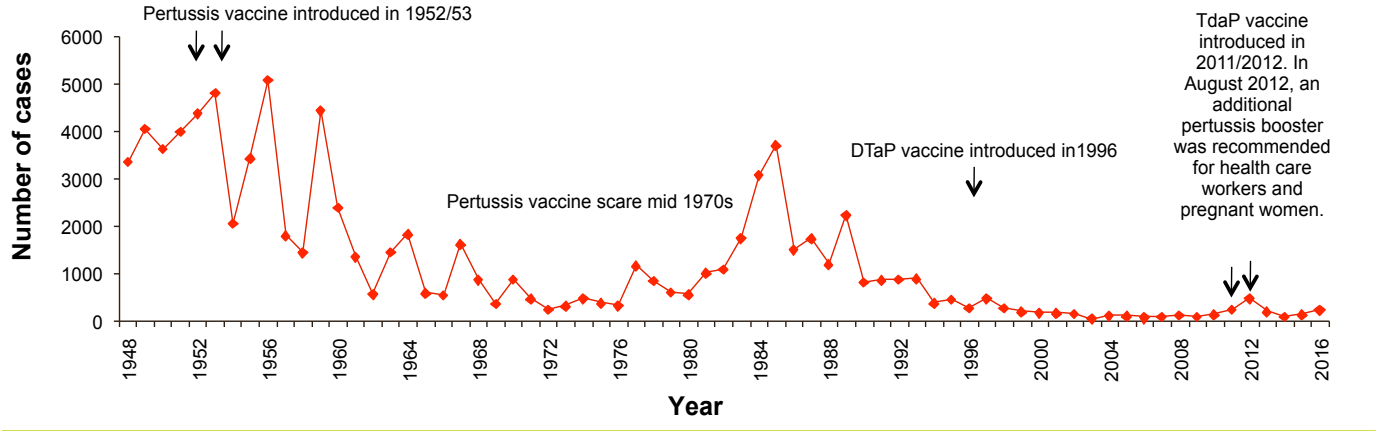

Figure 1. Number of notified pertussis cases in Ireland by year, 1948-2016
1948-June 2000 data collated by DoHC
July 2000-2016 data collated by HPSC

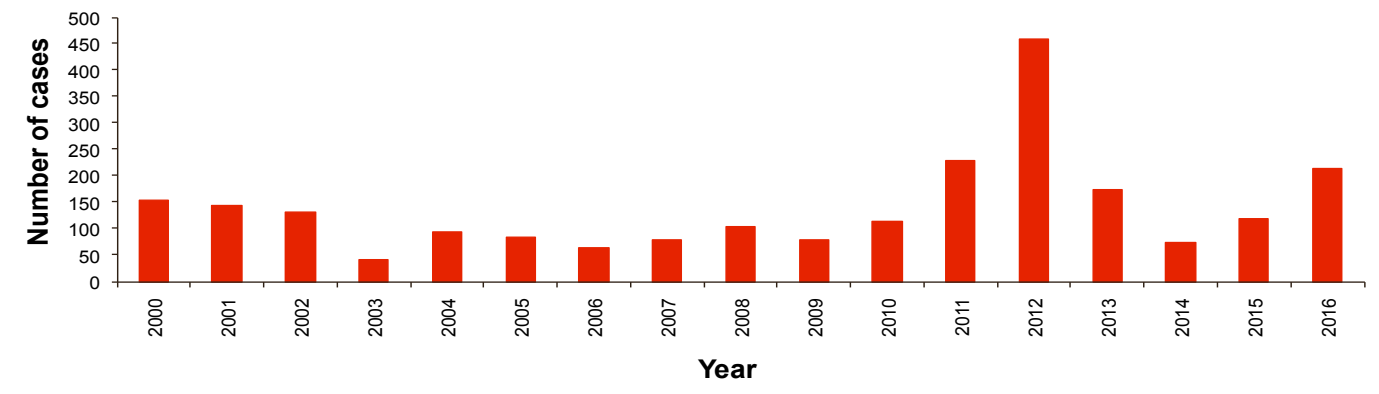

Figure 2. Number of notified pertussis cases in Ireland by year, 2000-2016

antibodies is unlikely to be high enough to provide passive protection to their infants prior to primary vaccination. The National Immunisation Advisory Committee (NIAC) has recommended that pregnant women should be offered tetanus and low dose diphtheria and acellular pertussis (Tdap) vaccine as early as possible after 16 weeks and up to 36 weeks gestation in each pregnancy, to protect themselves and their infant. Tdap can be given at any time in pregnancy after 36 weeks gestation although it may be less effective in providing passive protection to the infant. Tdap should be offered in the week after delivery to those women who were not vaccinated during their pregnancy.

In 2016, data on maternal antenatal vaccination status was provided for 74 children aged less than one year (88%, n=74/84). The mothers of 70 of these infant pertussis cases (83%, n=70/84) were unvaccinated during the antenatal period. Four of the mothers of the infant pertussis cases (5%, n=4/84) reported vaccination during the antenatal period; one was vaccinated at 27 weeks gestation, one at 34 weeks gestation, one at 38 weeks gestation while the number of weeks gestation at vaccination was unreported for the fourth case.

In Ireland, it is recommended that children be vaccinated with an acellular pertussis containing vaccine at two, four and six months of age and a booster dose at four to five years of age. In 2008, NIAC recommended a booster with low dose acellular pertussis vaccine for children aged 11-14 years. The adolescent pertussis booster was introduced into the school programme, in 19 LHOs, in 2011 and to all schools in 2012. In August 2012, an additional pertussis booster was recommended for health care workers and pregnant women; please see the HSE National Immunisation Office website at http://www.immunisation.ie for additional information on pertussis vaccination recommendations.

In 2016, the number of doses of pertussis vaccine the cases received was reported for 67% (n=142/213) of cases. Thirty seven per cent of cases (n=78/213) were unvaccinated; these cases ranged in age from one month to 81 years, with 73% (n=57/78) of these cases aged less than six months. Thirty six per cent of the unvaccinated cases (n=28/78) were less than two months of age and were therefore not eligible for pertussis vaccine in the Irish schedule.

Eight per cent (n=17/213) of cases were reported to have one dose of pertussis vaccine, these cases ranged in age from two months to five years. One per cent (n=3/213) had two doses of pertussis vaccine, these cases were six to 10 months of age. Fifteen per cent (n=31/213) had three doses of pertussis vaccine, these cases ranged in age from eight months to 15 years. Six per cent (n=12/213) had four doses of pertussis vaccine, these cases ranged in age from six to 16 years. One of the 213 cases had five doses of pertussis vaccine, this case was 16 years. Of the cases reported to have four or five doses of pertussis vaccine forty percent were classified as confirmed (n=5/13) and forty six percent (n=6/13) had four vaccine dates recorded.

Country of birth was reported as Ireland for 69 cases, a country other than Ireland for three cases, and was unknown or not specified for the remainder (n=141).

Where data were provided, reported symptoms included cough (98%, n=146/149), paroxysmal cough (92%, n=136/148), any inspiratory whoop (64%, n=86/134), post-tussive vomiting (54%, n=75/140), choking episodes in infant (44%, n=23/52), apnoea (30%, n=40/134) and cyanosis (27%, n=35/130). Where data were provided, reported complications included conjunctival haemorrhages, (7%, n=9/124), pneumonia (2%, n=3/133), acute encephalopathy (1%, n=1/134) and seizures (0.7%, n=1/135). One death was reported in a seven week old child; the child's mother was not vaccinated during pregnancy.

Table 1. Number of pertussis cases notified and the crude incidence rate per 100,000 population (CIR) by HSE Area in 2016

HSE Area	Number	CIR
HSE E	110	6.4
HSE M	6	2.1
HSE MW	3	0.8
HSE NE	12	2.6
HSE NW	5	1.9
HSE SE	29	5.7
HSE S	35	5.1
HSE W	13	2.9
Total	**213**	**4.5**

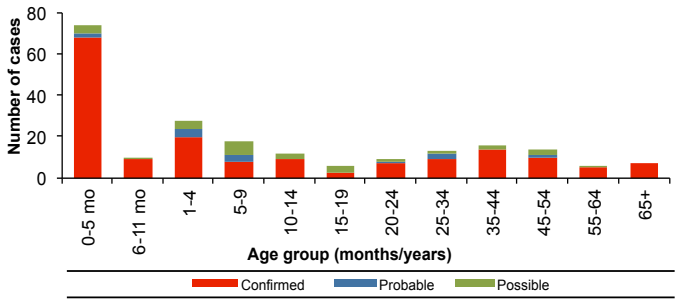

Figure 3. Number of notified pertussis cases in 2016 by age group and case classification.
'Mo' in graph indicates months ie 0-5 months and 6-11 months, the remaining age groups are in years

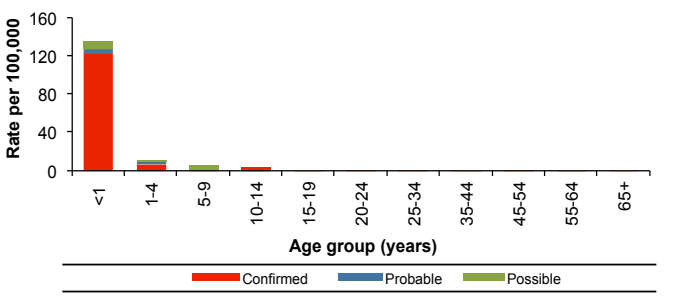

Figure 4. The age specific incidence rate (per 100,000 population) of notified pertussis cases in 2016 by case classification

Sixty four cases were hospitalised, representing 30% (n=64/213) of all cases and 41% (n=64/155) of cases where hospitalisation data was known. Eighty three per cent (n=53/64) of those hospitalised were aged less than one year and 33% (n=21/64) were less than two months of age.

Of the 213 cases, the likely setting of exposure to pertussis included home (21%, n=44), other family setting (2%, n=5), work (1%, n=2), school (0.5%, n=1), social setting (0.5%, n=1), and was unreported or not specified for the remainder (75%, n=160).

The likely source of exposure included sibling (8%, n=16), other relative (5%, n=10), mother (2%, n=5), father (1%, n=3), and was unknown or not specified for the remainder (84%, n=179).

Antibiotic usage was reported for 95% (n=145/153) of cases where this data was provided and for 68% of all cases (n=145/213). A second antibiotic was known to be given for 28% (n=40/145) of cases and known not to be given for 26% (n=37/145) of cases given a first antibiotic while this information was not provided for the remainder (47%, n=68/145).

Eleven localised pertussis outbreaks were notified during 2016, with 29 associated cases of illness. Nine outbreaks were associated with private houses, with 24 associated cases of illness, one was in a residential institution with three ill and one was at a scout event with two ill.

The figures presented in this summary are based on data extracted from the CIDR system on 24th August 2017. These figures may differ slightly from those published previously due to ongoing updating of notification data on CIDR. The 2016 census data was used here to calculate rates.

Acknowledgements
HPSC would like to thank all those who provided data for this report – Departments of Public Health, laboratories and clinicians.

1.7 Rubella

Summary

Number of cases, 2016: 1
Number of confirmed cases, 2016: 0

In 2016, one case (0.02/100,000) of rubella was notified in Ireland compared to two cases notified in 2015. The case in 2016 was in the age group <1 year and was classified as possible; unfortunately no samples for testing were obtained. These figures are based on data extracted from the Computerised Infectious Disease Reporting (CIDR) system on 25th July 2017. These figures may differ slightly from those published previously due to ongoing updating of data on CIDR.

WHO require information on discarded rubella cases ie rubella cases investigated and who were found not to meet the case definition. The HSE Areas reported the number of discarded CIDR cases to HPSC. For 2016, 14 cases were discarded from CIDR as following investigation they were not considered to be rubella cases. Discarded cases are not available in CIDR for reporting and are not included in the analysis above.

The Regional Verification Commission for Measles and Rubella Elimination (RVC) was established in the WHO European Region in 2011 to evaluate the documentation submitted by Member States with a view to verifying the elimination of measles and rubella at the regional level. The RVC has recommended establishment of national verification committees (NVC) in all Member States and suggested a standard format for annual status reports from countries. These reports include information on measles and rubella epidemiology, virologic surveillance supported by molecular epidemiology, the analysis of vaccinated population cohorts and the quality of surveillance, and the sustainability of the country's National Immunisation Programme. The review and evaluation of annual national reports will continue for at least three years after the RVC confirms that, according to established criteria, endemic measles and rubella transmission have been interrupted in all Member States of the Region. Only then can Regional elimination be declared.[1]

At the meetings of the European RVC for measles and rubella elimination, in October 2015, October 2016 and June 2017, the WHO European RVC concluded, that Ireland provided evidence for the elimination of rubella.[2,3,4]

Acknowledgements

HPSC would like to thank all those who provided data for this report – Departments of Public Health, laboratories and clinicians.

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1.8 *Streptococcus pneumoniae* (invasive)

Summary

Number of confirmed cases in 2016: 381
Number of confirmed cases in 2015: 368
Number of deaths in 2016: 48
Number of deaths in 2015: 37
Crude incidence rate of confirmed cases in 2016: 8.3/100,000

Background

Invasive *Streptococcus pneumoniae* infection is a notifiable disease in Ireland; clinicians and laboratories are legally obliged to notify this infection. For the purposes of this report the term invasive pneumococcal disease (IPD) will be used to describe these infections. IPD includes meningitis, bloodstream infection (BSI) with and without pneumonia, and invasive disease from other sterile sites.

Surveillance

A number of different initiatives are in place in Ireland for the surveillance of IPD. Data on IPD notifications are collated in the Computerised Infectious Disease Reporting (CIDR) system. Enhanced surveillance of IPD notifications is undertaken by Departments of Public Health. A separate surveillance strand (EARS-Net project) involving the microbiology laboratories and HPSC is used to monitor in detail the antimicrobial resistance profiles of invasive *S. pneumoniae* isolates from blood and/or CSF. EARS-Net laboratories can also collect additional information, including risk factors, admission and outcome for each patient notified with *S. pneumoniae* isolate. These data are collated by HPSC through the Enhanced Surveillance of Bloodstream Infection (ESBSI) system. In order to improve data quality, regular processes for cross-checking CIDR data with other data sources were established in 2012. To identify missing IPD notifications and/or missing information CIDR data were linked to both the typing and ESBI databases and additional information on either of these systems which is missing or incomplete in CIDR was collated.

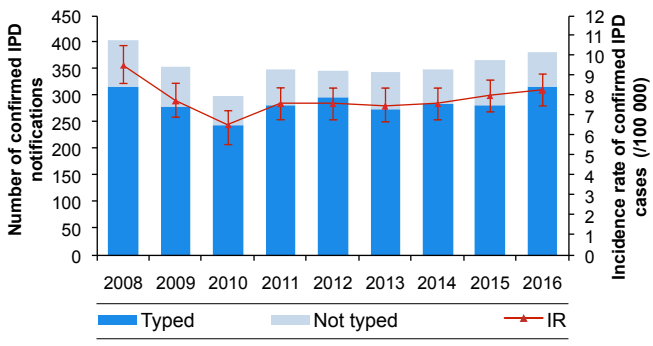

Figure 1. Number of confirmed invasive pneumococcal disease (IPD) notifications by typing status and the incidence rate (IR) of confirmed IPD with 95% confidence intervals, 2008-2016
Data source: CIDR

Since April 2007, the Irish Pneumococcal Reference Laboratory (IPRL) has provided a typing service to Irish laboratories for all invasive *S. pneumoniae* isolates. This is a collaborative project involving the Royal College of Surgeons in Ireland/Beaumont Hospital, the Children's University Hospital, Temple Street and HPSC. In addition, since August 2012 HPSC has participated in a European Centre for Disease Prevention and Control (ECDC) project called SpIDnet and since 2015 HPSC has joined the ECDC project I-MOVE+. Both projects aim to strengthen or set up long term active population-based IPD surveillance in order to estimate the direct and indirect impact of the pneumococcal conjugate vaccines (PCV) in all age groups: children less than five years of age, in those aged 5-64 years of age and in adults aged 65 and over in Europe. The I-Move+ study is now also studying the effectiveness of pneumococcal polysaccharide vaccine which offers protection against 23 serotypes (PPV23) and is recommended for those at risk of IPD and those older than 65 years. For more information please see following links to I-Move+: http://www.i-moveplus.eu/wp3 and SpIDnet (Epiconcept): http://www.epiconcept.fr/

Pneumococcal conjugated vaccine – use in national immunisation programme

In September 2008, the 7-valent pneumococcal conjugate vaccine (PCV7) was introduced into the Irish infant immunisation schedule at 2, 6 and 12 months of age. A catch-up campaign was also implemented at that time, targeting children <2 years of age. In December 2010, the 13-valent PCV vaccine (PCV13) replaced PCV7 in the infant schedule. Due to the introduction of Men B vaccine in to routine immunisation the third dose of PCV 13 was shifted to 13 months of age in December 2016 for children born on or after 1st October 2016. Uptake of three doses of PCV by 24 months of age for 2016 was 91%.

Definitions

In brief, isolation or detection of *S. pneumoniae* from a normally sterile site was classified as confirmed; detection of *S. pneumoniae* antigen from urine was classified as possible case. Since 2012, the previously used probable case definition is no longer applicable and any case in which *S. pneumoniae* antigen was detected from urine (previously defined as a probable case) was classified as possible, and antigen detection from a sterile site was categorised as confirmed. Since July 2015, the case definition of *S. pneumoniae* was amended and only those cases of IPD meeting the laboratory criteria for laboratory confirmed are now notifiable and urinary antigen detection (possible cases) are no longer notifiable.

PCV vaccine failure was defined as confirmed IPD case in a child caused by a PCV-serotype who has completed a PCV immunisation course appropriate for his age and disease onset is ≥ 14 days after last dose of PCV.

For this report notification data for IPD was extracted from CIDR on 3rd May 2017. These figures may differ slightly from those previously published due to ongoing updating of notification data on CIDR. For the 2012 - 2014 notifications, the 2012 HPSC case definition for IPD was used. For calculation of incidences 2011 CSO data were used.

Results

All IPD notifications

In 2016, 381 cases of IPD (8.3/100,000) were notified in Ireland, a decrease compared with 2015 (549 cases; 12.0/100,000). This decrease is related to an absence of possible cases notified in 2016 in comparison to 2015 due to case definition changes. Since July 2015 only confirmed cases have been notifiable. Consequently, in 2016 all notifications were classified as confirmed.

Confirmed IPD notifications

Focusing specifically on the confirmed IPD notifications only, 381 cases were notified in 2016 (8.3/100,000; 95% CI 7.5 - 9.1/100,000), a slight increase (not significant) in the number of cases compared with 2015 (8.0/100,000; 95% CI 7.2 - 8.8/100,000; 368 cases) (Figure 1). In 2016, the incidence of confirmed IPD decreased by 10% compared with 2008 (9.5/100,000; 95% CI 8.6 – 10.5/100,000; 404 cases; p<0.05) (Figure 1).

In 2016, 84% of the confirmed IPD notifications had an isolate submitted for serotyping, more than the proportion of cases in 2015 (77%), 2014 (81%), and 2008 and 2009 when 79% of notifications had an isolate typed. In 2012, 86% of all isolates were typed (Figure 1). In 2016, 40% of notifications (17/42) relating to children <5 years of age did not have an isolate submitted for serotyping. For six of the 17 cases IPD was confirmed by PCR only and no isolate was available. For the remaining eleven isolates (26%; 11/42) from a sterile site, no sample was available for typing.

During 2016, incidence rates by HSE area ranged from 6.1 per 100,000 (HSE W) to 10.2 per 100,000 (HSE SE,) (Figure 2). However, the incidence rates in each of the eight HSE areas were not statistically different from the national one.

In 2016, a clinical diagnosis was reported for 313 of the 381 confirmed cases (82%), which included BSI with pneumonia (n=222), meningitis (n=37), and other BSI for the remainder (n=54). This reflects an improvement in completeness of data provided in comparison to 2015 and 2014, when the clinical diagnosis was reported for 229 of the 368 (62%) and 168 of the 350 (48%) confirmed cases respectively, 20% more than in 2015 and 34% than in 2014.

More cases occurred in males (n=207, 54%) than in females. The median age of cases was 64 years (range 1 month to 94 years). Those aged 65 years and older accounted for half of the cases (49%, n=188). Within this age category the age specific incidence rate (ASIR) was highest in the oldest age groups; ≥85 years of age (75.3/100,000; n=44); 75-84 year age group (43.6/100,000; n=75); 65-74 year age group (22.3/100,000; n=68) (Figure 3). In children <2 years of age the ASIR was 17.2 cases per 100,000 population (n=26). A statistically significant decline (60%) in IPD incidence was seen in this age group when compared with 2008 (42/100,000; n=52; p<0.0001), highlighting the positive impact of the introduction of PCV7 and PCV13 in 2008 and 2010 respectively (Figure 3).

Medical risk factor for IPD was reported for 256 (67%) confirmed cases; 65 cases (17%) did not have an identified risk factor; for the remaining 60 cases this information was either unknown or not specified. The main medical risk factors reported included immunosuppressive condition or therapies (n=54; 21%), chronic lung disease (n=59; 41%), chronic heart disease (n=101; 39%), chronic liver disease

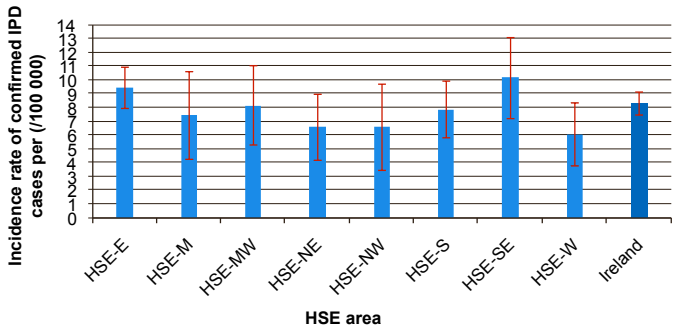

Figure 2. Crude incidence rate of confirmed invasive pneumococcal disease notifications by HSE area, 2016
Data source: CIDR

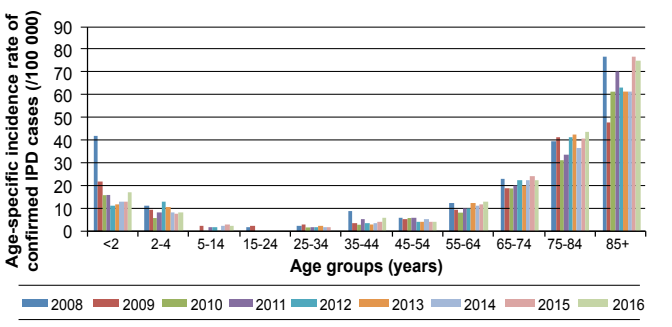

Figure 3. Age specific incidence rate of confirmed invasive pneumococcal disease notifications by age group, 2008-2016
Data source: CIDR

(n=21; 8%) and renal diseases (n=19; 7%). It should also be noted that being aged 65 years and older is also a recognised IPD risk factor; 188 (49%) cases in 2016 were in this age group, of whom 153 (81%) also reported a medical risk factor.

IPD death notifications

Outcome was reported in 85% (n=323) of the IPD notifications in 2016 versus 56% in 2015 and 39% in 2014. Among those whose outcome was reported, case fatality among IPD notifications was overall 18.8% (61/323); for 27 (8.3%) case-patients the cause of death was reported as directly due to IPD, in 13 case-patients it was not due to IPD and for the remaining 21, the cause of death was not specified or was unknown. Most of these deaths (60) occurred in adults (age range 36-94 years) and one in a child (<3 years of age). All deaths were in confirmed cases.

The increased completion in the reported outcome field since 2014 reflects improve enhanced data collection undertaken by the public health staff in the HSE areas as well as the input of a HPSC based research nurse who is funded by the EU projects (SpIDnet and IMOVE+). Additionally by linking CIDR data to the ESBI database it has been possible to identify missing outcome information in CIDR which can then be updated by HSE areas.

Impact of pneumococcal conjugate vaccines (PCV)

Serotyping data from the IPRL were used to assess the impact of the PCV programme on the distribution and burden of *S. pneumoniae* serotypes associated with IPD. In 2016, of the 381 confirmed IPD notifications reported in CIDR, 318 (84%) had isolates sent for serotyping; 4% of IPD infections were due to PCV7 serotypes (4, 6B, 9V, 14, 18C, 19F and 23F); 20% were associated with the six additional serotypes included in PCV13 (1, 3, 5, 6A, 7F and 19A); the remaining 76% of infections were due to non-vaccine types (NVTs).

Since introducing PCV7 to the Irish childhood immunisation schedule towards the end of 2008, there has been a substantial reduction in the overall burden of IPD disease. Reductions in the incidence of IPD due to PCV7 serotypes have been seen in all age groups (Figure 4a). Overall, the incidence of IPD due to PCV7 serotypes has significantly declined in 2016 compared with 2008 (90% decline, p<0. 001). The greatest impact has been seen in children <5 years of age where the incidence due to PCV7 serotypes has declined by 100% (p<0. 001) (Figure 4a). In 2016 the incidence of disease due to the additional six serotypes covered by the PCV13 declined by 90% in children <2 years of age compared with 2008 (Figure 4b). The decline was also observed in the other age groups with these additional six serotypes compared with 2008; however, this decline was not significant (Figure 4b). An increase in incidence due to NVTs was also seen in 2016 compared with 2008. In those aged <2 years and 65 years and older, an increase in incidence was observed in 2016 compared with 2015. There has been little change in the incidence of NVTs among other age groups (Figure 4c).

The predominant serotypes in circulation in 2016, were 8 and 12F (NVT), 19A and 3 (both included in PCV13), followed by serotypes 33F and 22F (both NVT). In children <5 years of age, the predominant serotypes were 19A and 3 (included in PCV13); 24F, 38, 33F, 35F and 23B (all NVTs). All these

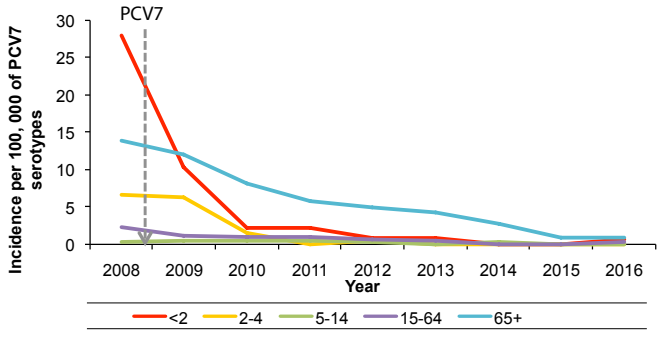

Figure 4a

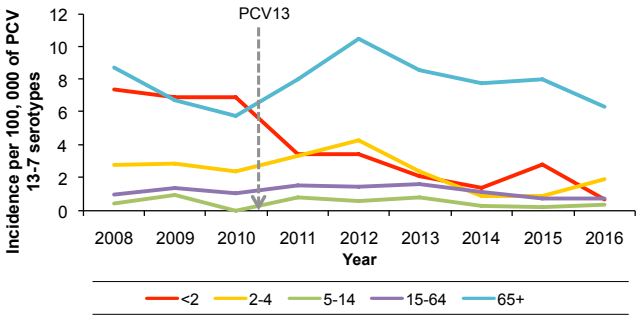

Figure 4b

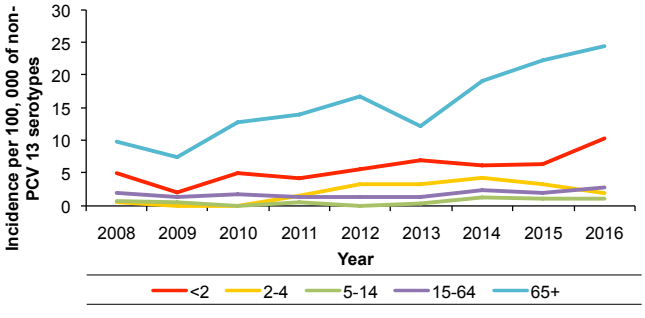

Figure 4c

Figure 4. Age specific incidence rate by age group of confirmed invasive pneumococcal disease cases due to (a) PCV7 serotypes, (b) the additional six serotypes covered by PCV13 and (c) non-vaccine types , 2008-2016.
Data source: Irish Pneumococcal Reference Laboratory

serotypes accounted for 69% of the isolates serotyped in this age group (Figure 5).

For ongoing updates, see "Slides – Impact of PCV in Ireland" at http://www.hpsc.ie/A-Z/VaccinePreventable/PneumococcalDisease/PostersPresentations/

PCV vaccine failures
Based on data obtained through the IPD enhanced surveillance system, two PCV vaccine failures were reported in 2016, one due to serotype 19A and one due to serotype 7F (both included in PCV 13). Since 2008, a total of 13 vaccine failures have been reported in addition to the two reported in 2016, two in 2015 (19A) two in 2014 (19A), three in 2013 (19A), two in 2012 (19F and 19A) and two in 2010 (19F and 14).

Penicillin non-susceptible *S. pneumoniae* (PNSP)
In 2016, the proportion of penicillin non-susceptible invasive *S. pneumoniae* (PNSP) was 16.5%, (0% and 16.5% with high and intermediate level resistance, respectively) while 13.2% of isolates were resistant to erythromycin (Data source: HPSC/EARS-Net Ireland). This compares to 17.5% and 15.2% in 2015, respectively. In 2016, the proportion of PNSP decreased slightly compared to 2015, and the overall trend for the past four years has been downward. In 2016, the proportion of *S. pneumoniae* with resistance to erythromycin decreased compared to 2015, and the overall trend for the past four years has been downward.

The predominant PNSP serotypes in 2016 were 8, 12F, 3 and 19A, whereas in 2008 serotypes 9V and 14 were the predominant serotypes associated with PNSP. For details on the antimicrobial resistance patterns of *S. pneumoniae*, please see the link on EARS-Net Report, Quarters 1-4 2016 https://www.hpsc.ie/a-z/microbiologyantimicrobialresistance/europeanantimicrobialresistancesurveillancesystemearss/earsssurveillancereports/2016reports/EARS-Net%20annual-quarterly%20data%20summary%20sheet_website_2016Q4.pdf

Laboratory survey
During 2016, in collaboration with the IPRL we undertook a survey of Irish clinical laboratories in relation to testing, diagnosis and notification of IPD in order to assess the quality and completeness of the national IPD surveillance programme.

Thirty-five of the 39 clinical microbiology laboratories participated (response rate 89.7%). Most laboratories (94%) had notification systems and processes in place to ensure that all IPD cases were notified. Most (91.4%) sent isolates to the IPRL for serotyping, with most (71.4%) sending isolates as soon as culture was positive. Based on the results of this survey it is evident that national IPD surveillance is comprehensive, however some potential gaps in notification and referral for serotyping were identified which will be addressed in 2017, with all laboratories encouraged to send isolates on a timely and regular basis to the IPRL.

Discussion
There was a slight increase (not significant) in the incidence of confirmed cases of IPD in Ireland in 2016 compared with 2015. Since its introduction in 2008, PCV7 has had a significant impact in reducing the overall burden of the disease in the total population. There has been a decline in IPD in all age groups due to serotypes covered by PCV7, indicating the indirect/herd immunity effect the vaccine confers on the population. The greatest impact has been in children <5 years of age where disease incidence due to PCV7 serotypes has fallen by 100%. The impact due to additional six serotypes covered by PCV13 vaccine was observed in children <2 years of age, amongst whom the reduction in the incidence of disease was 60%.

However, despite reductions in the IPD burden during childhood, the incidence of disease due to non-PCV7 serotypes has increased in other age groups. There has been a shift in the prevalent serotypes associated with invasive disease. Serotypes 8, 19A and 12F were the predominant serotypes identified in 2016.

Ireland's (HPSC's) participation in the EU funded projects, SpIDnet (since 2012) and I-Move+ (since 2015) is supporting efforts to strengthen IPD surveillance in Ireland. Through this project additional support for the collection of enhanced surveillance data that has been possible in a number of HSE regions. This has resulted in improved data collection for all cases (paediatric and adults). As a result, at national level it

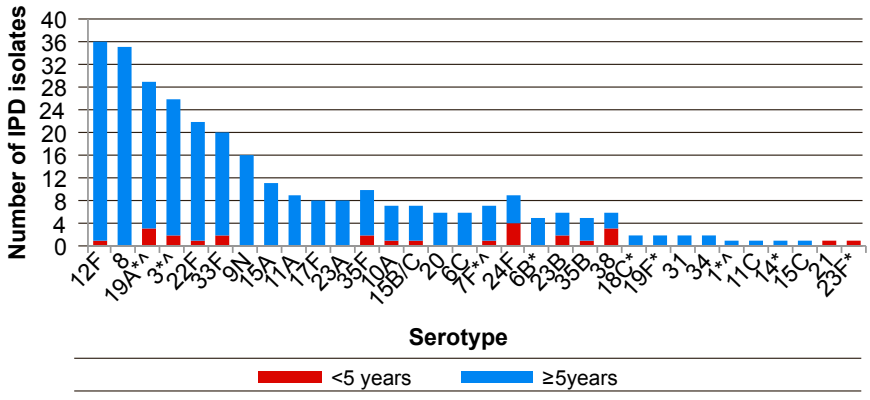

Figure 5. Serotype distribution of invasive Streptococcus pneumoniae isolates by age group (years) in Ireland, 2016
** Denotes serotypes included in PCV7*
**^ Denotes additional six serotypes included in PCV13 (PCV13-7)*
Data source: Irish Pneumococcal Reference Laboratory

is evident that a greater proportion of IPD notifications now have data on clinical presentation, risk factors, outcome and vaccination history.

To accurately assess the impact of PCV on immunisation programmes and to monitor for vaccine failures in Ireland, it is crucial that samples from sterile sites are obtained for culture and susceptibility. Isolates obtained by culture are required for serotyping and antibiotic susceptibility. Furthermore it is crucial that laboratories continue to send all invasive *S. pneumoniae* isolates for typing to the IPRL. Although 84% of confirmed notifications had an isolate submitted for serotyping in 2016, 16% (n=64) did not, including 17 cases in children <5 years of age. In six of these 17 cases, an isolate was not available for typing and confirmation was by PCR only. Serotype information is unavailable for 26% of confirmed notifications in this age group and the absence of this data is of concern.

Continued good quality IPD surveillance including the monitoring of invasive *S. pneumoniae* serotypes is crucial in identifying any epidemiological changes in the disease, in assessing the impact of PCV13 and PPV23 on public health and in guiding further vaccination strategies, including expanded valency vaccines.

1.9 Diphtheria

Summary

Number of cases, 2016: 1
Number of cases, 2015: 1

Diphtheria is an acute infectious disease affecting the upper respiratory tract and occasionally the skin. It is caused by toxigenic strains of *Corynebacterium diphtheriae*, an aerobic, pleomorphic, Gram-positive bacillus. Occasionally the disease may also be caused by *C.ulcerans or C.pseudotuberculosis*. Before introduction of immunisation, epidemics occurred every 10 years, with mortality rates of up to 50%. Effective protection against the disease is provided by active immunisation.

One case of non-fatal diphtheria was notified in 2016. The case, an unvaccinated male, aged 45-55 years was classified as confirmed. The case reported travel to an Asian country where there is a high incidence of diphtheria. *C. diphtheriae* (toxin producing) was isolated from a skin ulcer. The case did not develop any systemic complications associated with the disease but was hospitalised and treated for the illness.

The case that was reported in 2015 was female, aged 45-54 years, with no history of travel outside Ireland. This case presented with a skin wound that was culture positive for *C.ulcerans* (toxin producing). This latter case had an uncertain history of diphtheria vaccination. No epidemiological links to persons or animals with the organism could be identified for this case.

Summary of diphtheria epidemiology since 1948:
Since the 1940s the number of diphtheria cases has declined markedly, no cases were notified between 1968-2014 (Figure 1). In 2015 one case was notified, with another case notified in 2016 (Figure 2 shows data from 1963 to 2016).

Vaccination with five doses of diphtheria is recommended for all children and adolescents. The primary series (consisting of three doses of a diphtheria containing vaccine) is normally given in the first year of life. A booster is recommended at 4-5 years of age and another at 11-14 years of age. Almost 100% of vaccinated persons achieve protective antibody levels. However, immunity decreases with age and, with time since vaccination; over 50% may have insufficient protection 10 years after a booster diphtheria vaccine. Additional booster doses (as 'Tdap') may be given every 10 years for life.

For further information on diphtheria vaccination please see the HSE National Immunisation Office website at www.immunisation.ie.

The figures presented in this report are based on data extracted from the Computerised Infectious Disease Reporting (CIDR) system on 8th December, 2017.

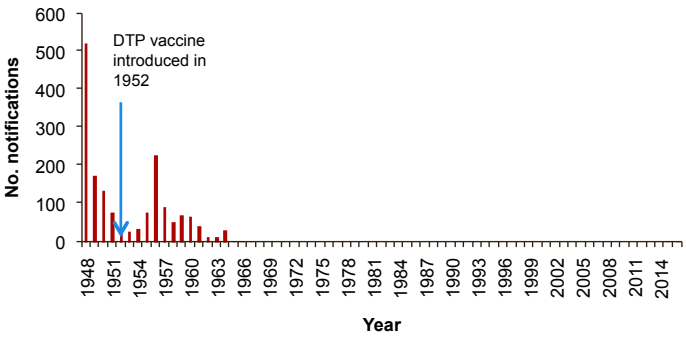

Figure 1. Diphtheria cases notified from 1948 to 2016

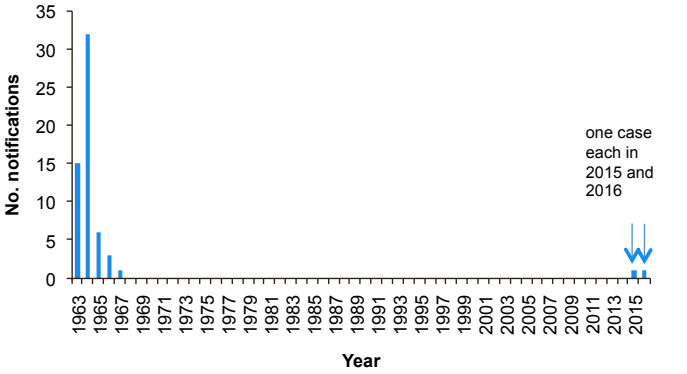

Figure 2. Diphtheria cases notified from 1963 to 2016

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ANNUAL
EPIDEMIOLOGICAL
REPORT

02

RESPIRATORY AND DIRECT CONTACT DISEASES

2.1 Influenza and other Seasonal Respiratory Viruses

2016/2017 influenza season summary:

Peak influenza-like illness rate: 90.4/100,000 population
Influenza predominant type/subtype: Influenza A(H3N2)
Confirmed influenza cases hospitalised: 1425
Confirmed influenza cases admitted to ICU: 51
Total notified influenza cases that died: 95
Excess mortality in those aged 65 years and older: Weeks 49 2016 - 4 2017
Number of acute respiratory infection/influenza outbreaks: 111

HPSC has worked in collaboration with the National Virus Reference Laboratory (NVRL), the Irish College of General Practitioners (ICGP) and the Departments of Public Health on the influenza sentinel surveillance project since 2000. During the 2016/2017 influenza season, 61 general practices (located in all HSE-Areas) were recruited to report electronically, on a weekly basis, the number of patients who consulted with influenza-like illness (ILI). Sentinel GPs send combined nose and throat swabs to the NVRL from ILI patients each week. The NVRL routinely test sentinel GP and non-sentinel respiratory specimens for influenza and a panel of other respiratory viruses.

Other surveillance systems set up to monitor ILI/influenza activity include:

- Surveillance of all calls to GP out-of-hours (OOHs) centres, monitored for self-reported influenza. These data were provided by HSE-NE.
- Surveillance of all confirmed influenza notifications, including hospitalisation status reported to the Computerised Infectious Disease Reporting System (CIDR) in Ireland
- Enhanced surveillance of hospitalised influenza cases aged 0-14 years
- Intensive Care Society of Ireland (ICSI) and the Critical Care Programme (CCP) enhanced surveillance of all critical care patients with confirmed influenza
- Surveillance of all reported influenza deaths
- All-cause excess mortality monitoring associated with the European mortality monitoring group (EuroMOMO)
- A network of sentinel hospitals reporting admissions data
- Acute respiratory infection and influenza outbreak surveillance
- Monitoring influenza vaccine effectiveness (I-MOVE study)

This report summarises influenza and other seasonal respiratory virus activity in Ireland during the 2016/2017 influenza season. The 2016/2017 season commenced on 3rd October 2016 (week 40 2016) and ended on 21st May 2017 (week 20 2017). The data presented in this summary were based on all data reported to HPSC by the 18th December 2017.

Sentinel GP Clinical Data

Influenza activity reported from the sentinel GP network in Ireland was at moderate intensity levels for all ages, and very high intensity levels for those aged 65 years and older during the 2016/2017 influenza season. Sentinel GP ILI consultation rates peaked at 90.4 per 100,000 population during week 1 2017 (the first week in January), the highest peak rate since the 2010/2011 season (figure 1). ILI rates first increased above baseline levels (18.3 per 100,000) during week 49 2016 and remained there for nine consecutive weeks, which is the average length of time above baseline in Ireland. ILI rates for all ages were above the medium intensity levels during weeks 1 and 2 2017 (figure 1). The highest age specific ILI rates were reported in those aged 65 years and older (peaking at 115.0/100,000), followed by the 15-64 year age group (peaking at 105.4/100,000). It is notable that the age specific rates in those aged 65 years and older were the highest ever reported and the peak rate during week 1 2017 exceeded the very high intensity threshold level for this age group.

Virological Data from National Virus Reference Laboratory (NVRL) – Influenza

Sentinel GP data: The NVRL tested 943 sentinel GP specimens for influenza virus during the 2016/2017 season. Four hundred and twenty (44.5%) sentinel specimens were positive for influenza: 407 influenza A (403 A(H3N2) and 4 A not subtyped) and 13 influenza B. There were no influenza A(H1N1)pdm09 influenza positive specimens detected by the sentinel GP network during the 2016/2017 season. Ninety seven percent of all confirmed influenza sentinel cases were positive for influenza A and 3% for influenza B. Of subtyped influenza A specimens, 100% were positive for influenza A(H3N2). Overall, 83% of ILI patients (with known vaccination status) were not vaccinated with the 2016/2017 influenza vaccine. Only three ILI patients were reported as having commenced antiviral treatment.

Non-sentinel data: The NVRL tested 11,245 non-sentinel respiratory specimens during the 2016/2017 season, 1429 (12.7%) of which were positive for influenza: 1361 influenza A (1304 A(H3N2), 5 A(H1N1)pdm09 and 52 A (not subtyped)) and 68 influenza B. Ninety-five percent of all confirmed influenza non-sentinel cases were positive for influenza A and 5% were positive for influenza B. Of subtyped influenza A specimens, 99.6% were positive for influenza A(H3N2).

Influenza A(H3N2) was the predominant influenza virus circulating during the 2016/2017 season. Influenza A accounted for 96% of all influenza positive specimens and influenza B for 4%. Of the 1712 influenza A sentinel and non-sentinel specimens that were subtyped, influenza A(H3N2) accounted for 99.7% and influenza A(H1N1)pdm09 for 0.3%. In total 1707 positive influenza A(H3N2) specimens were detected by the NVRL during the 2016/2017 season, this is the highest number of A(H3N2) viruses detected since this surveillance system began in 2000. Influenza positive specimens peaked during week 1 2017, with a total of 353 influenza positive specimens taken from patients during this week.

Influenza Virus Characterisation:
For the 2016/2017 influenza season, genetic characterisation of influenza viruses circulating in Ireland was carried out by the NVRL, on 117 influenza A(H3N2), one influenza A(H1N1)pdm09 and eight influenza B positive specimens. The majority of A(H3N2) viruses (72%, n=84/117) clustered in the genetic subclade 3C.2a1, a group represented by A/Bolzano/7/2016 and characterised by the hemagglutinin amino acid mutation N171K, often with N121K. Group 3C.2a1 was the dominant strain in Europe during the 2016/2017 season. Antigenic characterisation confirmed that these viruses were antigenically similar to the 2016/2017 vaccine strain, 3C.2a. Of particular interest in Ireland, 14.5% (17/117) of characterised A(H3N2) viruses clustered within the genetic subgroup 3C.3a, represented by A/Switzerland/9715293/2013 (the strain included in the 2015/2016 Northern Hemisphere vaccine), and had amino acid substitutions Q197K, S198P and S312N in HA1 antigenic sites B and C. 3C.3a viruses were rarely idenitfied elsewhere in Europe during the 2016/2017 season, representing less than 1% of circulating A(H3N2) viruses characterised. A further 16 A(H3N2) viruses (16/117; 14%) fell in the 2016/2017 vaccine component clade 3C.2a, represented by A/Hong Kong/4801/2014, the strain also recommended for the 2017/2018 vaccine. The 3C.2a viruses detected in Ireland fell into two clusters – one associated with N144K and one with R261Q. Influenza A(H1N1)pdm09 was infrequently detected in Ireland during the 2016/2017 season. One A(H1N1)pdm09 virus was characterised and belonged to the 6B.1 genetic clade, represented by A/Michigan/45/2015. Antigenic characterisation data has found this group to be antigenically indistinguishable from the 2016/2017 vaccine strain. The A/Michigan/45/2015 virus was selected for inclusion in the 2017/2018 Northern Hemisphere vaccine. Eight influenza B viruses were genetically characterised,

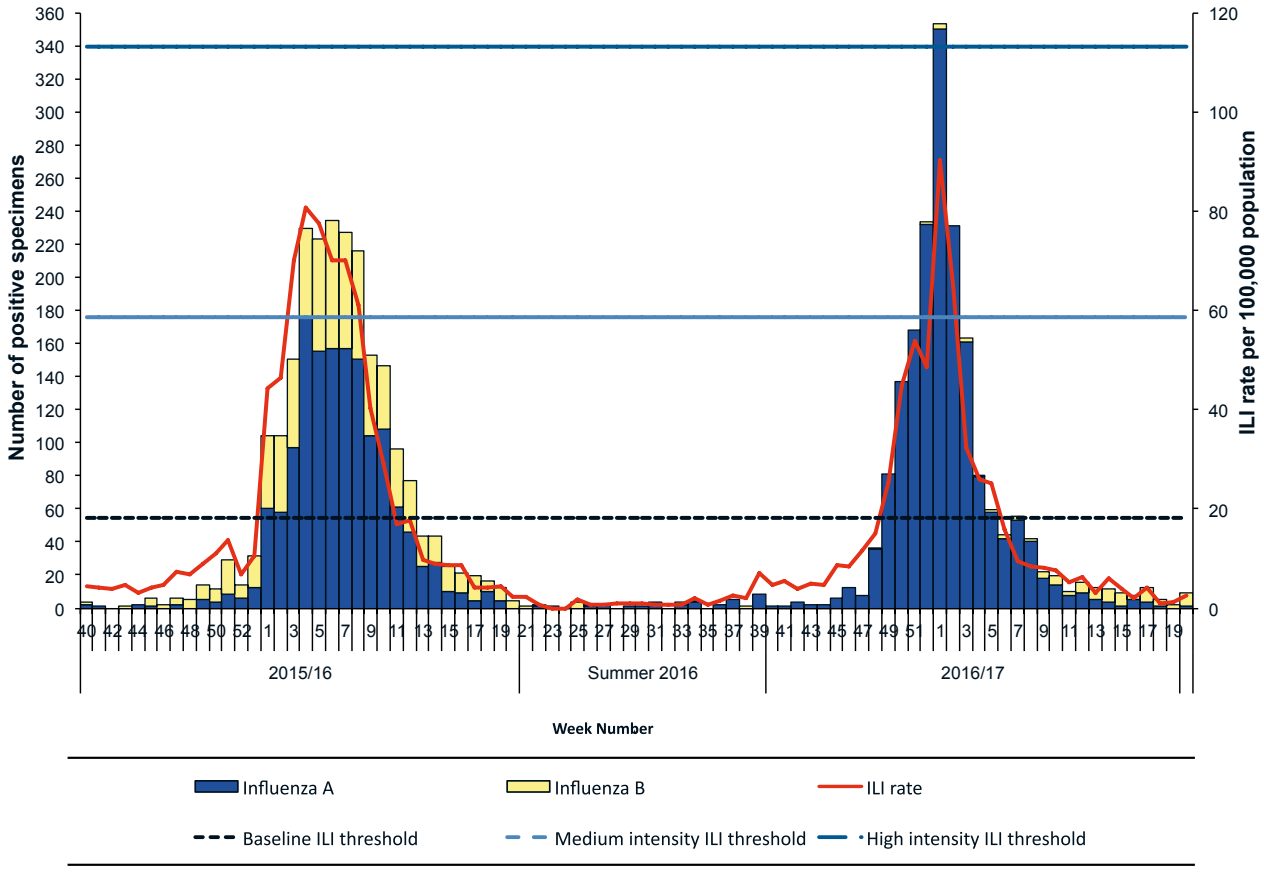

Figure 1: ILI sentinel GP consultation rates per 100,000 population, baseline ILI threshold, medium and high intensity ILI thresholds[1] and number of positive influenza A and B specimens tested by the NVRL, by influenza week and season. Source: Clinical ILI data from ICGP and virological data from the NVRL.

1 For further information on the Moving Epidemic Method (MEM) to calculate ILI thresholds: http://www.ncbi.nlm.nih.gov/pubmed/22897919

seven of which were B/Yamagata lineage viruses and one belonged to the B/Victoria lineage. All B/Yamagata viruses clustered in clade 3 represented by B/Phuket/3073/2013. The influenza B/Victoria lineage virus fell into the 1A group represented by B/Brisbane/60/2008, the virus recommended for the 2017/2018 vaccine. http://www.who.int/influenza/vaccines/virus/recommendations/en/

Virological Data from NVRL - Other seasonal respiratory viruses

During the 2016/2017 season respiratory syncytial virus (RSV) was at very high levels, with 1228 (10.9%) positive detections reported from non-sentinel sources, peaking during mid-December 2016. High levels of adenovirus (n=336; 3.0%), human metapneumovirus (hMPV) (n=345; 3.1%) and parainfluenza virus (PIV) type 3 (n=273; 2.4%) were also reported during the 2016/2017 season. In addition, 64 PIV-4, 24 PIV-2 and seven PIV-1 positive detections were reported during the season. RSV, adenovirus, hMPV and PIV-3 positive detections reached the highest numbers ever reported by the NVRL for any season.

Of the 943 sentinel GP specimens tested during the 2016/2017 season, 45 (4.8%) were positive for RSV, 32 (3.4%) hMPV, 15 (1.6%) adenovirus, 10 (1.1%) PIV-3, four (0.4%) PIV-2 and four (0.4%) PIV-4. There were no positive detections of PIV-1 from sentinel GP sources during the 2016/2017 season.

The total number of sentinel GP and non-sentinel specimens positive for seasonal respiratory viruses (including influenza, RSV, adenovirus, hMPV and parainfluenza virus types 1-4) peaked during week 1 2017 at 457. It should be noted that these data reported from the NVRL are analysed by the date the specimens were taken from patients.

Outbreaks

For the 2016/2017 season, 111 acute respiratory infection (ARI) and influenza outbreaks were notified to HPSC, 66 of which were associated with influenza A, four associated with influenza B, 21 with influenza (type/subtype not reported), four associated with RSV, two with human metapneumovirus (hMPV), one with parainfluenza virus and 13 ARI outbreaks with no pathogens identified. Of the 91 influenza outbreaks reported during the 2016/2017 season, the majority were in residential care facilities/community hospitals, mainly associated with influenza A and affecting those aged 65 years and older. All influenza A subtyped outbreaks were associated with influenza A(H3N2). The majority of outbreaks were notified from HSE-east and –south, table 1. Seventy-nine influenza outbreaks were reported from residential care facilities/community hospitals, 11 from acute hospital settings and one outbreak occurred on a coach tour. In total 35 deaths were recorded associated with these 91 influenza outbreaks. For all ARI and influenza outbreaks, vaccination status was reported for patients from nine residential care/healthcare facilities, with over 79% (296/374) of patients vaccinated prior to these outbreaks. Vaccination status was reported for staff from only six residential care/healthcare facilities, with only 17% (53/309) of staff reported as vaccinated prior to these outbreaks.Further information on influenza vaccine uptake is detailed in the Immunisation uptake chapter of the HPSC Annual Epidemiological Report, 2016.

GP Out-Of-Hours (OOHs)

The percentage of influenza-related calls to GP out-of-hours services in Ireland, peaked during week 1 2017 at 7.7%, coinciding with the peak in sentinel GP ILI consultation rates. The peak in influenza-related calls was the highest peak since the 2010/11 season. During the peak of activity, each service received on average 2.3 calls per hour relating to influenza.

Sentinel hospital admissions

Hospital respiratory admissions reported from a network of sentinel hospitals during the 2016/2017 season, peaked at 599 during week 52 2016. This is the highest peak level in recent years. The peak coincided with high levels of influenza activity. Total emergency admissions reported from sentinel hospitals peaked during weeks 47 (n=3056) and 48 (n=3050) 2016, coinciding with peak RSV activity and elevated influenza activity.

Influenza and RSV notifications

A total of 3336 influenza notifications were reported on Ireland's Computerised Infectious Disease Reporting System (CIDR) during the 2016/2017 influenza season; less than the 2015/2016 season (n=4252). Of the 3336 notifications, 3299 were reported as confirmed cases, 16 probable cases and 21 possible cases. Of the 3299 confirmed influenza cases, 1632 (49.5%) were positive for influenza A(H3N2), 7 (0.2%) influenza A(H1N1)pdm09, 1514 (45.9%) influenza A (not subtyped), 138 (4.2%) influenza B and 8 (0.2%) were notified with influenza type/subtype not recorded. Of the 1639 confirmed influenza A cases subtyped, 99.6% were influenza A(H3N2). A total of 2583 RSV notifications were reported to HPSC during the 2016/2017 season; the highest number of RSV notifications reported since RSV was made notifiable in 2012.

Table 1: Number of influenza outbreaks by HSE-Area for the 2016/2017 influenza season (n=91).

HSE-Area	No. of outbreaks	Total number ill	Total number lab confirmed	Total number hospitalised	Total number dead
HSE-E	26	241	69	28	4
HSE-M	5	63	22	3	4
HSE-MW	10	134	32	18	3
HSE-NE	8	98	31	7	1
HSE-NW	8	107	29	8	3
HSE-SE	7	121	33	17	6
HSE-S	22	354	42	14	10
HSE-W	5	39	22	25	4
Total	**91**	**1157**	**280**	**120**	**35**

Confirmed influenza cases hospitalised
During the 2016/2017 season, 1425 confirmed influenza cases (30/100,000 population) were reported as hospitalised; 43% of all confirmed influenza notified cases. The highest age specific rates in hospitalised cases for the 2016/2017 season were in those aged less than one year of age (n=74; 118.9 per 100,000 population) and those aged 65 years and older (n=699; 109.6 per 100,000 population) (table 2). The age specific rates in those aged 65 years and older were at the highest rate ever recorded in this age group, with 46% (319/699) of cases in this age group notified in the first two weeks of January. Of the 1425 hospitalised cases, 1361 (95.5%) were confirmed influenza A cases, 59 (4.1%) were influenza B cases and five (0.4%) influenza cases were notified with no influenza type/subtype recorded. Of the 567 subtyped influenza A cases, 99.5% were influenza A(H3N2) and only 0.5% were influenza A(H1N1)pdm09. Further data on confirmed influenza hospitalised cases for are detailed in tables 1-4.

Enhanced surveillance hospital data on 0-14 year age group
A total of 470 confirmed influenza cases aged between 0 and 14 years were notified on CIDR for the 2016/2017 influenza season, 268 (57%) of these cases were hospitalised. Over 95% (n=255) of hospitalised cases were positive for influenza A [118 A(H3N2) and 137 A (not subtyped)] and 5% (n=13) were positive for influenza B. The median age of cases was 2 years. Over 69% of cases were aged between 0 and 4 years, with 27% of cases aged less than one year. The most frequently reported symptoms included: fever (92.7%), cough (87.3%) and fatigue (70%). The most frequently reported complications included primary influenza viral pneumonia, secondary bacterial pneumonia, and other respiratory complications. The median length of stay in hospital was 2 days (ranging from 1 - 28 days). Approximately, 49% of hospitalised cases in this age group were reported as belonging to a risk group for influenza, with chronic respiratory disease (including asthma) being the most frequently reported risk group. Of the 84 cases with reported underlying medical conditions and known vaccination status, 88% were *not* vaccinated. Approximately, 45% of cases (81/182) commenced antiviral treatment. Additional surveillance data on paediatric cases admitted to critical care units are detailed below.

Confirmed influenza cases admitted to ICU
Of the 1425 hospitalised confirmed influenza cases reported during the 2016/2017 influenza season, 51 (4%) were admitted to critical care units (37 adults and 14 paediatric cases). Of the 51 critical care cases, 23 (45.1%) were infected with influenza A(H3N2), 22 (43.1%) with influenza A (not subtyped) and 6 (11.8%) with influenza B. No influenza A(H1N1)pdm09 critical care cases were notified during the 2016/17 season. Age specific rates for patients admitted to critical care units were highest in those aged 65 years and over (4.5 per 100,000 population) (table 2). The overall median age of all cases was 67 years. Underlying medical conditions were reported for 33 adults. The most frequently reported underlying medical conditions for adults were chronic heart disease (23/33, 69.7%) and chronic respiratory disease (18/33, 54.5%). No adult cases were reported as pregnant. Nineteen (51%) adult cases were reported as current/former smokers and two (5%) adult cases were reported to have alcohol related disease. Six paediatric cases were reported to have the following underlying medical conditions: neurological/neuromuscular, respiratory, cardiovascular and metabolic conditions. Thirty-three adult and six paediatric cases were ventilated during their stay in critical care units. The median length of stay in critical care for adult cases was 5 days and for paediatric cases 3 days. Of the 24 adult cases with known vaccination status, 58% were *not* vaccinated. Of the 12 paediatric cases with known vaccination status, 92% were *not* vaccinated. Eighty-four percent of all cases were reported to have received antiviral therapy. Seventeen adult (17/37; 46%) and three paediatric (3/14; 21%) cases admitted to critical care units during the 2016/2017 season died, giving a case fatality rate of 39%.

Mortality data
During the 2016/2017 influenza season, of the 3336 influenza cases notified, 95 (2.9%) cases were reported as having died. The case classification was confirmed for 87 of these cases, probable for one case and possible for seven cases. Of the 87 cases with known virology, 46 were associated with influenza A(H3N2), 36 with influenza A (not subtyped), one with influenza B and four with influenza type/subtype not recorded. No influenza A(H1N1)pdm09 associated deaths were reported. Influenza was reported as a cause of death (either on the death certificate or by the physician) for 68 cases. The median age of cases who died during the 2016/2017 influenza season was 80 years (interquartile range: 73-87). Cumulative excess all-cause mortality was reported in those aged 65 years and older for

Table 2: Age specific rate for confirmed influenza cases hospitalised and admitted to critical care during the 2016/2017 influenza season. Age specific rates are based on the 2016 CSO census.

	Hospitalised		Admitted to ICU	
Age (years)	**Number**	**Age specific rate per 100,000 pop.**	**Number**	**Age specific rate per 100,000 pop.**
<1	74	118.9	2	3.2
1-4	111	41.2	6	2.2
5-14	83	12.3	5	0.7
15-24	54	9.4	1	0.2
25-34	106	16.1	1	0.2
35-44	82	12.4	1	0.1
45-54	88	14.1	1	0.2
55-64	126	24.8	5	1.0
≥65	699	109.6	29	4.5
Unknown	2	–	0	–
Total	**1425**	**29.9**	**51**	**1.1**

eight consecutive weeks between weeks 49 2016 and 4 2017, reaching higher levels than previously recorded.

Summary tables of confirmed influenza hospitalised and critical care cases and notified influenza-associated deaths for all ages are detailed in 2-5.

Overview of the 2016/2017 season

In Ireland, the 2016/2017 influenza season commenced and peaked earlier than usual, with a peak in the first week in January. The season was characterised by almost complete predominance of influenza A(H3N2), which resulted in higher incidence of severe disease for those aged 65 years and older. The impact of influenza during the 2016/2017 season resulted in high hospitalisation rates in older age groups, an older median age of hospitalisation and admission to critical care units, a large number of outbreaks in residential care facilities and excess mortality in older age groups. This is in contrast to the 2015/2016 influenza season, when influenza A(H1N1)pdm09 predominated and mainly affected younger age groups.

Sentinel GP ILI consultation rates were above baseline levels for nine consecutive weeks during the 2016/2017 season, which is the average length of time ILI rates remain above baseline in Ireland. ILI rates were at the highest levels reported since the 2010/2011 season, with rates in those aged 65 years and older exceeding the very high intensity level threshold for this age group for the first time since surveillance began in 2000. The NVRL reported the highest number of influenza A(H3N2) viruses detected since surveillance began in 2000. Very high levels of RSV and high levels of adenovirus, human metapneumovirus and parainfluenza virus type 3 were also observed during the 2016/2017 season, compared to recent seasons.

The vast majority of influenza A(H3N2) viruses circulating in Ireland and Europe during the 2016/2017 season, belonged to the genetic subclade, 3C.2a1, a subclade that remained antigenically similar to the 2016/2017 vaccine strain, 3C.2a. Both the vaccine clade (3C.2a) and subclade (3C.2a1) are rapidly evolving and require close monitoring. For the 2017/2018 influenza season in the northern hemisphere, WHO recommended trivalent influenza vaccines contain the following strains: an A/Michigan/45/2015 (H1N1)pdm09-like virus; an A/Hong Kong/4801/2014 (H3N2)-like virus; and a B/Brisbane/60/2008-like virus (B/Victoria lineage).[2]

The number of influenza outbreaks reported during the 2016/2017 season was at the highest level recorded since

Table 3: Summary table of confirmed influenza cases hospitalised for all ages by influenza season: 2009/10-2016/17. Rates for 2009/10-2013/14 are based on the 2011 CSO census; rates for 2014/15-2016/17 are based on the 2016 CSO census.

	Hospitalised							
Season	**2009 pdm period**	**2010/11**	**2011/12**	**2012/13**	**2013/14**	**2014/15**	**2015/16**	**2016/17**
Predominant flu type	AH1pdm09	AH1pdm09; B	AH3	B; AH3 & AH1pdm09	AH3; AH1pdm09	AH3; B	AH1pdm09; B	AH3
Total cases	1059	968	147	469	693	1009	1856	1425
Crude rate /100,000	23.1	21.1	3.2	10.2	15.1	21.2	39.0	29.9
Median age (years)	17	29	27	32	51	59	30	67
Females	50%	55%	56%	57%	57%	53%	53%	52%
Total deaths - all causes	25	42	6	22	34	47	75	67
Case fatality rate	2%	4%	4%	5%	5%	5%	4%	5%

Table 4: Summary table of confirmed influenza cases admitted to critical care units for all ages by influenza season: 2009/10-2016/17. Rates for 2009/10-2013/14 are based on the 2011 CSO census; rates for 2014/15-2016/17 are based on the 2016 CSO census.

	Admitted to ICU							
Season	**2009 pdm period**	**2010/11**	**2011/12**	**2012/13**	**2013/14**	**2014/15**	**2015/16**	**2016/17**
Predominant flu type	AH1pdm09	AH1pdm09; B	AH3	B; AH3 & AH1pdm09	AH3; AH1pdm09	AH3; B	AH1pdm09; B	**AH3**
Total cases	100	121	15	39	83	69	161	**51**
Crude rate /100,000	2.2	2.6	0.3	0.8	1.8	1.4	3.4	**1.1**
Median age (years)	34	49	60	39	50	63	51	**67**
Females	50%	53%	80%	49%	41%	41%	42%	**33%**
Pregnant/postpartum (No.)	8	8	0	4	4	1	5	**0**
Cases with co-morbidities	82%	74%	93%	90%	85%	86%	83%	**93%**
% Vaccinated	NA	17%	-	-	32%	47%	18%	**31%**
Antiviral treatment	NA	NA	86%	88%	90%	83%	94%	**84%**
ICU: Hospital ratio	9%	13%	10%	8%	12%	7%	9%	**4%**
ICU Median LOS - Adult	12	14	5	9	9	9	9	**5**
ICU Median LOS - Paediatric	8	7	3	5	8	3	5	**3**
Mechanical ventilation (%)	86%	90%	77%	91%	94%	93%	92%	**98%**
ECMO (No.)	5	10	0	0	2	1	11	**0**
Total deaths - all causes	18	35	5	11	27	23	47	**20**
Case fatality rate	18%	29%	33%	28%	33%	33%	29%	**39%**

the 2009 pandemic. The majority of these outbreaks were caused by influenza A and mainly affected the elderly in residential care facilities. Reported influenza vaccination status of patients/clients in these outbreaks was high, whilst vaccination status of staff was low, highlighting the need to improve influenza vaccine uptake amongst health-care workers in order to reduce influenza-related morbidity and mortality. Further information on seasonal influenza vaccine uptake in hospitals and long term care facilities is available in the Immunisation uptake chapter of the HPSC Annual Epidemiological Report, 2016.

Excess all-cause mortality was reported in Ireland during the 2016/2017 season, with higher excess deaths than previously recorded among those aged 65 years and older, over 8 consecutive weeks, from early December 2016 to late-January 2017. Excess all-cause mortality in older age groups was also reported throughout Europe during the 2016/2017 season.[1]

The Irish overall adjusted influenza vaccine effectiveness (VE) estimates in preventing influenza confirmed infection in primary care during the 2016/2017 season for all influenza, influenza A(H3N2) and for all influenza in at risk groups were at moderate levels.

For the 2017/2018 season, existing surveillance systems in Ireland are being further strengthened. HPSC are currently reviewing severe influenza surveillance systems, with a view to improving their efficiency and reporting. A severe influenza surveillance working group has been established to review and implement the required changes to improve severe influenza surveillance in Ireland.

HPSC are focusing on improving influenza vaccine uptake and antiviral data on severe influenza cases, outbreaks, health care workers and those in risk groups for influenza. HPSC, ICGP and the NVRL are continuing to work on the European influenza vaccine effectiveness study (I-MOVE project), working together to increase GP and patient participation during the 2017/2018 season, in order to improve the precision of Irish influenza VE estimates. HPSC are also collaborating with the NVRL to increase influenza genetic testing, which will result in additional epidemiological information on evolving influenza genetic clades and subclades circulating each season in Ireland. Data from all of these surveillance projects will assist in guiding the management and control of influenza and of any future epidemics or pandemics. www.hpsc.ie

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2. WHO recommendations on the composition of influenza virus vaccines http://www.who.int/influenza/vaccines/virus/recommendations/en/

Acknowledgements

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Table 5: Summary table of notified influenza cases that died from all causes and were reported on Ireland's Computerised Infectious Disease Reporting System (CIDR) by influenza season: 2009/10-2016/17. Rates for 2009/10-2013/14 are based on the 2011 CSO census; rates for 2014/15-2016/17 are based on the 2016 CSO census.

	Influenza notifications - Deaths from all causes							
	Pandemic period	**2010/11**	**2011/12**	**2012/13**	**2013/14**	**2014/15**	**2015/16**	**2016/17**
Total deaths	32	43	12	38	58	66	84	95
Crude rate /100,000	0.7	0.9	0.3	0.8	1.3	1.4	1.8	2.0

2.2 Legionellosis

Summary

Number of cases in 2016: 10
Crude incidence rate: 2.1 per million

In 2016, there were 10 cases of Legionnaires' disease notified in Ireland, a rate of 2.1 per million population, which is a slight decrease from the rate of 2.5 per million observed in 2015. One death due to Legionnaires' disease was reported among the 10 cases, giving a case fatality rate of 10%.

The HSE areas who reported the cases in 2016 are shown in Table 1.

The majority of cases were male (60%). The median age for all cases was 62 years with a range from 28 to 82 years.

All ten cases were classified as confirmed. The organism involved in all confirmed cases, which was detected by urinary antigen test, was *Legionella pneumophila* serogroup 1. One case also had a confirmatory sputum sample culture of *Legionella pneumophila* serogroup 1. Monoclonal subtyping was not performed on the cultured isolate and was not available for any of the remaining cases because cultures were not available.

Seven cases were travel-associated. Countries of travel included Estonia (1), Hungary (1), Lithuania (2), Singapore (1) and Spain (2). Two of these travel-associated cases were linked to international travel related clusters. The remaining three cases were assumed to be community acquired.

No seasonality was evident in the cases in 2016, as described in Figure 1. The number of cases of Legionnaires' disease

Table 1. Number of Legionnaires' disease cases by HSE area of reporting in Ireland, 2016

Area of Reporting	No. of Cases
HSE-East	3
HSE-North East	3
HSE-Midlands	2
HSE-North West	1
HSE-West	1
Ireland	**10**

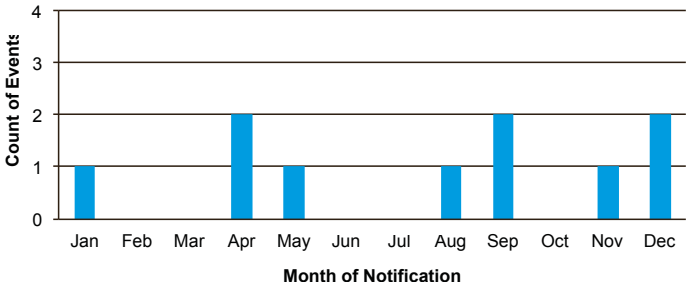

Figure 1. Number of Legionnaires' disease cases by month of notification in Ireland, 2016

Table 2. Number of Legionnaires' disease cases per million population in Ireland, 2009-2016
Legionnaires' events excluding Pontiac Fever cases

Age Group (years)	2009	2010	2011	2012	2013	2014	2015	2016
<30	0	1	0	0	0	0	0	1
30-39	0	0	0	1	1	1	1	1
40-49	0	2	0	1	3	1	1	1
50-59	2	1	1	1	4	2	3	1
60-69	3	3	4	6	1	3	1	2
70+	2	4	2	6	5	1	6	4
Total	**7**	**11**	**7**	**15**	**14**	**8**	**12**	**10**
Total CIR per million	**1.5**	**2.4**	**1.5**	**3.3**	**3.1**	**1.7**	**2.5**	**2.1**

To calculate the crude incidence rate (CIR), Census of the Population data was used as the denominator with Census 2016 for the analysis of 2014-2016 data and Census 2011 for the analysis of 2009-2013 data.

by month of notification between 2013 and 2016 is given in Figure 2. The annual trend over the past four years indicates that the number of notifications has been decreasing over time.

When the numbers of cases in 2016 were compared with the mean for the previous five years (see Figure 3), numbers were within historical limits.

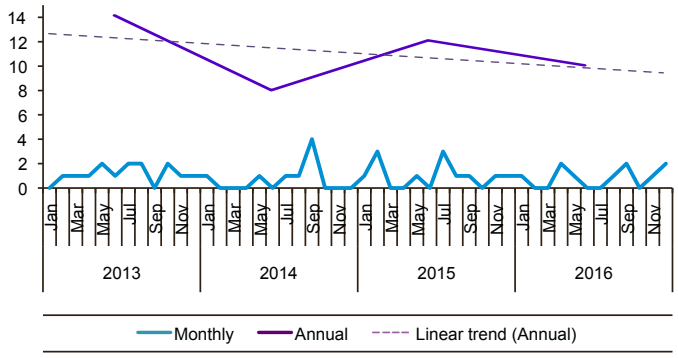

Figure 2. Number of Legionnaires' disease cases by month of notification and annually, 2013-2016

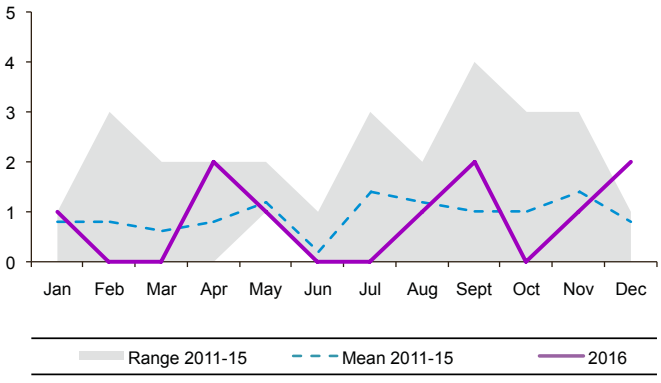

Figure 3. Number of Legionnaires' disease cases by month of notification in 2016 compared to the mean and range for the years 2011-2015

Figures for the year 2016 presented in this report were extracted from the computerised infectious disease reporting (CIDR) system on the 22nd August, 2017.

2.3 Invasive Group A Streptococcal Disease

Summary

Number of cases = 148
Crude incidence rate (CIR) = 3.11 per 100,000 population

The figures presented in this summary are based on data extracted from the Computerised Infectious Disease Reporting (CIDR) System on **10th August 2017.**

Notifications

In 2016, both the number and rate per 100,000 population of invasive group A streptococcal (iGAS) infection increased in comparison with 2015. n=148; rate = 3.11 [95% confidence interval (CI): 2.63-3.65] versus n=107; rate = 2.25 [95% CI: 1.84 – 2.72].

Case classification

The vast majority of cases were confirmed iGAS (n=147; 99%), with one probable case (n=1; 1%). A confirmed case has GAS or *Streptococcus pyogenes* isolated from a sterile site. A probable case has a diagnosis of streptococcal toxic shock syndrome (STSS) or necrotising fasciitis and GAS isolated from a non-sterile site.

Patient demographics

Of the 148 cases, 77 (52%) were male. The mean age was 44 years (range = 9 months – 92 years) and iGAS was more common in young children and older adults (Figure 1).

Geographic location and seasonal variation

Table 1 displays annual numbers and crude incidence rates (CIRs) of iGAS by HSE region (2012 – 2016). The highest number of cases and CIR in 2016 were from HSE East (n=68; CIR = 3.97 per 100,000 population). In six other HSE regions, increased iGAS notifications were observed. In HSE Midwest and HSE West, both cases and CIRs decreased in 2016. The peak month in 2016 was March (25 cases), followed by June (16 cases), January and December (14 cases each) (Figure 2). Figure 3 displays cumulative monthly iGAS cases from 2012 to 2016 inclusive. Following a dip in iGAS notifications in early 2015, the numbers subsequently increased in late 2015 and this increase was sustained in 2016. Data presented are based on the date the case was notified to public health, not on the date the case was first detected.

Isolate details

Of 147 confirmed cases, GAS was isolated from a sterile site in 110, with source site not reported for 37. Of reported sterile sites, GAS was isolated primarily from blood cultures

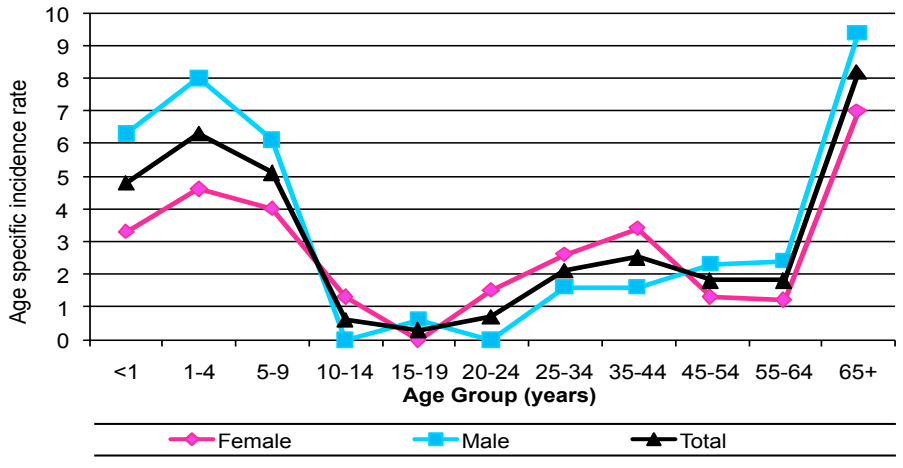

Figure 1. Age and sex specific rates of iGAS infection (2016)

(n=85; 77%), abscesses (n=9; 8%), deep tissue (n=8; 7%), joints (n=6; 5%), pleural fluid (n=1; 1%). For two cases, GAS was isolated from a second sterile site in addition to blood: pleural and pericardial aspirates (n=1) and joint (n=1).

There was one probable case in 2016 where GAS was isolated from a non-sterile site (eye swab). The case presented with orbital cellulitis, which represents a severe GAS infection but is not an iGAS case according to the case definition.

Typing data, based on sequencing of the *emm* genes that encode the M protein (the major virulence factor), were available on 127 isolates submitted from 26 laboratories: *emm*-types 1 (n=51; 40%), 12 (n=14; 11%), 28 (n=10; 8%), 3, 4 and 89 (n=6; 5% each) comprised 73% of all the isolates typed. Fifteen other *emm*-types (each represented by five isolates or less) were also detected. Of the 23 patients with STSS for whom *emm*-typing was undertaken, nine GAS isolates belonged to *emm*1 (39%) and four each to *emm*3 and *emm*28 (17%).

Enhanced surveillance data

Enhanced data were provided for 120 iGAS cases (81%), with variation in completeness of data supplied. Table 2 summarises characteristics of iGAS cases in Ireland from 2012 to 2016.

Clinical details

Clinical details were provided for 111 cases (75%). An iGAS case could have more than one clinical manifestation of infection. As in previous years, bloodstream infection (BSI) (n=90) and cellulitis (n=50) were the commonest presentations, followed by STSS (n=25), pneumonia (n=9), necrotising fasciitis (n=8), septic arthritis (n=7), peritonitis (n=5), erysipelas (n=2), myositis (n=2) and puerperal sepsis (n=2).

Risk factors

Risk factors were described for 93 iGAS cases (62%). An iGAS case could have more than one risk factor. No risk factors were identified for 27 cases.

Reported risk factors included; presence of skin or wound lesions (n=38), diabetes mellitus (n=10), malignancy (n=16), steroid use (n=8), varicella infection (n=8), injecting drug use (IDU) (n=4), alcoholism (n=2), recent childbirth (n=3) and non-steroidal anti-inflammatory drug (NSAID) use (n=2).

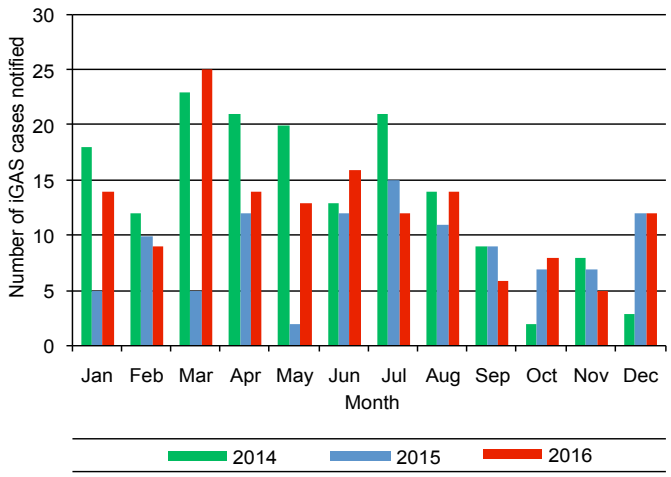

Figure 2. Monthly distribution of iGAS cases, 2014-2016

Table 1. Annual iGAS cases and crude incidence rates (CIRs) per 100,000 population by HSE area (2012-2016).

HSE Area	2012		2013		2014		2015		2016	
	n	CIR	n	CIR	n	CIR	n	CIR	n	CIR
HSE E	51	3.15	67	4.14	65	3.80	40	2.34	68	3.97
HSE M	7	2.48	7	2.48	4	1.37	7	2.39	10	3.42
HSE MW	8	2.11	16	4.22	13	3.39	6	1.56	12	3.13
HSE NE	11	2.50	14	3.18	12	2.60	10	2.17	15	3.25
HSE NW	5	1.94	6	2.32	3	1.17	7	2.73	3	1.17
HSE SE	16	3.22	21	4.22	18	2.61	9	1.30	15	2.17
HSE S	14	2.11	18	2.71	27	5.28	11	2.15	12	2.35
HSE W	10	2.25	19	4.27	22	4.86	17	3.75	13	2.87
IRELAND	122	2.66	168	3.66	164	3.44	107	2.25	148	3.11

CIRs for 2012-2013 were calculated using the 2011 census and for 2014-2016 using the 2016 census

Clinical management/severity

Surgical intervention was required for 28 patients (19%), with an age range = 11 months – 81 years. Of those, four were notified as STSS, five as necrotising fasciitis and two as having both STSS and necrotising fasciitis. Risk factor data on 23 of the surgical cases (82%) was described, with skin and wound lesions (n=10), age ≥65 years (n=6), diabetes (n=2), NSAID use (n=2), varicella (n=2), childbirth (n=1), IDU (n=1) and malignancy (n=1). An iGAS case requiring surgery could have more than one risk factor. No risk factors were identified for seven patients.

Intensive care unit (ICU) admission was required for 36 patients (24%), with an age range = 11 months – 88 years. Of those, 15 were notified as STSS, four as necrotising fasciitis and three as having both STSS and necrotising fasciitis. Risk factor data on 31 of the ICU cases (86%) was described, with age ≥65 years (n=16), skin and wound lesions (n=12), malignancy (n=5), steroid use (n=4), varicella infection (n=4), diabetes mellitus (n=3), alcoholism (n=2) and IDU (n=2). An iGAS case requiring ICU admission could have more than one risk factor. No risk factors were identified for six patients. Length of ICU stay was provided for 22 cases (61%); median = 3 days (range = 1 – 15).

Outcome

Outcome at seven days following GAS detection was reported for 74 cases (50%):

- Still alive = 70
- Died = 4, where GAS was listed as the main or contributory cause of death. The seven-day case fatality rate (CFR) for iGAS overall was 5%. Of 25 STSS cases, outcome at seven days was reported for 15 cases, with two deaths due to GAS (CFR = 13%)

Antimicrobial susceptibility testing

Twenty-eight microbiology laboratories reported antimicrobial susceptibility test (AST) data on 119 GAS isolates (blood; 110 and other specimens; 9) via the European Antimicrobial Resistance Surveillance Network (EARS-Net), with variation in AST panels. All isolates tested were susceptible to penicillin (n=119) and vancomycin (n=91). Resistance to erythromycin was reported in eight (7%) of 116 isolates, to clindamycin in seven (8%) of 89 isolates and to tetracycline in eight (13%) of 61 isolates tested.

Other epidemiological information

Seven cases of iGAS were reported as hospital-acquired (5%). There were no iGAS outbreaks reported in 2016 versus one outbreak in 2015.

Conclusion

Antimicrobial susceptibility data confirm that GAS remains susceptible to penicillin and that penicillin should continue to be the treatment of choice for iGAS.

Invasive GAS is a potentially life-threatening disease. In 2016, the CFR for iGAS infection was 5%.

A national service typing GAS *emm* genes has been provided since 2012 by the Irish Meningitis and Sepsis Reference Laboratory (IMSRL), based at Temple Street Children's University Hospital. In both 2016 and 2015 *emm*1 predominated, comprising 40% and 29% of all isolates typed, respectively. However, in 2014, *emm*3 predominated (36% of all isolates typed). Certain *emm* types, including *emm*1 and *emm*3, are associated with STSS, and STSS in turn is strongly associated with increased mortality. The changes observed in the predominant *emm* types in

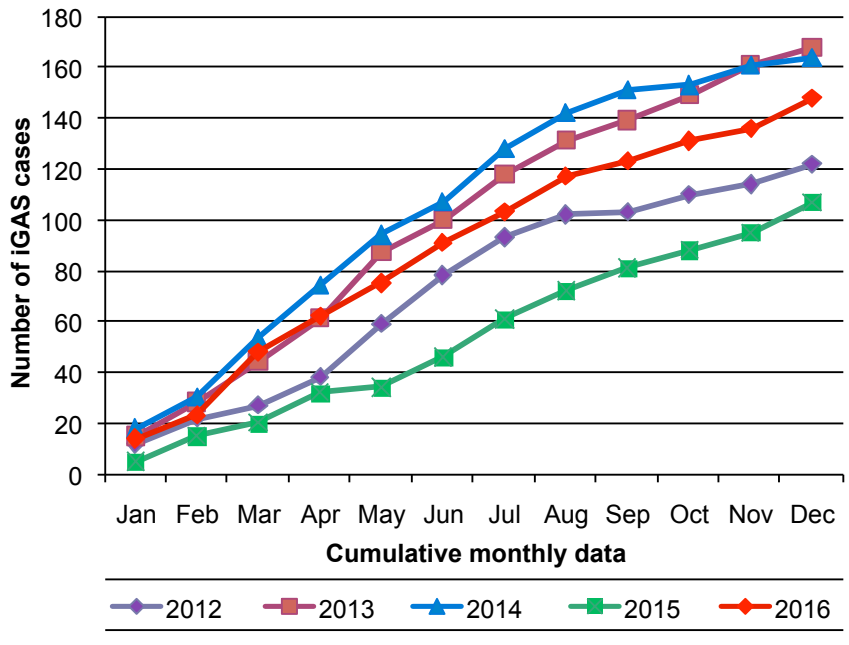

Figure 3. Cumulative monthly numbers of iGAS cases, 2012-2016

Table 2. Characteristics of iGAS cases (2012–2016) Data as of 16/08/2017

	2012	2013	2014	2015	2016
Notifications					
Total iGAS cases notified	122	168	164	107	148
iGAS incidence rate per 100,000 population	2.66	3.66	3.44	2.25	3.11
*Cases for which enhanced data provided** (%)*	*106 (87%)*	*156 (93%)*	150 (91%)	*95 (89%)*	120 (81%)
Patient Demographics					
Male (%)	59 (48%)	95 (57%)	94 (57%)	*60 (56%)*	77 (52%)
M:F ratio	0.94:1	1.30:1	1.34:1	*1.28:1*	1.08:1
Mean age	44	41	43	*42*	44
Median age	42	40	44	*42*	43
Age range	0-92	0-93	0-99	*0-99*	0-92
Paediatric cases (aged <18 years) (%)	28 (23%)	45 (27%)	47 (29%)	*26 (24%)*	40 (27%)
Older cases (aged 65+ years) (%)	42 (34%)	50 (30%)	56 (34%)	*34 (31%)*	52 (35%)
Clinical Presentation†					
Data on Clinical Presentation (%)	102 (84%)	141 (84%)	133 (81%)	*88 (82%)*	111 (75%)
Streptococcal Toxic Shock-like Syndrome (STSS) without NF (%)	22 (22%)	28 (20%)	18 (14%)	*11 (13%)*	22 (20%)
Necrotising fasciitis (NF) without STSS (%)	2 (2%)	6 (4%)	4 (3%)	*5 (6%)*	2 (2%)
STSS and NF (%)	4 (4%)	4 (3%)	3 (2%)	*0 (0%)*	3 (3%)
Bacteraemia with focal presentations (%)	37 (36%)	43 (30%)	43 (32%)	*33 (38%)*	43 (39%)
Bacteraemia with no focal presentations (%)	26 (25%)	37 (26%)	37 (28%)	*21 (24%)*	25 (23%)
Other focal presentations with no bacteraemia (%)	11 (11%)	23 (16%)	28 (21%)	*18 (20%)*	13 (12%)
Bacteraemia (%)	78 (76%)	106 (75%)	100 (75%)	*64 (73%)*	90 (81%)
Other focal presentations:					
Cellulitis (%)	40 (39%)	43 (30%)	57 (43%)	*34 (39%)*	50 (45%)
STSS (%)	26 (25%)	32 (23%)	21 (16%)	*11 (13%)*	25 (23%)
Pneumonia (%)	16 (16%)	24 (17%)	14 (11%)	*12 (14%)*	9 (8%)
Necrotising fasciitis (%)	6 (6%)	9 (6%)	7 (5%)	*5 (6%)*	8 (7%)
Septic arthritis (%)	7 (7%)	10 (7%)	10 (8%)	*13 (15%)*	7 (6%)
Peritonitis (%)	1 (1%)	4 (3%)	1 (1%)	*3 (3%)*	5 (5%)
Erysipelas (%)	3 (3%)	3 (2%)	2 (2%)	*1 (1%)*	2 (2%)
Myositis (%)	4 (4%)	3 (2%)	5 (4%)	*2 (2%)*	2 (2%)
Puerperal sepsis (%)	3 (3%)	4 (3%)	3 (2%)	*6 (7%)*	2 (2%)
Meningitis (%)	1 (1%)	3 (2%)	0 (0%)	*4 (5%)*	0 (0%)
Risk Factors†					
Data on risk factors (%)	95 (78%)	138 (82%)	126 (77%)	*77 (72%)*	93 (62%)
Skin lesions/wounds (%)	34 (36%)	56 (41%)	50 (40%)	*32 (42%)*	38 (41%)
Malignancy (%)	10 (11%)	23 (17%)	10 (8%)	*6 (8%)*	16 (17%)
Diabetes (%)	5 (5%)	16 (12%)	11 (9%)	*7 (9%)*	10 (11%)
Varicella (%)	8 (8%)	5 (4%)	6 (5%)	*3 (4%)*	8 (9%)
Steroid use (%)	8 (8%)	11 (8%)	6 (5%)	*6 (8%)*	8 (9%)
Injecting drug user (%)	6 (6%)	5 (4%)	5 (4%)	*3 (4%)*	4 (4%)
Childbirth (%)	6 (6%)	6 (4%)	4 (3%)	*5 (6%)*	3 (3%)
Alcoholism (%)	5 (5%)	6 (4%)	5 (4%)	*3 (4%)*	2 (2%)
Non-steroid anti-inflammatory drug use (%)	2 (2%)	4 (3%)	2 (2%)	*1 (1%)*	2 (2%)
No identified risk factor (%)	25 (26%)	47 (34%)	48 (38%)	*24 (31%)*	27 (29%)
Outcome at 7 days					
Data on outcome at 7 days (%)	65 (53%)	108 (64%)	102 (62%)	*73 (68%)*	74 (50%)
RIP/GAS main cause or contributory (%)	8 (12%)	16 (15%)	10 (10%)	*6 (8%)*	4 (5%)
STSS cases: Data on outcome at 7 days (%)	17 (65%)	26 (81%)	17 (81%)	*7 (64%)*	7 (64%)
STSS cases: RIP/GAS main cause or contributory (%)	6 (35%)	10 (38%)	6 (35%)	*1 (14%)*	1 (14%)
Severity					
Data on admission to ITU (%)	99 (81%)	153 (91%)	144 (88%)	*92 (86%)*	112 (76%)
Admitted to ITU (%)	40 (40%)	44 (29%)	36 (25%)	*25 (27%)*	36 (32%)
Data on surgical intervention (%)	85 (70%)	136 (81%)	127 (77%)	*86 (80%)*	99 (67%)
Surgical intervention required (%)	25 (29%)	39 (29%)	41 (32%)	*26 (30%)*	28 (28%)
Typing					
iGAS isolates that were typed (%)	109 (89%)	140 (83%)	130 (79%)	*92 (86%)*	127 (86%)
Emm-1 (%)	53 (49%)	41 (29%)	21 (16%)	*27 (29%)*	51 (40%)
Emm-3 (%)	4 (4%)	33 (24%)	47 (36%)	*4 (4%)*	6 (5%)
Emm-12 (%)	11 (10%)	4 (3%)	6 (5%)	*14 (15%)*	14 (11%)
Emm-28 (%)	8 (7%)	8 (6%)	12 (9%)	*12 (13%)*	10 (8%)
Emm-89 (%)	4 (4%)	13 (9%)	8 (6%)	*8 (9%)*	6 (5%)
Other *emm*-types (%)	29 (27%)	41 (29%)	36 (28%)	*27 (29%)*	40 (31%)

** Degree of completion of enhanced surveillance forms varies from case to case: information may not be available on all variables/categories, thus calculations of percentages take into account only those cases for which data are provided
†Note: A patient may have more than one clinical presentation or risk factor

circulation highlight the dynamic nature of iGAS infection. Ongoing surveillance is essential, specifically completion of the enhanced data questionnaire to gain a greater understanding of iGAS. There has been a reduction in the proportion of iGAS cases with accompanying enhanced surveillance data from 93% (2013) to 81% (2016). Referral of GAS isolates to IMSRL for epidemiological typing is also important, as certain *emm* types are associated with greater morbidity and mortality.

Acknowledgement
HPSC would like to thank colleagues in microbiology laboratories and Departments of Public Health for submitting data on iGAS and colleagues in IMSRL for sharing *emm* typing information.

Notes to colleagues in microbiology laboratories

1. Please forward any GAS isolates from normally sterile sites to IMSRL for typing, along with a completed IMSRL request form available from: https://www.cuh.ie/wp-content/uploads/2014/03/IMSRL-Request-Form-29-11-16.pdf
2. Please submit AST data on all iGAS cases along with EARS-Net quarterly returns
3. Please return a completed enhanced iGAS surveillance form on every patient with iGAS. The form can be downloaded from the HPSC website at: http://www.hpsc.ie/a-z/other/groupastreptococcaldiseasegas/surveillanceforms/

2.4 Invasive Group B Streptococcal Infections

Summary

Number of cases = 65
- Early-onset disease (EOD) = 42
- Late-onset disease (LOD) = 23

EOD rate per 1,000 live births = 0.66

LOD rate per 1,000 live births = 0.36

The figures presented in this summary are based on data extracted from Computerised Infectious Disease Reporting (CIDR) System on **11th August 2017**.

Background

Invasive group B streptococcal (iGBS; *Streptococcus agalactiae*) infection in infants <90 days old or stillborn infants has been notifiable in Ireland since January 2012. In neonates, two syndromes exist:

1. Early-onset disease (EOD) where age at onset/diagnosis <7 days
2. Late-onset disease (LOD) where age at onset/diagnosis 7 – 89 days

Both include sepsis, pneumonia and meningitis. Stillbirth associated with isolation/detection of *Streptococcus agalactiae* from the placenta or amniotic fluid is also notifiable. The rate is expressed per 1,000 live births. In 2016, there were 63,897 live births according to the Central Statistics Office (CSO). http://www.cso.ie/en/releasesandpublications/ep/p-vsys/vitalstatisticsyearlysummary2016/

Notifications

In 2016, 65 iGBS cases were notified. The majority were EOD (n=42; 65%); rate = 0.66. LOD accounted for 23 cases (35%);

Table 1. Annual iGBS cases and rates, stratified by EOD & LOD (2012 – 2016)

	EOD		LOD		TOTAL	
Year	n (%)	Rate*	n (%)	Rate*	n (%)	Rate*
2012	57 (75%)	0.80	19 (25%)	0.27	76	1.06
2013	42 (64%)	0.61	24 (36%)	0.35	66	0.96
2014	46 (68%)	0.68	22 (32%)	0.33	68	1.01
2015	43 (62%)	0.65	26 (38%)	0.39	69	1.05
2016	42 (65%)	0.66	23 (35%)	0.36	65	1.02

EOD, early-onset disease; LOD, late-onset disease
* Incidence rate per 1,000 live births
Live births in the Republic of Ireland (source: www.cso.ie): 2012, 71,674; 2013, 68,954; 2014, 67,295; 2015, 65,909; and 2016, 63,897

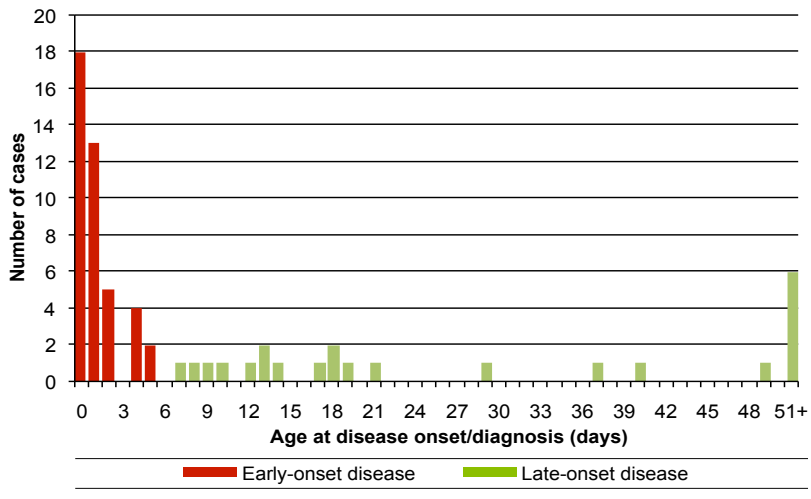

Figure 1. iGBS by age (in days) at diagnosis (2016) (EOD <7 days; LOD 7 – 89 days)

rate = 0.36 (Figure 1 and Table 1). Two cases presented with meningitis and two were associated with stillbirth.

The Irish Meningitis and Sepsis Reference Laboratory (IMSRL), based at Temple Street Children's University Hospital, provides a national typing service for Group B Streptococcus. IMSRL performs serotyping and multi-locus sequence typing (MLST) on iGBS isolates. Between 2012 and 2016, 167 iGBS isolates were received by IMSRL. Figure 2 displays the annual breakdown (2012 – 2016) of isolates by serotype. Serotype III has predominated as a cause of both EOD and LOD since typing began.

There are ten capsular serotypes of GBS (serotypes 1a, 1b and II – IX). Based on MLST data, GBS may be categorised into five main clonal complexes (1, 12, 17, 19 & 23). Figure 3 displays the annual breakdown (2012 – 2016) of isolates by MLST clonal complex. Clonal complex 17 includes serotype III and has predominated as a cause of both EOD and LOD since typing began.

Notes to colleagues in microbiology laboratories

Please forward any GBS isolates from normally sterile sites to IMSRL for typing, along with a completed IMSRL request form available from:
http://www.cuh.ie/healthcare-professionals/departments/irish-meningitis-sepsis-reference-laboratory-imsrl/

Acknowledgement
HPSC would like to thank colleagues in microbiology laboratories and Departments of Public Health for submitting data on iGBS since 2012 and colleagues in IMSRL for sharing typing information.

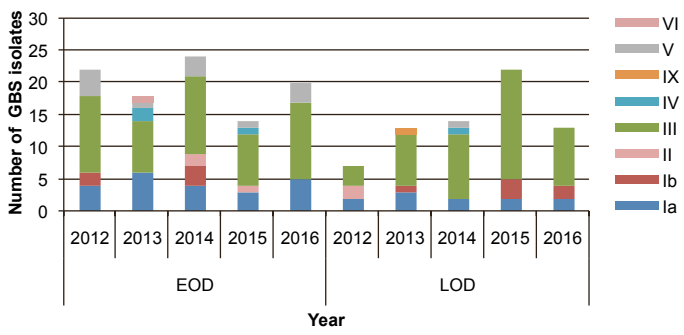

Figure 2. Serotype distribution of iGBS isolates 2012 - 2016. Source: IMSRL

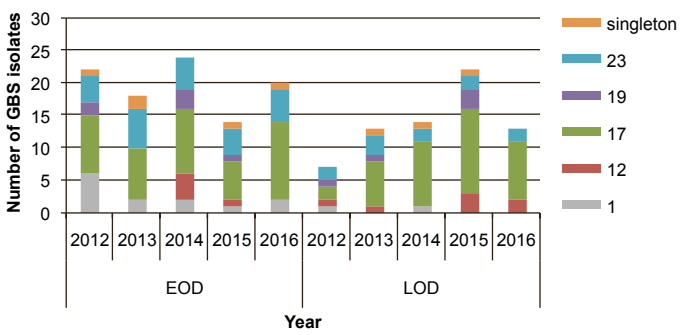

Figure 3. MLST clonal complex distribution of iGBS isolates 2012 - 2016. Source: IMSRL

2.5 Tuberculosis

Summary

Number of cases in 2016: 318

Number of cases in 2015: 294

In 2016, 318 cases of tuberculosis (TB) were notified in Ireland, corresponding to a crude incidence rate (CIR) of 6.9 per 100,000 population*, remaining stable in comparison to the CIR of 6.4 reported for 2015 (n=294). A summary of the epidemiology of TB in Ireland during 2016 is shown in table 1 while the number of cases and crude incidence rates from 2007-2016 with three-year moving averages are shown in figure 1.

The highest crude incidence rate was reported by HSE-E (8.4/100,000) while the lowest rate was reported by HSE-NW (1.9/100,000).

Cases ranged in age from two months to 89 years, with a median age of 41 years. The highest age-specific rate (ASIR) in 2016 occurred among those aged 25-34 years (10.6) followed by those aged 65 years and older (10.5). The rate among males (8.5) was higher than that among females (5.4). Rates among males were higher than females for all age groups except the 0-14 and 55-64 year age groups. The highest ASIR among males (13.2) was observed in those aged 65 years and older while the highest ASIR among females was observed in those aged 55-64 years. The male to female ratio (1.6:1) reported in 2016 was consistent with that reported in previous years.

Geographic origin

The proportion of TB cases born outside Ireland increased to 50.3% during 2016, compared to 43.2% reported in 2015. Correspondingly the crude rate in the foreign-born population increased from 16.6 per 100,000 population in 2015 to 20.9 per 100,000 population in 2016. The crude rate in the indigenous population remained stable at 3.9 per 100,000, the same as reported in 2015. There was a notable difference in age between cases born in Ireland and foreign born cases, with a median age of 54 years and 33 years respectively.

Site of infection

Pulmonary TB was reported in 211 (66.4%) cases and 97 (30.5%) had exclusively extrapulmonary disease. Site of infection was not reported for the remaining 10 cases. There were no cases of TB meningitis reported during 2016.

Microbiology

Culture results were available for 246 (77.4%) cases. Of the 246, 237 (96.3%) cases were culture confirmed and nine (3.7%) were culture negative. Species identification showed *M. tuberculosis* in 97.9% (232 cases), *M. bovis* in 1.3% (3

*All rates reported are calculated per 100,000 population using the 2011 Census

Table 1: Summary of the epidemiology of TB in Ireland, 2016

Parameter	2016		
	Number of cases	CIR	% of total cases
Total number of cases	318	6.9	n/a
Cases in indigenous population	145	3.9	45.6
Cases in foreign-born persons	160	20.9	50.3
Culture positive cases	237	5.2	74.5
Pulmonary cases	211	4.6	66.4
Smear positive pulmonary cases	85	1.9	26.7
TB meningitis cases	0	0.00	0.0
Multi-drug resistant cases	5	0.11	1.6
Extensively drug resistant cases	1	0.02	0.3
Mono-resistant to isoniazid	10	0.2	3.1
Deaths attributable to TB	7	0.2	2.2

cases) and *M. africanum* in 0.8% (2 cases). Of the 211 cases with a pulmonary component, 170 (80.6%) were reported as culture confirmed, and 85 (40.3%) were reported as smear positive.

Drug sensitivity

Information on antibiotic sensitivity testing was available for 230 (97.0%) of the 237 culture confirmed cases. Resistance was documented in 32 (13.5% and 10% of total cases) cases that reported antibiotic sensitivity, five of which were MDR-TB (1.6% of total cases) and one additional case was XDR-TB. Mono-resistance to isoniazid was recorded in 10 cases, to streptomycin in six, to pyrazinamide in four cases and rifampicin in one case. Five further cases reported non-MDR polyresistance (to isoniazid and an additional drug other than rifampicin).

HIV status

Information on HIV status was reported for 131 (41.2%) cases in 2016, an increase compared to 40.8% with HIV status reported in 2015. Of the cases with HIV status reported, four (3.1%) were HIV positive and 127 (96.9%) were HIV negative.

Outbreaks

During 2016, five outbreaks of TB were reported to HPSC, with 19 reported cases of active TB and 15 hospitalisations. No LTBI cases were reported for any of the 2016 outbreaks.

Two outbreaks were reported by HSE-W and one outbreak each was reported by HSE-E, -NW and -S. There were three general outbreaks, two of which occurred in a community setting with six and three cases of active TB respectively. The remaining general outbreak occurred in a multi-occupancy private residence with three associated cases of active TB. There were also two family outbreaks, comprising three and four cases each. One family outbreak occurred in a private house and one occurred across an extended family.

The number of outbreaks reported during 2016 remained stable compared to 2015. Figure 2 shows a summary of reported TB outbreaks from 2007 to 2016 by year of outbreak, number of active TB cases and number of persons with LTBI. Please note that numbers of LTBI for outbreaks reported during 2016 are provisional and may increase as outbreak investigations continue.

Further details on the epidemiology of TB cases reported in 2016 will be available in the HPSC Report on the Epidemiology of TB in Ireland, 2016 (www.hpsc.ie/a-z/vaccinepreventable/tuberculosistb/epidemiology/annualreports).

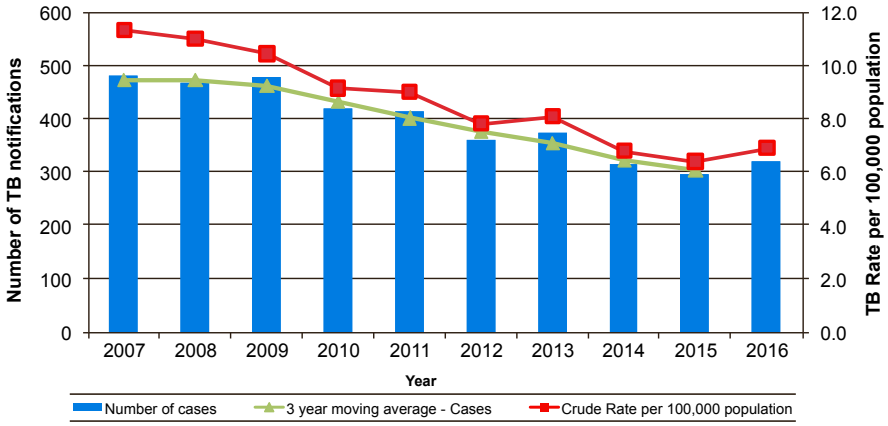

Figure 1: Notified cases of TB in Ireland with crude rates per 100,000 population, 2007 to 2016 and 3-year moving averages, 2007-2015

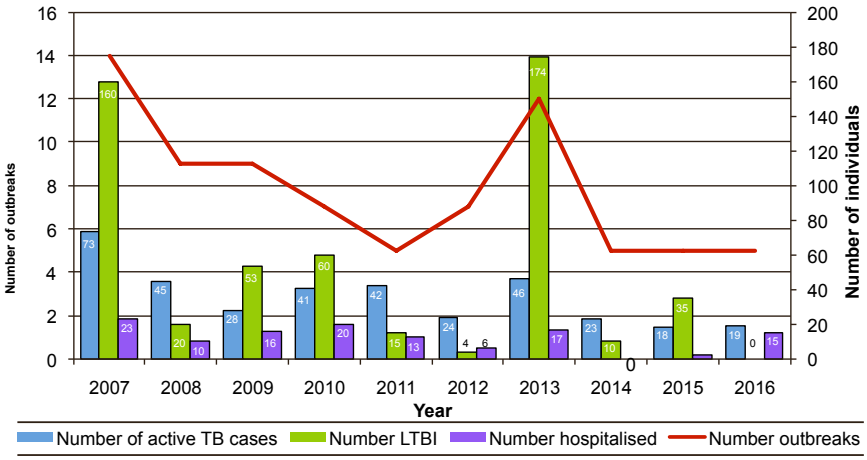

Figure 2: TB outbreak summary by year, 2007-2016

2.6 Chickenpox-hospitalised cases

Summary

Number of cases, 2016: 106
Crude incidence rate, 2016: 2.2/100,000

Chickenpox-hospitalised cases

The Health Act, 1947 entitles the Minister for Health to declare by regulation diseases that are infectious, covered by legislation and that require notification to a Medical Officer of Health. The infectious diseases notifiable in Ireland are regulated in the 1981 Infectious Diseases Regulations. The amendment S.I. No. 452 of 2011 to these regulations specified for the first time the disease chickenpox, hospitalised cases only, as notifiable. Chickenpox is caused by varicella-zoster virus. The case definition is available at www.hpsc.ie.

In 2016, 106 (2.2/100,000) hospitalised chickenpox cases were notified in Ireland compared to 69 (1.4/100,000) in 2015. In 2016, the largest number of cases was in the HSE E (table 1). Of the 106 cases, 72 (68%) were classified as confirmed, five (5%) as probable and 29 (27%) as possible. The highest age specific incidence rates were in those aged less than five years (figure 1). Of the 106 cases, 54 (51%) were female and 51 (48%) were male while sex was unreported for one case (1%).

Chickenpox/varicella outbreaks

The amendment S.I. No. 707 of 2003 to the infectious disease regulations specified that unusual clusters or changing patterns of illness that may be of public health concern must be reported. Therefore, outbreaks of chickenpox must be notified regardless of hospitalisation status. Two outbreaks of chickenpox were notified in 2016. Both outbreaks occurred in a childcare facility with a total of 12 ill.

The figures presented in this summary are based on data extracted from the Computerised Infectious Disease Reporting (CIDR) system on 6th September 2017. These figures may differ slightly from those published previously due to ongoing updating of notification data on CIDR. The 2016 census data was used here to calculate rates.

Acknowledgements
HPSC would like to thank all those who provided data for this report – Departments of Public Health, laboratories and clinicians.

Table 1. Number of notified hospitalised chickenpox cases and the crude incidence rate per 100,000 population (CIR) by HSE Area in 2016

HSE Area	Number	CIR
HSE E	54	3.2
HSE M	7	2.4
HSE MW	2	0.5
HSE NE	14	3.0
HSE NW	3	1.2
HSE SE	8	1.6
HSE S	13	1.9
HSE W	5	1.1
Total	**106**	**2.2**

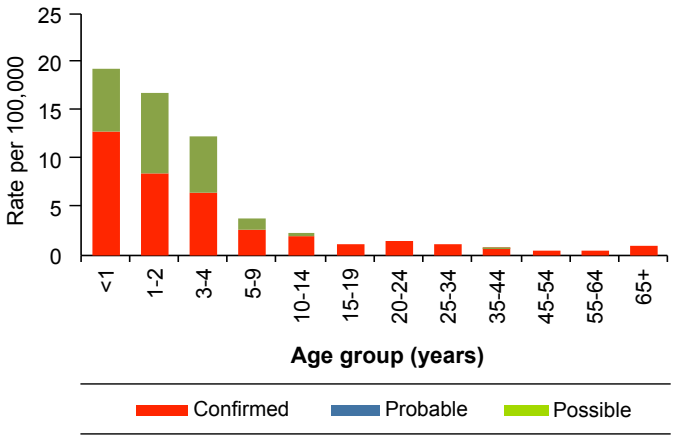

Figure 1. The age specific incidence rate (per 100,000 population) of notified hospitalised chickenpox cases in 2016 by case classification

2016

ANNUAL EPIDEMIOLOGICAL REPORT

03

INFECTIOUS INTESTINAL DISEASES

3.1 Campylobacteriosis

Summary

Number of cases, 2016: 2513
Crude incidence rate: 52.8/100,000

Campylobacteriosis is an acute zoonotic bacterial disease characterised by diarrhoea, abdominal pain, malaise, fever, nausea and vomiting. Symptoms generally last for only a few days. It is the commonest bacterial cause of gastroenteritis in Ireland and Europe.[1] Campylobacteriosis became a notifiable disease in Ireland in 2004 under the Infectious Diseases (Amendment) Regulations.

During 2016, 2513 cases were notified, an increase of 2.6% observed, compared with 2015. Among the 95% of notifications for which patient type was available, 27% of cases were hospital in-patients.

This corresponds to a crude incidence rate of 52.8/100,000 population, which is lower than the European crude incidence rate of 65.5 per 100,000 population.[1] This is sixth consecutive year for which campylobacteriosis levels were elevated compared with rates reported between 2004 and 2010 (Figure 1). Increasing use of PCR since 2013 as a primary diagnostic method may have impacted on ascertainment rates, however, this would seem not to explain the increase from 2011. During the period 2008-2015, 12 other EU MS (Austria, Estonia, France, Hungary, Italy, Latvia, Lithuania, Malta, Poland, Slovakia, Slovenia and Spain) also reported significantly increasing trends.[1]

During 2016, the highest CIRs occurred in HSE-M (70/100,000), HSE-SE (67/100,000) and HSE-W (66/100,000); similar to last year, the lowest CIRs were reported by HSE-NW (36/100,000) and -NE (37/100,000) (Figure 2).

There was variation in the size of the increase in reported incidence in the last six years between HSE-areas, with the largest increase reported by HSE-SE (74% increase in annual mean number of cases between 2011-2016 compared with the period 2004-2010) compared with a more modest 12% increase in annual mean number of cases in the HSE-NW between 2011-2016 compared with the period 2004-2010.

Campylobacteriosis occurs in all age groups with the highest rate of notification reported in the 0-4 year age group. This elevated rate in younger children is a well described characteristic of the disease and is also observed at European level. A comparison of the age-specific rate in 2016 and the mean age-specific incidence rate between 2004-

1. Rates are calculated per 100,000 population

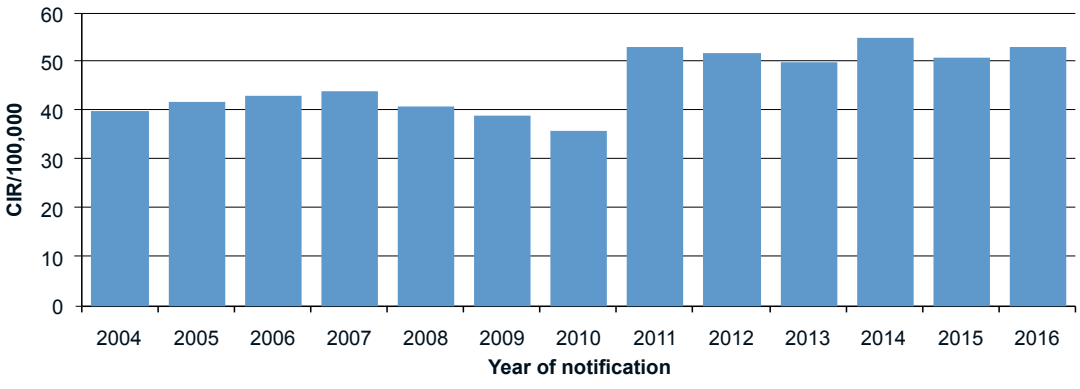

Figure 1. CIR per 100,000 population, Ireland 2004-2016

[1] Rates are calculated per 100,000 population

2010 (before the commencement of elevated rates in 2011) shows a marked increase in the CIRs among older people since 2010 (Figure 3); most notably, there has been a 2.5-fold increase in CIR in those aged 65 years and older in 2016 compared to the period 2004-2010.

Campylobacteriosis has a well-documented seasonal distribution with a peak in early summer. In Ireland, notifications typically peak during May to July. During 2016, notifications peaked between May and July (although more modest than observed in 2014 and 2015); there were elevated case numbers also in January 2016 (small January peaks have been observed since 2011 in the EU). A sharp peak in September 2016 coincided with a general outbreak in a CCF described below (Figure 4).

All *Campylobacter* cases notified in Ireland during 2016 were reported as laboratory confirmed. Formally, only culture confirmed *Campylobacter* cases are notifiable, however, there has been increasing implementation of culture independent methods for *Campylobacter* diagnosis since 2013 (i.e. PCR), and, although not all PCR-diagnosed cases have subsequently been culture confirmed, informally all laboratory diagnosed cases of *Campylobacter* have been accepted as notifications. Moreover, as there is currently no national reference facility for routine typing of *Campylobacter* isolates and only a small number of laboratories speciating isolates, information on *Campylobacter* species in the notification dataset is limited. In 2016, 17.9% (n=451) of isolates were speciated. Of the 451 speciated isolates, 93.1% (n=420) were *C. jejuni* and 6.0% (n=27) were *C. coli*.

Public health investigation of *Campylobacter* cases is not routine which limits data on the role of travel to the information which accompanied the specimen upon submission to the diagnosis laboratory. Travel is believed to be a relatively minor risk factor for campylobacteriosis in Ireland; in a case control study across the island of Ireland, 20% of cases reported travel outside of the island of Ireland during their potential incubation period.[2] Moreover, travel was not found to be significantly associated with infection after adjustment for other risk factors in the study. In the 2016 dataset, *country of infection* was completed for only 88 cases, of which eight were foreign-travel related (9%). Unascertainment of travel as a risk factor was reported previously in the United Kingdom for *campylobacter* laboratory surveillance data.[3]

During 2016, there were five notified outbreaks which included cases of campylobacteriosis (Table 1). Four were family outbreaks in private houses with a total of 9 persons ill (eight laboratory confirmed). There was one VTEC/ *Campylobacter* outbreak which included 32 confirmed campylobacter cases; the reported mode of transmission was foodborne and person-to-person spread. No food vehicles were implicated in any of three foodborne outbreaks, although chicken cooked at home was suspected for one family outbreak. Notification of outbreaks of *Campylobacter*

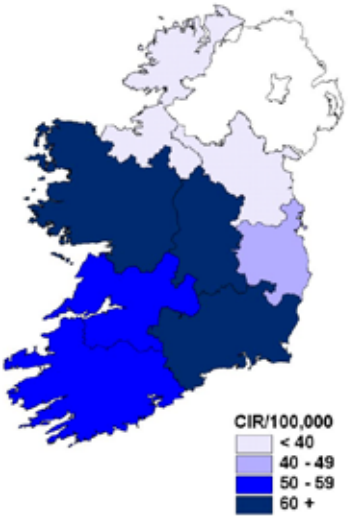

Figure 2. CIR by HSE-area, campylobacteriosis 2016

Table 1. Campylobacteriosis outbreaks summary, 2016 (CIDR)

Outbreak location	Mode of transmission	Number outbreaks	Number of confirmed campylobacter cases
Private house	P-P - Person-to-person	1	2
	Foodborne+-P-P	2	5
	Unknown	1	1
Childcare facility*	Foodborne and P-P	1	32
Total		5	40

**VTEC and Campylobacter outbreak*

are less common than for other bacterial gastrointestinal pathogens; increasingly this is being regarded as a reflection of our present ability to detect them as traditionally typing of *Campylobacter* strains has been of limited value. A recent Danish study using whole genome sequencing suggests that *Campylobacter* case clustering and even outbreaks appear to occur more often than previously assumed.[4]

References:

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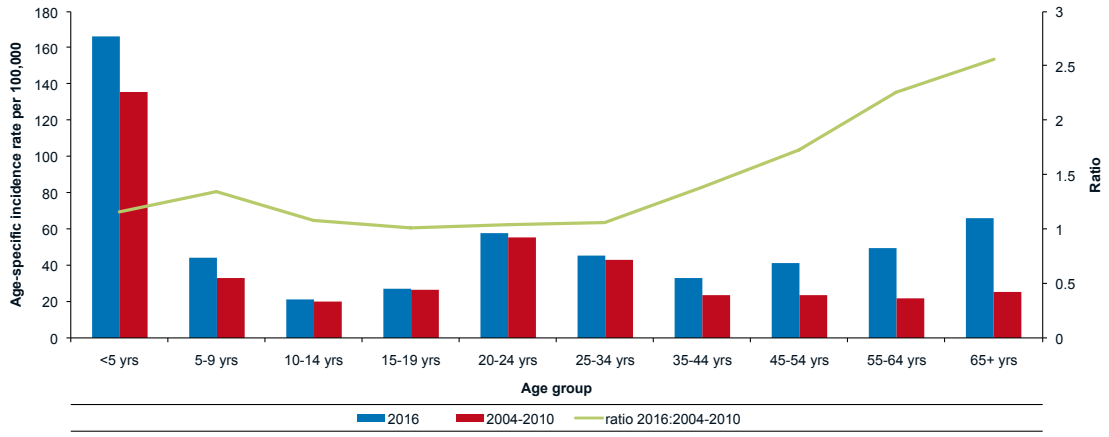

Figure 3. Age-specific incidence rate campylobacter 2016, mean age-specific incidence rate campylobacter 2004-2010, Ireland

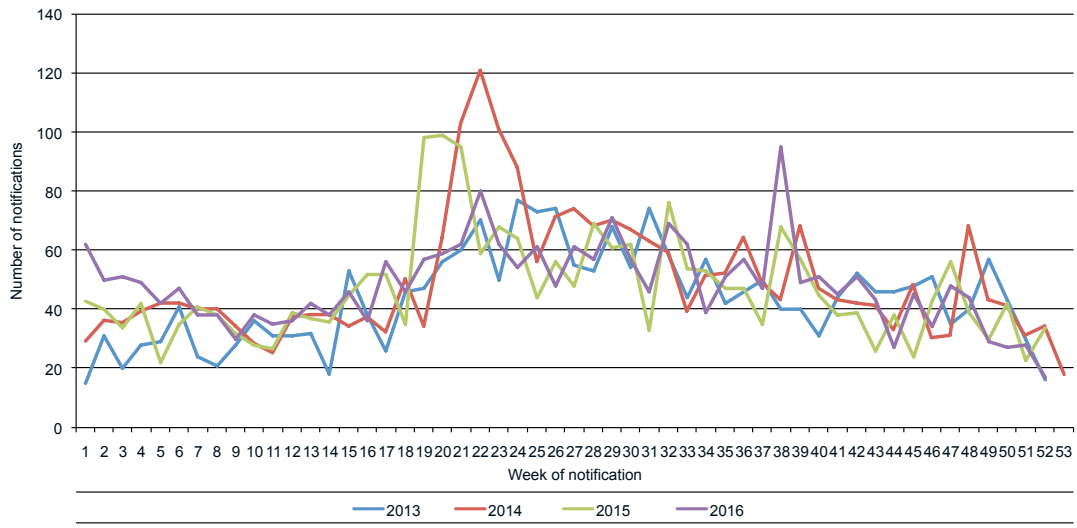

Figure 4. Weekly number of campylobacteriosis notifications in Ireland 2013-2016

3.2 Cryptosporidiosis

Summary

Number of cases, 2016: 561
Number of cases, 2015: 439
Crude incidence rate, 2016: 11.8/100,000

Cryptosporidium is a protozoal parasite that causes a diarrhoeal illness in humans known as cryptosporidiosis. It is transmitted by the faeco-oral route, with both animals and humans serving as potential reservoirs. Human cryptosporidiosis became a notifiable disease in Ireland in 2004, and the case definition in current use is published on the HPSC website.

In 2016, 561 cases of cryptosporidiosis were notified in Ireland, a crude incidence rate (CIR) of 11.8 per 100,000 population (Figure 1). This is a 23% increase in the CIR from 2015. There is no definitive trend for cryptosporidiosis in Ireland since the disease became notifiable. The most recent data available from ECDC shows a CIR across the EU of 3.1 per 100,000 in 2015, however, many countries do not have reporting systems for cryptosporidiosis. Ireland has reported the highest CIR of any MS since 2012, with the United Kingdom typically reporting the second highest incidence rate.[1] Of the notified cases in Ireland in 2016, 36.9% (n=202) were hospitalised. There were no reported deaths.

Consistent with previous years, the highest age-specific incidence rate was in children under five years of age, with 75 cases per 100,000 population in this age group (Figure 2). While there is likely to be a bias towards testing of diarrhoeal stool specimens from children (as opposed to adults) for *Cryptosporidium,* it is also likely that this distribution reflects to some extent a true difference in risk between adults and children.

Compared with 2015, the incidence rate in 2016 increased in all of the eight HSE areas (Figure 3). As in previous years, there was a strong urban-rural divide, with HSE-E having the lowest incidence rate (4.0 per 100,000). Although incidence remains low in HSE-E in 2016, the incidence rate has been increasing over the last three years (Figure 3). HSE-W, HSE-SE and HSE-M reported the highest incidence rates (19.0, 22.9 and 19.8 per 100,000, respectively).

As in previous years, the highest number of cases was notified in spring and peaked in April, followed by a second less intense peak in September (Figure 4). In 2016, 5.9% of the cryptosporidiosis cases (n=30) were reported as being acquired abroad (Table 1). This is lower than the percentage of travel-related cases in 2015 (12.7%) but higher than was reported in 2014 (3.7%). The highest proportion of travel-related cases in 2015 occurred in late summer/early autumn, with France and Spain being the most commonly reported travel-destinations (Figure 4).

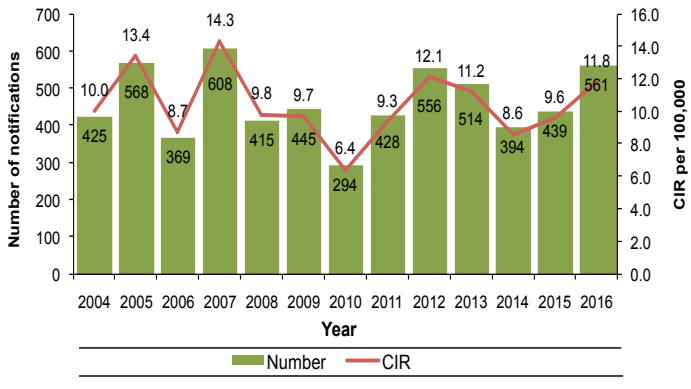

Figure 1. Annual number and crude incidence rate cryptosporidiosis, Ireland, 2004-2016

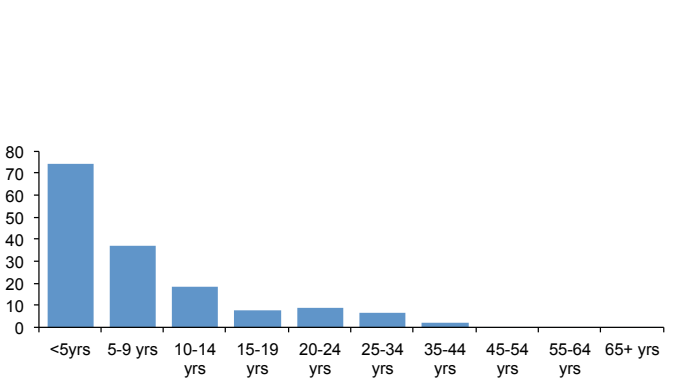

Figure 2. Age-specific incidence rate cryptosporidiosis, Ireland, 2016

Risk factors

Reviewing case-based enhanced surveillance data, exposure to farm animals or their faeces either by virtue of residence on a farm or by visiting a farm during the potential incubation period was common among cases; 63.5% of cases reported one or both of these exposures (Table 1). This is consistent with the low incidence of cryptosporidiosis among residents in the largely urban HSE-E population and the higher incidence reported in more rural parts of the country. The proportion of cases reporting exposure to pets and swimming pools was similar to last year (Table 1).

Table 2 shows the distribution of notified cases by home water supply type. Persons who are not served by public water supplies have an increased risk of cryptosporidiosis; they are over-represented among cases relative to the distribution of households by water supply type nationally. This was particularly noticeable for private well users (25.1% and 10.6%, respectively). However, it should be borne in mind that persons whose household drinking water is not from a public supply are more likely to be rural dwellers and therefore may also have a higher likelihood of exposure to farm animals and rural environments which are also likely to increase their risk.

Outbreaks

In total 20 cryptosporidiosis outbreaks were reported in 2016 (1 general and 19 family outbreaks), similar to the total number reported in 2014 and 2015. Overall since 2011 there has been an increase in the number of outbreaks notified.

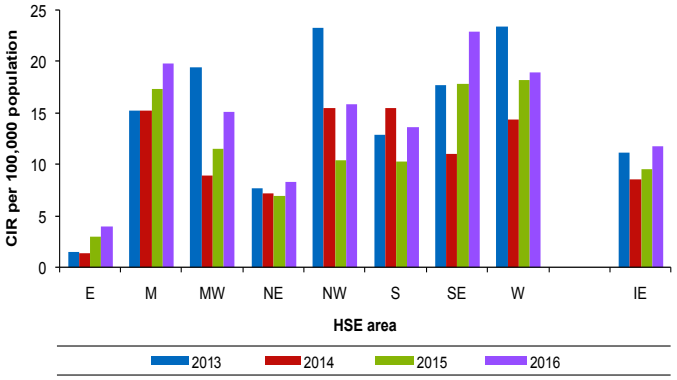

Figure 3. Regional crude incidence rates (CIR) cryptosporidiosis, Ireland, 2013-2016

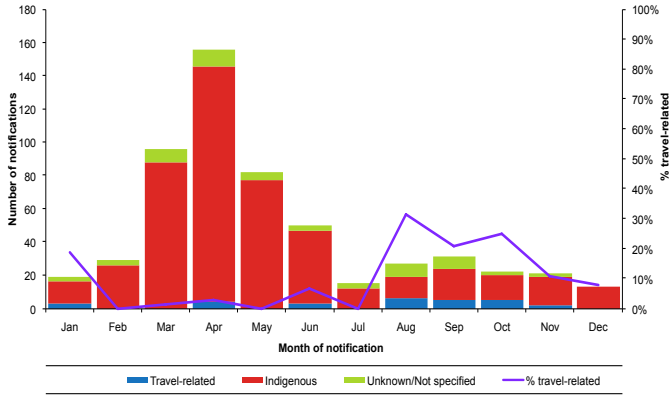

Figure 4. Seasonal distribution of cryptosporidiosis cases based on country of infection, Ireland, 2016

Table 1. Number of cases (and percentage of cases where information available) where selected risk factors were reported for cryptosporidiosis cases (n=561), Ireland, 2016

Risk factor	Yes	No	Unknown / Not specified	% of known
Travel outside of Ireland[a]	30	477	54	5.9%
Lives/cared for on farm	163	345	53	32.1%
Visited farm	183	279	99	39.6%
Lives/works on or visited farm[b]	303	174	84	63.5%
Swimming pool visit	121	375	65	24.4%
Other water based activities	31	353	177	8.1%
Contact with domestic pets	329	162	70	67.0%

[a]*Based on country of infection variable*
[b]*Composite of the two previous variables*

Table 2. Number of cases (and percentage of cases where information is available) by home water supply type compared to the number and percentage of households by water supply type, Ireland 2016

Home water supply of notified cases	Number of cases	% of known cases	No. households served by these water supply types in the general population 2016 (Census 2016)	% of known households	P value*
Group water scheme (private)	30	5.8%	40952	2.5%	
Group water scheme (public)	32	6.2%	106278	6.5%	
Other	1	0.2%	2281	0.1%	<0.001
Private well	130	25.1%	171926	10.6%	
Public water supply	325	62.7%	1306678	80.3%	
Unknown/not specified	43		69550		
Total	**561**		1697665	100%	

*Comparing the proportion of cases and households served by public water supplies versus all other supply types: X^2=100.25, P<0.001

This is most likely due to the increased recognition of small family outbreaks following the introduction of enhanced surveillance for cryptosporidiosis cases late in 2010.

The one general outbreak notified was associated with a childcare facility (Table 3 and Figure 5). This is fewest number of general cryptosporidiosis outbreaks reported in a single year since 2010.

The 19 family outbreaks notified in 2016 occurred in private homes; 43 cases were ill and seven were hospitalised. The most common transmission route reported in these outbreaks was by animal contact (seven outbreaks, 17 persons ill, five hospitalised), followed by person-to-person spread (three outbreaks, seven persons ill and no-one hospitalised), and waterborne (two outbreaks, six persons ill, no-one hospitalised). The transmission route was unknown for the remaining seven family outbreaks; 13 persons ill including two hospitalised cases (Table 3).

Summary

In 2016, the incidence of cryptosporidiosis in Ireland increased compared with 2015, being the highest reported incidence since 2012. It also remains high relative to most other EU countries with surveillance for cryptosporidiosis. The seasonal, age and regional distribution in incidence reported in 2016 was also typical of previous years; consistently there has been a higher incidence in springtime, in young children and in non HSE-E areas.

Outbreak and case-based surveillance data are consistent with animal contact being an important risk factor for cryptosporidiosis in Ireland; over half of notified cases reported contact with a farm. Person-to-person spread also appears to be an important mode of transmission. From the enhanced information on CIDR, exposure to water from non public supplies appears to present a higher risk of cryptosporidiosis; persons who are not served by public water supplies were over-represented among the sporadic cases relative to the distribution of households by water supply type nationally.

References

1.ECDC. Surveillance Atlas of Infectious Diseases. Available at http://atlas.ecdc.europa.eu/public/index.aspx?Dataset=27&FixDataset=1

Table 3: Number of outbreaks and number ill by transmission route and location, Ireland 2016

Outbreak location	Person-to-person		Waterborne		Animal/ Environmental contact		UNK/Not specified		Total	
	No. out-breaks	No. ill	No. outbreaks	No. ill	No. outbreaks	No. ill	No. outbreaks	No. ill	No. outbreaks	No. ill
Childcare facility	1	4	0	0	0	0	0	0	**1**	**4**
Extended family	0	0	0	0	1	5	0	0	**1**	**5**
Private house	3	7	2	6	6	12	6	10	**17**	**35**
Travel related	0	0	0	0	0	0	1	3	**1**	**3**
Total	**4**	**11**	**2**	**6**	**7**	**17**	**7**	**13**	**20**	**47**

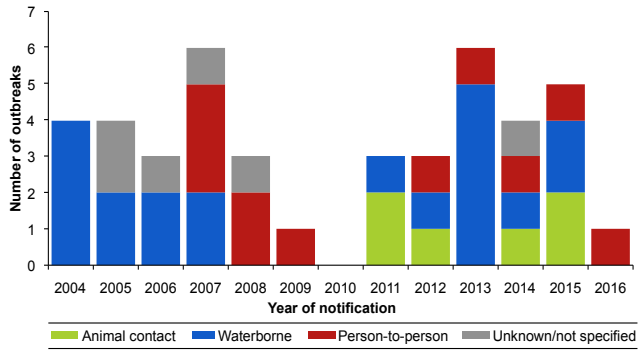

Figure 5. Number of general cryptosporidiosis outbreaks by transmission route and year, Ireland 2004-2016

Note: In this figure, reported transmission routes were grouped for simplicity. Any outbreak where food contributed was reported as foodborne, any outbreak where water contributed was reported as waterborne, any outbreak where animal contact contributed was reported as animal contact. Person-to-person outbreaks include only those outbreaks reported as being due only to person-to-person transmission.

3.3 Verotoxigenic *E. coli*

Summary

Number of VTEC cases, 2016: 839
Crude incidence rate, 2016: 17.6/100,000
Number of VTEC-associated HUS, 2016: 32
Number of VTEC cases, 2015: 730

For many years, Ireland has the highest verotoxigenic *Escherichia coli* (VTEC) notification rate in Europe, with the exception of 2011 when Germany reported the highest rate due to a large VTEC O104 outbreak linked with fenugreek seeds.[1-2] In 2015 (the most recent data available), the notification rate for confirmed VTEC cases in the European Union/European Economic Area was 1.33 per 100,000 (similar to 2014; 1.56/100,000) and the highest country-specific rates were in Ireland, the Netherlands and Norway (12.9, 5.1 and 4.3 per 100,000 population, respectively).[3]

The dominant transmission routes reported for VTEC infection in Ireland have been person-to-person spread, especially in childcare facilities and among families with young children, and waterborne transmission associated with exposure to water from untreated or poorly treated private water sources.[4-8] Other important transmission routes identified internationally include food (often minced beef products or fresh produce such as lettuce and spinach), and contact with infected animals or contaminated environments.[2, 9-10]

Materials and Methods

Infection with verotoxigenic *E. coli* became a notifiable disease in 2012; prior to that, VTEC had been notifiable under the category Enterohaemorrhagic *E. coli* (EHEC) since 2004. Enhanced epidemiological information was supplied as in previous years by HSE personnel, and the VTEC National Reference Laboratory at the Public Health Laboratory, Cherry Orchard Hospital Dublin (VTEC-NRL at PHL) provided VTEC confirmation and typing data. Data from all sources are maintained in the Computerised Infectious Disease Reporting (CIDR) system. Outbreaks of VTEC are notifiable since 2004 and these data are reported to CIDR by the eight regional Departments of Public Health.
Data from the Central Statistics Office (CSO) 2016 census were used to provide denominators for the calculation of national, regional and age-specific incidence rates in 2016.

Results

Incidence

In 2016, 839 cases of VTEC were notified in Ireland, equating to a crude incidence rate (CIR) of 17.6 per 100,000 (95% CI 16.4-18.8). Compared with 2015 (15.9 per 100,000) there was a 15% increase in the incidence of VTEC. Of the 839 VTEC notifications in 2016, 740 (88%) were classified as confirmed cases, 96 (11%) as probable cases and three as possible cases. The criteria under which notified cases were reported in 2016 are outlined in Table 1. As the classification of VTEC cases changed significantly upon the amendment of the Irish VTEC case definition in 2012, it is not valid to directly compare the number of notifications by case classification before 2012.

Of the 832 cases with laboratory evidence of infection, 697 were culture confirmed (268 with VTEC O26 and 174 with VTEC O157, with the remaining 255 caused by other serogroups), 135 were confirmed by PCR but were culture negative (includes 7 in which genes for serogroup O26

Table 1. Number of VTEC notifications by criteria for notification and case classification, Ireland, 2016

Notification criteria	Confirmed	Probable	Possible	Total
Laboratory confirmation by culture[a]	623	74		**697**
Laboratory confirmation by PCR only[b]	117	18		**135**
Reported solely on the basis of epidemiological link		4		**4**
Clinical HUS not meeting lab or epi criteria			3	**3**
Total	**740**	**96**	**3**	**839**

[a] Symptomatic culture confirmed cases are classified as confirmed cases, while asymptomatic culture confirmed cases are classified as probable cases
[b] Symptomatic PCR-confirmed cases are classified as confirmed cases, while asymptomatic PCR-confirmed cases are classified as probable cases

detected and 10 in which genes for serogroup O157 detected) (Tables 1 and 2). Until 2012, VTEC O157 were more commonly reported in Ireland than other serogroups; this trends was reversed since then with VTEC O157 accounting for just a quarter of notified cases in 2016 (Figure 1). VTEC O26 is now the most common serogroup reported accounting for almost 40% of cases in 2016. The crude incidence rate for VTEC O26 infections stands at 5.78/100,000 and for O157 stands at 3.86 per 100,000.

Severity of illness

Of the 839 notified cases in 2015, 713 (85%) were symptomatic. Among symptomatic cases (and where information available), 675/700 (91%) reported diarrhoea, 246/641 (38%) reported vomiting, 200/597 (34%) reported fever, 247/533 (46%) reported nausea, 425/600 (71%) reported abdominal pain and 261/666 (39%) developed bloody diarrhoea. Thirty two individuals developed HUS (3.8% of all notifications; 4.5% of symptomatic cases). This is the highest number of HUS cases since 2012 (n=33).

In 2016, 313 VTEC cases were hospitalised (38% of all notified cases; 42% of symptomatic). Six deaths occurred among VTEC cases, however none of these deaths was attributed to VTEC infection.

Of the 32 HUS cases, 12 were culture confirmed with *E. coli* O26, seven with *E. coli* O157, two with *E. coli* O145, one each

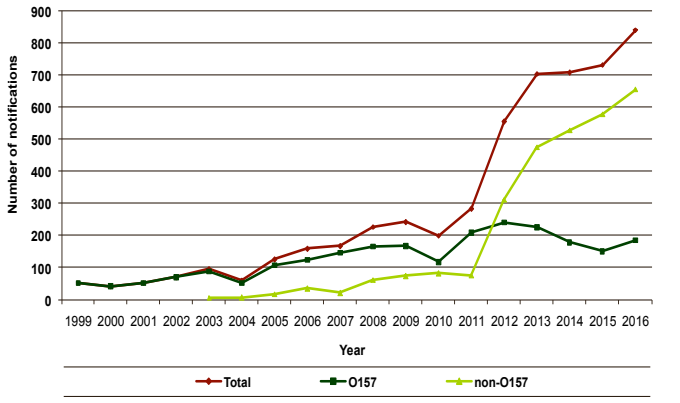

Figure 1. Annual number of confirmed and probable VTEC cases by serogroup, Ireland 1999-2016
Note: For simplicity in this figure, cases with mixed VTEC O157/other serogroup infections are included in the data for O157, as are probable cases linked to known E. coli O157 outbreaks. Non-O157 data includes cases with mixed non-O157 infections and probable cases linked to known O26 outbreaks

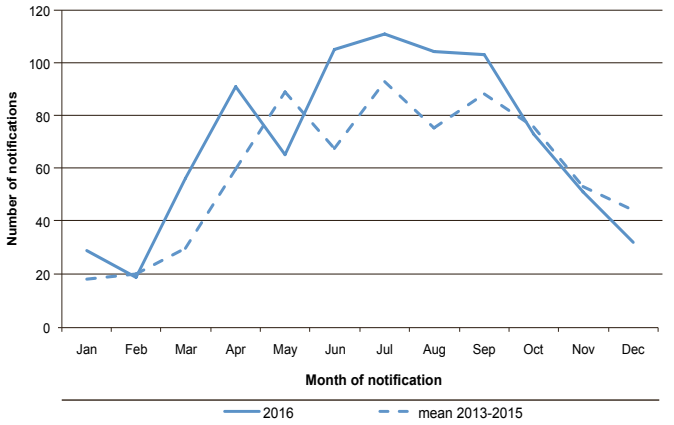

Figure 2. Seasonal distribution of the number of VTEC notifications in Ireland, 2016 and the mean of 2013-2015

Table 2. Number of VTEC notifications by serogroup, verotoxin and HUS status, Ireland, 2016

	Serogroup[a]	Verotoxin	HUS	non-HUS	Total	% with HUS
Laboratory confirmation by culture	O26	*vt1*	0	81	81	0%
		vt2	4	8	12	33%
		vt1+vt2	8	166	174	4.6%
		Not reported	0	1	1	0.0%
	O157	*vt1*	0	0	0	0.0%
		vt2	4	95	99	4.0%
		vt1+vt2	3	69	72	4.2%
		Not reported	0	3	3	0.0%
	Other	*vt1*	1	99	100	1.0%
		vt2	6	88	94	6.4%
		vt1+vt2	0	53	53	1.9%
		Not reported	0	8	8	0%
Laboratory confirmation by PCR only		*vt1*	0	45	45	0%
		vt2	3	54	57	5.3%
		vt1+vt2	0	29	29	0.0%
		Not reported	0	4	4	0.0%
Reported solely on the basis of epidemiological link		-	0	4	4	0.0%
Clinical HUS not meeting lab or epi criteria		-	3	0	3	100%
Total		**-**	**32**	**807**	**839**	**3.8%**

[a]For simplicity mixed infections were recorded as O157 if at least one strain was O157, as O26 if at least one strain was O26 but not O157, and as Other if only non-O157 or non-O26 strains were detected.

with *E. coli* O182, O2, O113, O103, and O148. Three were reported on the basis of a PCR positive result without culture confirmation and three were possible cases (i.e. clinical HUS, without meeting laboratory or epidemiological criteria).
HUS cases ranged in age from 1 month to 80 years and 69% (n=22) were in children under 15 years of age. Twenty-two of the HUS cases were considered sporadic, seven were part of family outbreaks and three were part of general outbreaks.

Seasonal distribution

Figure 2 shows the seasonal distribution of notifications in 2016 relative to the mean monthly number of cases in the years 2013-2015. Two peaks were observed in 2016; a smaller peak in April with a larger more protracted peak from June to October. As in previous years [19], VTEC O26 cases were more prevalent in the April-June period with VTEC O157 being more prevalent in July to October; infections due to all serogroups were uncommon in winter months (Figure 3).

Regional distribution

In 2016, the highest VTEC incidence rates were reported in the HSE-M and the HSE-MW. The rates were also significantly higher than the national crude incidence rate in the HSE-S, -SE and –W (Table 3). The incidence rates of VTEC in HSE-E, HSE-NE and HSE-NW were significantly lower than the national crude incidence rate. The highest incidence of VTEC-associated HUS was in HSE-MW and HSE-W (Table 3).

In the HSE areas except the HSE-E, the incidence of *E. coli* O26 in 2016 exceeded or equaled that of *E. coli* O157 (Figure 4).

Age-sex distribution

As in previous years, the highest reported age-specific incidence rate in 2016 was in the 0-4 year age group (94.7 per 100,000) (Figure 5).

Laboratory typing

In 2016, serogroup (culture positives only) and the verotoxin profiles of VTEC isolates/samples referred to the VTEC-NRL at PHL, Cherry Orchard Hospital are presented in Table 4. The most common serogroup reported among culture positive notifications was *E. coli* O26 (n=268), followed by *E. coli* O157 (n=174). Among the other serogroups listed by the World Health Organisation as having the highest association with HUS internationally, there were 45 *E. coli* O145, 12 *E. coli* O103 cases and 11 *E. coli* O111. Other serogroups with significant numbers of cases in 2016 included O91, O146 and O182.

As usual among *E. coli* O157 cases in Ireland, isolates containing the genes for *vt2* were more common (57%) than strains containing genes for both *vt1* and *vt2,* although a higher proportion of vt1 and vt2- containing strains of VTEC O157 were reported than in 2015. Among the VTEC O26 strains, those containing the genes for both *vt1* and *vt2* accounted for the majority (65%), followed by *vt1* only (30%) and those containing *vt2* making up the remaining 4% of *E. coli* O26 cases (Table 4).

Risk factors

Under the enhanced surveillance system for VTEC, risk factor information is routinely collected on all notifications (Table 5). Exposure to farm animals or their faeces and exposure to private well water were relatively common among cases in 2016; 38% and 44% reported these exposures, respectively. According to CSO data, in the general population, around 10.6% of households are served by private wells, indicating

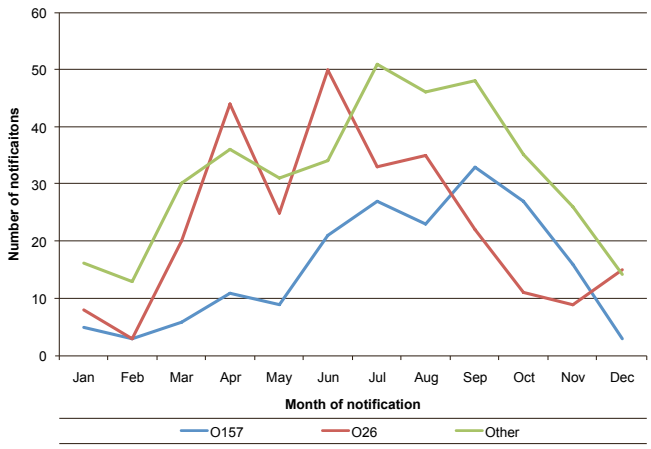

Figure 3: Seasonal distribution of VTEC notifications by serogroup, Ireland, 2016
For simplicity mixed infections were recorded as O157 if at least one strain was O157, as O26 if at least one strain was O26 but not O157, and as Other if only non-O157 or non-O26 strains were detected.

Table 3. Number and crude incidence rate VTEC by HSE area, and number and crude incidence rate of VTEC-associated HUS by HSE area, Ireland, 2016

HSE-area	Number of VTEC cases	Crude incidence rate /100,000 (95% CI)	Number HUS cases	Incidence of HUS /100,000 (95% CI)
E	131	7.7 (6.3-9.0)	4	0.2 (0.0-0.5)
M	92	32 (25-38)	1	0.3 (-0.3-1.0)
MW	124	32 (27-38)	7	1.8 (0.5-3.2)
NE	52	11 (8.2-14)	4	0.9 (0.0-1.7)
NW	31	12 (7.8-16)	1	0.4 (-0.4-1.1)
S	159	23 (19-27)	5	0.7 (0.1-1.4)
SE	131	26 (21-30)	4	0.8 (0.0-1.6)
W	119	26 (22-31)	6	1.3 (0.3-2.4)
IE	839	18 (16-19)	32	0.7 (0.4-0.9)

that, on a national basis, exposure to private wells appears to be more common among VTEC cases than among the general population. Unlike salmonellosis, foreign travel plays only a minor role in VTEC infection in Ireland, with the majority of infections acquired indigenously (96%). Where the information was available, just under a fifth of VTEC cases in 2016 were attending a childcare facility (CCF). When these analyses were restricted to notified VTEC under five years of age, 45% reported attendance at a childcare facility. This is similar to the proportion of children in the general population who use non-parental childcare (42%) as reported by the Central Statistics Office.[11]

Outbreak and environmental investigations

The outbreak surveillance system plays a key role in our understanding of the transmission of VTEC infection in Ireland. Ninety-eight VTEC outbreaks were notified in 2016, which included 250 of the 839 VTEC notifications. Forty-six outbreaks were due to *E. coli* O26, 21 to *E. coli* O157, 14 were mixed *E. coli* strain outbreaks, and 17 were caused by other VTEC strains.

The majority of outbreaks (n=91, 93%) were family outbreaks, with seven general outbreaks also notified. The 91 family outbreaks resulted in 175 persons becoming ill, with 30 hospitalised. The seven general outbreaks resulted in 52 persons becoming ill, with eight hospitalised. Eighty-four outbreaks occurred in private homes, six involved extended families, five involved childcare facilities, and there was one outbreak each in the community, associated with a pet farm (family outbreak) and associated with a restaurant. The suspected modes of transmission are listed in Table 6.

Person-to-person spread is consistently the most common mode of VTEC transmission reported in Ireland, particularly between young children, and was suspected to have played a role in 42 (56%) VTEC outbreaks in 2016 in which 107 persons were reported ill (Table 6 and Figure 5). Thirty-three of these outbreaks were reported as being solely due to person-to-person transmission, including four outbreaks which occurred in CCFs.

Waterborne transmission was reported to have contributed to 11 outbreaks (11%) with 29 persons ill.
This is lower than the number of waterborne VTEC outbreaks reported in 2015 (n=19) and 2012 (n=21) but similar to the number reported in 2013 (n=8) and 2014 (n=9) (Figure 6). Of the 11 outbreaks with links to waterborne transmission, ten were family outbreaks and one an extended family outbreak. At least nine outbreaks were associated with exposure to private wells; in five cases, the water quality was reported to be unsatisfactory.

Animal/environmental contact was reported to have contributed to 13 outbreaks (13%) with 22 persons ill (Figure 6). All were linked with private houses.

Three outbreaks were reported where food was believed to have contributed to transmission. Two were family outbreaks, while one general outbreak was reported associated with a restaurant. During the general outbreak investigation,eleven outbreak-related cases were identified, four of whom were hospitalised. Epidemiological, environmental and microbiological findings pointed to the serving of undercooked burgers as the likely cause.

For 39% (n=38) of VTEC outbreaks in 2015, the transmission route was reported as unknown (Table 6 and Figure 6).

Summary

The number of VTEC notifications in Ireland continued to rise in 2016. Within the European Union, Ireland continues to have the highest incidence rate for VTEC, reporting over seven times the European average in 2015.[3]

The upward trend observed in Ireland in recent years of non-O157 notifications continued in 2016 and reflects the more widespread use by the primary hospital laboratories

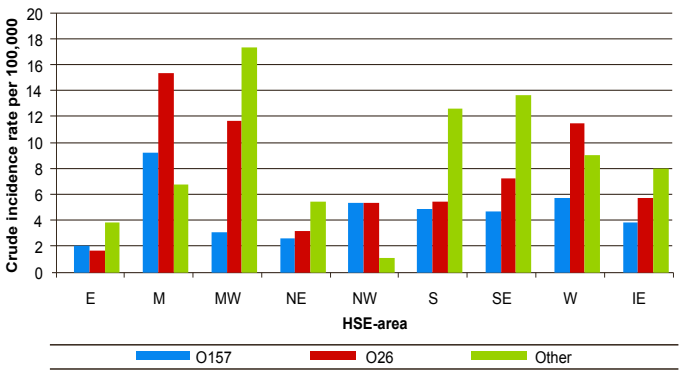

Figure 4: Crude incidence rate VTEC O157, O26 and other serogroups by HSE area, Ireland, 2016
For simplicity mixed infections were recorded as O157 if at least one strain was O157, as O26 if at least one strain was O26 but not O157, and as Other if only non-O157 or non-O26 strains were detected.

Table 4. Serotype and verotoxin (vt) profiles for strains associated with laboratory confirmed VTEC cases, as determined at the VTEC-NRL at PHL, Cherry Orchard Hospital, 2016

	Serogroup	VT1	VT1 + VT2	VT2	Not reported	Total
Culture positive notifications	O26	81	174	12	1	268
	O157	0	72	99	3	174
	O145	2	5	38	0	45
	O91	4	11	5	0	20
	O146	11	2	2	0	15
	O182	12	1	0	0	13
	O103	9	0	2	1	12
	O113	0	2	9	0	11
	O111	3	7	1	0	11
	O5	11	0	0	0	11
	Other*	48	25	37	7	117
PCR positive culture negative notifications		45	29	57	4	135

*Other includes Ungroupable strains

of diagnostic methods that detect a broader range of *E. coli* serogroups and the use of more sensitive molecular methods that detect verotoxin genes directly in stool samples[12] National guidance developed for the laboratory diagnosis of human VTEC in Ireland provides a co-ordinated approach to VTEC diagnosis in Ireland.[13]

Foodborne transmission was the first recognised transmission route for VTEC infection historically, with minced beef, unpasteurised dairy products, and fresh produce consumed raw all having been implicated in outbreaks across the world. Foodborne outbreaks typically comprise a small percentage of the total number of VTEC outbreaks in Ireland; this was also true for 2016, however, the general outbreak in 2016 associated with undercooked burgers underscored the importance of vigilance in relation to thorough cooking of burgers. The FSAI updated its advice to caterers in its Feb 2017 factsheet 'Advice for Caterers on Serving Burgers that are Safe to Eat'.[20] The advice emphasised that minced meat burgers should be fully cooked to ensure they are safe to eat and that 'caterers should not serve, offer or advertise undercooked or 'pink' burgers'.

Transmission by person-to-person spread, however, remained the most common transmission route reported in VTEC outbreaks and was involved in 56% of outbreaks. As usual, person-to-person spread was most frequently associated with private house and childcare facility outbreaks. Hand-washing and exclusion of cases in risk groups from high risk settings remains a key prevention measures for VTEC.[14]

In 2016, after person-to person spread, animal/ environmental contact was reported as the second most common route of transmission for VTEC outbreaks. This has long been recognised as a risk factor for VTEC infection [9-10] and cases due to this transmission route are not unexpected in Ireland given the large cattle population, the high proportion of rural dwellers, and the large number of farming families.[8] Advice is available on the HPSC website on how to minimise the risk of gastrointestinal infections following exposure to farm animals and environments, and for the safe recreational use of farmland.[16]

Contaminated drinking water was the third most commonly suspected mode of transmission. As in previous years, the outbreaks reported were linked with private water supplies. Exposure to water from contaminated untreated or poorly treated private water supplies has historically been recognised as a strong risk factor for VTEC infection in Ireland.[6-8, 15]This has been particularly pronounced following periods of heavy rainfall.

The focus for reducing the incidence of VTEC should be on reducing person-to-person and waterborne transmission. Efforts should focus initially on publicizing materials already developed in Ireland, including national guidance for crèche owners on the management of infectious-disease spread in CCFs [17], guidance for public health professionals on the

Table 5. Number of cases of VTEC (and percentage where information available) for selected risk factors, Ireland, 2016 (n=839)

Risk factor	Yes (% of known)	No	Unknown or not reported
Food suspected	44 (7.8%)	522	273
Exposure to farm animals or their faeces	289 (38%)	476	74
Exposure to private well water[a]	229 (44%)	523	87
Travel-associated[b]	30 (4.0%)	741	68
Attendance at a CCF[c]	140 (19%)	616	83
Attendance at a CCF[c] (among <5 yrs)	130 (45%)	159	22

[a]*Composite variable recoded from two different water supply exposure enhanced variables in CIDR*
[b]*Inferred from CIDR core variable Country of Infection*
[c] *CCF=childcare facility*

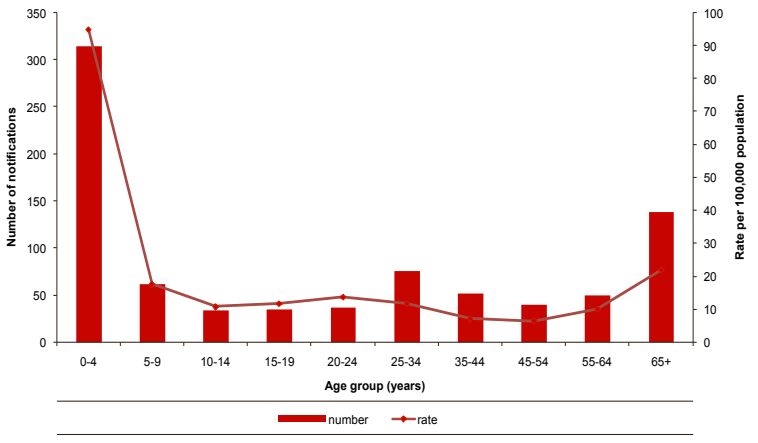

Figure 5. Number of notifications by age group, and age-specific VTEC incidence rates, Ireland 2016

management of VTEC cases and outbreaks in CCFs[14] and a leaflet developed for well owners outlining the infectious disease risks associated with drinking water from private wells, providing advice on actions that can be taken and what to do in the event the well water is contaminated.[18]

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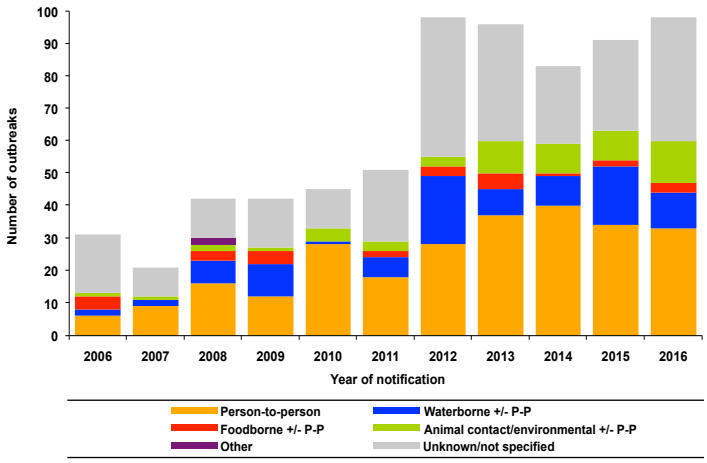

Figure 6. Number of VTEC outbreaks by suspected transmission route and year, Ireland, 2006-2016

Note: In this figure, reported transmission routes were grouped for simplicity. Any outbreak where food contributed was reported as foodborne, any outbreak where water contributed was reported as waterborne, any other outbreak where animal contact contributed was reported as animal contact. Person-to-person outbreaks include only those outbreaks reported as being due only to person-to-person transmission.

Table 6. VTEC outbreaks by suspected mode of transmission, Ireland, 2016

Transmission route	Number of outbreaks	Number ill	Number of associated CIDR events[a]
Person-to-person	33	84	80
Foodborne +/- person-to-person	3	16	31
Waterborne +/- person-to-person	11	24	29
Animal contact/Environment +/- person-to-person	13	22	26
Unknown/Not specified	38	80	84
Total	**98**	**226**	**250**

[a] *These figures may differ from the number ill, as asymptomatic cases identified as a result of screening will also be reported in CIDR*

3.4 Hepatitis A

Summary

Number of cases, 2016: 38
Crude notification rate, 2016: 0.8/100,000 population
Number of cases, 2015: 36

Hepatitis A is an acute self-limiting disease of the liver caused by the hepatitis A virus. The most common symptoms are fever, loss of appetite and nausea, followed within a few days by jaundice. Disease severity varies, with some people having a relatively mild disease course lasting one to two weeks and others having more severe and prolonged symptoms lasting several months. Many infected children are asymptomatic. Chronic infection does not occur. The virus is shed in the faeces of infected people and is primarily spread from person to person by the faecal-oral route (via hands or other objects or through food or water that has been contaminated with the faeces of an infected person, or directly through oral-anal contact).[1]

Hepatitis A infection occurs worldwide, but the risk of infection varies with levels of sanitation and personal hygiene. Ireland is considered a low incidence country. Over the past decade the number of cases reported each year has ranged from 19 to 50. Most cases notified in Ireland have a history of recent

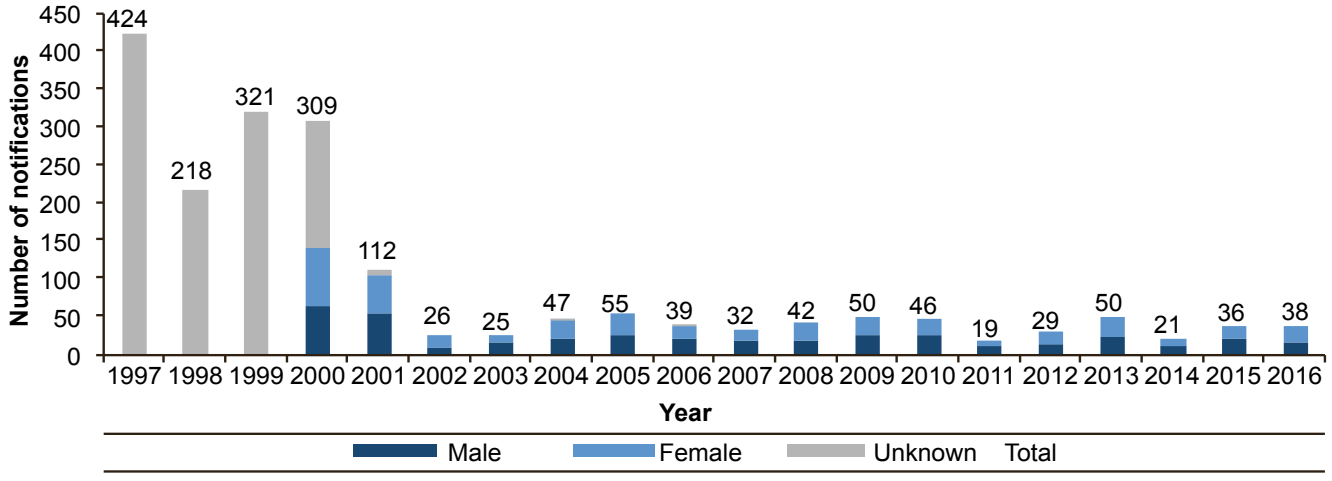

Figure 1. Number of hepatitis A notifications, by sex, 1997-2016

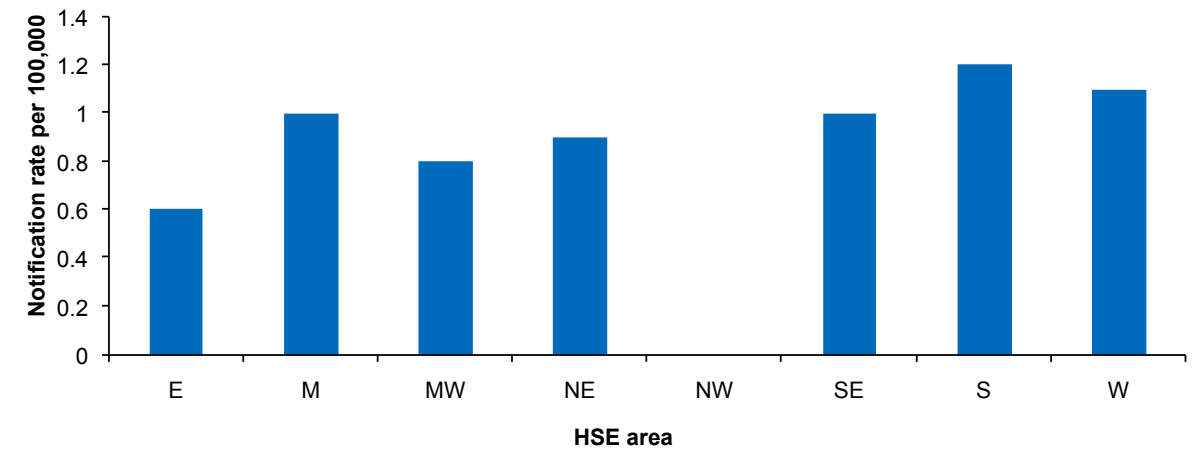

Figure 2. Notification rate for hepatitis A by HSE area, 2016

travel or are part of small family outbreaks, often including an index case who has travelled outside Ireland. There is a safe, effective vaccine for hepatitis A.[1]

The incidence of hepatitis A in Ireland has been low in recent years and remained low in 2016, with 38 cases notified (0.8/100,000 population) (figure 1). This was very similar to 2015 (n=36, 0.8/100,000 population) and the average number of cases notified annually over the past ten years (mean: 36, median: 37). Case classification was reported for all cases and thirty seven (97%) were laboratory confirmed. The notification rate in each HSE area is shown in figure 2.

Forty two percent (n=16) of cases in 2016 were male and 58% (n=22) were female. The highest notification rates were in children and young to middle-aged adults, with 53% (n=20) of cases aged between 0 and 14 years and 39% (n=15) aged 25-44 years (figure 3).

There were 14 sporadic cases of hepatitis A in 2016 and 24 cases associated with nine distinct outbreaks. Eight of the sporadic cases were likely to have been infected outside Ireland and six were infected in Ireland. One of the cases infected in Ireland was linked to a household contact visiting from an endemic country. The index cases in eight of the nine outbreaks were infected outside Ireland. The one outbreak not associated with travel involved two children in HSE E and no source of infection was identified. Aside from Ireland, the most common countries of infection were Sudan (n=6, 4 cases associated with two outbreaks and 2 sporadic cases), Egypt (n=5, 4 linked cases and one sporadic case), Pakistan (n=4, 3 linked cases and 1 sporadic case) and Spain (n=3, 2 cases associated with an outbreak and 1 index case in an outbreak with additional cases infected in Ireland).

The figures presented in this summary are based on data extracted from the Computerised Infectious Disease Reporting (CIDR) System on 2nd October 2017. These figures may differ from those published previously due to ongoing updating of notification data on CIDR. Notification rates are expressed per 100,000 population and are calculated using the 2016 census.

Acknowledgements

HPSC would like to thank all those who provided data for this report – Departments of Public Health, laboratories and clinicians.

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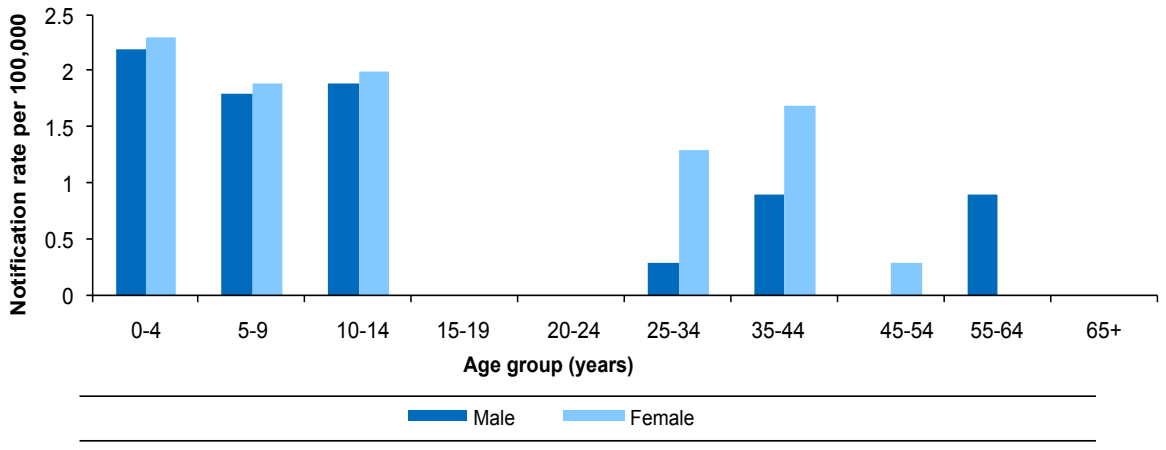

Figure 3. Hepatitis A age and sex-specific notification rates/100,000 population, 2016

3.5 Hepatitis E

Summary

Number of cases notified, 2016: 90

Number of clinical cases: 56

Crude notification rate clinical cases, 2016: 1.2/100,000 population

Number of cases detected through blood donor screening: 34

Combined clinical and blood donor screening notification rate: 1.9/100,000 population

Percentage of blood donors HEV positive, 2016: 0.044%

Hepatitis E infection is a disease of the liver caused by hepatitis E virus (HEV), a virus which can infect both animals and humans. Most HEV infections are asymptomatic or mildly symptomatic. Therefore, a large proportion of cases are not diagnosed. However, hepatitis E infection can cause liver failure in those with pre-existing liver disease or in pregnant women. Infection is usually self-limiting and resolves in one to five weeks without any treatment. Rarely, chronic hepatitis E infection may develop in people who have a suppressed immune system.[1]

In developed countries, HEV is usually spread from animals to humans through the consumption of undercooked pig and game meat, processed pork or shellfish. It can also be spread directly through handling animals, particularly pigs.[1] A study of pigs in the United Kingdom found that 6% were infected with HEV at the time of slaughter and that 93% had antibodies against HEV (current or past infection).[2] Direct spread of hepatitis E from person to person is very rare, although the virus has passed between people through blood transfusions.[3]

Traditionally, hepatitis E was considered an infection associated with travel to areas with poor sanitation. However, an increasing number of indigenous cases have been identified across Europe in recent years and this led to hepatitis E becoming notifiable in Ireland on December 15th 2015 (Amendment to the Infectious Diseases Regulations, SI 566). The Irish Blood Transfusion Service (IBTS) introduced HEV screening for all blood donations on January 4th 2016.

In order to collect information on the clinical features and risk factors for HEV infection in Ireland, the Departments of Public Health and the IBTS agreed to complete enhanced surveillance forms (ESF) for hepatitis E cases (www.hpsc.ie/a-z/hepatitis/hepatitise/surveillanceforms/) for a one year trial period from the start of July 2016 to the end of June 2017. The IBTS completed the ESF developed by Public Health England from January to June 2016 and

*Table 1. Number and percentage of cases who responded "yes" to each symptom and Fisher's exact test p-value for a difference between clinical and IBTS blood donor screening cases (p≤0.05 indicates a significant difference)**

	Clinical cases		IBTS blood donor screening cases		All		P-value
	Num	%	Num	%	Num	%	
Any symptoms	15	88.2	10	33.3	25	53.2	0.001
Loss of appetite	11	68.8	3	10.0	14	30.4	<0.001
Joint pain	10	62.5	0	0.0	10	21.7	<0.001
Dark coloured urine	8	50.0	1	3.3	9	19.6	<0.001
Fever	7	46.7	2	6.7	9	20.0	0.003
Jaundice	7	43.8	1	3.3	8	17.4	0.001
Weakness of limbs/tingling	6	37.5	0	0.0	6	13.0	0.001
Nausea	5	33.3	2	6.7	7	15.6	0.032
Abdominal pain	4	26.7	3	10.0	7	15.6	0.199
Headaches	4	26.7	0	0.0	4	8.9	0.009
Vomiting	3	18.8	0	0.0	3	6.7	0.039
Diarrhoea	0	0.0	2	6.7	2	5.3	1
Other neurological symptoms	4	30.8	0	0.0	4	9.3	0.006
Other symptoms	9	64.3	7	23.3	16	36.4	0.017

*Information only available for those for whom enhanced forms were completed (17 clinical and 30 IBTS blood donor screening cases, cases with no response for a given question were not included in the denominator for that question)

they provided copies of these forms to HPSC. This form was similar to the one adopted in Ireland in July 2016 and the data collected were comparable. The IBTS also provided data on the total number of blood donors and the number who tested positive for current HEV infection, by age and sex, in 2016.

This is the first report on hepatitis E notifications in Ireland. The figures presented in this summary are based on data extracted from the Computerised Infectious Disease Reporting (CIDR) System on 13th September 2017 and from an in-house database used for enhanced data. HEV notification rates for clinical cases are expressed per 100,000 population and are calculated using the 2016 census. IBTS blood donor denominator data were used for calculating the percentage of blood donors who tested positive for HEV.

Results

There were 90 notifications of hepatitis E in 2016 (1.9/100,000 population). The most likely country of infection was available for 46% (n=41) of cases. Of these, 90% (n=37) were likely to have been infected in Ireland. Country of birth was available for 41% (n=37) and 89% (n=33) of these were born in Ireland. There were no cases notified in females who were pregnant and only a small number of cases reported regular medications or pre-existing serious diseases that would be likely to impact on the severity of their HEV infection.

Clinical cases (n=56)

Sixty two percent (n=56, 1.2/100,000 population) of HEV notifications were clinical cases. These cases were detected because they presented with clinical symptoms or liver function test results consistent with viral hepatitis. Enhanced surveillance forms were available for 71% (n=17) of clinical cases notified since July 2016, of whom 88% (n=15) were symptomatic. The most common symptoms reported were loss of appetite (69%), joint pain (63%), dark urine (50%), fever (47%) and jaundice (44%) (table 1). One patient with HEV died in 2016. His death was not attributed to HEV.

Notification rates for clinical HEV cases were significantly higher in older age groups. Almost two thirds of clinical cases (66%, n=37) were aged 50 years or older and the median age at notification was 57 years (55 years for males and 57 years for females).There were slightly more males than females, with males accounting for 55% (n=31) of clinical cases of HEV (figure 1).

Cases were distributed across all regions but notification rates were lower in HSE SE, S and W (figure 2).

Cases diagnosed through IBTS blood donor screening (n=34)

Thirty eight percent (n=34) of HEV cases notified in 2016 were blood donors detected through routine screening of blood donations. Enhanced surveillance forms were available for 88% (n=30). Cases diagnosed through

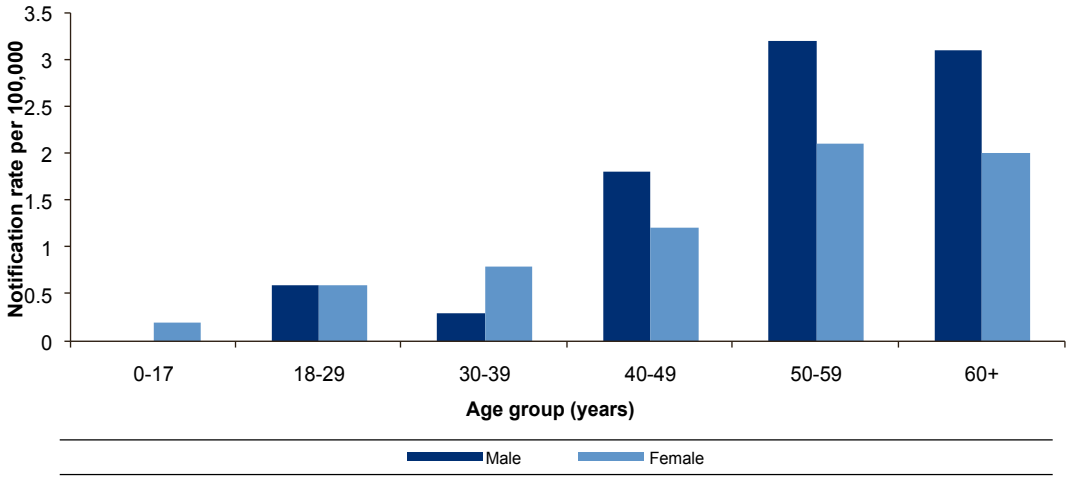

Figure 1. Age and sex specific notification rates per 100,000 population for clinical cases of hepatitis E, 2016

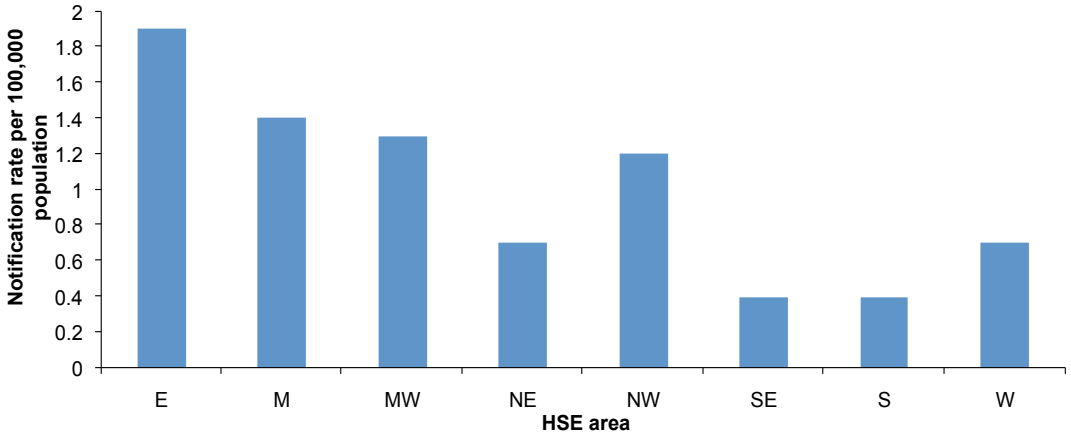

Figure 2. Notification rate for clinical cases of hepatitis E by HSE area, 2016

screening of blood donations were mostly asymptomatic, but one third (n=10) disclosed mild symptoms (mostly fatigue and gastrointestinal symptoms) when questioned post-diagnosis (table 1).

The age and sex distribution of HEV cases diagnosed through blood donor screening is influenced by the age and sex profile of blood donors. The IBTS provided denominator data on the number of blood donors in 2016 so that the percentage of donors testing HEV positive could be calculated. Although the age and sex profile of blood donors is not the same as that of the general population, the percentage who test positive for HEV provides a useful estimate of the incidence and prevalence of acute HEV infection in Ireland. The overall prevalence of HEV in blood donors in 2016 was 0.044%.

Over three quarters (76%, n=26) of HEV notifications detected through blood donor screening were male. The IBTS HEV positivity rate was significantly higher in male blood donors (0.059%) compared to female donors (0.025%) in 2016 (figure 3). The age profile of the blood donors who tested positive for HEV was much younger than that of clinical cases. Eighty five percent of cases identified through donor screening (n=29) were aged between 18 and 49 years and the median age at notification was 37.5 years (41 years for males and 25 years for females). The prevalence of HEV among blood donors aged less than 50 years (0.053%) was more than double that of those aged 50 years or older (0.024%) (figure 3).

*Table 2. Number and percentage of cases who responded "yes" to each exposure in the 9 weeks before illness or HEV diagnosis**

	All	
	Num	%
One or more pork products	44	97.8
Bacon	38	86.4
Pork meat	37	84.1
Pork sausages	37	84.1
Sliced ham, pre-packed	29	74.4
Black pudding	28	65.1
Cured pork e.g. salami	28	63.6
Ham, off the bone/joint	24	61.5
Pork pate	10	23.3
Pork pie	2	4.7
Pork liver	2	4.6
Other pork offal	0	0.0
Other pork products	7	17.5
Undercooked pork	1	3.1
Game	7	15.6
Shellfish	22	48.9
Worked at/visited farm/stable/petting farm/zoo	8	19.1
Physical contact with animals	35	77.8

*Information only available for those for whom food histories on the enhanced forms were completed (15 clinical and 30 IBTS blood donor screening cases, cases with no response for a given question were not included in the denominator for that question)

Food preferences and animal exposures

Food histories were completed for 45 cases of HEV (15 clinical cases and 30 IBTS blood donor screening cases). All but one responded that they were likely to have eaten one or more pork products in the nine weeks before illness or diagnosis (table 2). The most commonly consumed pork products were bacon (86%), pork meat (84%), pork sausages (84%) and sliced ham (74%). Except for cured pork, there were no statistically significant differences in food exposures between clinical and blood donor screening cases.

Although physical contact with animals was also very common (78% of cases), this was not a likely source of infection as contact was mostly with pets such as dogs and cats. No cases reported contact with pigs.

Discussion

The number of notifications of HEV in Ireland in 2016 was higher than was predicted prior to HEV becoming notifiable. Older males have previously been reported as being at higher risk of HEV infection[4] and indeed notification rates for clinical cases of HEV in Ireland in 2016 were marginally higher in males compared to females, and were significantly higher in those aged 50 years and over. Male blood donors were also more likely to test positive than female blood donors. However, the age profile of cases diagnosed through blood donor screening was very different to that of symptomatic cases, with younger donors more likely to test positive. Overall indications in Ireland are that older age is not associated with higher likelihood of HEV infection, just of symptomatic infection, and that males are more likely to be infected with HEV.

Although pork consumption was almost universal amongst cases of HEV in Ireland in 2016, we cannot definitively state that infection was due to pork consumption as we

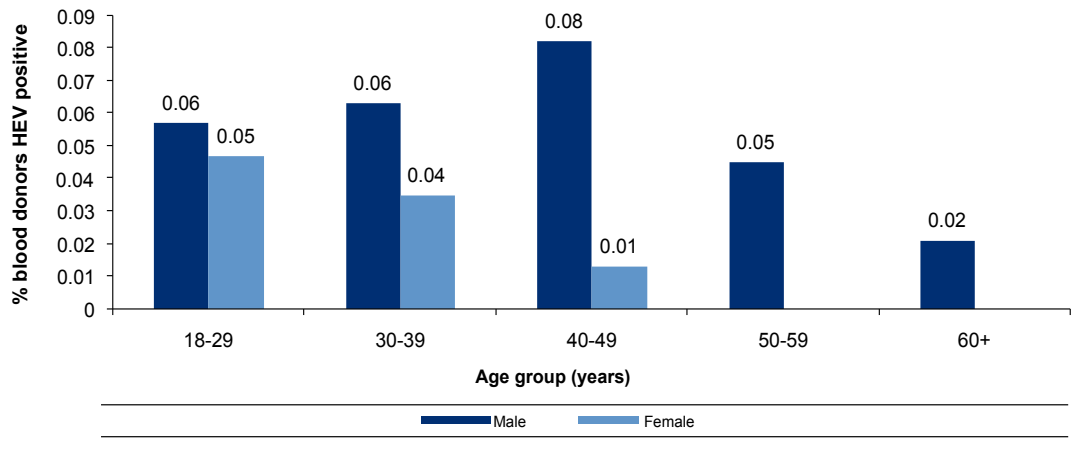

Figure 3. Percentage of blood donors who tested positive for hepatitis E, by age group and sex, 2016 (IBTS data)

do not have data from a comparable general population control group to indicate that pork consumption is higher in cases compared to non-cases. Pork consumption is likely to be very high in the general population in Ireland, particularly over a nine week time period. In a national adult nutrition survey carried out between 2008 and 2010, 1,500 participants were asked to record all food consumed over a four day time period. Meat was consumed by 98% of respondents. Seventy three percent reported consuming bacon or ham and 38% had consumed sausages.[5]

Similarly high levels of pork consumption have been found in other studies. A hepatitis E case control study, carried out in England and Wales in 2011, found that 88% of cases had consumed sausages compared to 75% of controls and that 96% of cases had consumed ham compared to 83% of controls. These differences between cases and controls were not statistically significant. However, a statistically significant association was found between the consumption of sausages and ham purchased at a particular supermarket chain and hepatitis E infection.[6]

Only one HEV case notified in Ireland in 2016 reported consumption of undercooked pork. Results from studies looking at the different combinations of time and temperature required to inactivate HEV in food have varied depending on the food or food substitute used (71°C for between 5 and 20 minutes).[4] The Food Safety Authority of Ireland currently recommends cooking pork thoroughly to a minimum of 75°C in the thickest part of the meat.[7]

Acknowledgements

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3.6 Rotavirus

Summary

Number of cases: 2,372
Crude incidence rate: 51.7/100,000 population

Rotavirus is the commonest global cause of paediatric gastrointestinal infection and causes sporadic, seasonal and occasionally severe gastroenteritis of infants and young children, characterised by vomiting, fever and watery diarrhoea. Transmission is usually person-to-person, mainly via the faecal-oral route. Children less than two years of age are most susceptible to infection, although cases are often seen in elderly and immunocompromised adults, particularly in institutional settings. By the age of six years, virtually all children will have had at least one episode of rotavirus infection. Symptoms usually last for only a few days but in severe cases hospitalisation may be required due to dehydration.

Prior to 2004, rotavirus cases were notified under the "Gastroenteritis in children under two years" disease category. From 2004 to 2010, rotavirus was notifiable in all age groups under the "Acute Infectious Gastroenteritis" (AIG) disease category, until it became notifiable as a disease in its own right under the Infectious Diseases (Amendment) Regulations 2011 (S.I. No. 452 of 2011). Since March 2013, rotavirus notifications from HSE-East are based on laboratory testing results rather than patient episodes. Notifications from HSE-E may also refer to area of laboratory testing rather than area of patient residence.

Rotarix™ vaccine was introduced in Ireland in December 2016 for all babies born from 1st October 2016 onwards. Rotarix™ is a live attenuated monovalent vaccine. Vaccine is administered orally in two doses at 2 months and 4 months. Both doses must be administered by 8 months old.

During 2016, there were 2,372 cases of rotavirus notified in Ireland, corresponding to a national crude incidence rate (CIR) of 51.7 per 100,000 population (figure 1).* This is a marked decrease of 43% compared to 2015 (90.6) and a decrease of 6.7% compared to the mean CIR during 2006-2015 (56.7).

Significant geographical variation was observed in regional

* All rates are per 100,000 population

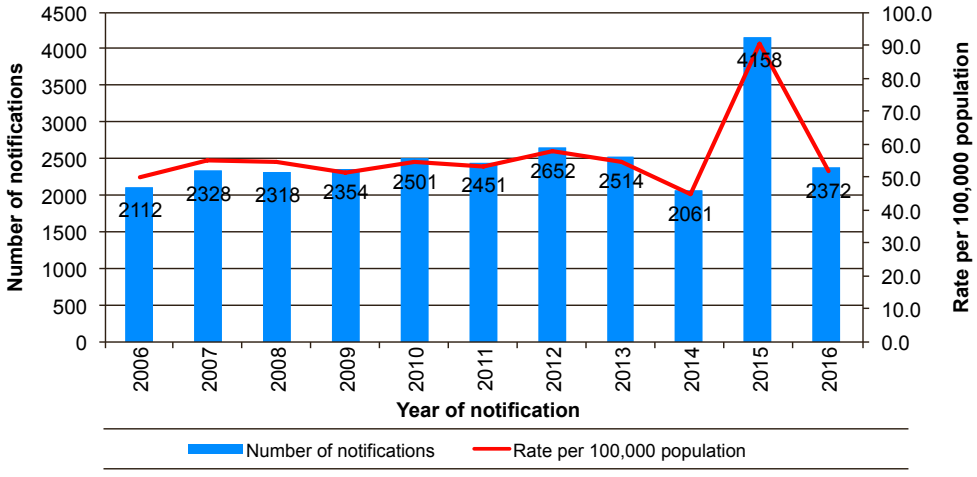

Figure 1: Number of rotavirus notifications and crude incidence rate per 100,000 population by year (CIDR)

rotavirus CIR. The highest regional CIRs were observed in HSE-M (73.3), -SE (58.3) and -W (54.8). The lowest regional CIR was observed in HSE-NW (38.3) and HSE-NE (44.5).

Rotavirus infection has a well-documented seasonal pattern in Ireland with the number of cases typically peaking during March to May. During 2016, rotavirus notifications peaked during May (n=594) and June (n=476). Figure 2 illustrates the seasonal variation in rotavirus cases by month of notification for 2016 compared to the mean monthly number of notifications reported during 2006 to 2015.

During 2016, 1,100 cases (46.4%) were female and 1,269 (53.5%) were male. Sex was not reported for the remaining three cases.

Seven outbreaks of rotavirus were notified during 2016 with 55 cases of associated illness, five of whom were hospitalised. Five general outbreaks occurred, two in child-care facilities, two in nursing homes and one in a hospital. The remaining two outbreaks were family outbreaks that occurred in private homes. Six outbreaks reported mode of transmission as person to person or airborne spread while mode of transmission was unknown for the remaining outbreak.

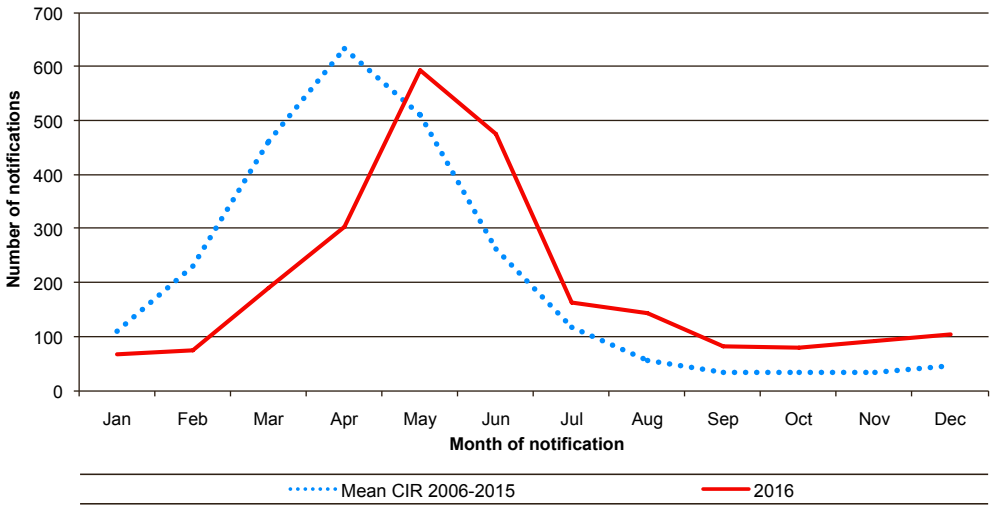

Figure 2: Number of rotavirus notifications by month, 2016 compared to mean monthly number of notifications 2006-2015 (CIDR)

3.7 Salmonella

Summary

Number of confirmed cases: 302
Crude incidence rate: 6.3/100,000 population

Salmonellosis typically presents clinically as an acute enterocolitis, with sudden onset of abdominal pain, diarrhoea, nausea, headache and occasionally vomiting. Fever is almost always present. Dehydration, especially amongst vulnerable populations such as infants, the immunocompromised and the elderly, may be severe. Invasive infection occurs in a proportion of cases. *S.* Typhi and *S.* Paratyphi can cause enteric fever, a severe systemic life threatening condition, but these are not common in Ireland and are almost invariably travel-associated.

The common reservoirs for non-typhoidal *Salmonella* are the intestinal tract of domestic and wild animals (including birds), which may result in a variety of foodstuffs, of both animal and plant origin, becoming contaminated with faecal organisms either directly or indirectly. The organism may also be transmitted through direct contact with infected animals or humans or faecally contaminated environments. Infected food handlers may also act as a source of contamination for foodstuffs. Of particular concern is the number of cases of infection associated with direct contact with reptiles kept as companion animals.

During 2016, 302 cases of salmonellosis were notified, corresponding to a crude incidence rate (CIR) of 6.3 per 100,000 population (Figure 1). The annual CIR has been decreasing gradually over the last eight years (from 10.8/100,000 in 2007 to between 5.7 and 6.3 in the last three years). The 302 cases notified in 2016 represent a 12% increased compared to 2015. The highest CIR in 2016 occurred in HSE-M (8.9/100,000) and the lowest in HSE-NE (4.6/100,000).

The highest age-specific incidence rate among both sexes was in children under 5 years of age (19.9/100,000). This is likely to be influenced by clinicians more readily seeking clinical samples in that age group. The lowest age specific rate was observed in the 35-44 year age group (3.4/100,000). The male to female ratio was in general higher in children and adults under 25 years (1.4:1), and lower in adults 25 years and older (0.6:1).

Disease Severity
Diarrhoea was the most common symptom (94% of cases) among notified cases in 2016 (Table 1), followed by abdominal pain (80%). Bloody diarrhoea occurred among

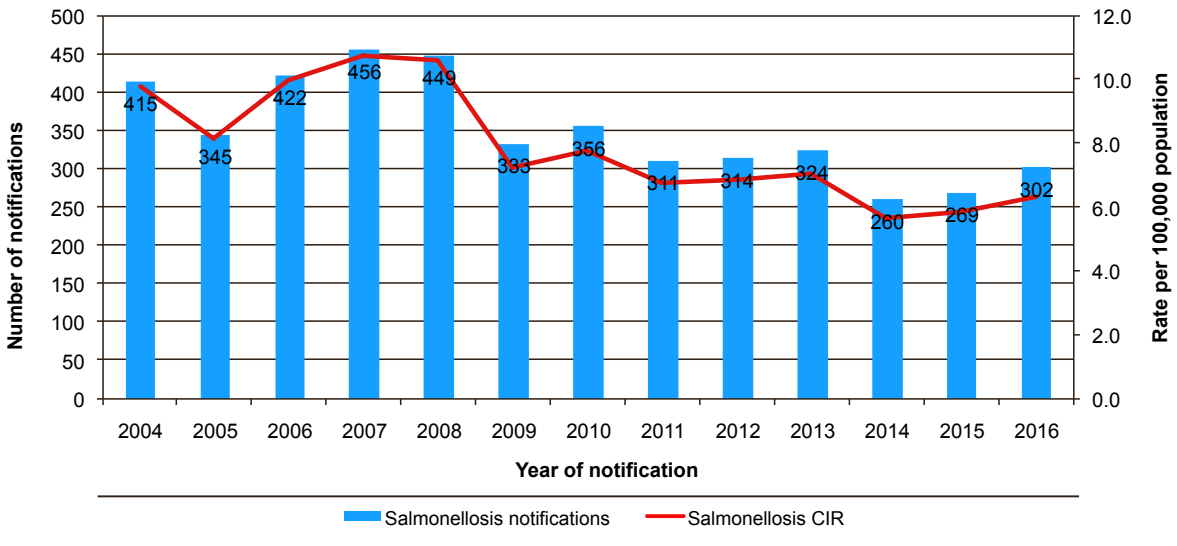

Figure 1: Salmonellosis notifications and CIR by year of notification (CIDR)

28% of cases. Median duration of illness was seven days (range 1-50 days), based on observations for 161 cases. Forty-one per cent of cases (121/292) were hospitalised. There was one death reported in an elderly woman as being due to salmonellosis among the notifications in 2016.

Foreign travel as a risk factor for salmonellosis in Ireland
Country of infection was reported for 91% of notifications in 2016. Where country of infection was reported, 46% of cases were travel-associated (126/275). Overall, case numbers peaked between May and November. This was true for both indigenous and travel-related cases, although there was less pronounced seasonal variation for indigenous cases than for travel-related cases (Figure 2).

Among travel associated cases (n=126), the most common countries of infection reported were Spain (n=38), Thailand (n=13), Poland (n=9) and Turkey (n=8). The popularity of a country as a travel destination is likely to be an important factor in determining the number of cases associated with each country.

As might be expected, cases who acquired their disease in Ireland or other parts of Europe were younger than cases who acquired their disease during long-haul travel (Table 2). Disease acquired in Ireland was more commonly caused by *S.* Typhimurium and monophasic Typhimurium strains (40%) than by *S.* Enteritis strains (20%), with other strains making up the remaining 40% of cases. By contrast, disease acquired in Europe was associated most commonly associated with *S.* Enteritidis (56%), followed by other strains (28%), with *S.* Typhimurium and monophasic Typhimurium strains accounting for only 16% of cases. For cases associated with acquisition in the rest of the world, non-Enteritis, non-Typhimurium cases predominated (65%), *S.* Enteritidis accounting for 24% and *S.* Typhimurium and monophasic Typhimurium strains for 11% of cases (Table 2).

Animal contact as a risk factor
Contact with pets (in particular exotics like snakes and turtles), contact with pet food (e.g. frozen rodents), contact with wildlife (e.g. hedgehogs), and contact with cattle, have all been associated with an increased risk of salmonellosis, especially in children. In 2016, 36% (86/237) of salmonellosis cases reported contact with pets (five of which were reptiles), 4% (9/231) reported contact with farm animals, 2% (2/127) reported contact with wildlife, and 12% (22/189) reported contact with pet feed (none with frozen feeder rodents).

Typhoid/Paratyphoid:
In 2016 ten cases of typhoid were notified. All were associated with travel to Asia, principally Pakistan (n=5) and India (n=3). Four cases occurred in children aged 5 years or less. Seven paratyphoid cases were notified. Six were adult

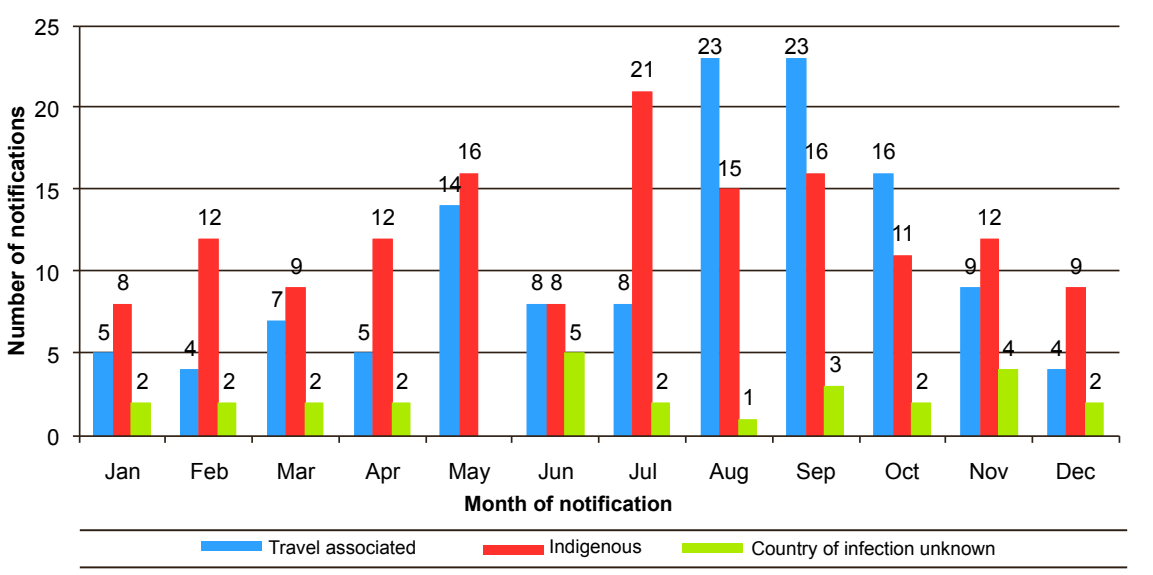

Figure 2: Salmonellosis notifications by month of notification and country of infection, 2016 (CIDR)

Table 1: Disease severity of notified salmonella cases 2016 (CIDR)

Symptom/disease feature	Number with Symptom	Number without Symptom	Number symptom Unknown	Percentage of cases with symptom (among known)
Diarrhoea	259	18	25	94%
Bloody diarrhoea	73	184	45	28%
Nausea	151	89	62	63%
Abdominal pain	199	50	53	80%
Fever	161	89	52	64%
Headache	58	134	110	30%
Myalgia	32	152	118	17%
Rash	13	183	106	7%

and one was a child. Six were associated with travel to Asia –all were *S.* Paratyphi A. For one elderly case of *S.* Paratyhi B, acquisition was reported to have been in Ireland.

National *Salmonella*, *Shigella* and *Listeria* Reference Laboratory (NSSLRL) data:
The National *Salmonella*, *Shigella* and *Listeria* Reference Laboratory (NSSLRL) based in Galway has been providing reference services nationally since 2000. In 2016, the NSSLRL analysed 310 human *Salmonella* isolates referred for further typing, including eleven *S.* Typhi and seven *S.* Paratyphi. Figure 3 shows the distribution of serotypes over this time period. Cases due to *S.* Typhimurium decreased by 10% compared to 2015, while those due to *S.* Enteritidis and other serotypes increased by 20% and 22% respectively.

More detail on the distribution of human *Salmonella* isolates by phage type and their resistance to antimicrobials is reported in the National *Salmonella, Shigella* & *Listeria* Reference Laboratory of Ireland, Annual Report for 2016[1]. This report also details new developments in relation to the use of whole genome sequencing during 2017.

Outbreaks
During 2016, nine small outbreaks of salmonellosis were reported, comprising 24 cases of illness and four hospitalisations. Seven were in private homes while two involved extended family. Three outbreaks were reported as due to person to person spread, three were foodborne+/- person-to-person spread, two animal contact +/- person-to-person spread, while mode of transmission for the remaining outbreak was reported as unknown.

References:
National *Salmonella Shigella* & *Listeria* Reference Laboratory of Ireland, Annual Report for 2016. Available at:
http://www.saolta.ie/documents/nsslrl-annual-report-2016

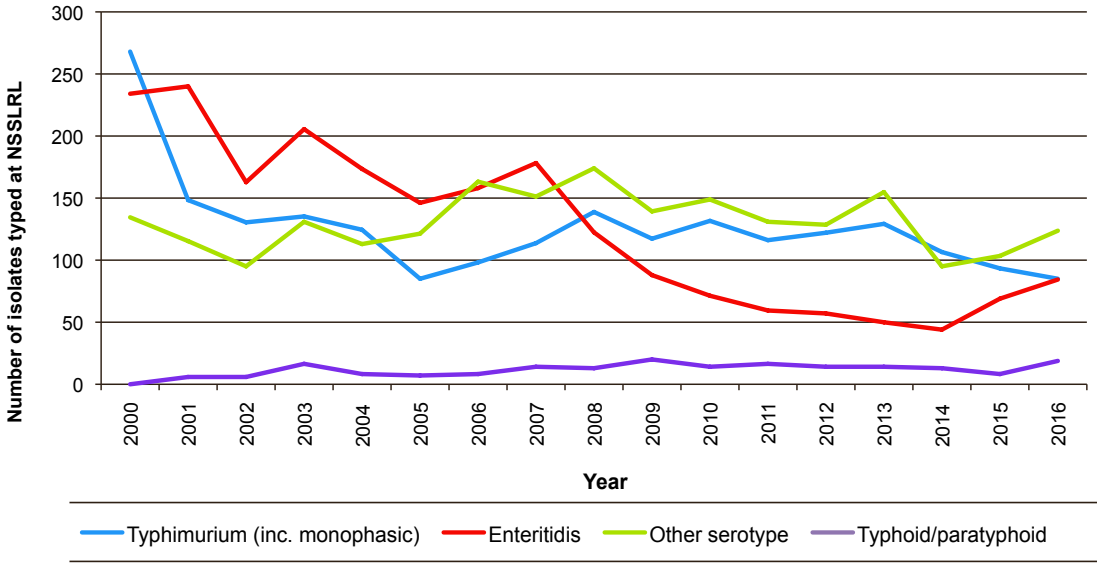

Figure 3: Annual number of Salmonella isolates referred to NSSLRL by serotype (NSSLRL)

Table 2: Salmonellosis notifications acquired in Ireland, Europe and Rest of the World by age group and serotype, 2016 (CIDR)

Characteristic		Ireland	Europe	Rest of the world	Unknown /Not Specified	Total
Age group	<15 yrs	64	28	10	4	106
	15-44 yrs	41	15	35	14	105
	45-64 yrs	22	18	7	6	53
	65+ yrs	22	9	4	3	38
Serotype	Typhimurium	27	5	4	7	43
	4,[5],12:i:-	30	6	2	4	42
	Enteritidis	28	39	13	4	84
	Other	58	19	35	11	123
	Not specified	6	1	2	1	10
Total		**149**	**70**	**56**	**27**	**302**

3.8 Less common gastroenteric infections

Listeriosis

In 2016, 13 cases of listeriosis were notified, a decrease compared to 2015 when 19 cases were reported. For 2016, this equates to a crude incidence rate of 0.27 per 100,000 population.

In 2016, two neonatal cases and one pregnancy-related case were reported (Figure 1). The number of adult/juvenile cases reported in 2015 decreased by 29% (n=10) compared with 2015 (n=14) (Figure 1). Seven of the ten adult/juvenile cases were male, cases ranged in age from 51 to 88 years and half (n=5) were 65 years of age and older. Three adult/juvenile cases had septicaemia, three had meningitis and septicaemia, two had other symptoms and symptoms were not specified for two. One patient died; the cause of death was not reported but the patient had an underlying illness.

Since 2007, the National *Salmonella, Shigella* and *Listeria* Reference Laboratory (NSSLRL) in Galway provides a national service for the typing of *Listeria* strains. Isolates from eleven of the 13 notified cases in 2016 were referred by the primary laboratories for serotyping. Serotype 4b was the most common (n=6) followed by serotype 1/2a (n=5) (Table 1).

In Ireland, listeria remains a hazard for the elderly, persons with underlying illness, and other vulnerable groups most especially pregnant women and neonates. Occasionally, neonatal losses are reported in women for whom English is not their first language. Safefood has an advice leaflet outlining the risks to pregnant women from *Listeria* in a range of languages.

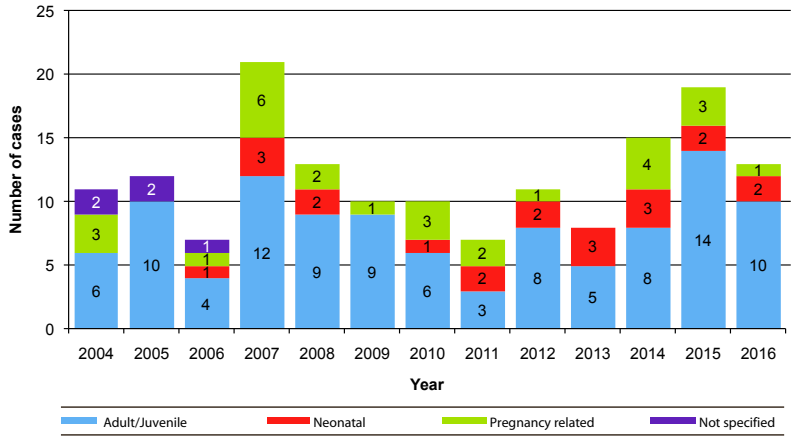

Figure 1: Number listeriosis notifications by case type, Ireland, 2004-2016

*Table 1: Listeriosis notifications by case type and serotype, Ireland, 2016**

Type	Serotype 1/2a	Serotype 1/2b	Serotype 4b	Not referred for serotyping	Total
Adult or juvenile	6	0	3	1	**10**
Pregnancy-related	0	0	0	1	**1**
Neonatal	0	0	2	0	**2**
Total	**6**	**0**	**5**	**2**	**13**

* Typing data provided by the National Salmonella, Shigella and Listeria Reference Laboratory (NSSLRL)

Giardiasis

In 2016, there were 202 cases of giardiasis notified, corresponding to a crude incidence rate (CIR) of 4.2 per 100,000 population, an increase of 30% in CIR compared to 2015. This increase appears to be largely due to recent changes in laboratory practice with respect to selection of stools for testing consequent to the introduction of newer, more sensitive, molecular detection methods.

Cases ranged in age from ten months-90 years with a median age of 34 years. The male to female ratio was 1.3:1.0. The majority of cases were diagnosed in GP patients (65.0%).

Country of infection was reported for 70.2% of cases in 2016, an increase compared to 2015 (Figure 2). Of the 142 cases where country of infection was reported, 58 (41.0%) were reported as being associated with foreign travel. Twenty eight different countries were reported, the most common of which were India (n=12), Spain (n=5), and Pakistan (n=4). Eighty-four cases (59.0% of those with country of infection information) were reported as being acquired in Ireland, a further increase compared to the 51% reported in 2015. Country of infection was not reported for the remaining 60 cases.

It is likely that there is a degree of under-ascertainment of indigenous Irish cases of giardiasis, when the incidence in Ireland is compared with that in England & Wales. It would be important for practitioners to bear in mind that the majority of cases of giardiasis in Ireland are likely not to be travel related were the true incidence known with any degree of accuracy.

Nine family outbreaks of giardiasis were notified in 2016, with 25 persons ill. One was considered to be due to person to person transmission, with transmission route unknown for the remaining family outbreaks. In addition, one MSM outbreak with two persons ill was reported.

Yersiniosis

In 2016, there were three cases of yersiniosis reported. All three infections were in adult females and were due to *Y. enterocolitica*. The reported incidence of yersiniosis in Ireland is low relative to the EU as a whole, and to Northern Europe in particular.

Foodborne intoxications

There were no cases or outbreaks of *Bacillus cereus,* botulism, *Clostridium perfringens* (type A) food-borne intoxication or staphylococcal food poisoning notified in 2016.

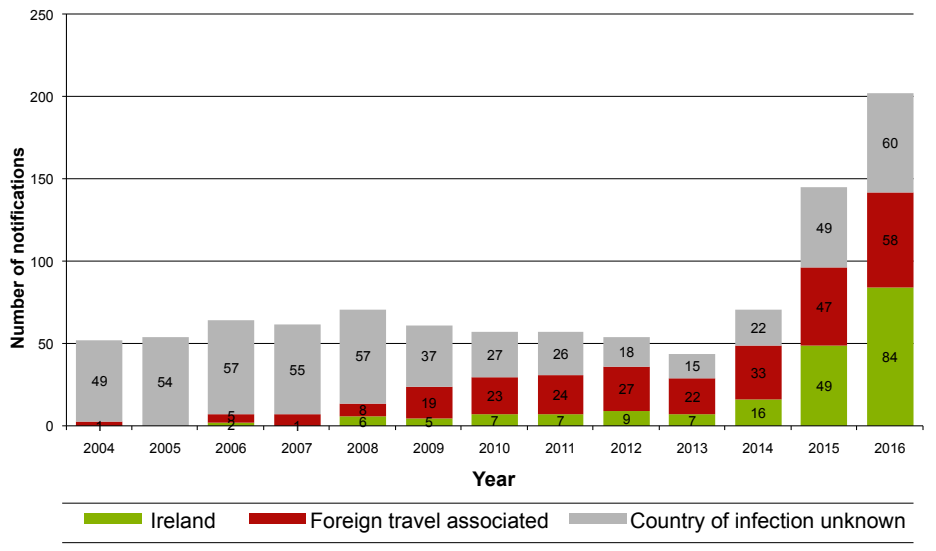

Figure 2: Number of giardiasis notifications by travel status, 2004-2016

3.9 Shigellosis

Summary

Number of notifications: 84
Crude incidence rate: 1.8/100,000

Shigellosis is caused by the bacterium *Shigella*. There are four species of this bacterium *S. sonnei*, *S. boydii*, *S. flexneri* and *S. dysenteriae*. *S. dysenteriae* produces a very powerful toxin that produces severe damage to the lining of the gut. The bacteria are only found in humans. Anyone can get shigellosis, but those who are at greater risk include children in child care centres and their parents, overseas travellers, institutionalized people and men who have sex with men (MSM).

Eighty four cases of shigellosis were notified in Ireland in 2016, corresponding to a crude incidence rate (CIR) of 1.8 per 100,000. This represents a decrease of 7% compared to 2015. Of 82 cases where hospitalisation status was recorded, 24 (29%) were reported as hospital in-patients. All were laboratory confirmed.

The excess of male cases compared to females was slightly lower compared to 2014 and 2015 at 1.5: 1.0 (figure 1). During 2016, cases ranged in age from 10 months to 89 years (median age=31 years). The male to female ratio was highest in the age range 25-44 years (2.5:1.0).

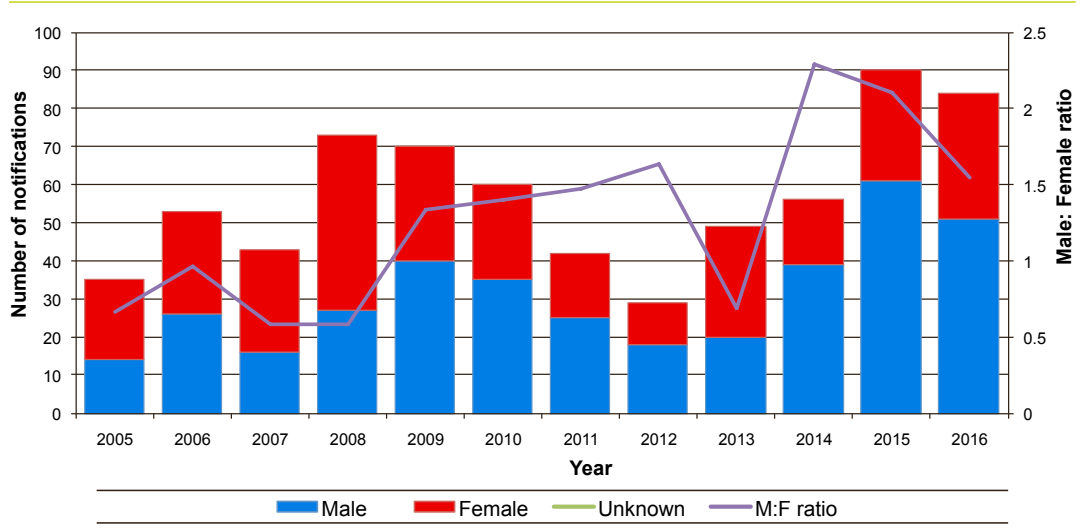

Figure 1: Annual number of notifications shigellosis by sex and year, Ireland 2004-2016 (Data source: CIDR)

Table 1: Number of Shigella notifications by species and country of infection, Ireland 2016

Organism	Ireland	Africa	Asia	Caribbean	South America	Unknown/Not specified	Total
S. boydii	1		1				2
S. dysenteriae			2				2
S. flexneri	16	2	2	0	3	4	27
S. sonnei	19	6	12	1	1	6	45
S. species	1		3	1		3	8
Total	37	8	20	2	4	13	84

Table 2: Shigellosis outbreaks 2016 (Data source: CIDR)

HSE-area	Outbreak type	Location	Transmission mode	Number ill	Serotype
HPSC	General	Community	Foodborne	14	S. sonnei
HSE-E	General	Community	Person-to-person	5	S. flexneri 2a

Information on travel history is very valuable when reviewing surveillance data for possible indigenous clusters. Data on country of infection was available for 85% of shigellosis notifications this year. Thirty-four cases were reported as being associated with foreign travel in at least 22 countries during 2016. Thirty-seven cases were reported as being acquired in Ireland (52% of known), while no country of infection information was available for 13 cases.

S. sonnei was the most common species reported (n=45), followed by *S. flexneri* (n=27), both of which were commonly associated with indigenous acquisition.

Two general shigellosis outbreaks were notified in 2016, resulting in 19 cases of illness and seven associated hospitalisations (Table 2). A small outbreak of *Shigella flexneri* 2a comprising 5 cases was reported among MSM. A foodborne outbreak comprising 14 cases of *S. sonnei* across the Republic and Northern Ireland was epidemiologically linked to consumption of pre-prepared toasted sandwiches at a restaurant chain.

More detailed typing of *Shigella* isolates can provide useful information on the relatedness of strains which is used by public health personnel to outrule/provide evidence for links between cases during investigations of case clusters. The National *Salmonella*, *Shigella* and *Listeria* Reference Laboratory (NSSLRL) provide laboratory services for speciation, serotyping, antimicrobial resistance profiling, and most recently, Whole Genome Sequencing (WGS) of *Shigella* isolates. The species/serotype and antimicrobial resistance patterns of these cases are reported in Table 3.

During 2016, almost 90% of *Shigella* isolates recovered in primary hospital laboratories were referred for typing at the NSSLRL in Galway. Speciation and antimicrobial resistance (AMR) profiling were key in defining the extent of the two general outbreaks reported in 2016, demonstrating the importance of referral of all *Shigella* isolates for typing.

Table 3: Shilgella isolates referred to NSSLRL in 2016 by species and AMR profile

Species	Number by species	AMR profile	Number by species and AMR
Shigella boydii	2	none	1
		SuTTm	1
Shigella dysen-teriae	3	ASSuTTm	1
		SuTTm	1
		SuTTmNa	1
Shigella flexneri 1a	1	SSuTTm	1
Shigella flexneri 1c	2	ASSuTTmAzt	1
		T	1
Shigella flexneri 2a	19	ACSAzt	1
		ACSSuTTm	5
		ACSSuTTmNaCp	1
		ACST	2
		ACSTTm	2
		ACTTmNaCp	5
		ASSuTmNaCp	2
		SSuTm	1
Shigella flexneri 3a	1	ACST	1
Shigella flexneri 3b	1	ACT	1
Shigella flexneri 4c	2	ACSSuTTmNaCp	1
		SuTTm	1
Shigella flexneri 6	1	SuTTmNaCp	1
Shigella flexneri X variant	1	ACST	1
Shigella sonnei	41	ASSuTm	1
		ASSuTTm	1
		ASSuTTmCtx	1
		ASSuTTmNa	1
		ASSuTTmNaAzt	2
		ASSuTTmNaCpAzt	1
		ASSuTTmNaGm	1
		ASuTTmNaCpAzt	1
		SSuTm	1
		SSuTTm	5
		SSuTTmNa	6
		SSuTTmNaCp	5
		Su	1
		SuTm	1
		SuTTm	2
		SuTTmNa	3
		Tm	8
Total	**74**	**Total**	**74**

2016

ANNUAL EPIDEMIOLOGICAL REPORT

04

VECTORBORNE AND ZOONOTIC DISEASES

4.1 Malaria

Summary

Number of cases: 88
Crude incidence rate[1]: 1.8/100,000

1 Rates calculated per 100,000 population as per Census 2016

In 2016, 88 malaria cases were notified in Ireland, an increase of 8.6% in comparison to 81 cases reported in 2015 (Figure 1). Among European Union (EU) member states reporting malaria data to the European Centre for Disease Prevention and Control, Ireland had the fifth highest incidence rate for imported malaria in 2014 (the latest year for which comparative data are available); only Belgium, Norway, Sweden and the United Kingdom had higher reported incidence rates.

In common with the rest of the EU, males predominated with a male:female ratio of 2.2:1.0. The highest numbers of cases were aged between 25 and 54 years. The number of paediatric cases reported was 14, an increase compared to six cases reported during 2015 (Figure 1). Nine paediatric cases did not have details on endemic areas visited, reason for travel or on malarial prophylaxis taken. For the five paediatric cases with such details reported, all reported visiting family in their country of origin as their reason for travel to countries in sub-Saharan Africa. Of these five paediatric cases, only one reported taking malaria prophylaxis but no details on compliance were available for this case. Three paediatric cases reported not taking any prophylaxis for their travel, while the remaining paediatric case did not have information on prophylaxis reported.

Among all age groups, the category of traveller most affected in Ireland continued to be African immigrants and their families who were exposed while returning to visit family in their country of origin. This almost certainly reflects the greater frequency with which this group travels to malarious areas, but also reflects Ireland's importance as a destination for those emigrating from English speaking West Africa. Of the 31 cases (35.2%) in 2016 where reason for travel was reported, 61.3% cited visiting family in their country of origin, all of whom travelled to Africa. Other reasons cited for travel this year were business/professional travel (n=6), Irish citizen living abroad (n=2), other reason for travel (n=2), foreign visitor ill in Ireland (n=1) and new entrant to Ireland (n=1).

Probable country of infection was reported for 36 cases (40.9%). Nigeria remained the country most frequently visited, accounting for 52.8% of cases where country of infection was reported. The remaining 17 cases were exposed in 13 other countries within Africa and one case acquired their infection in India. The majority of cases who reported travel to Nigeria were visiting family in country of origin (16/19) with known reason for travel. One case reported no

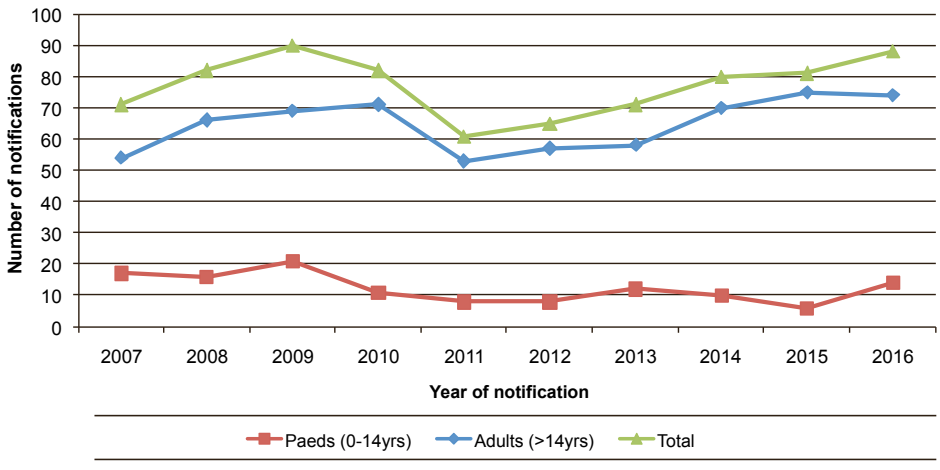

Figure 1: Annual number of malaria notifications by age, Ireland 2007-2016

recent history of travel to an endemic area. This case was thought to have acquired their malaria in an airport in a non-endemic country.

Plasmodium falciparum accounted for 86.9% of infections in 2016, reflecting the dominance of exposure in Africa as the source of the majority of notifications. Five cases of *P. ovale*, five cases of *P. vivax* and one case of *P. malariae* were also reported. The remaining four cases did not have *Plasmodium* species specified.

HPSC resources for health professional include a poster which can be downloaded from the HPSC website for display in GP surgeries, maternity/paediatric hospitals and emergency departments. The material advises immigrant families travelling to Africa to consult their doctor about malaria before travelling. A leaflet for intending travellers, available in English and French, highlights the value of antimalarial prophylaxis and protection against mosquito bites. Clinical Guidelines on the Management of Suspected Malaria are also available on the HPSC website.

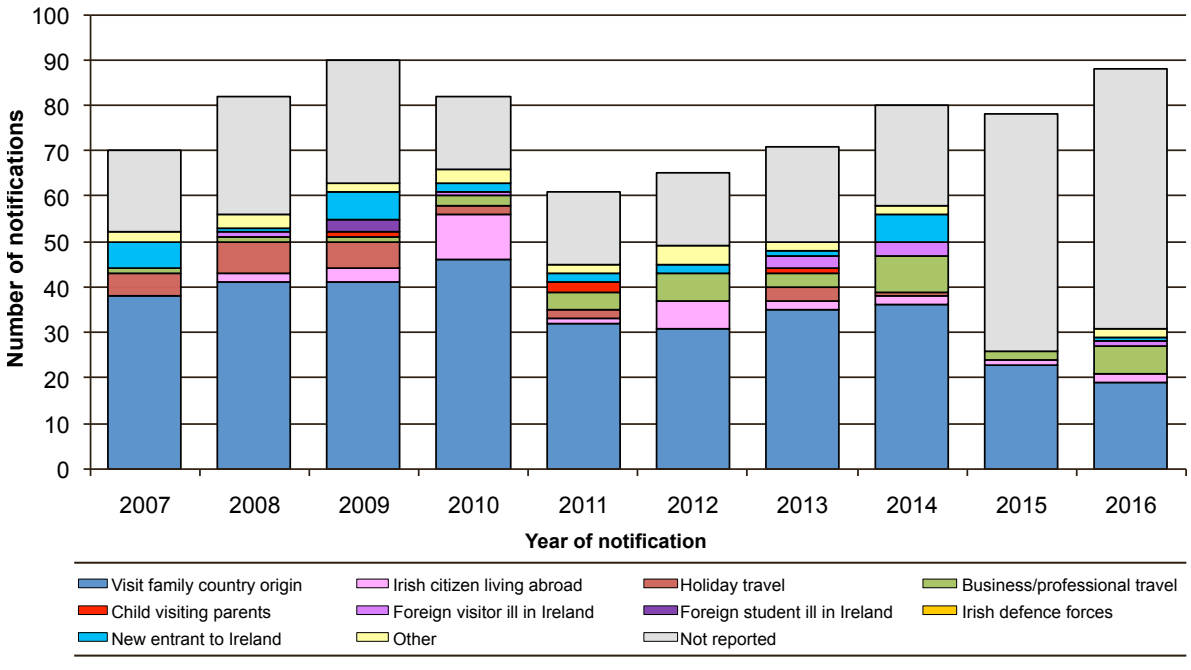

Figure 2: Annual number of notifications malaria by reason for travel, Ireland 2007-2016

4.2 Leptospirosis

Summary

Number of cases: 26
Crude incidence rate: 0.6/ 100,000 population

During 2016, 26 cases of leptospirosis were notified in Ireland, corresponding to a crude incidence rate (CIR) of 0.6 per 100,000 population. This represents an increase compared to 16 cases notified in 2015 (Figure 1). The EU crude incidence rate was 0.2 per 100,000 in 2015, latest year for which data was available. Among the countries that reported leptospirosis incidence in 2015, Ireland reported the fifth highest incidence rate after Croatia, Slovenia, Portugal and the Netherlands.

The age range of cases was 9-67 years (mean age=39.5 years, median age=39 years). Cases in the younger age groups are more likely to be associated with recreational exposure and history of foreign travel while older cases are mainly indigenous and associated with occupational exposure. Figure 1 illustrates the annual trend by travel history. The leptospirosis notification dataset is typically dominated by adult males, and this year was no exception with male cases accounting for 80.8% of cases (Table 1).

Of the 23 cases who reported details of potential exposures, 11 cases (47.8%) were believed to have acquired their illness occupationally. Of the occupationally exposed cases, five were farmers, two had animal contact, two had river water contact and two had exposure to contaminated environments. Six cases (26.1%) were reported as being associated with recreational activities, including river water exposure. Five cases (21.7%) reported residential exposure and one case reported accidental exposure to potentially contaminated environments. Exposure details were not reported for the remaining three cases (11.5%). Figure 2 shows the trend in notifications by exposure group and year.

Among the 21 cases for which hospital admission status was reported, 16 (76%) required hospitalisation.

Activities that continue to be associated with leptospirosis risk in Ireland include farming and recreational activities such as water sports. In recent years, travel to Asia and other tropical destinations has emerged as a risk factor for leptospirosis.

Table 1: Leptospirosis notifications by age and sex, 2016

Age group (years)	Female	Male	**Total**
5-9 yrs	1		**1**
15-19 yrs	1	1	**2**
20-24 yrs	1	1	**2**
25-34 yrs	1	3	**4**
35-44 yrs	1	5	**6**
45-54 yrs		6	**6**
55-64 yrs		3	**3**
65+ yrs		2	**2**
Total	**5**	**21**	**26**

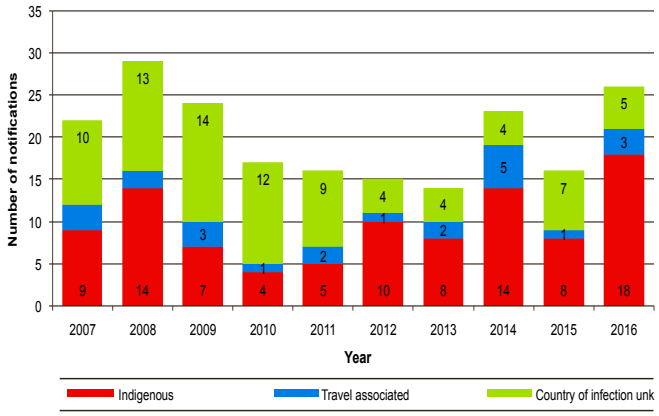

Figure 1: Annual number of leptospirosis notifications by year and travel history (Data source: CIDR)

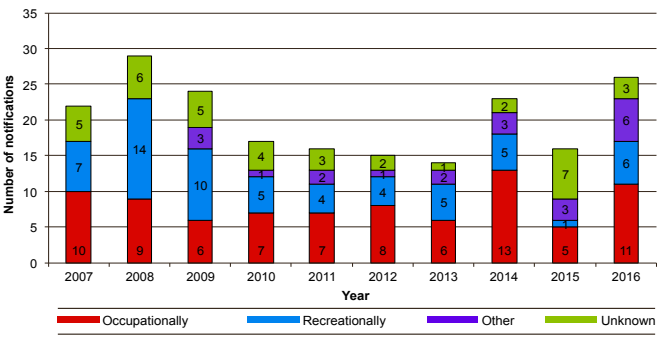

Figure 2: Annual number of leptospirosis notifications by exposure group by year (Data source: CIDR)

4.3 Other Notifiable Non-IID Zoonotic Diseases

Brucellosis
Two cases of brucellosis were notified. This compares to a mean number of 1.8 cases annually between 2011 and 2015.

Echinococcosis
Two cases were reported during 2016, the first cases reported since 2007. Country of infection was not reported for either case.

Table 1: Non-IID zoonoses notifications by age and sex, 2016

Disease Short Name	Age Group	Female	Male	Total
Brucellosis	45-54 yrs		1	**1**
	65+ yrs	1		**1**
Echinococcosis	5-9 yrs	1		**1**
	15-19 yrs		1	**1**
Q fever	35-44 yrs		2	**2**
	45-54 yrs		1	**1**
	55-64 yrs	1	2	**3**
Toxoplasmosis	5-9 yrs		1	**1**
	10-14 yrs	1		**1**
	15-19 yrs		2	**2**
	20-24 yrs	1	2	**3**
	25-34 yrs	4	3	**7**
	35-44 yrs	8		**8**
	45-54 yrs	2		**2**
Total		**19**	**15**	**34**

Q Fever
Six cases of Q fever were reported in Ireland in 2016, an increase compared to four cases reported during 2015. Five cases were male and the median age was 51.5 years.

Toxoplasmosis
During 2016, 24 cases of toxoplasmosis were notified which remains stable compared to 26 cases reported in 2015. Among cases where patient type was reported, 25% were hospitalised. Cases ranged in age from 5 to 47 years (median: 32.5 years). No congenital cases were reported in 2016.

As in previous years, more cases were reported among females then males, (M:F ratio 0.5:1.0). This was particularly evident among females in the 25-44 year age group, which accounted for half of the total cases. This is most likely a reflection of enhanced testing during pregnancy.

Trichinosis
No cases of trichinosis were notified in Ireland in 2016.

Table 2: Non-IID zoonoses notifications by HSE, 2016

HSE area	Brucellosis	Echinococcosis	Q fever	Toxoplasmosis	Total
HSE-E				8	**8**
HSE-M				1	**1**
HSE-MW		1	1	1	**3**
HSE-NE	1		2		**3**
HSE-NW				1	**1**
HSE-SE	1		1	1	**3**
HSE-S				6	**6**
HSE-W		1	2	6	**9**
Total	**2**	**2**	**6**	**24**	**34**

Table 3: Non-IID zoonoses notifications by patient type, 2016

Patient Type	Brucellosis	Echinococcosis	Q fever	Toxoplasmosis	Total
GP Patient	1		2	9	**12**
Hospital Day Patient	1				**1**
Hospital Inpatient		1	3	5	**9**
Hospital Outpatient		1		6	**7**
Not Specified			1		**1**
Unknown				4	**4**
Total	**2**	**2**	**6**	**24**	**34**

4.4 Other Vectorborne Diseases

In addition to malaria, there are nine further notifiable vectorborne diseases in Ireland, chikungunya, dengue, lyme neuroborelliosis, tularemia, typhus, tickborne encephalitis (TBE), West Nile fever, yellow fever and zika virus infection. The case definitions for these diseases are outlined on the HPSC website at: http://www.hpsc.ie/NotifiableDiseases/CaseDefinitions/.

A summary of vectorborne diseases notified during 2016 is reported below. Table 1 displays the number of cases of vectorborne diseases by HSE area, Table 2 displays cases by age group in years while Table 3 displays cases by probable country of infection.

Chikungunya fever

Chikungunya is a mosquito-borne viral infection that causes fever and severe joint pain. Other symptoms include muscle pain, headache, nausea, fatigue and rash. The disease mostly occurs in Africa, Asia and the Indian subcontinent. However a major outbreak in 2015 affected several countries of the Region of the Americas.

One case of chikungunya was reported in Ireland during 2016, with a recent travel history to Kenya.

Dengue fever

Dengue is a mosquito-borne viral infection that can cause flu-like illness and occasionally develops potentially lethal complications. Dengue is found in tropical and sub-tropical climates worldwide, mostly in urban and semi-urban areas. The global incidence of dengue has grown dramatically in recent decades with about half of the world's population now at risk. 2016 was characterized by large dengue outbreaks worldwide, with the WHO Region of the Americas region reporting more than 2.4 million cases, approximately 3 times higher than in 2014. During 2016, a dengue vaccine Dengvaxia (CYD-TDV)®, was registered in several countries for use in individuals 9-45 years of age living in endemic areas.

Eighteen confirmed cases of dengue fever were notified in Ireland during 2016. Seven cases were reported as GP patients, two were admitted to hospital and one case each attended Emergency Department and hospital out-patient services. The remaining seven cases did not have patient type reported. Country of infection was reported for three cases (16.7%). One case each reported probable country of infection as Brazil, Malaysia and Philippines (table 3). The remaining 15 cases (66.7%) did not have a country of infection specified. Just over two thirds of cases were female.

Table 1: Vectorborne notifications by HSE area, 2016

HSE area	Chikungunya disease	Dengue fever	Lyme disease	Zika virus infection	Total
HSE-E		11	3	9	**23**
HSE-M		1	2		**3**
HSE-MW		1	5		**6**
HSE-NE		1		2	**3**
HSE-NW			1	1	**2**
HSE-SE		1			**1**
HSE-S	1	2	8		**11**
HSE-W		1	2	1	**4**
Total	**1**	**18**	**21**	**13**	**53**

Table 2: Vectorborne notifications by age group, 2016

Age group	Chikungunya disease	Dengue fever	Lyme disease	Zika virus infection	Total
0-4 yrs				1	**1**
5-9 yrs			4		**4**
10-14 yrs		1			**1**
15-19 yrs		2			**2**
20-24 yrs		2	1	1	**4**
25-34 yrs		6	2	4	**12**
35-44 yrs	1	2	5	6	**14**
45-54 yrs		5	3	1	**9**
55-64 yrs			3		**3**
65+ yrs			3		**3**
Total	**1**	**18**	**21**	**13**	**53**

Lyme neuroborreliosis
Lyme neuroborreliosis is an infection caused by a spiral-shaped bacterium called *Borrelia burgdorferi* that is transmitted to humans by bites from infected ticks, generally hard-bodied ticks (*Ixodidae).* Lyme disease can affect anyone but is commonest among people whose leisure or work activities takes place in heathland, light woodland and other grassy areas or brings them in contact with certain animals e.g. deer and sheep.

During 2016, 21 cases of lyme neuroborreliosis were notified in Ireland, eight female (38.1%) and 13 male (61.9%). Cases were reported from six of the eight HSE areas (table 1). Nine patients were GP patients, six were hospital in-patients, four were reported as hospital out-patients and two were hospital day patients (table 2). Probable country of infection was reported as Ireland for four cases, Ecuador for one case and the United States for one case. The remaining 15 (71.4%) cases did not report country of infection (table 3).

West Nile virus
West Nile virus (WNV) is a mosquito-borne viral infection transmitted primarily by *Culex* mosquitoes. WNV can cause a fatal neurological disease in humans but approximately 80% of people who are infected will not show any symptoms. In addition to vector-borne transmission, the virus may also be transmitted through contact with other infected animals, their blood, or other tissues. WNV is maintained in a cycle involving transmission between birds and mosquitoes. Humans, horses and other mammals can be infected. WNV is commonly found in Africa, Europe, the Middle East, North America and West Asia. Vaccines are available for use in horses but not yet available for people.

No cases of West Nile virus were notified in Ireland in 2016.

Zika virus infection:
Zika virus infection is a mosquito-borne viral infection transmitted primarily by *Aedes* mosquitoes. People with zika virus infection can have symptoms including mild fever, skin rash, conjunctivitis, muscle and joint pain, malaise or headache, which normally last for two to seven days. There is scientific consensus that Zika virus is a cause of microcephaly and Guillain-Barré syndrome.

During 2016, 13 cases of zika virus infection were notified in Ireland, seven female (53.8%) and six male (46.2%). Cases were reported from four of the eight HSE areas (Table 1). Nine patients were GP patients, two were hospital out-patients, one was a hospital in-patient and one was reported as other unspecified patient type (Table 2).

Three cases reported probable country of infection as Brazil, three as Trinidad and Tobago, two as Mexico while one case each reported Bahamas, Costa Rica, Guatemala, Jamaica and Nicaragua (Table 3).

Twelve cases were due to mosquito-borne transmission and one case of congenital infection was reported. Microcephaly was subsequently detected in the infant with congenital zika virus infection.

Tickborne encephalitis
No cases of tickborne encephalitis were notified in Ireland in 2016.

Tularaemia
No cases of tularaemia were notified in Ireland in 2016.

Typhus
No cases of typhus were notified in Ireland in 2016.

Yellow fever
No cases of yellow fever were notified in Ireland in 2016.

Table 3: Vectorborne notifications by probable country of infection, 2016

Country of infection	Chikungunya disease	Dengue fever	Lyme disease	Zika virus infection	Total
Bahamas				1	**1**
Brazil		1		3	**4**
Costa Rica				1	**1**
Ecuador			1		**1**
Guatemala				1	**1**
Ireland			4		**4**
Jamaica				1	**1**
Kenya	1				**1**
Malaysia		1			**1**
Mexico				2	**2**
Nicaragua				1	**1**
Philippines		1			**1**
Trinidad and Tobago				3	**3**
United states			1		**1**
Unknown		15	15		**30**
Total	**1**	**18**	**21**	**13**	**53**

2016

ANNUAL
EPIDEMIOLOGICAL
REPORT

05

BLOOD-BORNE AND SEXUALLY TRANSMITTED INFECTIONS

5.1 Hepatitis B

Summary

Number of cases, 2016: 488
Crude notification rate, 2016: 10.2/100,000 population
Number of cases, 2015: 548

Hepatitis B is a vaccine preventable disease caused by the hepatitis B virus. It is transmitted through percutaneous or mucocutaneous contact with the blood or body fluids of an infected person. Symptoms of acute infection may include anorexia, abdominal discomfort, nausea and vomiting, often followed by jaundice. Symptoms are frequently milder and without jaundice in children. Acute infection is usually asymptomatic in infants. After acute HBV infection, the risk of developing chronic hepatitis B declines with increasing age.[1] Approximately 90% of infants infected at birth will develop chronic infection, compared to 20-50% of children infected between the ages of one and five years. Only 1-10% of those infected as older children or adults will develop chronic hepatitis B. An estimated 15-25% of those who develop chronic infection with die prematurely of either cirrhosis of the liver or hepatocellular carcinoma.

The prevalence of hepatitis B in the general population in Ireland is low (less than 1%). This is similar to other northern European countries (0.1-0.7%).[2] Most cases fall into defined risk groups such as people with multiple sexual partners, sexual or household contacts of known cases, people who inject drugs (PWID) and people who were born in countries with intermediate (2-7%) or high (≥8%) hepatitis B endemicity.

The number of hepatitis B cases reported in Ireland decreased by 11% in 2016, with 488 cases (10.2/100,000 population) notified compared to 548 in 2015. Hepatitis B notifications had been generally decreasing since their highest levels in 2008 (n=898, 21.2/100,000 population), but recent trends indicate that notifications are stabilising rather than continuing to decline. Annual hepatitis B notifications since 1997 are shown in figure 1.

The highest notification rates were in HSE E (17.2/100,000 population, n=295) and HSE NE (9.8/100,000 population, n=45). Geographic trends for the past four years are shown in figure 2.

All cases were laboratory confirmed. Ninety three percent (n=454) of the 488 notifications contained information on acute/chronic status. Of these, 7% (n=32, 0.7/100,000 population) of cases were acutely infected and 93% (n=422, 8.9/100,000 population) were chronically infected. Both

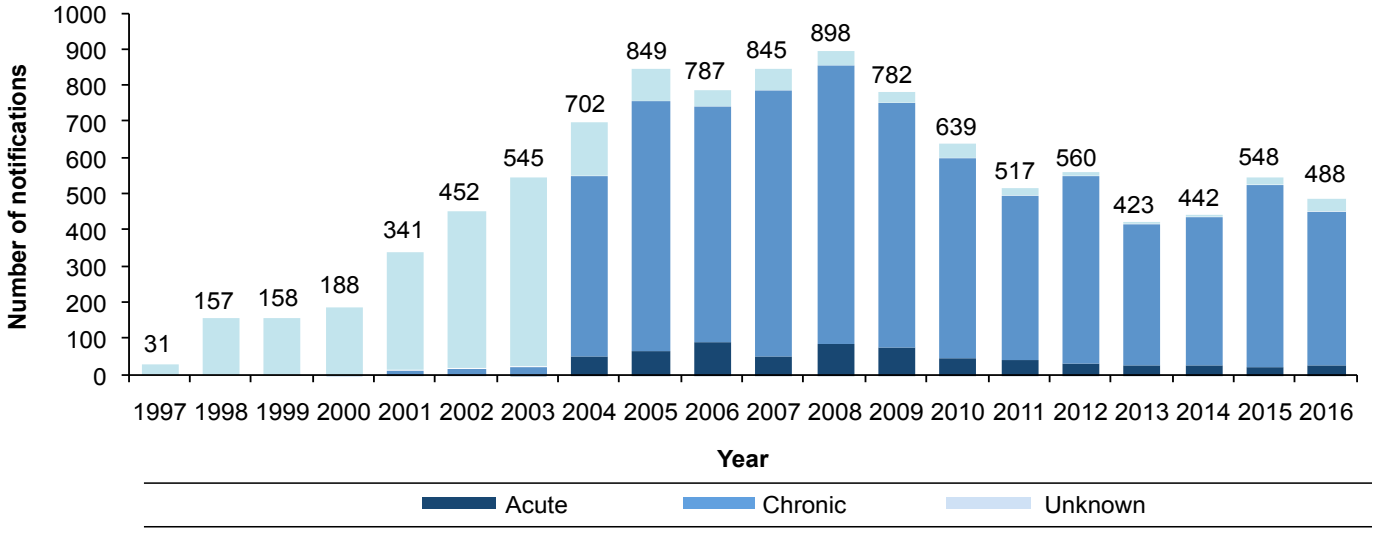

Figure 1. Number of hepatitis B notifications by acute/chronic status, 1997-2016

acute and chronic cases of hepatitis B are notifiable in Ireland.

Acute cases (recent infections)

The number of acute cases of hepatitis B notified in Ireland was relatively low, but increased slightly in 2016 (n=32) compared to 2015 (n=26) (figure 3). Seventy eight percent (n=25) of acute cases notified in 2016 were male. Seventy two percent of cases (n=23) were aged between 25 and 44 years and the median age at notification was 35.5 years (figures 3 & 4).

Information on risk factor was available for 81% (n=26) of the acute cases notified in 2016. Of these, 65% (n=17) were likely to have been sexually acquired (ten heterosexual and seven men who have sex with men (MSM)). The most likely risk factor for one case was injecting drug use and two additional cases reported snorting cocaine but had not injected drugs. Other risk factors were reported for two cases and no risk factor was identified for four cases despite public health follow up.

Country of birth was specified for 78% (n=25) of acute cases, 64% (n=16) of whom were born in Ireland. Country of infection was reported for 60% (n=19), 74% (n=14) of whom were infected in Ireland. The reason for testing was known for 28 cases and most were tested because they were experiencing symptoms (n=21, 75%) or because they requested STI screening (n=3, 11%).

Chronic cases (long-term infections)

Notifications of chronic hepatitis B almost halved between peak levels in 2008 (n=768) and 2013 (n=387). The number of chronic cases reported then increased by 6% in 2014 and by 22% in 2015, but decreased by 16% in 2016 (n=422) (figure 5). Of the 422 chronic cases notified in 2016, 56% (n=237) were male, 42% (n=177) were female and sex was not reported for 8 cases. Eighty seven percent (n=369) of chronic cases were aged between 20 and 54 years when notified and the median age at notification was 34 years (figures 5 & 6).

Although primary risk factor was reported for a minority of chronic cases in 2016, data on country of birth or asylum seeker status was available for 53% (n=223). Of these, 78%

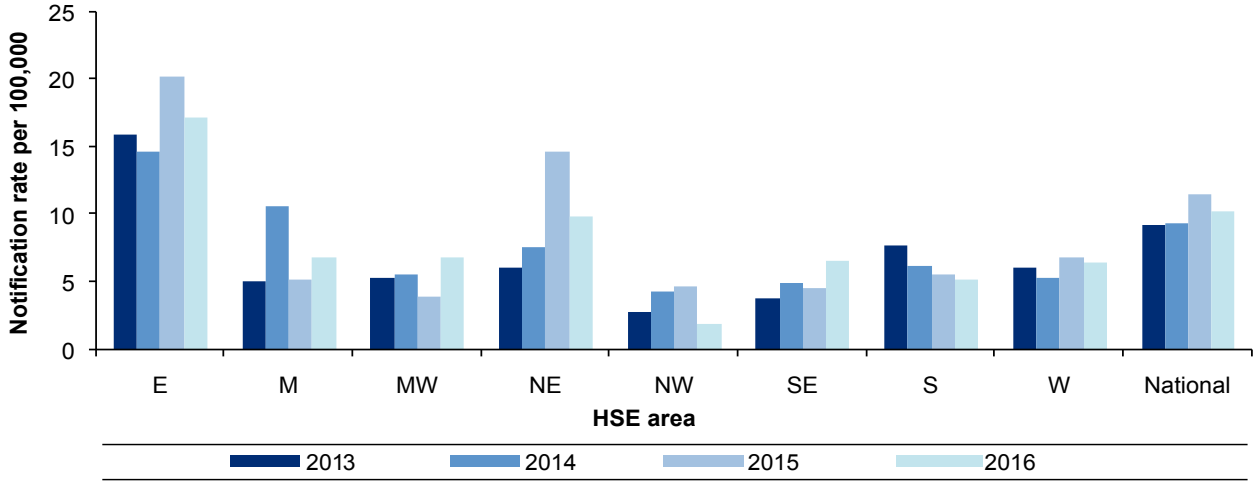

Figure 2. Hepatitis B notification rates/100,000 population, by HSE area, 2013-2016

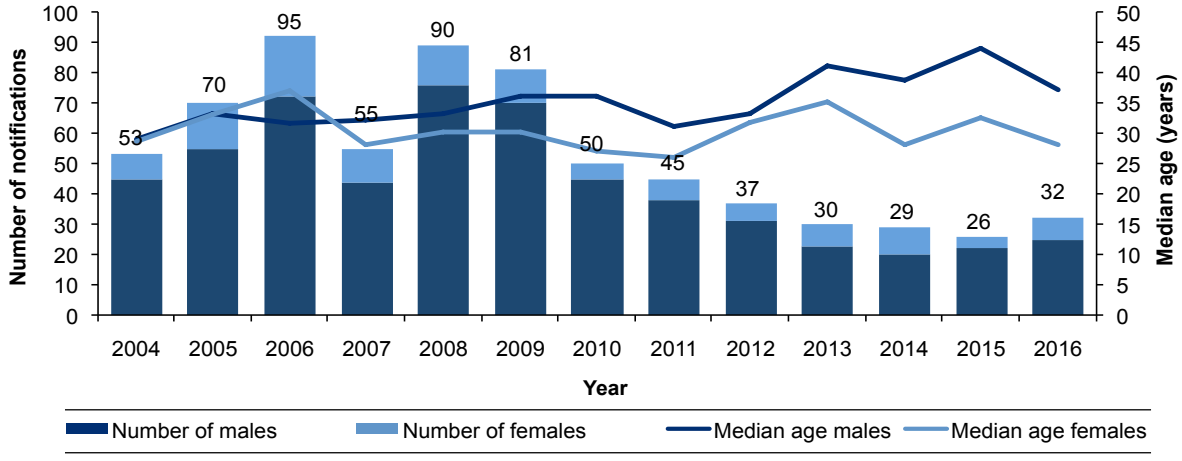

Figure 3. Number of acute cases of hepatitis B notified, by sex and median age, 2004-2016

(n=175) were either born in a hepatitis B endemic country (hepatitis B surface antigen prevalence >2%) or were asylum seekers. Most of these cases are likely to have been infected outside Ireland, but the actual mode of acquisition of infection is unknown for the majority. Where country of birth was available (48%, n=202), the most common birth countries were in Asia (34%, n=69), central or eastern Europe (33%, n=67), sub-Saharan Africa (23%, n=47) and western Europe (6%, n=13). Of those born in western Europe, eleven were born in Ireland.

The reason for testing was known for 64% (n=269) of chronic cases. The main reasons were: antenatal screening (26%, n=69), re-testing of known cases (not previously notified) (20%, n=53), asylum seeker screening (11%, n=30) and STI screening (8%, n=21).

Immigration and hepatitis B notifications

Hepatitis B notifications are influenced by trends in immigration to Ireland. The large increase in the number of hepatitis B cases between 1997 and 2008 (figure 1) coincided with significant numbers of people migrating to Ireland from hepatitis B endemic countries.[3] The economic downturn in 2008 was reflected in a decline in both immigration and hepatitis B notifications. The subsequent economic recovery has resulted in increased immigration in recent years and this is likely to have contributed to the recent increase in hepatitis B notifications. Figure 7 shows trends in hepatitis B notifications alongside immigration trends.

Co-infections

Co-infection with other bloodborne viruses, such as hepatitis C and HIV, can lead to more severe liver disease and an increased risk of liver cancer in people with hepatitis B infection. Four hepatitis B cases notified in 2016 were co-infected with hepatitis C and thirteen additional cases were co-infected with HIV. Other sexually transmitted infections were also reported for some of the cases of hepatitis B notified in 2016. Five had recently been diagnosed with chlamydia, three with syphilis (two HIV positive), one with gonorrhoea and one with genital herpes simplex (HIV positive).

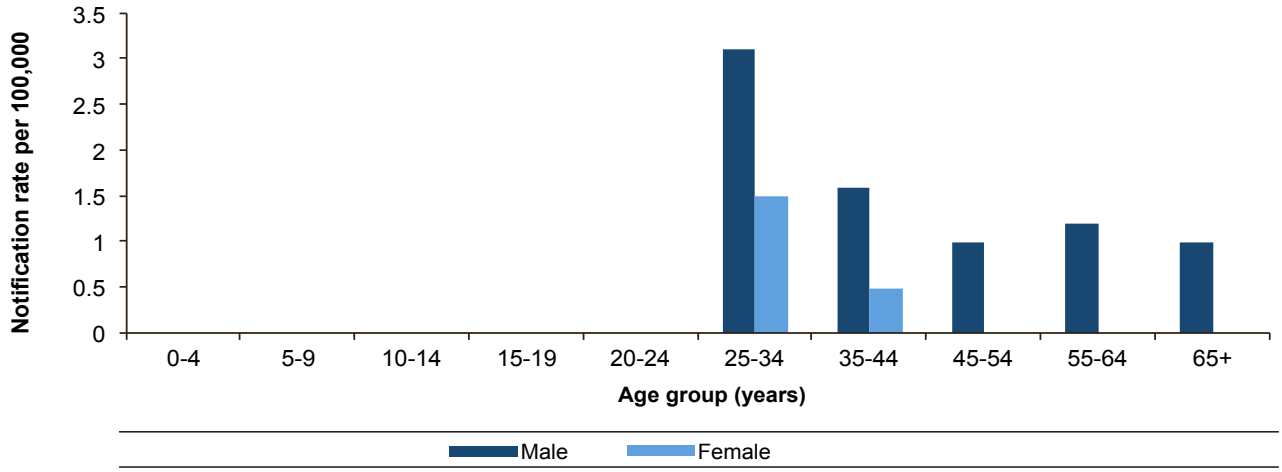

Figure 4. Age and sex-specific notification rates/100,000 population for acute cases of hepatitis B, 2016

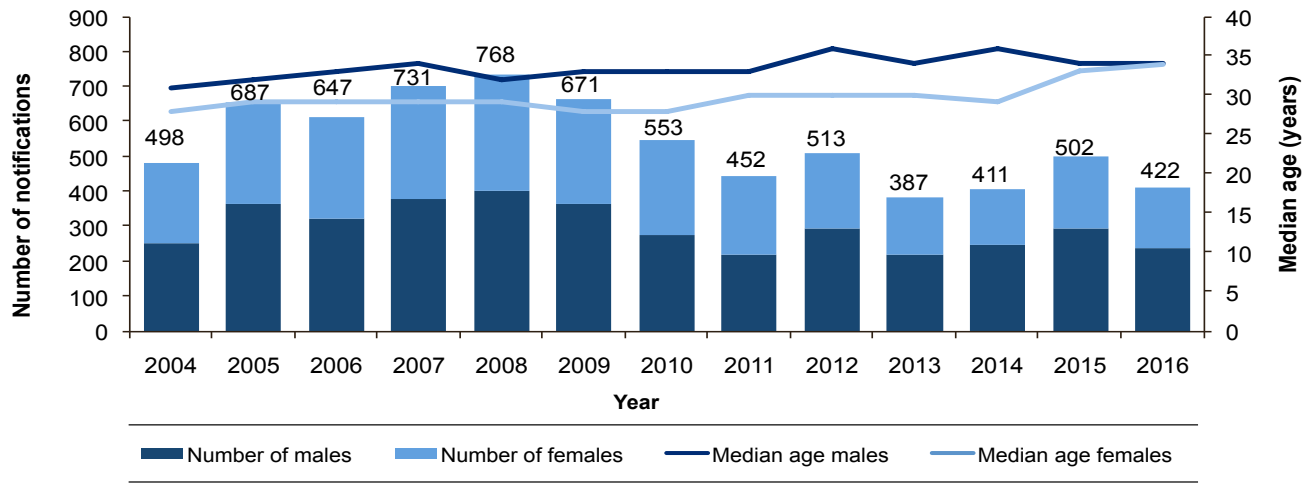

Figure 5. Number of chronic cases of hepatitis B notified, by sex and median age, 2004 to 2016

Discussion

Hepatitis B notifications more than halved between 2008 and 2013. However, this rapid rate of decline has not continued in recent years and the notification rate now appears to be stabilising. The vast majority of hepatitis B notifications in Ireland are chronic cases and largely reflect people migrating to Ireland from hepatitis B endemic countries. The number of acute cases of hepatitis B increased in 2016 but remained relatively low. Most acute cases notified in Ireland are sexually acquired.

The figures presented in this summary are based on data extracted from the Computerised Infectious Disease Reporting (CIDR) System on 12th October 2017. These figures may differ from those published previously due to ongoing updating of notification data on CIDR. Notification rates are expressed per 100,000 population and are calculated using the 2016 census.

Acknowledgements

HPSC would like to thank all those who provided data for this report – Departments of Public Health, laboratories and clinicians.

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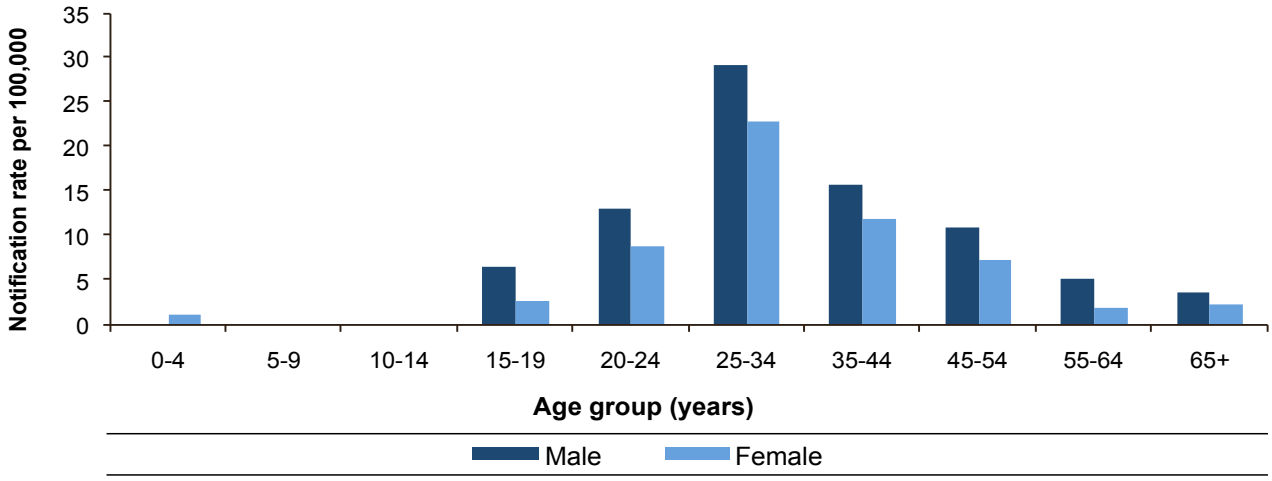

Figure 6. Age and sex-specific notification rates/100,000 population for chronic cases of hepatitis B, 2016

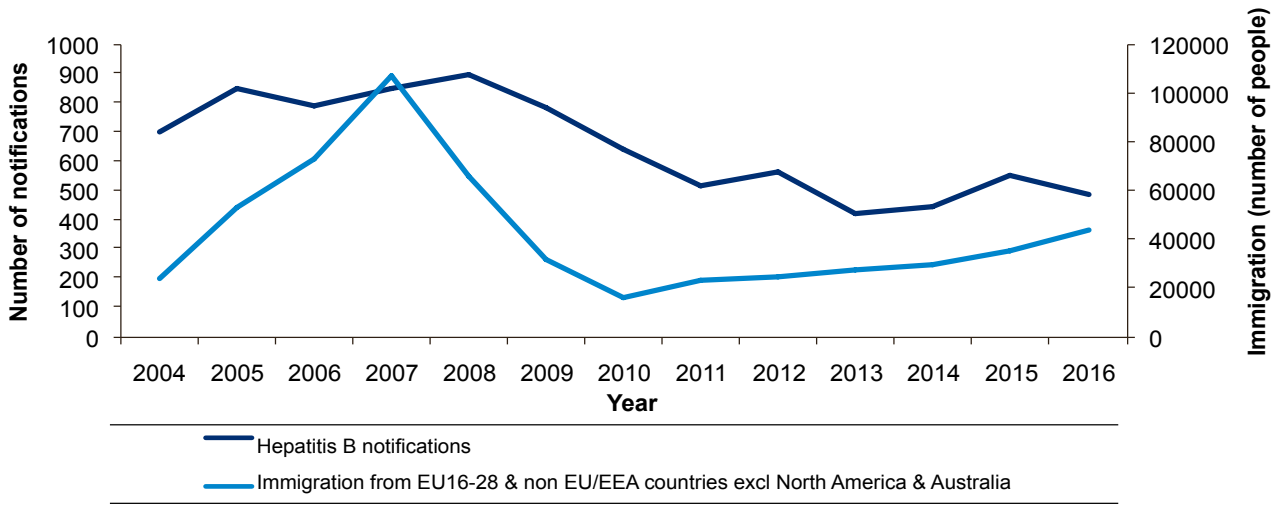

*Figure 7. Number of hepatitis B notifications and number of immigrants from EU16-28 & non EU/EEA countries (*excluding north America and Australia)*

5.2 Hepatitis C

Summary

Number of cases, 2016: 645
Crude notification rate, 2016: 13.5/100,000 population
Number of cases in 2015: 674

Hepatitis C is a major cause of liver disease worldwide. The hepatitis C virus (HCV) is primarily transmitted through sharing contaminated equipment when injecting drugs or through receipt of unscreened blood or blood products (this is no longer a risk in Ireland).[1,2] Sexual, occupational and vertical transmission can also occur but are less common. The risk of sexual transmission is increased in men who have sex with men (MSM), particularly those who are HIV positive or have other sexually transmitted infections.[3]

Infection is initially asymptomatic in most cases, but approximately 75% of those infected fail to clear the virus and develop chronic infection. Between 5 and 20% of chronically infected individuals develop cirrhosis of the liver after 20 years of infection. Of those with cirrhosis, 1.5 to 2.5% will go on to develop hepatocellular carcinoma (liver cancer) each year.[1] There have been major advances in the treatment of hepatitis C in recent years. The latest generation of direct-acting antivirals (DAAs) can cure more than 90% of patients using all-oral drug regimes, which have fewer side effects than previous treatments.[4]

The overall prevalence of chronic hepatitis C in Ireland is estimated to be between 0.4 and 0.8%[5] and is comparable to other northern European countries (0.1-0.6%).[6] Most cases fall into defined risk groups such as people who inject drugs (PWID) and people who received unscreened blood or blood products in the past.[7]

There were 645 notifications of hepatitis C in 2016 (13.5/100,000 population). This is a slight decrease compared to 2015 (n=674, 14.2/100,000 population) (figure 1). Notifications have declined by 58% since peak levels in 2007 (n=1538). However recent trends indicate that the rate of decline is slowing and levels are stabilising. Notification rates for each HSE area for the past four years are shown in figure 2. Seventy percent of notifications in 2016 were from HSE E (n=450, 26.3/100,000 population).

More than two thirds of the cases of hepatitis C reported in 2016 were male (71%, n=460), 28% (n=182) were female and sex was not reported for three cases. The highest notification rates were in young to middle aged adults, with 80% (n=519) of cases aged between 25 and 54 years. The median age at notification has gradually increased from 31 years in 2004 to a high of 39 years since 2014 (figures 1&3).

Risk factors

Information on most likely risk factor was reported for 49% (n=313) of the cases of hepatitis C notified in 2016 (figure 4). Almost two thirds (66%, n=206) of cases were PWID. The proportion of cases attributed to injecting drug use has decreased in recent years (80% in 2014, 72% in 2015), but risk factor data completeness varies from year to year so this trend must be interpreted with caution (figure 4).

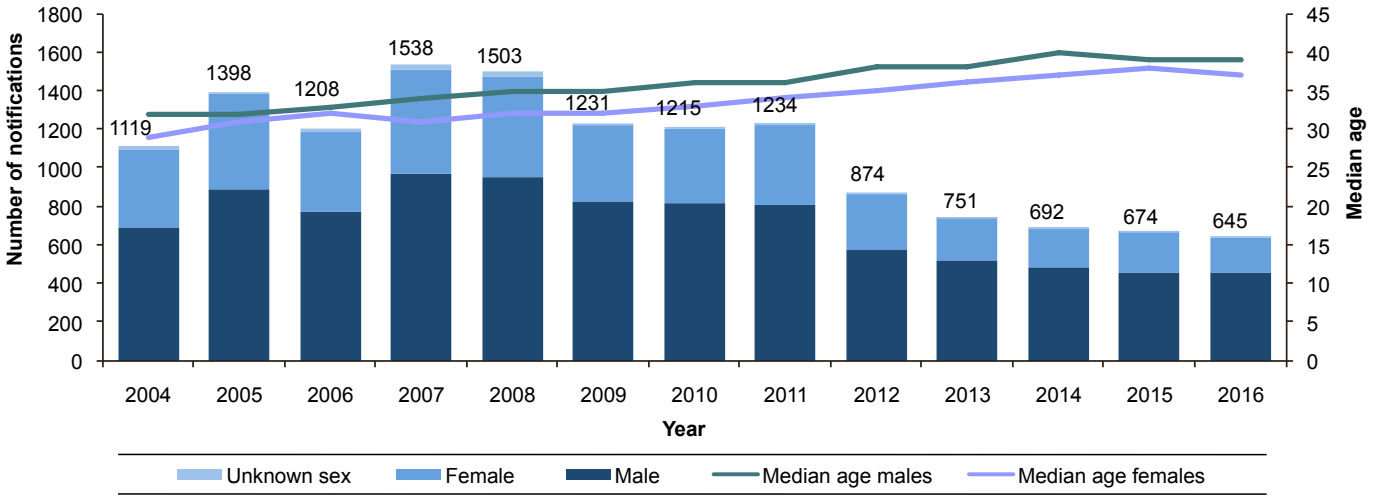

Figure 1. Number of notifications of hepatitis C and median age at notification, by sex, 2004-2016

Twelve percent (n=36) of cases were likely to have been infected sexually (24 were MSM, 9 were heterosexual and sexual orientation was not reported for the remaining 3 cases). There were five additional cases of hepatitis C identified as MSM in 2016, but sexual acquisition was not reported as their risk factor for infection. Two of these cases also injected drugs and this was reported as their most likely source of infection. The remaining three MSM cases currently have risk factor entered as unknown on CIDR. There was an increase in the number of hepatitis C cases identified as MSM in 2016 (n=29 compared to 8 in 2015 and 4 in 2014). A significant proportion of these cases were co-infected with HIV and had multiple other sexually transmitted infections (STIs), indicating that sexual transmission of hepatitis C is likely to be occurring in a particularly high risk cohort (figure 5). Of the 29 MSM cases, 66% (n=19) were HIV positive and 58% (n=11) of these cases had at least one diagnosis of gonorrhoea, syphilis, chlamydia, lymphogranuloma venereum or genital herpes simplex virus in 2015 or 2016. Half of the 10 HIV negative MSM cases had also recently been diagnosed with one or more sexually transmitted infections (figure 5). Nineteen of the MSM cases of hepatitis C were acute (new) infections, 2 were chronically infected at diagnosis and the acute/chronic status was not known for the remaining 8 cases.

Other reported risk factors for hepatitis C cases included contaminated blood or blood products (4%, n=13), tattooing or body piercing (3%, n=8) and vertical (mother to baby) transmission (2%, n=5). No risk factor was identified for 28 cases despite Public Health follow up. Six of the cases infected through blood or blood products were infected in Ireland. The exposure had occurred many years in the past, but these cases were notified for the first time in 2016. Figure 4 shows recent risk factor trends for hepatitis C in Ireland.

Country of birth

Data on country of birth were available for just over a third of hepatitis C cases (34%, n=219) in 2016. Where information was available, 40% (n=87) of cases were born in Ireland, 35% (n=76) were central or eastern European, 11% (n=23) were born in other western European countries, 7% (n=16) were Asian, 5% (n=10) were African, 2% (n=4) were from Latin American countries and 1% (n=3) were born in North America. Just under a third of cases with information on country of birth or asylum seeker status were born in a hepatitis C endemic country (≥2% anti-HCV prevalence) or were asylum seekers. However, information on country of birth is more likely to be reported for non-Irish nationals and the actual proportion of hepatitis C cases born in Ireland is likely to be higher than this. Figure 6 shows the most likely

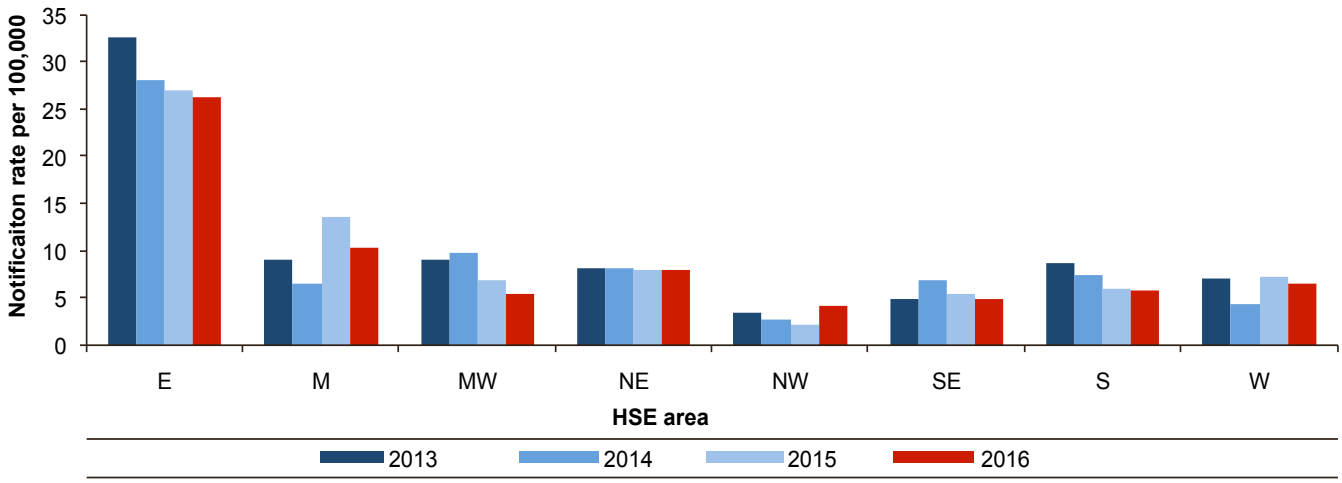

Figure 2. Notification rates/100,000 population for hepatitis C by HSE area, 2013-2016

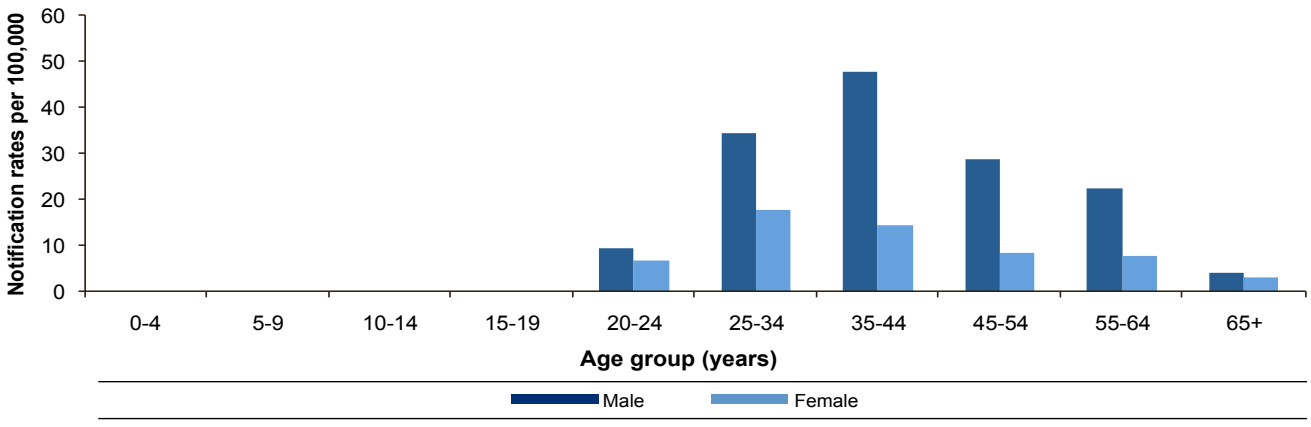

Figure 3. Age and sex-specific notification rates/100,000 population for hepatitis C, 2016

risk factor for infection by region of birth for the 219 cases where country of birth was known.

Genotype

Hepatitis C genotype data were collected retrospectively from National Virus Reference Laboratory and were available for 23% (n=146) of notifications in 2016. Of these, 62% (n=91) were genotype 1, 30% (n=44) were genotype 3, 6% (n=8) were genotype 2 and 2% (n=3) were genotype 4. Subtype was available for 95% (n=86) of genotype 1 cases, 79% of which were genotype 1a. This may not be representative as genotype data were very incomplete in 2016. Genotype was available for 52% of hepatitis C cases notified between 2013 and 2015. Over this period 60% of cases with data were genotype 1, 33% were genotype 3, 4% were genotype 2 and 3% were genotype 4.

Co-infections

Co-infection with HIV can increase the risk of acquiring hepatitis C sexually, and both HIV and hepatitis B co-infections can lead to more severe liver disease and an increased risk of liver cancer in those with hepatitis C infection. The number of hepatitis C cases who were HIV positive at diagnosis doubled to 38 in 2016 (6% of all cases). The increase was particularly evident in MSM. Of those with information on risk factor or sexual orientation, 18 were MSM (53%), 15 were PWID (44%) and one was an MSM who also injected drugs (3%). In contrast, of the 19 HIV co-infected cases in 2015 with risk factor information, 9 (64%) were PWID, 4 (29%) were MSM and 1 (7%) was an MSM who also injected drugs.

Five of the cases of hepatitis C notified in 2016 were co-infected with hepatitis B. Two were born in countries which are endemic for both hepatitis B and C and no enhanced data were available for the remaining three.

Discussion

Hepatitis C notifications have decreased in recent years. The decline was fairly dramatic in 2012 but this may have been partially attributable to the introduction of new case definitions specifically excluding cases known to have resolved infection. While notifications have continued to decline each year since 2012, the rate of decline is slowing. Trends in notifications of hepatitis C are difficult to interpret as acute and chronic infections are frequently asymptomatic and most cases diagnosed and notified are identified as a result of screening in risk groups. Therefore, notification patterns are heavily influenced by testing practices which

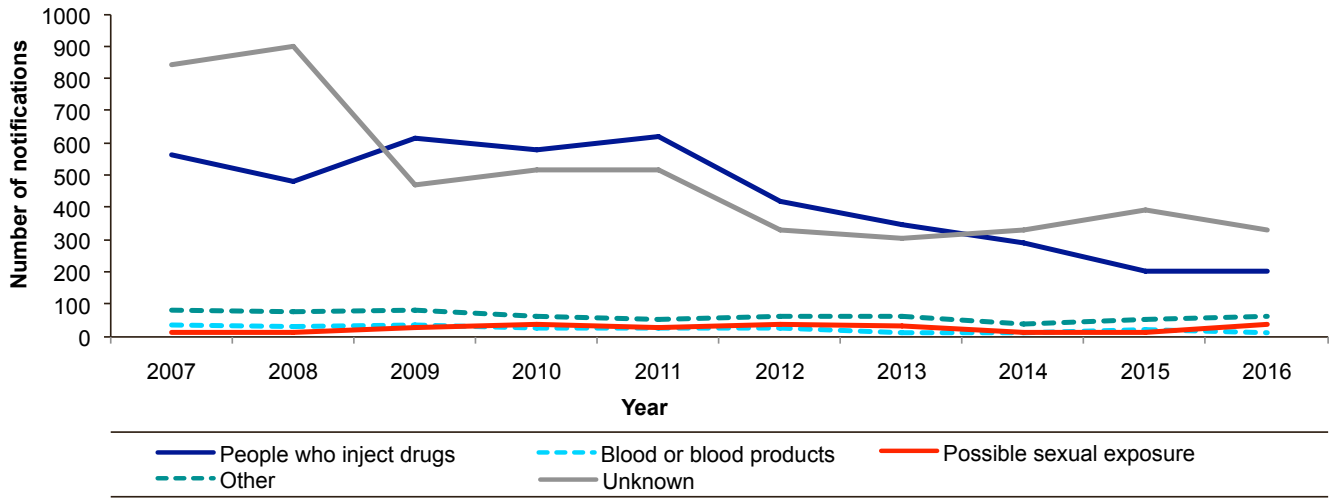

Figure 4. Number of hepatitis C notifications by most likely risk factor (where risk factor known, 52%, n=5,422) 2007-2016

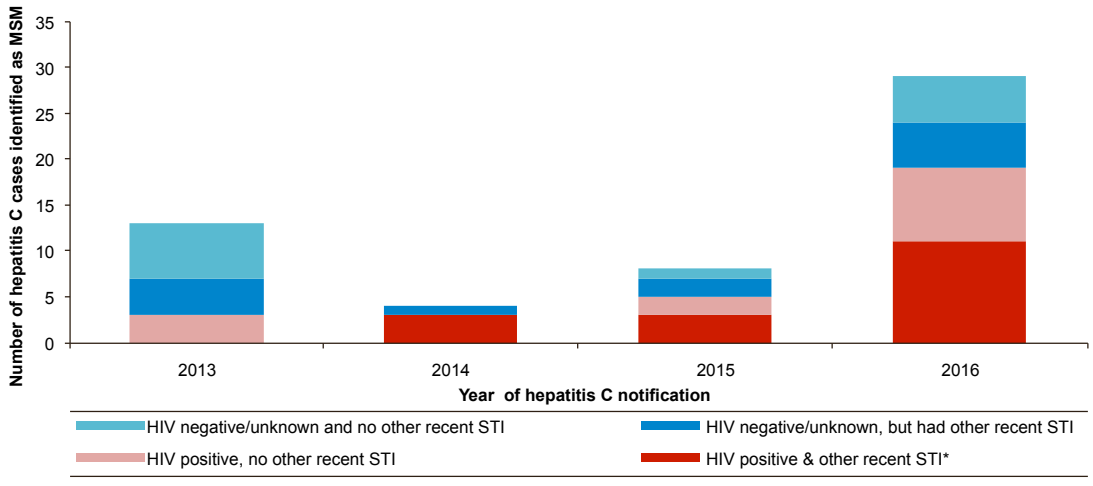

Figure 5. Number of hepatitis C cases identified as MSM between 2013 and 2016, by HIV status at the time of hepatitis C notification and other recent STI status.*

**Gonorrhoea, syphilis, chlamydia, lymphogranuloma venereum or genital herpes simplex in the same year as hepatitis C notification or in the year prior to hepatitis C notification*

may vary over time and thus may not accurately reflect incidence.

Risk factor data were available for almost half of the cases of hepatitis C notified in 2016. The distribution of risk factors for these cases may differ from cases where data were not available. Where information on risk factor was available, approximately two thirds of cases were PWID who were likely to have been infected through unsafe injecting practices. Anecdotally, the proportion of drug users who are injecting is decreasing and the incidence of hepatitis C appears to be decreasing in this population. This is supported by a reduction in the proportion of hepatitis C notifications attributed to drug use in recent years. The proportion of sexually acquired cases of hepatitis C has increased in the last 18 months, particularly amongst MSM. Increases in HIV and other sexually transmitted infections were also identified in MSM in 2015 and 2016 and a national multidisciplinary outbreak response group was established in early 2016 to develop an action plan for Public Health intervention (www.hpsc.ie/a-z/specificpopulations/menwhohavesexwithmenmsm/).

The figures presented in this summary are based on data extracted from the Computerised Infectious Disease Reporting (CIDR) System on 5th October 2017. These figures may differ from those published previously due to ongoing updating of notification data on CIDR. Notification rates are expressed per 100,000 population and are calculated using the 2016 census.

Acknowledgements

HPSC would like to thank all those who provided data for this report – Departments of Public Health, laboratories and clinicians.

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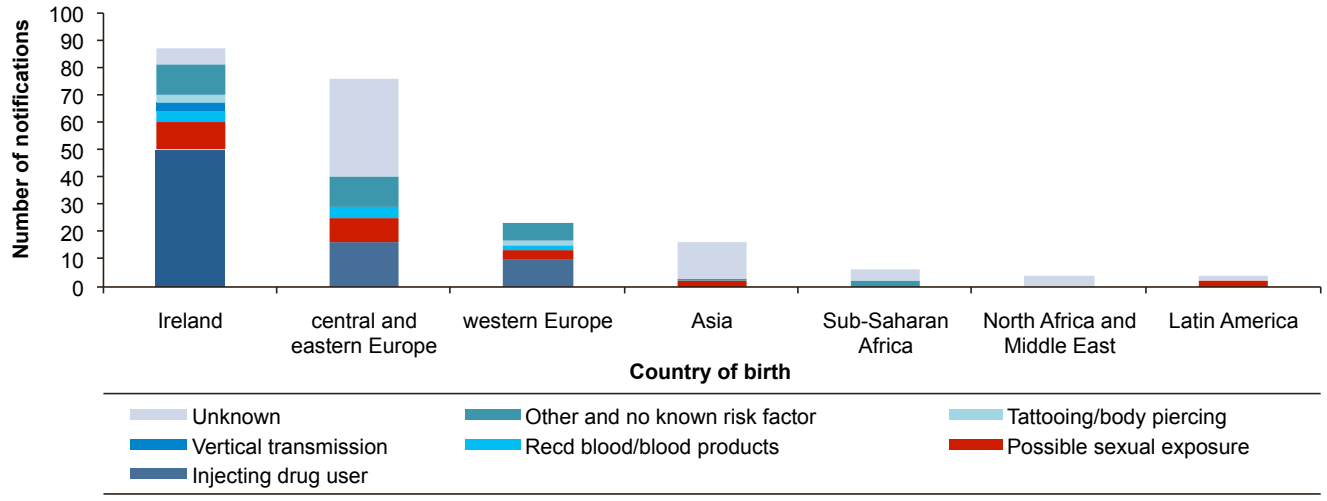

Figure 6. Number of hepatitis C notifications by most likely risk factor and country/region of birth (where country of birth known, 34%, n=219), 2016

5.3 HIV

Summary

Number of notifications: 508
Crude notification rate: 10.7 per 100,000 population

In 2016, 508 people were newly diagnosed with HIV in Ireland, giving a rate of 10.7 per 100,000 population. Between 2010 and 2014, HIV diagnosis rates in Ireland were stable but increased by 30% between 2014 and 2015 and by 5% between 2015 and 2016. However, excluding those with a previous HIV diagnosis in another country, the number of diagnoses decreased by 6% in 2016. For a summary of new HIV diagnoses in 2016, see Table 1.

Age and gender
In 2016, 77% of diagnoses were in men and 23% in women. Most people (73%) were aged between 25 and 49 years at diagnosis and the median age was 35 years.

Probable route of transmission (see figure 1)
Information on probable route of transmission was available for 84% of diagnoses. Among all notifications, sex between men remains the predominant mode of HIV transmission reported in Ireland (51%) followed by heterosexual transmission (28%). Four percent were among people who inject drugs (PWID). There were three cases where the route of transmission was reported as mother to child transmission (MTCT). Two had previously been diagnosed HIV positive abroad and the third was a baby born in Ireland in 2016.

Geographic origin
Of the diagnoses in 2016, 61% were born abroad, 26% were born in Ireland and 13% did not have information on country of birth. The geographic origin varied by risk group: the majority of heterosexual cases (64%) were born in sub-Saharan Africa; the majority of cases among men who have sex with men (MSM) were either born in Latin America (36%) or Ireland (32%) and the majority of cases among PWID (71%) were born in Ireland.

Previous testing abroad
Notifications of HIV include all people who are diagnosed HIV positive for the first time in Ireland and include a number of people who have been previously diagnosed HIV positive abroad. In 2016, 34% of diagnoses were in people known to be previously diagnosed HIV positive abroad, and the majority of these (86%) had transferred their HIV care to Ireland. The proportion of diagnoses who are previously positive abroad has increased in recent years (21% in 2012).

Late diagnosis
Information on stage of diagnosis (CD4 count at diagnosis or AIDS defining illness at diagnosis) was available for 63% of cases in 2016. From the available information, 37% of people newly diagnosed in 2016 were late presenters (with CD4 <350 cells/µl or an AIDS defining illness at diagnosis) and 19% had advanced HIV infection (with CD4 <200 cells/µl or an AIDS defining illness at diagnosis). However, excluding those with a previous HIV diagnosis abroad, the proportion of people who presented late was 44%. Among the people

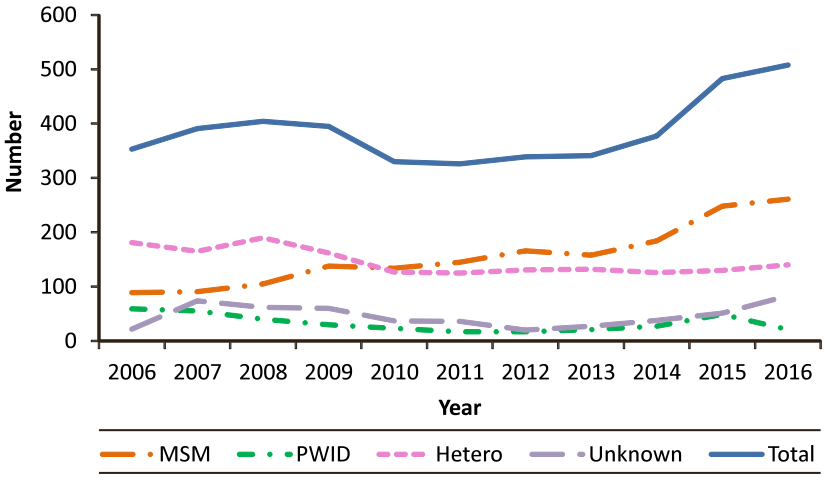

Figure 1: Trends in HIV diagnoses by route of transmission, 2006 to 2016

being diagnosed with HIV for the first time, the groups with the highest proportion presenting late were females (57%), heterosexual males (58%), heterosexual females (57%), people aged over 50 years (61%) and people born in sub-Saharan Africa (57%).

Discussion

While there was a slight increase in the overall number of diagnoses of HIV in Ireland in 2016, there was a welcome reduction in the number of diagnoses among people who had not been previously diagnosed abroad. Given the increasing number of cases new to Ireland already known to be HIV positive, it is essential to focus on early engagement in care and immediate initiation of antiretroviral therapy (ART) which will be of direct clinical benefit and will also prevent onward transmission. This is in line with advice from both the World Health Organization (WHO) and the HSE (1, 2).

MSM accounted for just over half of diagnoses in 2016 and are the group most affected by HIV in Ireland. However, the proportion of MSM diagnosed with HIV prior to arrival in Ireland has been increasing and was 42% in 2016 compared to 16% in 2012. The number of new diagnoses in MSM not previously diagnosed abroad dropped by 14% in 2016 compared to 2015.

Diagnoses among heterosexuals remained stable since 2010 with an average of 130 notifications per year. As in previous years, the majority of heterosexual cases were born in sub-Saharan Africa and it is of concern that people from sub-Saharan Africa presented later in the course of their HIV infection compared to other groups.

Diagnoses among PWID decreased in 2016 compared to 2015 and accounted for 4% of cases. An outbreak of HIV among homeless drug users in Dublin occurred in 2014 and 2015. Prevention and control efforts were targeted to this group and the outbreak was declared over in February 2016 (3). However, this group remains vulnerable to future outbreaks of HIV and other blood borne viruses.

The detailed 2016 annual report and slide set are available at http://www.hpsc.ie/a-z/hivstis/hivandaids/hivdataandreports/

The latest report on Antenatal HIV Testing in Ireland is available at http://www.hpsc.ie/a-z/hivstis/hivandaids/antenatalhivtesting/reportsonantenatalhivtestinginireland

Note: Data for this chapter were extracted from CIDR in August, 2017 and were correct at the time of publication.

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Table 1: Characteristics of HIV diagnoses, 2016

Number of HIV diagnoses		508
Rate of diagnoses (per 100,000 population)		10.7
Gender	Males (%)	77.4
	Females (%)	22.6
	Male to female ratio	3.4
Age	Median age of adult cases (years)	35
	Age range of adult cases (years)	18-72
	Young people aged 15-24 years (%)	7.9
	Aged 50 and older (%)	9.5
Probable Route of Transmission	MSM (%)	51.4
	Heterosexual (%)	27.6
	Injecting Drug Use (%)	4.1
	Mother to Child transmission (%)	0.6
	Other (%)	0.4
	Unknown (%)	15.2
Region of Birth	Born in Ireland (%)	25.4
	Born Abroad (%)	61.2
	Unknown (%)	13.4
Previous history of testing	Previously tested positive abroad (%)	34.4
	Transfer of care overall (% among those previously positive abroad)	29.1 (86.3%)

5.4 Sexually Transmitted Infections (STIs)

Summary

Total number of STIs in 2016: 12,984
Most frequently reported STI in 2016: *Chlamydia trachomatis* infection (n=6,893)

Summary

During 2016, a total of 12,984 cases of sexually transmitted infections (STIs) were reported. The most frequently reported STIs were *Chlamydia trachomatis* infection (n=6,893), gonorrhoea (n=1,957), ano-genital warts (n=1,593) and herpes simplex (genital) (n=1,369) (table 1). Compared to 2015, the largest increase was in cases of gonorrhoea which increased by 51% (to 1,957).

The burden of STIs is greatest among those aged 15-24 years, and among men who have sex with men (MSM). Notifications among those aged 15-24 years accounted for 48% of chlamydia notifications, 37% of gonorrhoea notifications and 43% of herpes simplex (genital) notifications. MSM accounted for 67% of gonorrhoea, 88% of syphilis, and 100% of lymphogranuloma venereum (LGV) cases where mode of transmission was known.

Chlamydia trachomatis infection

Chlamydia trachomatis infection was the most frequently reported STI with 6,893 notifications in 2016. The notification rate (NR) increased to 144.7 per 100,000 population, from 142.7/100,000 in 2015. The NR among males increased by 6% and decreased by 2% in women compared to 2015. Chlamydia infections were steady in the years from 2011 to 2013, with rates between 139.6/100,000 and 136.4/100,000 population (figure 1). More than three-quarters of chlamydia cases were among those under 30 years, with the largest proportion aged 20-24 years (40%). Just over half of cases were among women with the highest rate among women aged 20-24 years. The rate in females in this age group is consistently higher than males. In 2016, the rate in females (1,165.7 per 100,000) was almost 1.4 times greater than in males in this age group (843.8 per 100,000).

Gonorrhoea

In 2016, 1,957 cases of gonorrhoea were reported in Ireland, giving a notification rate of 41.1 per 100,000 population. This was a 51% increase on the notification rate in 2015 (27.2 per 100,000); there has been a more than fourfold increase in the rate since 2009. In 2016, the notification rate in males increased by 59% from 45.7/100,000 population in 2015 to 72.6/100,000 population in 2016 and amongst women the NR increased by 11% to 10.1/100,000. The vast majority of gonorrhoea cases were among men (n=1,709, 87%). Almost a third of cases (27%, n=524) were among people aged between 20 and 24 years old. Mode of transmission was available for 64% of cases (n=1,249) in 2016. Where data were known, mode of transmission was reported as MSM for 67% of cases (n=839) and heterosexual for 33% of cases (n=408; 169 males and 239 females). There were two cases of mother to child transmission in 2016. Genital and pharyngeal sites were the most frequently first reported sites of infection among males (32%, n=547 and 28%, n=467 respectively). Pharyngeal infections were the first reported site in 26% of all gonorrhoea cases in 2016, which has important implications for treatment of gonorrhoea as the pharynx may be a reservoir for antimicrobial resistant gonorrhoea. In all, 511 (26%) cases diagnosed with gonorrhoea were also diagnosed with another STI in 2016, including 17% who also had chlamydia and 2% who were newly diagnosed with HIV.

Table 1: Number, notification rate (NR) per 100,000 population & median age of persons with STIs, 2016

STI	Number	NR	Median Age (range)
Chlamydia trachomatis infection	6,893	144.7	25 years (15-70 years)*
Ano-genital warts (AGW)	1,593	33.5	NA
Gonorrhoea	1,957	41.1	27 years (15-81 years)*
Herpes simplex (genital)	1,369	28.7	26 years (15-77 years)
Non-specific urethritis (NSU)	740	15.6	NA
Syphilis (early infectious)	305	6.4	33 years (18-73 years)
Trichomoniasis	79	1.7	32 years (19-68 years)
Lymphogranuloma venereum (LGV)	48	1.0	35 years (20-54 years)
Total	**12,984**		-

*Excludes those <14 years; NA: case-based data were not collected

Ano-genital warts

During 2016, 1,593 cases of ano-genital warts were reported in Ireland giving a notification rate (NR) of 33.5 per 100,000 population, a decrease from 2015 (38.7/100,000) (figure 1). There were more notifications among men (53%) than women (36%). Sex was not provided for 11% of cases. The age- and sex-specific notification rates were higher in men than women in all age groups. The highest age-specific notification rate was among men aged 25-29 years (129.5/100,000) Age group however was not provided for 36% of cases. The numbers reported here are likely to be an underestimate of the true numbers of cases as data were not reported from every STI clinic. Further details on the completeness of reporting are available in the report *Ano-genital warts in Ireland, 2016*, available on the HPSC website, www.hpsc.ie.

Herpes simplex (genital)

There were 1,369 cases of herpes simplex (genital) notified in Ireland during 2016 corresponding to a NR of 28.7 per 100,000 population, a small increase from 2015 (26.8/100,000) (figure 1) and the third consecutive year in which the notification rate has increased. Most cases were reported as Herpes simplex virus (HSV) type 1 (62%), with 36% reported as HSV type 2. Subtype was not reported for 2% of cases. Almost three-quarters of cases (n=995) were in women. The highest age-specific rate was among 20-24 year olds (149.1/100,000). The rate among women in this age group (234.5/100,000) was three and a half times greater than among men (64.7/100,000).

Trichomoniasis

During 2016 there were 79 cases of trichomoniasis notified in Ireland corresponding to a NR of 1.7 per 100,000 population, a slight increase on the previous year (1.2/100,000) but not significantly different. All reported cases were among women. The highest sex- and age-specific rates were among women aged 25-29 years (13.1/100,000).

Lymphoganuloma venereum (LGV)

There were 48 LGV cases reported in 2016 giving a NR of 1.0 per 100,000 population (compared with 20 cases in 2015, 35 cases in 2014 and five cases in 2013). The majority of cases were reported in HSE East (n=42), two cases were reported in both HSE Midwest and HSE Northeast, and one case each was reported in HSE Southeast and HSE West. All cases were among men who have sex with men (MSM). Two-thirds of cases (67%) were HIV positive. Thirty two cases had a diagnosis of another STI (excluding HIV) in 2016. Most (85%) of these cases (n=41) were linked to an outbreak among MSM in the Greater Dublin area. Multidisciplinary outbreak control teams (OCTs) were convened by the Department of Public Health, HSE East to actively investigate cases and instigate control measures[1].

Non-specific urethritis

A total of 740 cases of non-specific urethritis were reported in 2016 compared with 1,028 cases in 2015, a decrease of 28% and a NR of 15.6 per 100,000 population.

More detailed annual reports on STIs are available on the HPSC website at http://www.hpsc.ie/A-Z/HIVSTIs/SexuallyTransmittedInfections/Publications/STIReports/STIAnnualReports/.

Weekly reports on STIs and HIV are available on the HPSC website at http://www.hpsc.ie/A-Z/HIVSTIs/SexuallyTransmittedInfections/Publications/STIReports/STIWeeklyReports/.

Data on syphilis, HIV and hepatitis B are presented elsewhere in this report.

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Note: CIDR information is updated on an on-going basis with the most up to date information available and so numbers reflect the date of extraction from CIDR. Data for this chapter were extracted from CIDR in October and November, 2017.

Acknowledgements

The Health Protection Surveillance Centre (HPSC) would like to thank all those who provided data for this report, particularly the STI clinics, and the infectious disease surveillance staff within the Departments of Public Health, the laboratories, and GP clinics.

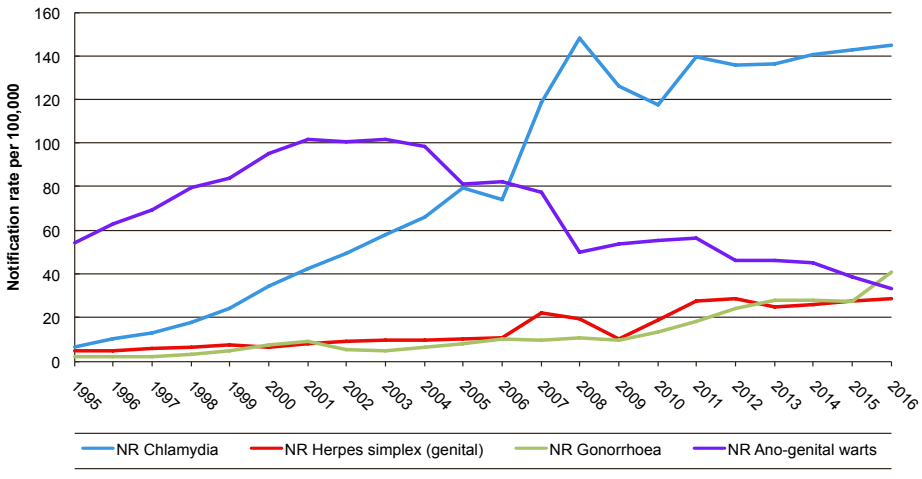

Figure 1 Trend in notification rate (NR) per 100,000 population of selected STIs, 1995-2016

5.5 Syphilis

Summary

Number of early infectious syphilis cases: 305
Notification rate of early infectious syphilis: 6.4/100,000 population

A change in the case definition and laboratory notification criteria for syphilis was made in January 2014, whereby only laboratory diagnosed early infectious syphilis (EIS) cases, and re-infections of syphilis, became notifiable. These laboratory diagnosed notifications were then reviewed clinically, staged, and subsequently deactivated in the CIDR system by Public Health if they were not EIS cases as determined by clinical assessment. The staging of syphilis cases, Public Health follow-up and CIDR deactivation was found to be time consuming for both STI clinics and Public Health Departments with a time lag of up to six months following initial notification. Simplifying the surveillance provides more timely information which is essential to inform the response to the current increase in EIS amongst men who have sex with men (MSM). From 1st July 2016, updated laboratory criteria for notification of syphilis cases to Public Health have been applied. Laboratories were requested to notify **any new case** that fits one or more of the updated laboratory criteria, **and** any syphilis **re-infections**. Laboratories continue to use their own internal criteria for notification of re-infections. This case definition remained current from 1st July 2016 onwards.

During 2016, 430 cases of syphilis were notified in CIDR based on laboratory criteria (data extracted 20th Sept., 2017); 260 between the 1st of January and the 30th of June and 170 between the 1st of July and the 31st of December. In total, 305 notified cases of syphilis met the criteria for laboratory diagnosis of EIS during 2016; of the 260 notified in the first half of the year, stage of infection was reported as EIS following clinical review for 135 cases (i.e. enhanced surveillance forms were received for 52% of cases) and based on the updated laboratory criteria applied from 1st July, the 170 cases notified in the second half of the year were reported as EIS. Enhanced surveillance forms were received for 46% of cases in the second half of the year.

In addition to notifications of EIS there was one possible

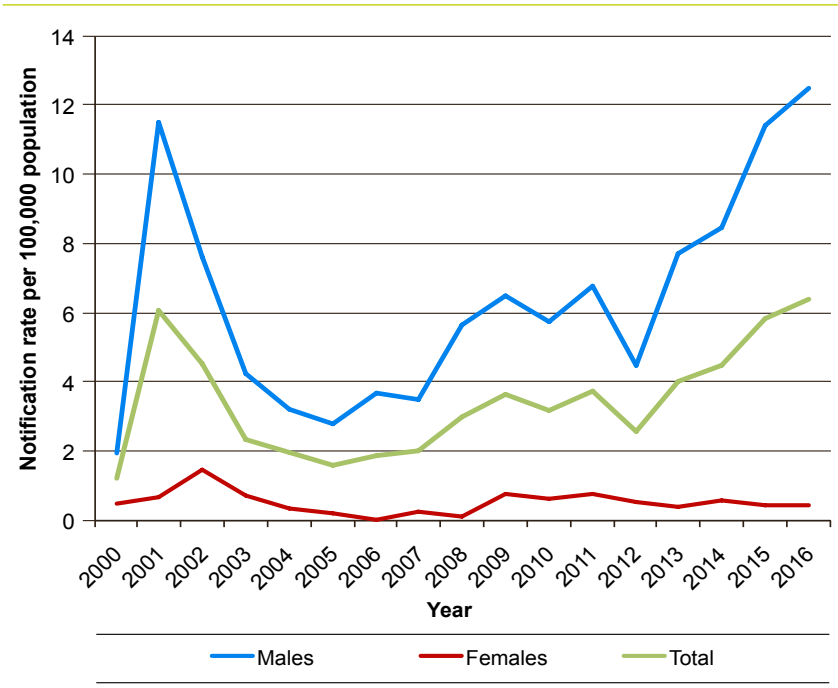

Figure 1: Notification rate of early infectious syphilis (per 100,000 population), 2000-2016

case of congenital syphilis notified in 2016. This child will be followed-up until they are 18 months old to determine whether positive laboratory test results were a result of infection or the presence of maternal antibodies.

Between 1st January and 30th June 2016, this analysis focuses on cases fitting the laboratory criteria and clinical criteria (n=135) and so the number of early cases for the first half of 2016 is likely to be an under-estimate of the true number of early infectious syphilis cases.

The notification rate for early infectious syphilis in 2016 was 6.4 per 100,000 population, an increase of 10% compared to 2015 (5.8 per 100,000). Figure 1 shows the trend in notification rate (NR) for early syphilis cases from 2000 to 2016.

Of the 305 early infectious syphilis cases notified in 2016:

- 124 (41%) were classified as primary syphilis, 35 (11%) as secondary syphilis, 48 (16%) as early latent syphilis, and 98 (32%) as EIS, not otherwise specified (n.o.s.).
- Rates varied throughout the country, with the age-standardised notification rate (ASNR) (10.4 per 100,000) in HSE East (Dublin, Kildare and Wicklow) 1.6 times the national rate (6.4 per 100,000). The ASNR in four HSE areas (West, Southeast, Northwest and Northeast) were significantly lower than the national rate (figure 2).
- The majority of cases occurred in males (n=295; 97%), with a male to female ratio of 30:1.
- The notification rates in men and women were 12.5 and 0.4 per 100,000 population, respectively (figure 1).
- The majority of cases (60%) were reported in people aged between 25 and 39 years.
- Almost three quarters of cases were identified at a dedicated STI clinic and 18% were identified in general practice.
- Of the 305 EIS cases in 2016, 222 (73%) were among MSM and 29 (10%) were among heterosexuals (8 female and 21 male). For 54 cases (17%), the mode of transmission was unknown.
- The percentage of cases among MSM who were co-infected with HIV in 2016 continued to rise (39% compared to 30% in 2015).
- One male heterosexual case was co-infected with HIV.
- Two out of 10 female cases were pregnant at the time of diagnosis.
- Among patients diagnosed with EIS, there were an additional 126 cases of STIs (other than HIV) diagnosed during 2016. Since full patient identifiers were not provided for all cases, the true figure for STI co-infections is likely to be much higher.

Discussion

2016 was the third year for which only cases of early infectious syphilis were notifiable. The aim of reporting early infectious syphilis is to improve completeness of information and data quality. The proportion of cases for which enhanced surveillance forms were received decreased in 2016 when compared to recent years (50% versus 61% in 2015, 73% in 2014 and 60% in 2013). The true number of early infectious syphilis cases may be higher than reported here, as only cases with both laboratory and clinical data indicating early infectious syphilis were included in the analysis for the first half of 2016.

In 2016, the notification rate of early syphilis increased to 6.4 per 100,000, the highest rate since the syphilis outbreak among MSM in Dublin in 2001 (6.1/100,000). The increase in early syphilis in 2016 was concentrated among men (97% of cases). The rate among men increased to 12.5 per 100,000 compared to 7.7/100,000, 8.4/100,000 and 11.8/100,000 in 2013, 2014 and 2015, respectively. The rate

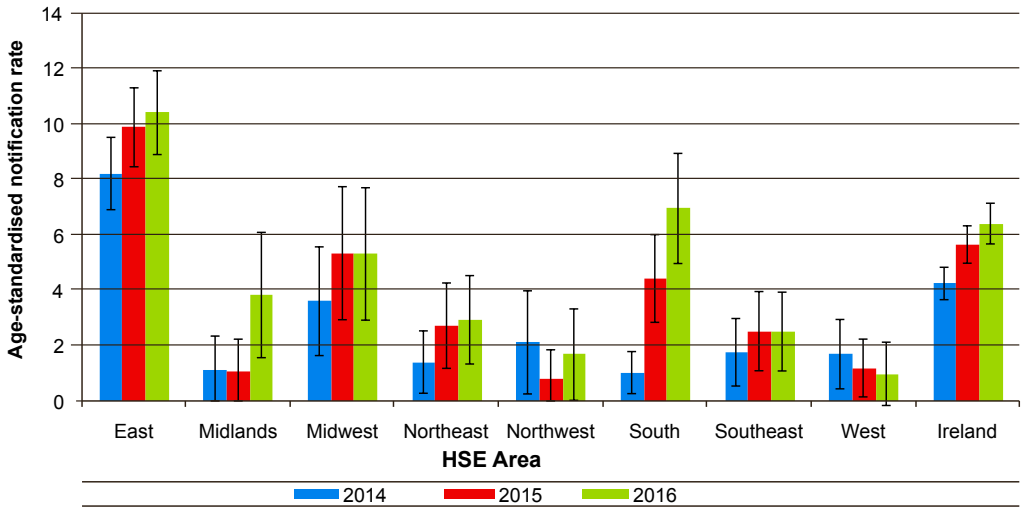

Figure 2: Age-standardised notification rate of early infectious syphilis by HSE area, 2014-2016

among women remained steady in 2016, at 0.4 per 100,000 compared to 0.6/100,000, 0.4/100,000 and 0.4/100,000 in 2013, 2014 and 2015, respectively.

The increase in 2016 was among men for whom mode of transmission was not recorded. Cases without a reported mode of transmission increased from 6% in 2015 to 18% (n=54) in 2016. Of these, the proportion by sex is the same as those cases where mode of transmission is reported (96% among males and 4% among females). Since 2012, EIS among MSM has increased by 170% (from 81 in 2012 to 222 in 2016).
Cases among heterosexuals decreased in 2016 by 12% (29 versus 33 in 2015). Rates of EIS in HSE East remain significantly higher than the national rate with most cases in HSE East occurring among MSM, confirming that this area remains a centre of transmission within Ireland. Most of the other cases in HSE East were among men for whom mode of transmission data were missing.

The proportion of EIS cases co-infected with HIV in 2016 increased to 34% in 2016 from 29% in 2015 and 25% in 2014. Of those co-infected with HIV, the number diagnosed with HIV in the same year as their syphilis diagnosis was 25% (compared to 39% in 2015 and 26% in 2014). The proportion of HIV co-infection continues to be higher among MSM compared to heterosexuals. The proportion of cases co-infected with HIV remains a concern as co-infection increases the risk of acquiring and transmitting HIV[1].

In December 2015, preliminary analysis of 2015 data pointed to a significant increase in EIS and other STIs among MSM[2]. This analysis also pointed to a change in the demographics of cases, with an increasing proportion of cases among Latin American MSM living in Ireland (up from 6% in 2012 to 25% in 2015). A growing number of MSM acquired their infection in Ireland in 2015 (74%) compared to previous years (59% in 2014). Similar increased trends in HIV and other STIs were also a cause for concern. In response, a national multidisciplinary multi-sectoral group was established in early 2016. The response involves three main strands of work covering epidemiology, interventions, and communications. Throughout 2016 ongoing analysis of trends were undertaken by the epidemiological subgroup and this continues in 2017.

During 2016 a number of interventions were implemented including an additional clinic at the Gay Men's Health Service, employment of two outreach workers, increased distribution of condoms and lubricant as well as health promotion materials. This work continues in 2017. Information on the work of the National MSM Outbreak Response Group is available at http://www.hpsc.ie/a-z/specificpopulations/menwhohavesexwithmenmsm/.

A more detailed analysis of syphilis in Ireland in 2016 is available in the report Syphilis in Ireland, 2016, which is available on the HPSC website.

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Note: CIDR information is updated on an on-going basis with the most up-to-date information available and so numbers reflect the date of extraction from CIDR. Data for this chapter were extracted on 21st September, 2017.

Acknowledgements

The Health Protection Surveillance Centre (HPSC) would like to thank all those who provided data for this report, particularly the STI clinics, and the infectious disease surveillance staff within the Departments of Public Health, the laboratories and GPs.

Table 1: Summary of early infectious syphilis cases, 2012, 2013, 2014, 2015 and 2016

	2012		2013		2014		2015		2016	
	n	%	n	%	n	%	n	%	n	%
Total number of early cases	115		184		204		268		305	
Male	101	87.8	175	95.1	191	93.6	258	96.3	295	96.7
Men who have sex with men (MSM)	81	70.4	120	65.2	140	68.6	220	82.1	222	72.8
Heterosexuals	24	20.9	22	12.0	36	17.6	33	12.3	29	9.5
Unknown mode of transmission	10	8.7	43	23.4	28	13.7	15	5.6	54	17.7
Median age (years)	33		33		32		33		33	
Age range (years)	19-68		19-73		19-70		20-65		18-73	

2016

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06

OTHER INFECTIONS

6.1 Viral Encephalitis

Summary

Number of cases, 2016: 61

Number of cases, 2015: 47

Number of cases, 2014: 67

Crude incidence rate, 2016: 1.3/100,000

Encephalitis due to viruses not otherwise specified (NOS) are notifiable under the disease category 'viral encephalitis'. Details of viral encephalitis cases caused by other notifiable diseases, if any, are presented in other chapters in this report.

In 2016, 61 cases of viral encephalitis (NOS) (VE) were notified in Ireland (1.28/100,000 population) compared to 47 (0.98/100,000) in the previous year (Figure 1). One contributing factor to the increase in numbers can be attributable to increase in the number of herpes simplex virus type 2 from three to nine cases and by the increase in varicella/herpes zoster virus cases from two to six cases.

The number of VE cases among males (n=23) was considerably less than in females (n=35), a M:F ratio of 0.66:1, with three cases remaining not attributed to either sex. The median age of cases was 34 years (range two weeks to 87 years); 15 (24.6%) cases occurred in those aged 65 or more years and 12 cases (19.7%) in children under five years of age in 2016. There were six cases each of herpes simplex virus type 1 (HSV1) and varicella/herpes zoster virus (VZV) among the 15 VE cases in those aged > 65 years (Figure 1, Table 1).

All 61 VE cases were laboratory tested positive and case classified as confirmed. All but two had a causative pathogen identified: herpes simplex virus (HSV) (n=28; 45.9%), VZV (n=24; 39.3%), human herpes virus type 6 (HHV 6) (n=6; 9.8%), parechovirus (n=1; 1.6%) and not specified (n=2; 3.3%) (Figure 2).

Caution is advised regarding the detection of HHV 6 DNA in cerebral spinal fluid (CSF) specimens, especially in those cases aged less than three months as HHV 6 DNA can be chromosomally integrated as it may not be clinically relevant. Two of the six cases of HHV 6-related encephalitis in 2016 however, occurred in patients less than three months of age.

There were one reported death in a <6 months old with HHV6, but the actual cause of death was not known. There were no imported cases associated with VE in 2016.

The figures presented in this report are based on data extracted from the Computerised Infectious Disease Reporting (CIDR) system on 9th November, 2017. These figures may differ from those published previously due to on-going updating of notification data in CIDR.

Table 1. Number, age-specific incidence rates and proportion of viral encephalitis (NOS) cases by age group, Ireland, 2016

	Causative pathogen							
Age Group	**herpes simplex virus (HSV)**	**varicella/herpes zoster virus (VZV)**	**human herpes virus type 6 (HHV6)**	**enterovirus**	**not specified**	**Total**	**ASIR**	**% Proportion**
<1	1	0	6	1	0	8	12.85	13.1
1-4	2	0	0	0	2	4	1.49	6.6
5-14	2	0	0	0	0	2	0.30	3.3
15-24	2	5	0	0	0	7	1.21	11.5
25-44	6	10	0	0	0	16	1.14	26.2
45-64	7	2	0	0	0	9	0.79	14.8
65+	8	7	0	0	0	15	2.35	24.6
All ages	28	24	6	1	2	61	1.28	100
% total cases	45.9	39.3	9.8	1.6	3.3	100		

Note: ASIR, age specific incidence rate per 100,000 population of total cases, based on Census 2016 data

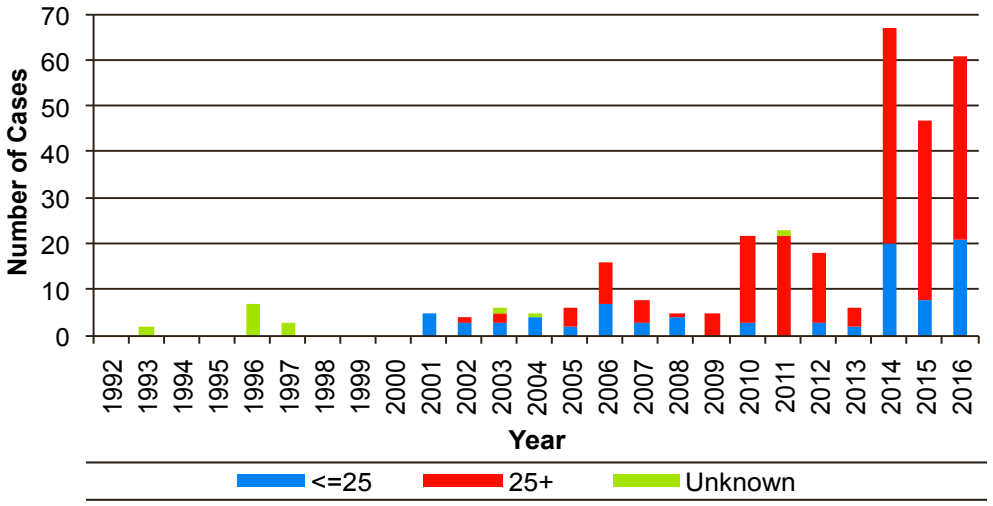

*Figure 1. Number of viral encephalitis (NOS) cases by age group and year, Ireland, 1992-2016**
** includes the late notification of 15 cases in 2013 reported in early 2014*

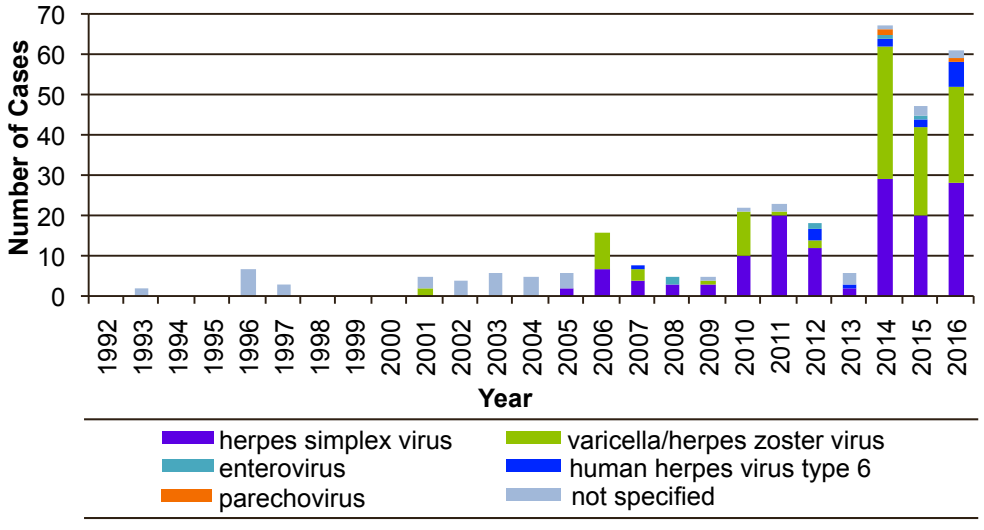

*Figure 2. Number of viral encephalitis (NOS) cases by causative pathogen and year, Ireland, 1992-2016**
** includes the late notification of 15 cases in 2013 reported in early 2014*

6.2 Viral Meningitis

Summary

Number of cases, 2016: 299
Number of cases, 2015: 261
Number of cases, 2014: 435
Crude incidence rate, 2016: 6.3/100,0

Meningitis due to viruses not otherwise specified (NOS) are notifiable under the disease category 'viral meningitis'. Details of viral meningitis caused by other specified notifiable diseases (such as mumps and influenza viruses, if any) are presented in other chapters in this report.

The steady increase in annual notifications, which started back in 2007 and continued up until 2014, fell sharply in 2015 when 261 were reported, only to increase again to 299 (Figure 1). It should be noted that the very high number of cases reported in 2014 include the late notification of seven cases from 2013 (based on their specimen dates) reported during weeks 5 and 6 of 2014. No viral meningitis, NOS-related outbreaks were reported in 2016.

Since 1997, eight deaths have been reported with cases of viral meningitis (NOS), one of which was attributable to the enterovirus infection itself. None were reported in 2016.

Of the 299 cases notified in 2016, 297 (99.3%) were classified as confirmed and one each that was probable and possible (0.3% each). There were more cases among males (n=162) than in females (n=132), giving a male to female ratio of 1.23:1. Five cases were reported with unknown gender details in 2016.

The national crude incidence rate in 2016 was 6.3 (95% CI 5.6–7.0) cases per 100,000 population, a 14.6% increase compared with the previous year when 261 cases were notified (5.5/100,000). The highest age specific incidence rate (ASIR) in 2016 was in infants <1 year of age (308.4/100,000; n=192), followed by the 25-34 year age group (5.3/100,000; n=35). The lowest ASIR was in the 55-64 year age group (ASIR 0.6/100,000 (n=3)) (Table 1).

In 2016 the highest frequency of cases was in children aged 1 to 2 months (n=81) and in those aged between 15 to 39 years (n=78) with an overall median age of 89 days (range one week to 85 years) (Figure 2). Seventy-seven percent of cases (n=231) occurred in those under 25 years of age (Figure 3, Table 1).

By HSE region, the highest rate was in HSE E at 8.7/100,000 (95%CI 7.3–10.1) and lowest in HSE S at 3.9/100,000 (95%CI 2.4-5.4), with the latter rate significantly below the national rate (Figure 4).

In 2016, enteroviruses were the most common pathogen associated with viral meningitis, accounting for 81.3% (n=243/299) of all notifications (Figure 3, Table 1). It is only

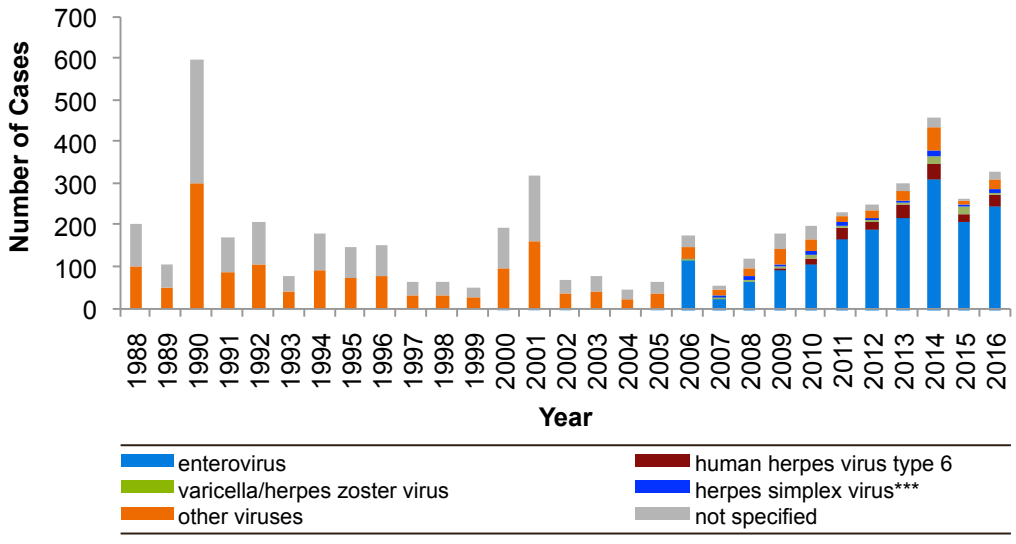

*Figure 1. Number of viral meningitis (NOS) cases by organism type and year, Ireland, 1988-2016**
** includes the late notification of seven cases in 2013 reported in early 2014*

since 2017 have enterovirus types been routinely linked to events on CIDR because of the enterovirus typing service in the NVRL, but one enterovirus-related VM case in 2016 was linked to a coxsackie virus infection.

Enterovirus was also the most common pathogen in infants under one year of age with viral meningitis (NOS) in 2016; 159 out of total of 192 cases in that age group (82.8%) were reported to have this virus. Between 2006 and 2016 enteroviruses accounted for 74.9% (n=1745/2331) of all viral meningitis (NOS) cases, with typical summer peaks observed each year (Figure 5). The large number of enterovirus-related viral meningitis cases observed in recent years is likely due in part to improved notification and investigation with laboratory confirmation.

In 2016, human herpes virus (type 6) (HHV 6) was the causative pathogen for 9.4% (n=28) notifications, varicella/herpes zoster virus (VZV) for 3.0% (n=9), parechovirus for 2.3% (n=7) and herpes simplex virus (HSV) for 2.0% (n=6)(Figure 3, Table 1). There were 2.0% (n=6) cases with no viral pathogen specified. Caution is recommended regarding the detection of HHV 6 DNA in cerebral spinal fluid (CSF) specimens, especially in those cases aged less than 3 months (n=14/28; 50%) as HHV 6 DNA can be chromosomally integrated. When this occurs the HHV 6 DNA can be inherited through the germ line and therefore when it is detected, it may not be clinically relevant.

The figures presented in this report are based on data extracted from the Computerised Infectious Disease Reporting (CIDR) system on 9th November, 2017. These figures will differ from those published previously due to on-going updating of notification data in CIDR.

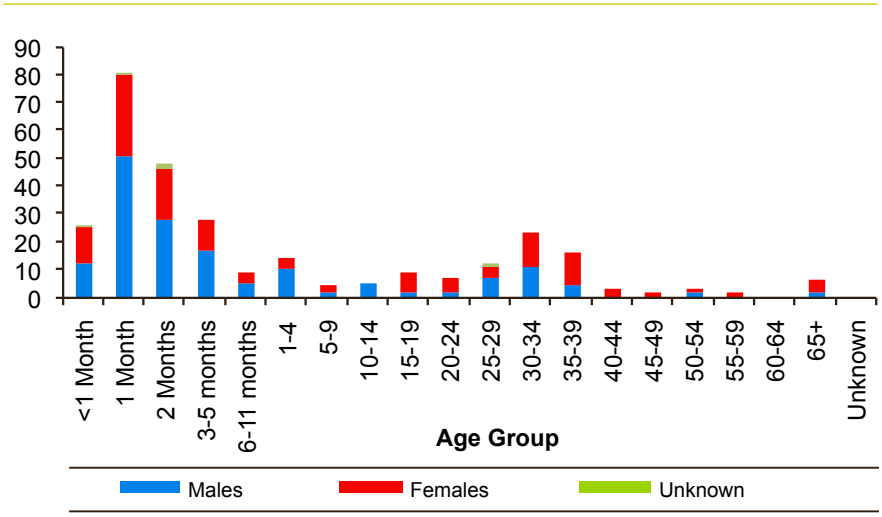

Figure 2. Number of viral meningitis (NOS) cases by age group and sex, Ireland, 2016

Table 1. Number, age-specific incidence rates and proportion of viral meningitis (NOS) notifications by age group and causative pathogen, Ireland, 2016

Age Group	Causative pathogen						Total	ASIR	% Proportion
	enterovirus	varicella/herpes zoster virus	human herpes virus type 6	herpes simplex virus	coxsackievirus	parecho-virus			
<1	159	24	0	0	7	2	192	308.4	64.2
1-4	10	4	0	0	0	0	14	5.2	4.7
5-9	4	0	0	0	0	0	4	1.1	1.3
10-14	4	0	0	0	0	1	5	1.6	1.7
15-19	5	0	2	1	0	1	9	3.0	3.0
20-24	6	0	0	0	0	1	7	2.6	2.3
25-34	33	0	2	0	0	0	35	5.3	11.7
35-44	17	0	0	2	0	0	19	2.5	6.4
45-54	2	0	3	0	0	0	5	0.8	1.7
55-64	2	0	0	0	0	1	3	0.6	1.0
65+	1	0	2	3	0	0	6	0.9	2.0
All Ages	243	28	9	6	7	6	299	6.3	100
% Total	81.3	9.4	3.0	2.0	2.3	2.0	100.0		

ASIR, age specific incidence rate per 100,000 population of total cases; based on census 2016 data

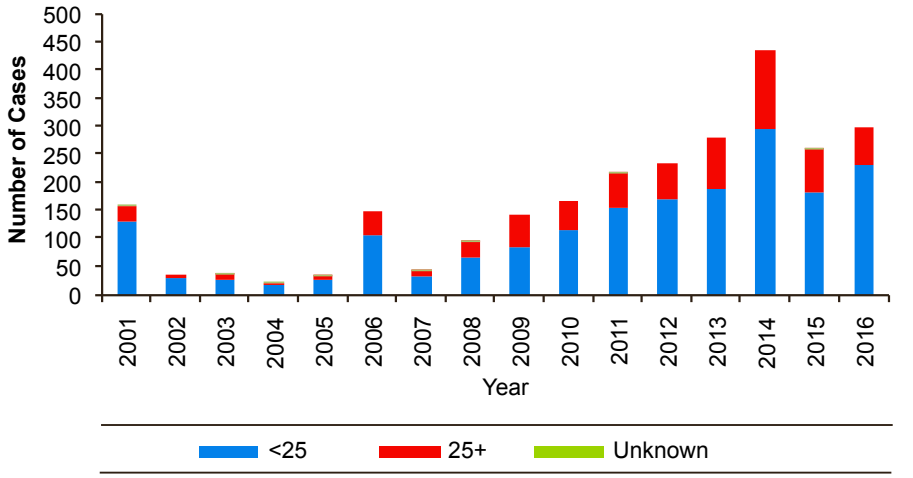

*Figure 3. Number of viral meningitis (NOS) cases by age group (<25, >25 years of age) and year, Ireland, 2001-2016**
** includes the late notification of seven cases in 2013 reported in early 2014*

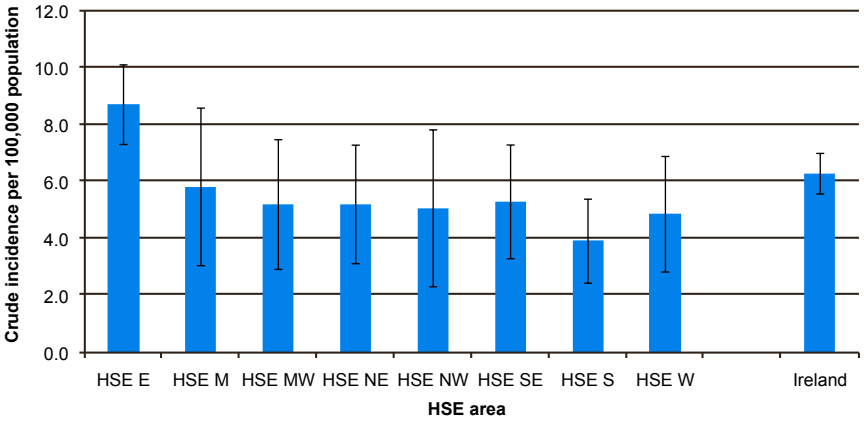

Figure 4. Crude incidence rates per 100,000 population with 95% confidence intervals for viral meningitis (NOS) cases by HSE area, Ireland, 2016

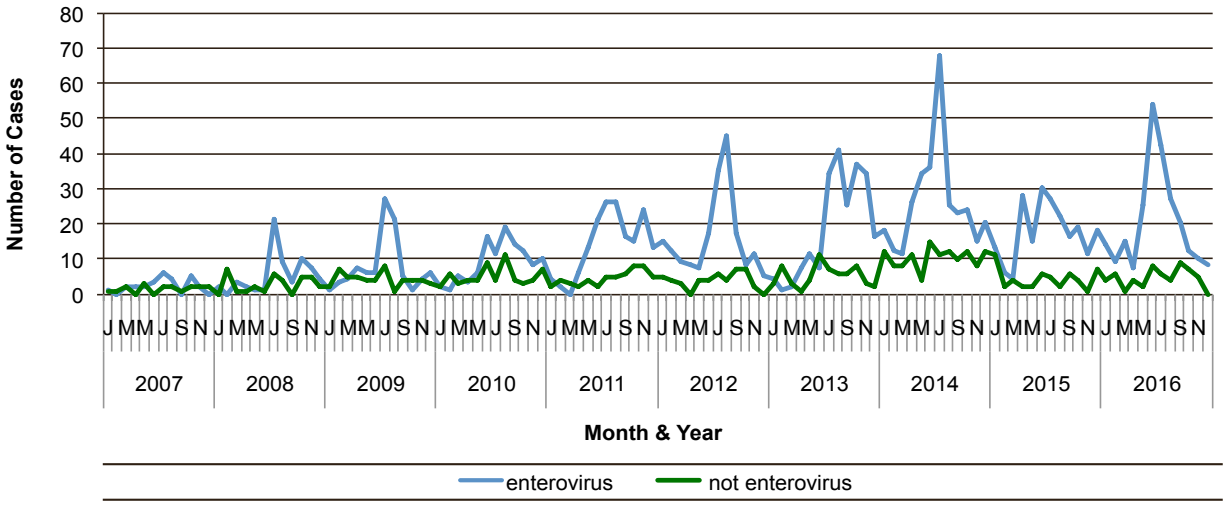

*Figure 5. Monthly number of enterovirus-related and non-enterovirus related cases of viral meningitis, NOS notifications, 2007-2016**
** includes the late notification of seven cases in 2013 reported in early 2014*

6.3 Creutzfeldt-Jakob disease

Summary

Number of cases, 2016: 5
Number of cases, 2015: 5

Five cases of Creutzfeldt-Jakob disease (CJD) were notified in 2016 identical to 2015 when five cases were also notified. All cases in 2016 were sporadic CJD cases. Two cases were in the age group 55-64 years and three were in the age group ≥65 years. Four cases were female and one was male.

In total, 80 cases of CJD were notified since CJD was first specified as a notifiable disease in December 1996 (figure 1). Figure 2 shows the 80 CJD notifications by age group. The majority (81%, n=65) of the cases were aged greater than 54 years. Of the 80 cases, 42 were female and 38 were male. Seventy-six cases were sporadic CJD, two were familial CJD and two were iatrogenic.

Variant CJD (vCJD) is specified as a separate notifiable disease. No cases have been notified since 2006. In total, four cases of vCJD were notified since vCJD became notifiable in December 1996. A summary of these four cases was provided in the 2006 HPSC annual report.

Data presented in this summary are based on notifications from HSE Areas and from the Irish National Creutzfeldt-Jakob Disease Surveillance Unit. Annual figures published here are based on the year the notification was entered on the Computerised Infectious Disease Reporting (CIDR) system and consequently may differ from annual figures published by the Irish National Creutzfeldt-Jakob Disease Surveillance Unit.

Acknowledgements
HPSC would like to thank all those who provided data for this report – Irish National Creutzfeldt-Jakob Disease Surveillance Unit, Departments of Public Health, laboratories and clinicians.

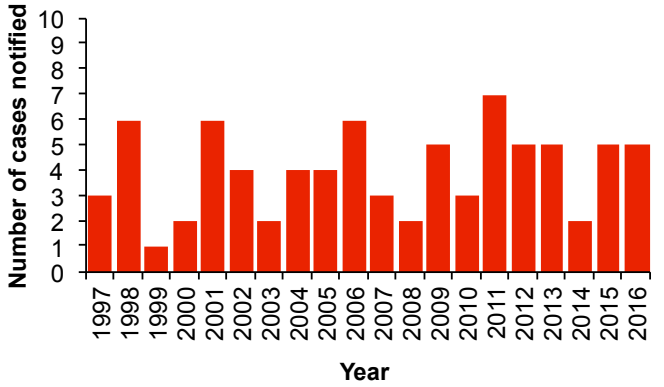

Figure 1. Number of CJD notifications by year from December 1996 to 2016

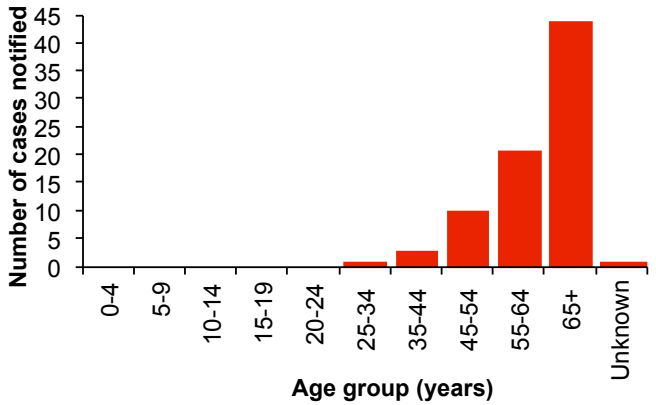

Figure 2. Number of CJD notifications (n=80) from December 1996 to 2016 by age group

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07

INFECTIOUS DISEASE OUTBREAKS

7. Outbreaks

Summary

Number of outbreaks: 549
Number of IID outbreaks: 393
Number of non-IID outbreaks: 158

During 2016, 549 outbreaks of infectious diseases were reported with 6,937* associated cases of illness, including 411 (5.9%) cases hospitalised and 23 deaths.† Regional variation in the numbers of outbreaks reported was observed between HSE areas. The highest outbreak reporting rates‡ were observed in HSE-NW (25.3/100,000 population) while the lowest rate was observed in HSE-E at (5.9) and -NE (8.5). Table 1 details the regional distribution of all outbreaks by HSE area and disease.

The number of outbreaks reported peaked in December. This peak was mainly due to high numbers of influenza, norovirus and acute infectious gastroenteritis (AIG) outbreaks. A secondary peak was also observed earlier in the year during April. This peak was mainly due to norovirus, verotoxigenic *E. coli* infection (VTEC) and AIG outbreaks. Figure 1 illustrates the number of IID and non-IID outbreaks by month of notification during 2016.

Similar to previous years, airborne/person-to-person spread was reported as the mode of transmission for the majority of outbreaks (68.9%, n=378). Mode of transmission was reported as unknown for 21.1% of outbreaks. Table 2 details all outbreaks by infectious disease and probable mode of transmission.

The most frequently reported outbreak locations were private houses (n=155, 28.2%), nursing homes (n=99, 18.0%), hospitals (n=85, 15.5%) and community hospital/long-stay units (n=79, 14.4%). The highest numbers ill were reported from outbreaks in nursing homes (n=1,595), hospitals (n=1,342) and hotels (n=1,017). However it should be noted that a single hotel outbreak during 2016 resulted in 896 of the hotel associated cases.

General outbreaks accounted for 69.2% (n=380) of all outbreaks notified during 2016. The remaining outbreaks (30.8%, n=169) were reported as family/household outbreaks.

* Two norovirus outbreaks did not report the number ill or number of associated laboratory confirmed cases. Three outbreaks reported zero symptomatic cases and consisted of laboratory confirmed asymptomatic individuals.

† Outbreak data extracted from CIDR on 10/08/2017.

‡ All rates are calculated per 100,000 population as per Census 2016

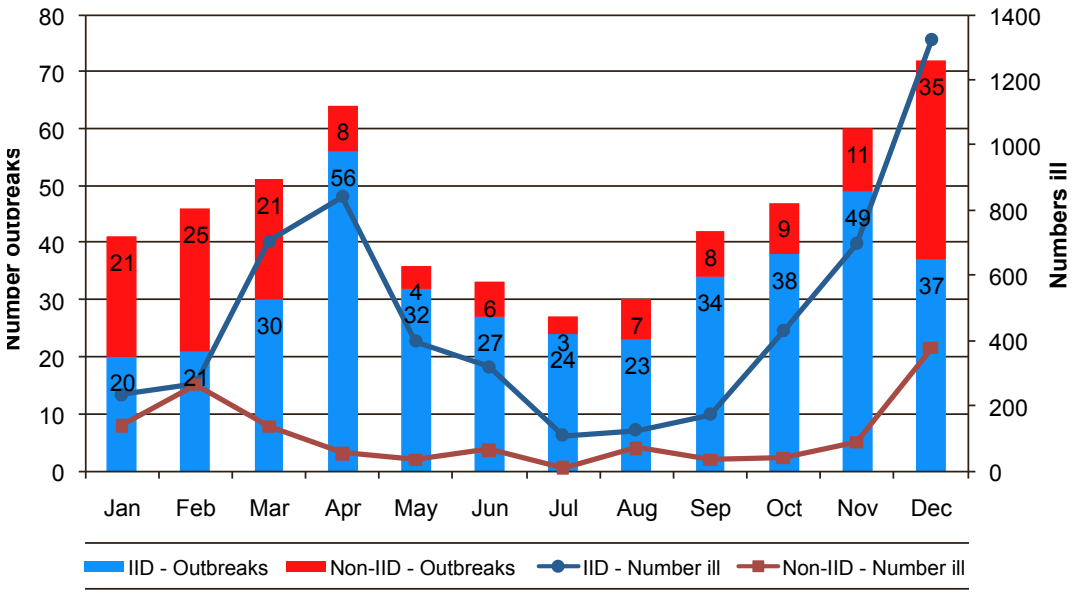

Figure 1: Number of IID and non-IID outbreaks by month of notification and associated numbers ill, 2016

Table 1 Number of IID and non-IID outbreaks by disease and HSE area, 2016

IID/ Non-IID	Disease	HSE-E	HSE-M	HSE-MW	HPSC	HSE-NE	HSE-NW	HSE-SE	HSE-S	HSE-W	Total
IID	AIG	12	3	3		8	19	18	18	13	**94**
	C. difficile			2		3				2	**7**
	Campylobacteriosis					1				3	**4**
	Cryptosporidiosis	1	2	1		1	4	5	2	4	**20**
	Giardiasis	5						4	1		**10**
	Hepatitis A (acute)	3	1			1		1	1	1	**8**
	Noroviral infection	26	11	11		10	13	14	33	13	**131**
	Rotavirus	1				3	2		1		**7**
	Salmonellosis	2		3		1		2		1	**9**
	Shigellosis	1			1						**2**
	Typhoid								1		**1**
	VTEC	7	30	13	1	4	5	10	17	11	**98**
Non-IID	Acinetobacter					1					**1**
	ARI	5					6	3	11	1	**26**
	Chickenpox	1							1		**2**
	CPE							1			**1**
	CRE	1					1	1		1	**4**
	Gonorrhoea			1			1				**2**
	Hand, foot and mouth								1		**1**
	Hepatitis B (acute and chronic)	1									**1**
	Impetigo								1		**1**
	Influenza	18	1	8		4	7	9	13	5	**65**
	Lymphogranuloma venereum	1									**1**
	Malaria		1								**1**
	Measles				1					1	**2**
	Meningococcal disease						1				**1**
	MRSA		1	1			1		1		**4**
	Mumps	2		1			2	3	2		**10**
	Pertussis	8		1				2	1		**12**
	RSV	2				1	2	1	4		**10**
	Scabies					1		1	2		**4**
	Tuberculosis	1					1		1	2	**5**
	VRE	3						1			**4**
Total number of outbreaks		101	50	45	3	39	65	76	112	58	**549**
Crude outbreak incidence rate		5.9	17.1	11.7	n/a	8.5	25.3	14.9	16.2	12.8	**11.5**

Table 2: Number of IID and non-IID outbreaks by disease and probable route of transmission, 2016

IID/Non-IID	Disease	Transmission						
		P-P / Airborne	Animal contact	Food-borne	Water-borne	Unknown	Other	Total
IID	AIG	77		4		13		**94**
	C. difficile	5				1	1	**7**
	Campylobacteriosis	1		2		1		**4**
	Cryptosporidiosis	4	7		2	7		**20**
	Giardiasis	1				8	1	**10**
	Hepatitis A (acute)	3				5		**8**
	Noroviral infection	108				23		**131**
	Rotavirus	6				1		**7**
	Salmonellosis	3	2	3		1		**9**
	Shigellosis	1		1				**2**
	Typhoid			1				**1**
	VTEC	33	9	3	11	38	4	**98**
Non-IID	Acinetobacter					1		**1**
	ARI	24				2		**26**
	Chickenpox	2						**2**
	CPE						1	**1**
	CRE	1				2	1	**4**
	Gonorrhoea	2						**2**
	Hand, foot and mouth	1						**1**
	Hepatitis B					1		**1**
	Impetigo	1						**1**
	Influenza	59				6		**65**
	Lymphogranuloma venereum	1						**1**
	Malaria						1	**1**
	Measles	2						**2**
	Meningococcal disease	1						**1**
	MRSA	2				1	1	**4**
	Mumps	10						**10**
	Pertussis	10				2		**12**
	RSV	10						**10**
	Scabies	4						**4**
	Tuberculosis	5						**5**
	VRE	1				3		**4**
Total		**378**	**18**	**14**	**13**	**116**	**10**	**549**
% outbreaks		*68.9*	*3.3*	*2.6*	*2.4*	*21.1*	*1.8*	*100.0*

Infectious intestinal disease (IID) outbreaks
During 2016, 391 IID outbreaks were reported, accounting for 71.2% of all outbreaks. This was an increase of 24.1% compared to the number of reported during 2015 (n=315). After norovirus, the next most commonly reported IID outbreaks were VTEC and AIG. Table 3 details the total number ill by disease and the median number ill per outbreak for disease where five or more outbreaks were reported.

Non-infectious intestinal disease (Non-IID) outbreaks
During 2016, 158 non-IID outbreaks were reported, accounting for 28.8% of all outbreaks. This represents a decrease of 18.1% compared to the number reported during 2015 (n=193). After influenza, the next most commonly reported non-IID outbreaks were acute respiratory infections.

Table 3: Outbreak disease[§] by size of outbreak, 2016

IID/Non-IID	Disease	Number of outbreaks	Total number ill	Mean number ill	Median number ill	Range
IID	Noroviral infection	131	3724	28.9	16	1 - 896
	VTEC	98	230	2.3	2	0 - 16
	AIG	94	1424	15.1	7.5	1 - 338
	Cryptosporidiosis	20	53	2.7	2	2 - 5
	Giardiasis	10	29	2.9	2.5	1 - 5
	Salmonellosis	9	24	2.7	2	2 - 6
	Hepatitis A (acute)	8	22	2.8	2	2 - 5
	Rotavirus	7	55	7.9	7	2 - 18
	C. difficile	7	29	4.1	3	2 - 9
Non-IID	Influenza	65	700	10.8	9	2 - 36
	ARI	26	214	8.2	6.5	3 - 24
	Pertussis	12	31	2.6	2	2 - 6
	Mumps	10	58	5.8	2	2 - 31
	RSV	10	85	8.5	8.5	2 - 21
	Tuberculosis	5	19	3.8	3	3 - 6

[§] Values shown for diseases with more than five outbreaks.

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IMMUNISATION UPTAKE

8.1 Immunisation uptake at 12 and 24 months of age

Summary

Among children at 12 months of age in 2016 uptake of:
D_3, T_3, P_3, Hib_3, $Polio_3$, $HepB_3$ and PCV_2 was 91%
$MenC_2$ was 89% (combined Quarters 1 and 2 data only)
$MenC_1$ was 95% (combined Quarters 3 and 4 data only)

Among children at 24 months of age in 2016 uptake of:
D_3, T_3, P_3, Hib_3, $Polio_3$ and $HepB_3$ reached the target of 95%
MMR_1 was 92%
PCV_3 and Hib_b were 91%
$MenC_3$ was 87%

Introduction

In 2016, HPSC was provided with quarterly immunisation uptake data for each of the Local Health Offices (LHOs). HPSC collated these data and quarterly reports were produced which are available on the HPSC website. The annual immunisation uptake rates presented here represent the collation of the 2016 quarterly data. The proportion of children who completed the recommended primary childhood immunisation schedule by 12 months (born between 01/01/2015 and 31/12/2015) and 24 months (born between 01/01/2014 and 31/12/2014) of age in 2016 are reported.

Children who were 12 and 24 months of age in 2016 were recommended one dose of vaccine against tuberculosis (BCG vaccine) at birth or by one month of age; three doses of vaccines against diphtheria (D_3), tetanus (T_3), pertussis (P_3), *Haemophilus influenzae* type b (Hib_3), polio ($Polio_3$) and Hepatitis B ($HepB_3$) with one dose of each recommended at two, four and six months of age; and three doses of pneumococcal conjugate vaccine (PCV_3) recommended at two, six and 12 months of age (table 1). Also at 12 months of age a dose of MMR (MMR_1) was recommended and at 13 months a dose of Hib (Hib_b) was recommended (table 1). The immunisation schedule changed in 2015 for children born on or after July 1st 2015 after the NIAC recommended changing the meningococcal C (MenC) immunisation schedule in the primary childhood programme from three doses at 4, 6 and 13 months to two doses at 4 and 13 months because of evidence that a single dose of MenC vaccine provides protection for the first year of life. Further vaccinations are recommended for older children and adults. Please see the HSE-National Immunisation Office website at www.immunisation.ie for current and detailed information on the Irish primary childhood immunisation schedule and also recommended vaccinations for older children and adults.

In children at 12 months of age in 2016, born between 01/01/2015 and 31/12/2015, uptake of BCG, D_3, T_3, P_3, Hib_3, $Polio_3$, $HepB_3$ and two doses of PCV (PCV_2) was measured. In

Table 1. Primary childhood immunisation schedule for children born between 01/07/2008 and 30/09/2016

Age	Children born 01/07/2008 to 30/06/2015	Children born 01/07/2015 to 30/09/2016
Birth	BCG	BCG
2 months	DTaP/Hib/IPV/HepB (6 in 1) + PCV	DTaP/Hib/IPV/HepB (6 in 1) + PCV
4 months	DTaP/Hib/IPV/HepB (6 in 1) + MenC	DTaP/Hib/IPV/HepB (6 in 1) + MenC
6 months	DTaP/Hib/IPV/HepB (6 in 1) + PCV + MenC	DTaP/Hib/IPV/HepB (6 in 1) + PCV
12 months	MMR + PCV	MMR + PCV
13 months	MenC + Hib	MenC + Hib

Please note the primary immunisation schedule changed in 2015 for children born on or after 01/07/2015 and changed in 2016 for children born on or after October 1st 2016. Please see the HSE-National Immunisation Office (NIO) website at www.immunisation.ie for current and detailed information on the Irish primary childhood immunisation schedule and also recommended vaccinations for older children and adults

BCG Bacille Calmette Guerin vaccine
DTaP Diphtheria, Tetanus and acellular Pertussis vaccine
HepB Hepatitis B vaccine
Hib *Haemophilus influenzae* type b vaccine
IPV Inactivated Polio Virus vaccine
MenC Meningococcal group C vaccine
MMR Measles, Mumps and Rubella vaccine
PCV Pneumococcal Conjugate Vaccine

children at 12 months of age in Quarters 1 and 2 2016, born between 01/01/2015 and 30/06/2015, uptake of two doses of MenC ($MenC_2$) was measured and in children at 12 months of age in Quarters 3 and 4 2016, born between 01/07/2015 and 31/12/2015 uptake of one dose of MenC ($MenC_1$) was measured. In children at 24 months of age in 2016, born between 01/01/2014 and 31/12/2014, uptake of D_3, T_3, P_3, Hib_3, $Polio_3$, $HepB_3$, $MenC_3$, PCV_3, MMR_1, Hib_b, one dose of vaccine against meningococcal group C ($MenC_b$) on or after twelve months of age and one dose of vaccine against pneumococcal conjugate vaccine (PCV_b) on or after twelve months of age were measured.

The immunisation uptake rates are reported here by Community Healthcare Organisation and LHO. The uptake rates presented here were rounded to zero decimal place. While there are 32 LHOs the immunisation uptake rates for the LHOs of North Lee and South Lee are reported as a combined figure.

Caveats to data

National BCG data for 2016 are presented in this report and compared to 2015 data. The available national BCG cohort data may be around 89% of the national birth cohort in 2016 and 90% in 2015 (these figures are estimates only). In Cavan/Monaghan, Louth and Meath, i.e. the former HSE NE, where a neonatal BCG programme is implemented, data were not available for reporting. In CHO2, i.e. the former HSE W, the neonatal BCG programme was not routinely or comprehensively implemented in all LHOs. Therefore, data provided for CHO2 reflects BCG vaccination data for just a small proportion of all babies born here.

BCG vaccine stock in all CHOs expired at the end of April 2015. At the time of writing of this report the HSE continues to experience ongoing delays with the supply of BCG vaccine. This continues to be a Europe wide issue. The number of cases of TB has been steadily falling in Ireland. The number of cases of TB for the years 2014 and 2015 was at the lowest level since records began. Most European countries do not give BCG vaccine to all babies. The National Immunisation Advisory Committee (NIAC), an independent expert group on immunisation and the Health Information and Quality Authority (HIQA) have both recommended that BCG vaccine does not now need to be given routinely to all babies in Ireland. For further information please see https://www.hse.ie/eng/health/immunisation/news/bcg17.html

As uptake of $MenC_3$ was low since Q3 2010 and as those over 12 months and less than 12 years of age need only one dose of MenC and those aged 12-23 months need only one dose of PCV, data on $MenC_b$ (one dose of MenC on or after first birthday and before second birthday) and PCV_b (one dose of PCV on or after first birthday and before second birthday) were requested in 2012 for the first time. The $MenC_b$ and PCV_b data were available for only eight CHOs in 2015 and 2016. The available national cohort data may be around 91% of the national birth cohort in 2016 and 2015 (these figures are estimates only).

Immunisation uptake rates at 12 months

Ninety-one per cent of children, at 12 months of age in 2016, received D_3, T_3, P_3, Hib_3, $Polio_3$, $HepB_3$ and PCV_2 (table 2). Compared with 2015, the uptake rates for these vaccines were unchanged in 2016.

The MenC immunisation schedule changed in 2015 for children born on or after July 1st 2015. Eighty-nine per cent of children, at 12 months of age in Quarters 1 and 2 2016, received $MenC_2$ and 95% of children, at 12 months of age in Quarters 3 and 4 2016, received $MenC_1$ (table 2).

The available 2016 BCG cohort data may be around 89% (estimate only) of the national birth cohort. BCG vaccine stock in all HSE Areas expired at the end of April 2015. At the time of writing of this report the HSE continues to experience ongoing delays with the supply of BCG vaccine. This continues to be a Europe wide issue. National BCG uptake in 2016, based on available data, was 72%, 9%, 0.08% and 0.03% in Quarters 1, 2, 3 and 4, respectively.

Among the CHOs, uptake rates for D_3, T_3, P_3, Hib_3, $Polio_3$ and $HepB_3$ ranged from 88% to 94% and PCV_2 ranged from 87% to 94% (table 2). $MenC_2$ uptake rates during Quarters 1 and 2 2016 ranged from 85% to 93% (table 2). $MenC_1$ uptake rates during Quarters 3 and 4 2016 ranged from 92% to 96% (table 2).

Among the LHOs, uptake rates for D_3, T_3, P_3, Hib_3, $Polio_3$ and $HepB_3$ ranged from 81% to 96% and PCV_2 ranged from 78% to 96% (table 2). The target uptake of ≥95% was reached in Sligo/Leitrim, Roscommon and Longford/Westmeath for D_3, T_3, P_3, Hib_3, $Polio_3$, $HepB_3$, $MenC_1$ and PCV_2, in Roscommon, Laois/Offaly and Longford/Westmeath for $MenC_2$ in Quarters 1 and 2 and in total for 18 LHOs for $MenC_1$ in Quarters 3 and 4.

Immunisation uptake rates at 24 months

National annual immunisation uptake rates, in children at 24 months of age in 2016, were 95% for D_3, T_3, P_3, Hib_3, $Polio_3$ and $HepB_3$, 92% for MMR_1, 91% for PCV_3 and Hib_b and 87% for $MenC_3$ (table 3). This is the sixth year national annual uptake rates reached the target of ≥95% for D_3, T_3, P_3, Hib_3, $Polio_3$ and $HepB_3$. Compared with 2015, the uptake rates for D_3, T_3, P_3, Hib_3, $Polio_3$, $HepB_3$ and Hib_b were unchanged while $MenC_3$, PCV_3 and MMR_1 declined by one percent (figure 1).

Eight of the CHOs were able to provide uptake data on $MenC_b$ (one dose of MenC on or after first birthday and before second birthday) and PCV_b (one dose of PCV on or after first birthday and before second birthday) in 2016. The available data may be around 91% (estimate only) of the national birth cohort. Where data were available, national uptake was 89% for $MenC_b$ and 93% for PCV_b at 24 months of age (table 3).

Among the CHOs uptake rates for D_3, T_3, P_3, Hib_3, $Polio_3$ and $HepB_3$ ranged from 92% to 97%, MMR_1 ranged from 89% to 95%, PCV_3 ranged from 88% to 97%, Hib_b ranged from 86% to 94% and $MenC_3$ ranged from 83% to 94% (table 3). Among the eight CHOs in a position to provide data PCV_b uptake ranged from 90% to 94% and $MenC_b$ uptake ranged from 86% to 91% (table 3).

The target uptake of ≥95% was reached in six CHOs during 2016 for D_3, T_3, P_3, Hib_3, $Polio_3$ and $HepB_3$, in one CHO for PCV_3 and MMR_1 and in none for Hib_b, $MenC_3$, $MenC_b$ and PCV_b (table 3).

Table 2. Immunisation uptake (%) at 12 months of age in 2016 (i.e. cohort born 01/01/2015-31/12/2015) by LHO and CHO

Community Healthcare Organisation (CHO)	Local Health Office/ CHO	Number in cohort for BCG*	Number in cohort for D_3T_3†	Immunisation Uptake (%)						
				BCG	D_3#	Hib_3	$HepB_3$	$MenC_2$‡	$MenC_1$‡	PCV_2
CHO1	Cavan/Monaghan	na	1909	na	92	92	92	93	97	95
	Donegal	2080	2080	28	92	92	91	87	96	92
	Sligo/Leitrim	1261	1261	31	96	95	95	93	97	95
	CHO1 Total*	**3341**	**5250**	**29**	**93**	**93**	**92**	**91**	**96**	**94**
CHO2	Galway	3493	3493	1	94	94	94	93	96	94
	Mayo	1583	1583	23	93	93	93	92	96	93
	Roscommon	825	825	3	95	95	95	95	96	96
	CHO2 Total	**5901**	**5901**	**8**	**94**	**94**	**94**	**93**	**96**	**94**
CHO3	Clare	1570	1579	25	93	93	93	91	96	93
	Limerick	1616	1927	25	89	89	89	86	93	89
	Tipperary NR/East Limerick	1782	1824	27	91	91	91	88	96	91
	CHO3 Total	**4968**	**5330**	**25**	**91**	**91**	**91**	**88**	**95**	**91**
CHO4	North Cork	1433	1413	27	90	90	90	87	93	87
	North South Lee	5612	5554	26	91	91	91	87	95	88
	West Cork	729	728	26	81	81	81	77	87	78
	Kerry	1757	1746	23	92	92	92	86	94	87
	CHO4 Total	**9531**	**9441**	**26**	**90**	**90**	**90**	**86**	**94**	**87**
CHO5	Carlow/Kilkenny	1830	1830	23	91	91	91	87	96	90
	South Tipperary	1211	1211	27	93	93	93	92	98	93
	Waterford	1740	1740	27	91	91	91	90	95	89
	Wexford	2015	2015	24	92	92	92	93	94	92
	CHO5 Total	**6796**	**6796**	**25**	**92**	**92**	**92**	**90**	**95**	**91**
CHO6	Dublin South	1683	1683	18	92	92	92	88	96	92
	Dublin South East	1582	1582	16	92	92	92	90	94	92
	Wicklow	1720	1720	18	89	89	89	82	94	88
	CHO6 Total	**4985**	**4985**	**17**	**91**	**91**	**91**	**86**	**95**	**91**
CHO7	Dublin South City	1724	1724	17	91	91	91	86	95	91
	Dublin South West	2400	2400	24	93	93	93	92	96	93
	Dublin West	2525	2525	6	90	90	90	90	95	91
	Kildare/West Wicklow	3641	3641	19	93	93	93	90	95	93
	CHO7 Total	**10290**	**10290**	**17**	**92**	**92**	**92**	**90**	**95**	**92**
CHO8	Laois/Offaly	2351	2351	24	94	94	94	95	94	94
	Longford/Westmeath	1840	1840	20	96	96	96	97	96	96
	Louth	na	1852	na	90	90	90	90	94	92
	Meath	na	3012	na	90	90	90	90	94	93
	CHO8 Total*	**4191**	**9055**	**22**	**92**	**92**	**92**	**93**	**95**	**94**
CHO9	Dublin North West	3476	3476	22	89	89	89	85	93	89
	Dublin North Central	1897	1897	24	88	88	88	84	91	88
	Dublin North	3954	3954	8	88	88	88	84	93	88
	CHO9 Total	**9327**	**9327**	**16**	**88**	**88**	**88**	**85**	**92**	**88**
Ireland		**59330**	**66375**	**20**	**91**	**91**	**91**	**89**	**95**	**91**

na=not available

*BCG data were unavailable for Cavan/Monaghan, Louth and Meath

BCG vaccine stock in all areas expired at the end of April 2015. At time of writing the HSE continues to experience ongoing delays with the supply of BCG vaccine. This continues to be a Europe wide issue. The number of cases of TB has been steadily falling in Ireland. The number of cases of TB for the years 2014 and 2015 was at the lowest level since records began. Most European countries do not give BCG vaccine to all babies. The National Immunisation Advisory Committee (NIAC), an independent expert group on immunisation and the Health Information and Quality Authority (HIQA) have both recommended that BCG vaccine does not now need to be given routinely to all babies in Ireland. Please see http://www.hse.ie/eng/health/immunisation/pubinfo/babychildimm/vaccprevdisease/tb/ for further information.

National BCG uptake, based on available data, was 72%, 9%, 0.08% and 0.03% in Quarters 1, 2, 3 and 4, respectively.

†The denominator/number in cohort varied slightly according to vaccine. D_3T_3 cohort is shown here.

#Since T_3, P_3 and $Polio_3$ uptake identical to D_3 uptake only D_3 uptake figures are presented

‡The immunisation schedule changed in 2015 for children born on or after July 1st 2015 after the National Immunisation Advisory Committee (NIAC) recommended changing the meningococcal C (MenC) immunisation schedule in the primary childhood programme from three doses at 4, 6 and 13 months to two doses at 4 and 13 months because of evidence that a single dose of MenC vaccine provides protection for the first year of life. Hence uptake of two doses of MenC ($MenC_2$) was measured during Quarters 1 and 2 (birth cohort 01/01/2015-30/06/2015) and uptake of one dose of MenC ($MenC_1$) was measured during Quarters 3 and 4 (birth cohort 01/07/2015-31/12/2015). Please note the immunisation schedule changed in 2016 for children born on or after October 1st 2016. Please see the HSE-National Immunisation Office (NIO) website at http://www.immunisation.ie for current and detailed information on the Irish primary childhood immunisation schedule and also recommended vaccinations for older children and adults.

Please note while North Lee and South Lee are two separate LHOs their combined immunisation uptake data are reported here.

Table 3. Immunisation uptake (%) at 24 months of age in 2016 (i.e. cohort born 01/01/2014-31/12/2014) by LHO and CHO

Community Healthcare Organisation (CHO)	Local Health Office/CHO	Number in cohort for D_3*	Immunisation Uptake (%)							
			D_3†	$HepB_3$	Hib_b	$MenC_3$	$MenC_b$	PCV_3	PCV_b	MMR_1
CHO1	Cavan/Monaghan	1934	97	97	91	89	90	93	94	94
	Donegal	1971	95	93	90	83	89	87	92	90
	Sligo/Leitrim	1292	97	97	96	87	96	90	96	96
	CHO1 Total	**5197**	**96**	**95**	**92**	**86**	**91**	**90**	**94**	**93**
CHO2	Galway	3565	97	97	95	95	na	96	na	96
	Mayo	1648	97	97	91	91	na	98	na	93
	Roscommon	878	98	98	96	96	na	97	na	96
	CHO2 Total	**6091**	**97**	**97**	**94**	**94**	**na**	**97**	**na**	**95**
CHO3	Clare	1496	95	95	94	90	93	91	93	93
	Limerick	1874	93	93	90	87	90	90	91	91
	Tipperary NR/East Limerick	1779	95	94	88	85	88	92	94	93
	CHO3 Total	**5149**	**94**	**94**	**90**	**87**	**90**	**91**	**93**	**92**
CHO4	North Cork	1342	96	96	92	88	90	91	92	93
	North South Lee	5611	95	95	89	86	88	91	92	91
	West Cork	682	92	92	89	84	86	88	89	90
	Kerry	1779	96	96	91	88	90	92	93	93
	CHO4 Total	**9414**	**95**	**95**	**90**	**87**	**88**	**91**	**92**	**92**
CHO5	Carlow/Kilkenny	2018	95	95	93	87	90	92	94	94
	South Tipperary	1232	97	96	95	88	92	94	95	95
	Waterford	1836	94	93	92	86	89	90	92	92
	Wexford	2126	96	96	95	89	93	93	95	94
	CHO5 Total	**7212**	**95**	**95**	**93**	**88**	**91**	**92**	**94**	**94**
CHO6	Dublin South	1679	95	95	92	90	92	92	93	93
	Dublin South East	1679	95	95	92	90	91	92	93	93
	Wicklow	1762	94	94	86	82	85	89	92	90
	CHO6 Total	**5120**	**94**	**94**	**90**	**87**	**89**	**91**	**93**	**92**
CHO7	Dublin South City	1616	95	95	89	86	89	89	91	91
	Dublin South West	2443	97	97	95	89	94	92	96	96
	Dublin West	2656	95	95	86	83	86	89	92	91
	Kildare/West Wicklow	3834	95	95	92	89	92	92	93	93
	CHO7 Total	**10549**	**95**	**95**	**91**	**87**	**90**	**91**	**93**	**93**
CHO8	Laois/Offaly	2509	97	97	97	90	92	93	95	96
	Longford/Westmeath	1930	97	97	97	91	94	95	95	96
	Louth	1824	94	94	87	83	86	89	91	90
	Meath	3175	95	95	89	86	88	90	91	91
	CHO8 Total	**9438**	**96**	**96**	**92**	**87**	**90**	**91**	**93**	**93**
CHO9	Dublin North West	3547	94	94	87	84	87	89	91	90
	Dublin North Central	1862	91	91	84	80	84	86	89	88
	Dublin North	4152	91	91	86	84	86	88	89	89
	CHO9 Total	**9561**	**92**	**92**	**86**	**83**	**86**	**88**	**90**	**89**
Ireland		**67731**	**95**	**95**	**91**	**87**	**89**	**91**	**93**	**92**

*As the denominator/number in cohort varied slightly according to vaccine the D_3 cohort is shown here
†Since T_3, P_3, Hib_3 and $Polio_3$ uptake identical to D_3 uptake only D_3 uptake figures are presented
Please note while North Lee and South Lee are two separate Local Health Offices their combined immunisation uptake data are reported here

D_3, Hib_b, $MenC_3$ and MMR_1 uptake rates are mapped by LHO in figure 2. Among the LHOs the uptake rates ranged from 91% to 98% for D_3, T_3, P_3, Hib_3, $Polio_3$ and $HepB_3$, 89% to 96% for PCV_b, 88% to 96% for MMR_1, 86% to 98% for PCV_3, 84% to 97% for Hib_b, 84% to 96% for $MenC_b$ and 80% to 96% for $MenC_3$ (table 3).

The target uptake of ≥95% was reached in 23 LHOs for D_3, T_3, P_3, Hib_3 and $Polio_3$, 21 for $HepB_3$, in eight for Hib_b, in seven LHOs for MMR_1, in six for PCV_b, in four LHOs for PCV_3, in two LHOs for $MenC_3$ and in one LHO for $MenC_b$ (table 3). Galway and Roscommon were the only LHOs to reach the target of ≥95% for D_3, T_3, P_3, Hib_3, $Polio_3$, $HepB_3$, Hib_b, $MenC_3$, PCV_3 and MMR_1 for children at 24 months (table 3).

Conclusion

National immunisation uptake rates, in children at 12 months of age in 2016, were 91% for D_3, T_3, P_3, Hib_3, $Polio_3$, $HepB_3$ and PCV_2. The MenC immunisation schedule changed in 2015 for children born on or after July 1st 2015. Eighty-nine per cent of children, at 12 months of age in Quarters 1 and 2 2016, received $MenC_2$ and 95% of children, at 12 months of age in Quarters 3 and 4 2016, received $MenC_1$.

In 2016, national uptake rates at 24 months for $MenC_3$ (87%), Hib_b (91%), PCV_3 (91%) and MMR_1 (92%) were lower than the target uptake of ≥95%. In 2016, national uptake rates at 24 months of age for D_3, T_3, P_3, Hib_3, $Polio_3$ and $HepB_3$ reached the target rate of ≥95%. This is the sixth year national annual uptake rates reached the target of ≥95% for these vaccines. Based on available data uptake of $MenC_b$ was 89% and uptake of PCV_b was 93%. The target uptake

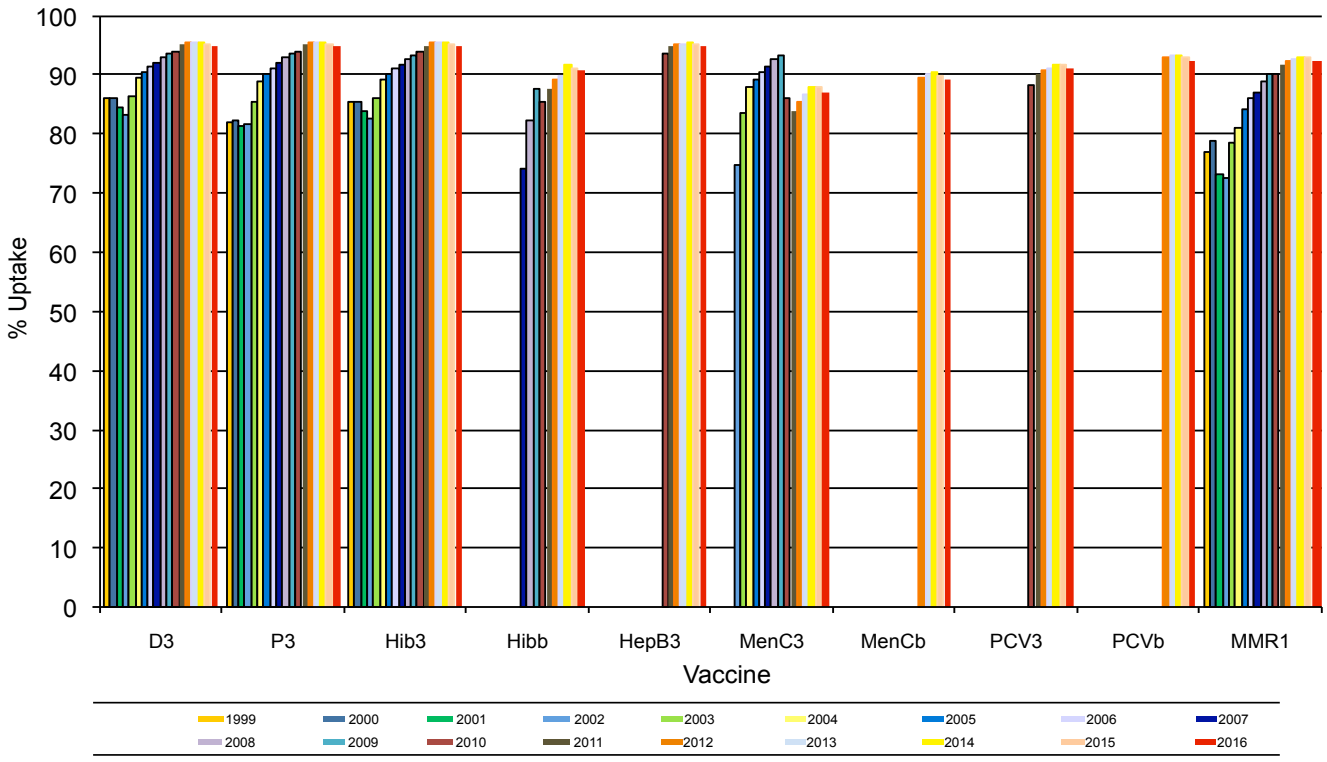

Figure 1. National annual immunisation uptake rates (based on available data) at 24 months, 1999-2015

Since T_3 and $Polio_3$ uptake identical to D_3 uptake only D_3 uptake figures presented.
P_3 uptake could not be calculated accurately during 1999-2001 as DTaP/DT uptake was reported as a combined value for the HSE NE during 1999, Quarters 3 and 4 2000 and Quarter 1 2001 and the HSE NW in 2000 and 2001. The 2002 $MenC_3$ figure is based on uptake rates for Quarter 3 and Quarter 4 2002 only. The 2005 MMR_1 uptake figure is incomplete as the HSE E was unable to provide MMR data for Quarter 4 2005, due to technical problems. The 2006 MMR_1 figure includes the Quarter-1 2006 HSE E figure, which is an estimate only due to technical problems. The 2007 national Hib_b figure is incomplete, as the HSE W data for Quarter 1 2007 and the HSE NW data for Quarter 3 2007 were not available. The 2007 national Hib_b figure also includes the HSE SE data which are an underestimate due to data extraction methods. The 2008 Hib_b figure is incomplete as the HSE SE data for Q2 2008 and the HSE MW data for Quarter 3 2008 were not available. The 2008 national $MenC_3$ figure is incomplete as the HSE E and HSE MW $MenC_3$ data for Quarter 3 2008 were not available. The 2009 data are incomplete as the following were unavailable: the Quarter 1 2009 HSE E D_3, T_3, P_3 and $Polio_3$ data for those born on the 31/03/2007; the Quarter 2 2009 HSE E Dublin North Hib_b uptake data and; the Quarter 4 2009 HSE MW data, HSE E Dublin North Hib_b data and HSE SE Hib_b data for those given a Hib dose as part of the five in one or six in one vaccine after 12 months of age. The 2010 data are incomplete as the following were unavailable: the Quarter 1 2010 HSE M and HSE S data and the HSE E Dublin North Hib_b data; the Quarter 2 2010 HSE M data and; the Quarter 4 2010 HSE NE data. As a new childhood immunisation schedule was introduced in 2008, for those born on or after July 1st 2008, the 2010 $HepB_3$ and PCV_3 data at 24 months are for those born between July 1st and December 31st 2008 (i.e. Quarters 3 and 4 2010 data) only. The MenCb and PCVb data were available for only six of the eight HSE Areas from Q1 2012 to Q4 2014 and for seven of the eight HSE Areas (eight of the nine CHOs) for 2015 and 2016.

of ≥95% was reached in six CHOs during 2016 for D_3, T_3, P_3, Hib_3, $Polio_3$ and $HepB_3$, in one CHO for PCV_3 and MMR_1 and in none for Hib_b, $MenC_3$, $MenC_b$ and PCV_b. Galway and Roscommon were the only LHOs to reach the target of ≥95% for D_3, T_3, P_3, Hib_3, $Polio_3$, $HepB_3$, Hib_b, $MenC_3$, PCV_3 and MMR_1 for children at 24 months.

Quarterly Reports

The immunisation reports for Quarters 1 to 4 2016 are available on the HPSC website in *Topics A-Z* under the heading *vaccination*.

Acknowledgements

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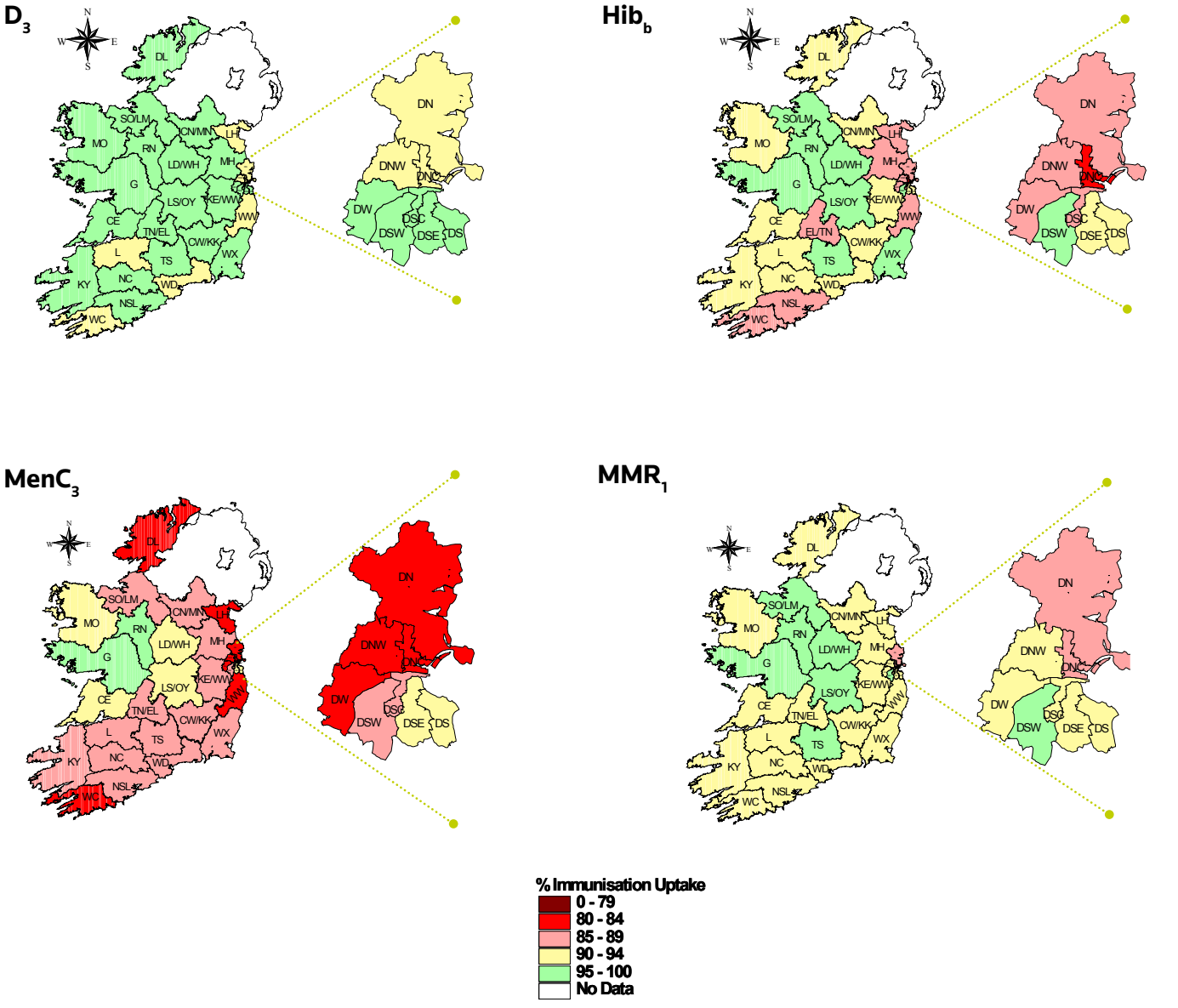


Figure 2. D_3, Hib_b, $MenC_3$ and MMR_1 immunisation uptake rates (%) in those 24 months of age in 2016 by Local Health Office (LHO)
LHOs in Dublin are highlighted separately for ease of viewing
North Lee and South Lee are separate LHOs, however, their combined (labelled NSL on the map) immunisation uptake rate is reported here
Please see table 4 to translate LHO abbreviations

Table 4. Local Health Office (LHO) abbreviations used in this chapter

Local Health Office Abbreviations	Local Health Office
CE	Clare
CN/MN	Cavan/Monaghan
CW/KK	Carlow/Kilkenny
DL	Donegal
DN	Dublin North
DNC	Dublin North Central
DNW	Dublin North West
DS	Dublin South
DSC	Dublin South City
DSE	Dublin South East
DSW	Dublin South West
DW	Dublin West
G	Galway
KE/WW	Kildare/West Wicklow
KY	Kerry
L	Limerick
LD/WD	Longford/Westmeath
LH	Louth
LS/OY	Laois/Offaly
MH	Meath
MO	Mayo
NC	North Cork
NSL*	North South Lee*
RN	Roscommon
SO/LM	Sligo/Leitrim
TN/EL	Tipperary North /East Limerick
TS	South Tipperary
WC	West Cork
WD	Waterford
WX	Wexford
WW	Wicklow

*Please note while North Lee and South Lee are two separate LHOs their combined immunisation uptake data are reported

8.2 DTaP/IPV* and MMR† vaccine uptake 2015/2016

Key Points

Uptake of the DTaP/IPV (also known as the 4 in 1) vaccine among junior infant schoolchildren during 2015/2016 in HSE-administered LHOs (Local Health Offices) was 91.9% and in GP-administered LHOs it was 90.4%

Uptake of the MMR vaccine among junior infant schoolchildren during 2015/2016 in HSE-administered LHOs was 91.5% and in GP-administered LHOs it was 90.7%

Overall, uptake of the DTaP/IPV and MMR vaccines at national level during 2015/2016 was estimated to be 91.8% and 91.5%, respectively.

Background

DTaP/IPV* and MMR vaccines are now primarily administered by the HSE school immunisation teams, with only two LHOs providing these vaccines via GP local services only. Data on the uptake of DTaP/IPV and MMR vaccines among junior infant schoolchildren has been collated nationally since the 2011/2012 academic school year and was first published January 2013[1]. Since then, annual (academic year) reports, based on data submissions from each area, are published on the HPSC website.

Since 2015 all LHOs immunisation offices are asked to input the data relating to school based junior infant DTaP/IPV and MMR vaccine programme onto the HSE School Immunisation System (SIS). Although most areas are now using SIS for recording these data, some areas continue to use alternate information systems. There is agreement that all school based vaccines will be inputted onto SIS for the 2016/2017 academic year. In this report we provide data for the 2015/2016 academic year DTaP/IPV and MMR vaccination programme and compare uptake with previously reported data.

DTaP/IPV* and MMR† vaccine uptake 2015/2016

Uptake of the DTaP-IPV* and MMR† vaccines in 4-5 year olds/junior infant schoolchildren was monitored across all LHOs during the 2015/2016 academic year. Data from HSE-vaccine administered LHOs is based on what was recorded on SIS on 24th April 2017, although some LHOs had not entered all of their data at the time of data extraction. For the latter LHOs, the returns reported here are based on data provided directly to HPSC by mid-October 2016, except for Wexford, whose updated figures were reported on the 17th May 2017.

All uptake data, provided by immunisation coordinators and other administrative staff[2] were entered on to a MS-Excel database and compared to those reported for the previous 2014/2015 season, where possible.

1 http://ndsc.newsweaver.ie/epiinsight/1s4r7v3qv7n?a=1&p=30773765&t=17517774
2 Data for the North West area were provided to HPSC by the local Department of Public Health

Table 1. Proportion of DTaP-IPV vaccine and MMR uptake in HSE-administered LHOs attributable to GPs in 2015/2016

	% Vaccine Uptake Administered by GPs	
LHO	**DTaP-IPV**	**MMR**
North Cork	26%	26%
Kerry	12.5%	12.5%
South Lee	6.6%	6.6%
North Lee	6%	6%
Dublin South	5.5%	6.1%
West Cork	4.9%	4.9%
Wexford	2.1%	2.1%
Offaly	0.08%	0.16%

* DTaP-IPV = Diphtheria, Tetanus, acellular Pertussis and Polio vaccine
†MMR = Measles, Mumps and Rubella vaccine

*Table 2. Overall uptake of the DTaP-IPV and MMR vaccines in junior infants during the 2015/2016 academic year***

		HSE administered LHOs						GP administered LHOs					
		DTaP-IPV vaccine			MMR vaccine			DTaP-IPV vaccine			MMR vaccine		
CHO	LHO Name	Cohort	Number children who have received 1 dose DTaP-IPV vaccine	%	Cohort	Number children who have received 1 dose MMR vaccine	%	Cohort	Number children who have received 1 dose DTaP-IPV vaccine	%	Cohort	Number children who have received 1 dose MMR vaccine	%
1	Cavan/Monaghan	2,063	1,943	94.2%	2,063	1,940	94.0%	HSE	HSE	HSE	HSE	HSE	HSE
	Donegal	GP	GP	GP	GP	GP	GP	2,450	2,160	88.2%	2,450	2,160	88.2%
	Sligo/Leitrim	GP	GP	GP	GP	GP	GP	1,515	1,425	94.1%	1,515	1,437	94.9%
	CHO 1 Total	**2,063**	**1,943**	**94.2%**	**2,063**	**1,940**	**94.0%**	**3,965**	**3,585**	**90.4%**	**3,965**	**3,597**	**90.7%**
2	Galway	3,868	3,440	88.9%	3,868	3,431	88.7%	HSE	HSE	HSE	HSE	HSE	HSE
	Mayo	1,768	1,684	95.2%	1,801	1,676	93.1%	HSE	HSE	HSE	HSE	HSE	HSE
	Roscommon	965	884	91.6%	965	887	91.9%	HSE	HSE	HSE	HSE	HSE	HSE
	CHO 2 Total	**6,601**	**6,008**	**91.0%**	**6,634**	**5,994**	**90.4%**						
3	Clare	1,592	1,476	92.7%	1,592	1,476	92.7%	HSE	HSE	HSE	HSE	HSE	HSE
	Limerick	2,131	1,934	90.8%	2,131	1,940	91.0%	HSE	HSE	HSE	HSE	HSE	HSE
	Tipperary North	2,065	1,887	91.4%	2,065	1,886	91.3%	HSE	HSE	HSE	HSE	HSE	HSE
	CHO 3 Total	**5,788**	**5,297**	**91.5%**	**5,788**	**5,302**	**91.6%**						
4	Kerry	1,966	1,849	94.0%	1,966	1,847	93.9%	HSE	HSE	HSE	HSE	HSE	HSE
	North Cork	1,567	1,517	96.8%	1,567	1,517	96.8%	HSE	HSE	HSE	HSE	HSE	HSE
	North Lee/South Lee	5,924	5,623	94.9%	5,924	5,619	94.9%	HSE	HSE	HSE	HSE	HSE	HSE
	West Cork	772	709	91.8%	772	710	92.0%	HSE	HSE	HSE	HSE	HSE	HSE
	CHO 4 Total	**10,229**	**9,698**	**94.8%**	**10,229**	**9,693**	**94.8%**						
5	Carlow/Kilkenny	2,148	2,054	95.6%	2,148	2,049	95.4%	HSE	HSE	HSE	HSE	HSE	HSE
	South Tipperary	1,344	1,261	93.8%	1,344	1,263	94.0%	HSE	HSE	HSE	HSE	HSE	HSE
	Waterford	2,003	1,947	97.2%	2,003	1,860	92.9%	HSE	HSE	HSE	HSE	HSE	HSE
	Wexford	2,282	2,149	94.2%	2,282	2,147	94.1%	HSE	HSE	HSE	HSE	HSE	HSE
	CHO 5 Total	**7,777**	**7,411**	**95.3%**	**7,777**	**7,319**	**94.1%**						
6	Dublin South	1,927	1,783	92.5%	1,927	1,783	92.5%	HSE	HSE	HSE	HSE	HSE	HSE
	Dublin South East	1,847	1,542	83.5%	1,849	1,526	82.5%	HSE	HSE	HSE	HSE	HSE	HSE
	Wicklow	2,031	1,961	96.6%	2,031	1,949	96.0%	HSE	HSE	HSE	HSE	HSE	HSE
	CHO 6 Total	**5,805**	**5,286**	**91.1%**	**5,807**	**5,258**	**90.5%**						
7	Dublin South City	1,590	1,426	89.7%	1,590	1,420	89.3%	HSE	HSE	HSE	HSE	HSE	HSE
	Dublin South West	2,126	1,948	91.6%	2,126	1,947	91.6%	HSE	HSE	HSE	HSE	HSE	HSE
	Dublin West	2,786	2,547	91.4%	2,786	2,535	91.0%	HSE	HSE	HSE	HSE	HSE	HSE
	Kildare/West Wicklow	4,297	3,995	93.0%	4,297	3,991	92.9%	HSE	HSE	HSE	HSE	HSE	HSE
	CHO 7 Total	**10,799**	**9,916**	**91.8%**	**10,799**	**9,893**	**91.6%**						
8	Laois/Offaly	2,714	2,491	91.8%	2,725	2,480	91.0%	HSE	HSE	HSE	HSE	HSE	HSE
	Longford/Westmeath	2,142	2,019	94.3%	2,142	2,024	94.5%	HSE	HSE	HSE	HSE	HSE	HSE
	Louth	2,154	2,012	93.4%	2,154	2,011	93.4%	HSE	HSE	HSE	HSE	HSE	HSE
	Meath	3,598	3,354	93.2%	3,598	3,348	93.1%	HSE	HSE	HSE	HSE	HSE	HSE
	CHO 8 Total	**10,608**	**9,876**	**93.1%**	**10,619**	**9,863**	**92.9%**						
9	Dublin North	4,404	3,583	81.4%	4,396	3,591	81.7%	HSE	HSE	HSE	HSE	HSE	HSE
	Dublin North Central	1,396	1,305	93.5%	1,399	1,298	92.8%	HSE	HSE	HSE	HSE	HSE	HSE
	Dublin North West	3,553	3,090	87.0%	3,553	3,076	86.6%	HSE	HSE	HSE	HSE	HSE	HSE
	CHO 9 Total	**9,353**	**7,978**	**85.3%**	**9,348**	**7,965**	**85.2%**						
	National Total	**69,023**	**63,413**	**91.9%**	**69,064**	**63,227**	**91.5%**	**3,965**	**3,585**	**90.4%**	**3,965**	**3,597**	**90.7%**

GP=Vaccine administered by GPs in these areas; HSE=Vaccine administered by HSE public health personnel in these areas; Target population HSE-vaccine administered areas: All children in Junior Infants on the school register on 30/09/2015 for the 2015/2016 academic year; Target population in GP-vaccine administered areas: All children born between 01/09/2009 and 31/08/2010

HSE-school team versus GP-vaccine administered LHOs
In 2015/2016, vaccines were delivered in 21 LHOs by HSE school teams only, in eight other HSE-administered LHOs where GPs deliver a small percentage of vaccines and in two LHOs based in the North West by GPs only (Table 1).

Target populations
For the 2015/2016 academic year, the target population in HSE-vaccine administered LHOs was all children in junior infants on the school register on the 30th September 2015. For GP-vaccine administered LHOs, the target population was all children born between the 1st September 2009 and 31st August 2010.

The different ways in which the target populations have been defined in the HSE- and GP-vaccine administered LHOs has meant that a national uptake for either vaccine cannot be accurately calculated. Donegal and Sligo/Leitrim, two GP–vaccine administered LHOs, are part of Community Health Organisation (CHO) area 1, which also includes the HSE-vaccine administered LHO Cavan/Monaghan. This means that the uptake in CHO area 1 cannot be compared to the other eight CHO areas 2 to 9. However, in order to estimate uptake at a national level, the cohorts for Cavan/ Monaghan, Donegal and Sligo/Leitrim have been combined.

Uptake of DTaP-IPV vaccine
Between 2014/2015 and 2015/2016, the overall uptake of the DTaP-IPV vaccine in HSE-vaccine administered LHOs increased from 91.5% to 91.9%. In 2015/2016, the average uptake among these LHOs was 92.3% with a range from 81.4% in Dublin North to 97.2% in Waterford. Of the 29 HSE-vaccine administered LHOs, 13 reported an average uptake decline of -2.6% whilst 16 others reported an average increase of +3.7%. The largest reduction in uptake was reported by Dublin North (-7.7%) and the highest increase was each reported by Mayo and Limerick (+8.7%).
During the same period of time, overall DTaP-IPV vaccine uptake in exclusively GP-vaccine administered LHOs (Donegal; Sligo/Leitrim) fell slightly from 92.3% to 90.4%: Donegal reported an uptake reduction of -2.9%, whilst Sligo/Leitrim reported a slight decrease of -0.3%.

Uptake of MMR vaccine
The overall uptake of the MMR vaccine between 2014/2015 and 2015/2016 in HSE-vaccine administered LHOs increased from 91.3% to 91.5%. In 2015/2016, the average uptake among these LHOs was 91.9% with a range from 81.7% in Dublin North to 96.8% in North Cork. Of the 29 HSE-vaccine administered LHOs, 13 reported an average uptake reduction of -2.9% whilst 16 others reported an average increase of +3.4%. The largest reduction in uptake was reported by Dublin North (-7.0%) and the highest increase was reported by Limerick (+9.1%).

Overall MMR vaccine uptake in exclusively GP-vaccine administered LHOs decreased from 91.8% to 90.7% during the same time period: Donegal reported an uptake decrease of -2.1%, whilst Sligo/Leitrim reported a decrease of -0.3%.
MMR catch-up vaccination

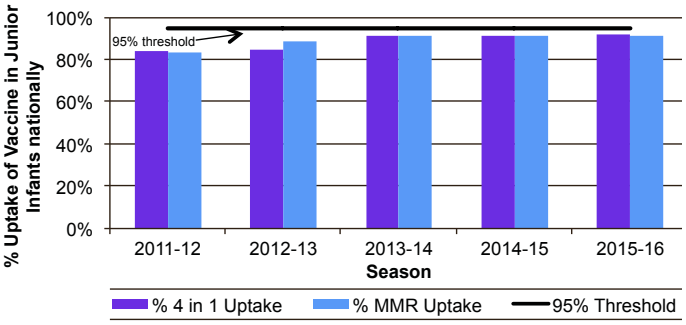


Figure 1. Percentage uptake of the DTaP/IPV and MMR vaccines in HSE administered areas between 2011/2012 and 2015/2016

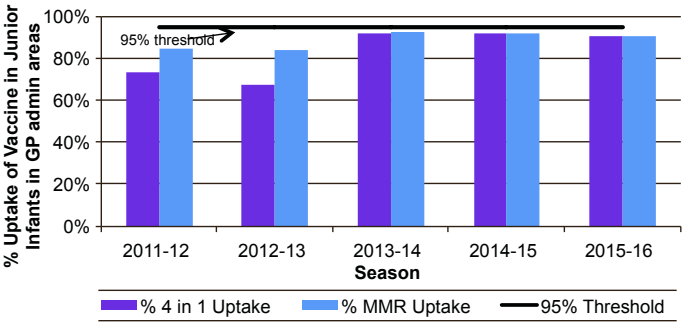


Figure 2. Percentage uptake of the DTaP/IPV and MMR vaccines in GP administered areas between 2011/2012 and 2015/2016

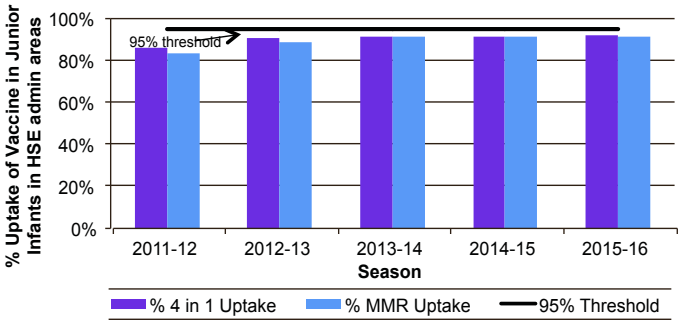
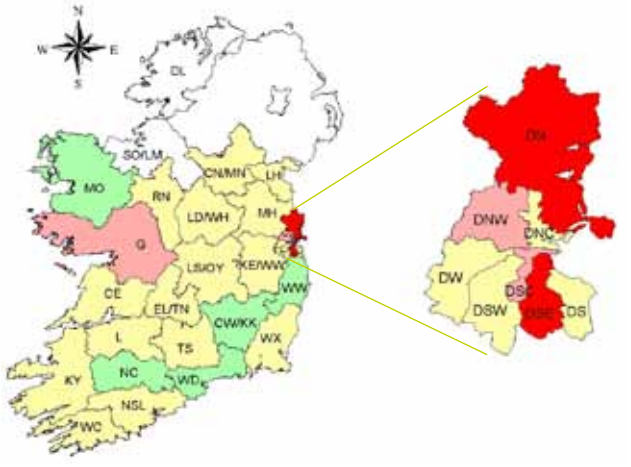
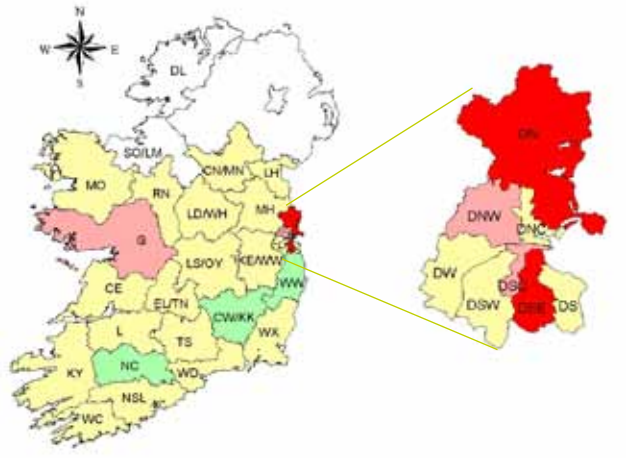


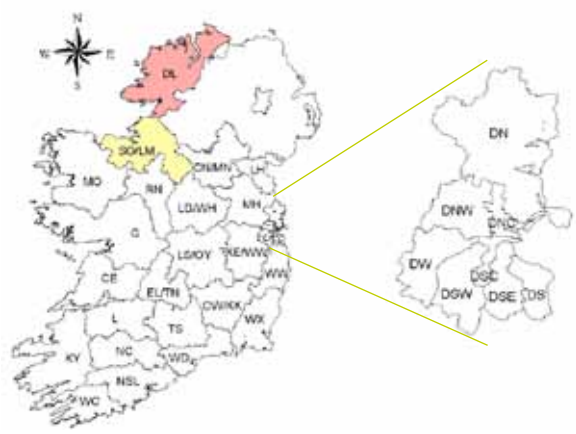
Figure 3. Estimated percentage uptake of the DTaP/IPV and MMR vaccines nationally between 2011/2012 and 2015/2016



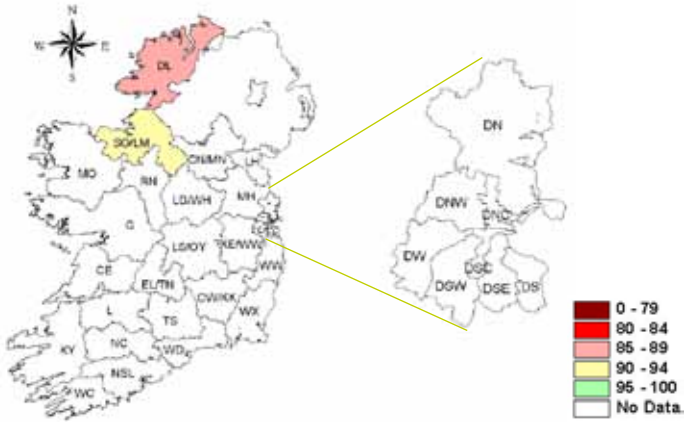
HSE-DTaP-IPV Vaccine Administered LHOs



HSE-MMR Vaccine Administered LHO



GP-DTaP-IPV Vaccine Administered LHOs



GP-MMR Vaccine Administered LHOs

Figure 4. LHO Maps of DTaP-IPV & MMR percentage vaccine uptake at Junior Infants level during the 2015/2016 academic year

Seven‡ HSE-vaccine administered LHOs reported on the number of children needing a catch-up MMR dose one month later after been given their first dose. The total number of children identified was 89 (range one to 30). Of these 89 children, 59 (66.3%) received a catch-up vaccine dose (range zero to 23) (data not shown).

Figures 1 to 3 present trends in the percentage uptake of the DTaP/IPV and MMR vaccines between 2011/2012 and 2015/2016 in HSE administered areas, GP administered areas and as an national estimate, respectively.

Details of the overall uptake of the two vaccines in the HSE- and GP-vaccinated LHOs during 2015/2016 are presented in Table 2 and in the maps in Figure 4.

Discussion

Although at national level uptake of DTaP/IPV and MMR has improved in recent years, little progress has been made at national level since 2013-2014 when a plateau was reached. It is of concern that uptake of these vaccines is sub-optimal among junior infants, both nationally and in a majority of CHOs and LHOs. Uptake less than 95% for these vaccines indicates vulnerability amongst the children who have not availed of the vaccines aimed at preventing serious diseases (diphtheria, tetanus, pertussis, polio, measles, mumps, and rubella). Even if all children in these cohorts had received their vaccines in early childhood, booster doses are needed to provide protection in the forthcoming years.

Limitations

The data presented here represent vaccines administered for these age cohorts. It is possible that some children may have received their booster doses prior to preschool age if they came from another jurisdiction or were vaccinated earlier than the normal schedule for other reasons (travel, exposure to cases of these diseases). However, if this did occur the proportion would be very small.

Acknowledgements

Many thanks to all HSE staff, Department of Education and Skills staff, staff in all educational settings, GPs, parents and children/students, who implemented, participated in and supported all these vaccination programmes.

Notes

*DTaP-IPV = Diphtheria, Tetanus, acellular Pertussis and Polio vaccine, also known as the 4 in 1 vaccine
†MMR = Measles, Mumps and Rubella vaccine
‡Excludes Laois
**In table 2, data in HSE vaccine administered LHOs based on what was recorded on SIS only on 24th April 2017 although some LHOs had not entered all their data at the time of data extraction. For the latter LHOs the returns reported here are based on data provided by them directly to HPSC by mid October 2016, except for Wexford, whose updated figures were reported on the 17th May 2017.

8.3 HPV, MenC booster and Tdap vaccine uptake 2015/2016

Key Points

Among the recommended cohorts in the academic year 2015/2016:

72.3% of girls had at least stage 2 HPV vaccine (considered to have completed a two dose HPV vaccine course);

86.7% of children had MenC booster vaccine and;

89.2% of children had Tdap vaccine.

Background

HPV

Following a recommendation from the National Immunisation Advisory Committee (NIAC), that human papillomavirus (HPV) vaccine should be given to 12 year old girls, a routine Health Service Executive (HSE) school HPV vaccination programme began in May 2010 for girls in the first year of second level school and age equivalent in special schools and home schooled. The aim of the programme is to protect girls from their future risk of developing cervical cancer.

An HPV catch-up campaign for girls in sixth year of second level schools and their age equivalents in non-second level schools (ie special schools, home schooled, Community Training Centres and Youthreach) was added in the academic year 2011/2012 and continued during the academic years 2012/2013 and 2013/2014.

Quadrivalent HPV vaccine, which protects against HPV types 6, 11, 16 and 18 associated with 70% of cervical cancer, has been used in the school vaccination programme since the programme began. A schedule of two vaccine doses given at least six months apart was recommended since the academic year 2014/2015 for girls aged <15 years. Prior to this a schedule of three vaccine doses given over a six month period was recommended. This change is based on more recent data which showed that the immune response to two doses of the vaccine in 9-13 year old girls is comparable to a three dose course. The HPV vaccine does not protect against all cervical cancers, so regular cervical screening is still needed.

MenC

MenC (meningococcal group C) vaccine is recommended as part of the primary childhood immunisation programme. In recent years, evidence has emerged that immunity to meningococcal disease reduces over time, so a booster dose is recommended now to provide additional protection. NIAC recommends vaccination with a booster MenC vaccine at 12-13 years of age. The MenC booster vaccine was introduced into the HSE schools immunisation programme in September 2014. This vaccine is offered to students in first year of second level schools and their age equivalents in special schools and home schooled.

Tdap

NIAC recommends vaccination with Tdap (tetanus and low-dose diphtheria and acellular pertussis) vaccine at 11-14 years of age. The Tdap vaccine was introduced to the HSE schools immunisation programme on a phased basis from September 2011. The HSE extended the Tdap vaccination programme to all areas from September 2012. This vaccine is offered to students in first year of second level school and their age equivalents in special schools and home schooled. It replaces the previous school based Td (Tetanus and low dose diphtheria) vaccination programme. The adolescent booster was changed because more cases of pertussis have been occurring in adolescents and adults due to the waning immunity that occurs over time, combined with a reduction in natural boosting.

The target for uptake of two doses of vaccine for the HPV vaccination programme is ≥85% and target uptake of MenC booster and Tdap vaccine is ≥95%.

The vaccinations are provided by vaccination teams from the Local Health Offices (LHOs) who go into schools in their areas to vaccinate or provide vaccination clinics free of charge for children in the target cohorts. Vaccinations provided through the schools immunisation programme are entered into the School Immunisation System (SIS). Please see the HSE-National Immunisation Office (NIO) website at www.immunisation.ie for detailed and current information on the school vaccination programme.

Cohort for vaccination in the academic year 2015/2016

The cohort for the 2015/2016 HPV, Tdap and MenC booster vaccination programme was children (girls only for HPV vaccine)

- in **first year of second level schools**
- **and their age equivalents** ie those who were born between 01/09/2003 and 31/08/2004
  - attending special schools or
  - registered with the Child and Family Agency Education Welfare Services to be home schooled.

Terminology used in this report

At least stage 1 - means a girl had a stage 1 HPV vaccine recorded on SIS, this girl may or may not have had a stage 2 HPV vaccine recorded on SIS.

At least stage 2 - means a girl had a stage 2 HPV vaccine recorded on SIS, she may or may not have had stage 1 HPV vaccine recorded on SIS.

Girls with at least stage 2 HPV are considered to have completed a course of vaccination. Prior to the 2014/2015 academic year girls with at least stage 3 HPV were considered to have completed a course of vaccination.

Home schooled - refers to children registered with the Child and Family Agency Education Welfare Services to be educated at home. These children were recorded on SIS and reported here as home schooled.

Out of school - refers to vaccinated children who were neither enrolled in a second level school, special school nor registered with the Child and Family Agency Education Welfare Services as home schooled.

Local Health Office (LHO) - refers to the LHO the school is located in (it does not refer to the LHO the child is resident in).

Outside cohort - refers to those who were vaccinated but who were not in first year of second level schools or their equivalents in non-second level schools ie they were outside the cohorts recommended for vaccination.

The denominator for second level schools was defined as the number of children (girls only for HPV vaccine) on the school roll on 30th September 2015 for first year. The denominator for age equivalent to first years in second level schools was defined as children (girls only for HPV vaccine) born between 01/09/2003 and 31/08/2004 on the school roll of special schools or registered with the Child and Family Agency Education Welfare Services on 30th September 2015. All the denominator data was entered onto SIS by the relevant System Administrator.

Uptake of HPV, MenC booster and Tdap vaccines
Here we report on the uptake of HPV, MenC booster and Tdap vaccines in the academic year 2015/2016, provided through the school immunisation programme and recorded on SIS on the 24th January 2017. These figures are subject to change due to ongoing updating of data on the database.

The data presented here are the result of collaboration between NIO, School Immunisation Teams, Immunisation Coordinators, Immunisation System Administrators, Immunisation administrative staff and HPSC.

Uptake of HPV vaccine
In Ireland, 72.3% of girls in second level schools and their age equivalents in special schools and home schooled were recorded as having received at least HPV stage 2 (considered to have completed a two dose course) (Table 1). In the 2014/2015 academic year, 86.9% of girls in second level schools and their age equivalents in special schools and home schooled were recorded as having received at least HPV stage 2 (considered to have completed a two dose course)[1]. Data are not directly comparable with academic years prior to 2014/2015. Prior to the academic year 2014/2015 a three dose schedule was recommended. In the academic year 2013/2014 88.2% of girls in first year in second level schools were recorded as having received at least HPV stage 2 while 84.9% of girls in first year in second level schools were recorded as having received at least HPV stage 3.[2]

Among the nine Community Healthcare Organisations (CHOs), in the academic year 2015/2016, uptake of at least HPV stage 2 among girls ranged from 66.3% to 77.6%; with none reaching the target of ≥85% uptake. While among the 32 LHOs uptake of at least HPV stage 2 ranged from 60.2% to 83.5%.

An additional 26 girls were recorded as being outside the cohorts recommended for vaccination and having received at least HPV stage 2 (Table 1).

Uptake of MenC booster vaccine
In the academic year 2015/2016, uptake of the MenC booster vaccine in children in first year in second level schools and their equivalents in special schools and home schooled was 86.7% (Table 2). In the academic year 2014/2015, uptake of the MenC booster vaccine in children in first year in second level schools and their equivalents in special schools and home schooled was 87.9%.[3]

In the academic year 2015/2016, there was some regional variation with uptake among the CHOs ranging from 80.8% to 88.9%.

In 2015/2016, an additional 136 children were recorded as being outside the cohort recommended for vaccination and having received MenC booster vaccine (Table 2).

Uptake of Tdap vaccine
In the academic year 2015/2016, uptake of the Tdap vaccine in children in first year in second level schools and their equivalents in special schools and home schooled was 89.2% (Table 3). Uptake was 89.1 % in the academic year 2014/2015; and uptake was 83.7% in the academic year 2013/2014 among the 31 LHOs, out of a total of 32 LHOs, reporting data.[4, 5]

In the academic year 2015/2016, there was some regional variation with uptake among the CHOs ranging from 84.7% to 91.0%.

In 2015/2016, an additional 122 children were recorded as being outside the cohort recommended for vaccination and having received Tdap vaccine (Table 3).

This chapter was amended November 2019 to update the HPV target rate.

Acknowledgements
Many thanks to all HSE staff, National Immunisation Office staff, school immunisation teams, immunisation coordinators, immunisation system administrators, immunisation administrative staff, Department of Education and Skills staff, Child and Family Agency Education Welfare Services staff, staff in all educational settings, parents and children/students, who implemented, participated in and supported the school vaccination programme.

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Table 1. HPV uptake data among girls in the routine cohort in the academic year 2015/2016 (data extracted from the School Immunisation System 24/01/2017)

Community Healthcare Organisation (CHO)	Local Health Office/Community Healthcare Organisation (CHO)	2015/2016							
		Girls in first year in second level schools and age equivalent* in special schools, home schooled and out of school					Outside cohort		
			Numbers vaccinated with:		% Vaccinated with:			Numbers vaccinated with:	
		Denominator	at least stage 1	at least stage 2	at least stage 1	at least stage 2	Denominator	at least stage 1	at least stage 2
CHO1	Cavan/Monaghan	876	683	620	78.0%	70.8%	N/A	1	1
	Donegal	1081	871	777	80.6%	71.9%	N/A	0	0
	Sligo/Leitrim	678	547	481	80.7%	70.9%	N/A	0	0
	CHO1 Total	**2635**	**2101**	**1878**	**79.7%**	**71.3%**	**N/A**	**1**	**1**
CHO2	Galway	1745	1395	1271	79.9%	72.8%	N/A	4	4
	Mayo	918	695	623	75.7%	67.9%	N/A	2	1
	Roscommon	283	226	190	79.9%	67.1%	N/A	1	0
	CHO2 Total	**2946**	**2316**	**2084**	**78.6%**	**70.7%**	**N/A**	**7**	**5**
CHO3	Clare	800	677	607	84.6%	75.9%	N/A	2	1
	Limerick	1026	857	759	83.5%	74.0%	N/A	0	0
	Tipperary NR/East Limerick	967	810	717	83.8%	74.1%	N/A	1	1
	CHO3 Total	**2793**	**2344**	**2083**	**83.9%**	**74.6%**	**N/A**	**3**	**2**
CHO4	North Cork	610	460	380	75.4%	62.3%	N/A	0	0
	North Lee - Cork	1267	1056	914	83.3%	72.1%	N/A	0	0
	South Lee - Cork	1238	1007	852	81.3%	68.8%	N/A	1	1
	West Cork	359	257	216	71.6%	60.2%	N/A	0	0
	Kerry	963	742	581	77.1%	60.3%	N/A	0	0
	CHO4 Total	**4437**	**3522**	**2943**	**79.4%**	**66.3%**	**N/A**	**1**	**1**
CHO5	Carlow/Kilkenny	1073	945	865	88.1%	80.6%	N/A	0	0
	South Tipperary	550	452	395	82.2%	71.8%	N/A	2	0
	Waterford	829	704	646	84.9%	77.9%	N/A	0	0
	Wexford	1094	884	724	80.8%	66.2%	N/A	0	0
	CHO5 Total	**3546**	**2985**	**2630**	**84.2%**	**74.2%**	**N/A**	**2**	**0**
CHO6	Dublin South	886	736	664	83.1%	74.9%	N/A	8	1
	Dublin South East	638	546	518	85.6%	81.2%	N/A	1	1
	Wicklow	756	625	557	82.7%	73.7%	N/A	0	0
	CHO6 Total	**2280**	**1907**	**1739**	**83.6%**	**76.3%**	**N/A**	**9**	**2**
CHO7	Dublin South City	753	695	621	92.3%	82.5%	N/A	0	0
	Dublin South West	798	666	590	83.5%	73.9%	N/A	1	1
	Dublin West	1093	917	777	83.9%	71.1%	N/A	1	1
	Kildare/West Wicklow	1747	1584	1418	90.7%	81.2%	N/A	0	0
	CHO7 Total	**4391**	**3862**	**3406**	**88.0%**	**77.6%**	**N/A**	**2**	**2**
CHO8	Laois/Offaly	1126	996	862	88.5%	76.6%	N/A	2	2
	Longford/Westmeath	1098	899	762	81.9%	69.4%	N/A	0	0
	Louth	992	913	828	92.0%	83.5%	N/A	2	0
	Meath	1397	1090	968	78.0%	69.3%	N/A	4	4
	CHO8 Total	**4613**	**3898**	**3420**	**84.5%**	**74.1%**	**N/A**	**8**	**6**
CHO9	Dublin North West	1421	1147	987	80.7%	69.5%	N/A	4	3
	Dublin North Central	677	539	474	79.6%	70.0%	N/A	0	0
	Dublin North	1615	1262	1076	78.1%	66.6%	N/A	4	2
	CHO9 Total	**3713**	**2948**	**2537**	**79.4%**	**68.3%**	**N/A**	**8**	**5**
Home schooled		51	1	1	2.0%	2.0%	N/A	1	0
Total of LHOs and home schooled		**31405**	**25884**	**22721**	**82.4%**	**72.3%**	**N/A**	**42**	**24**
Out of school		N\A	0	0	N/A	N/A	N/A	2	2
Total of LHOs and home schooled and out of school		N\A	25884	22721	N\A	N\A	N/A	44	26

*Age equivalents are those born between 01/09/2003 and 31/08/2004.
Outside cohort refers to those who were vaccinated but who were outside the routine cohort for vaccination.
Local health office (LHO) refers to the LHO of the school. Therefore, in reports the LHOs of homeschooled and out of school children do not appear.
The denominator for second level schools was defined as the number of children on the school roll on 30th September 2015 for first year. The denominator for age equivalent to first years in second level schools was defined as children born between 01/09/2003 and 31/08/2004 on the school roll of special schools or registered with the Child and Family Agency Education Welfare Services on 30th September 2015. All the denominator data was entered onto the School Immunisation System (SIS) by the relevant System Administrator.
'At least stage 1' means a girl had a stage 1 recorded on SIS, this girl may or may not have had a stage 2 recorded. Similarly, 'at least stage 2 'means a girl had a stage 2 recorded on SIS, they may or may not have had stage 1 recorded.
N/A-Not applicable
Home schooled refers to children registered with the Child and Family Agency Education Welfare Services to be educated at home. These children were recorded on SIS and reported here as home schooled.
Out of school refers to vaccinated children who were neither enrolled in a second level school, special school nor registered with the Child and Family Agency Education Welfare Services as home schooled.

Table 2. MenC booster vaccine uptake data, provided through the school immunisation programme, among children in the academic year 2015/2016 (data extracted from the School Immunisation System 24/01/2017)

Community Healthcare Organisation (CHO)	Local Health Office/Community Healthcare Organisation (CHO)	2015/2016				
		Children in first year in second level schools and age equivalent* in special schools, home schooled and out of school			Outside cohort	
		Denominator	Numbers vaccinated with MenC booster	% Vaccinated with MenC booster	Denominator	Numbers vaccinated with MenC booster
CHO1	Cavan/Monaghan	1850	1533	82.9%	N/A	1
	Donegal	2238	2009	89.8%	N/A	0
	Sligo/Leitrim	1321	1204	91.1%	N/A	5
	CHO1 Total	**5409**	**4746**	**87.7%**	**N/A**	**6**
CHO2	Galway	3399	2877	84.6%	N/A	9
	Mayo	1774	1553	87.5%	N/A	3
	Roscommon	574	499	86.9%	N/A	2
	CHO2 Total	**5747**	**4929**	**85.8%**	**N/A**	**14**
CHO3	Clare	1534	1358	88.5%	N/A	3
	Limerick	1958	1683	86.0%	N/A	0
	Tipperary NR/East Limerick	1949	1700	87.2%	N/A	15
	CHO3 Total	**5441**	**4741**	**87.1%**	**N/A**	**18**
CHO4	North Cork	1196	1078	90.1%	N/A	1
	North Lee - Cork	2698	2367	87.7%	N/A	0
	South Lee - Cork	2565	2278	88.8%	N/A	1
	West Cork	695	582	83.7%	N/A	1
	Kerry	1983	1643	82.9%	N/A	1
	CHO4 Total	**9137**	**7948**	**87.0%**	**N/A**	**4**
CHO5	Carlow/Kilkenny	2092	1934	92.4%	N/A	18
	South Tipperary	1159	1005	86.7%	N/A	6
	Waterford	1715	1591	92.8%	N/A	0
	Wexford	2327	1957	84.1%	N/A	0
	CHO5 Total	**7293**	**6487**	**88.9%**	**N/A**	**24**
CHO6	Dublin South	1928	1661	86.2%	N/A	31
	Dublin South East	1182	1112	94.1%	N/A	0
	Wicklow	1515	1314	86.7%	N/A	1
	CHO6 Total	**4625**	**4087**	**88.4%**	**N/A**	**32**
CHO7	Dublin South City	1482	1338	90.3%	N/A	1
	Dublin South West	1828	1484	81.2%	N/A	3
	Dublin West	2167	1792	82.7%	N/A	1
	Kildare/West Wicklow	3661	3360	91.8%	N/A	0
	CHO7 Total	**9138**	**7974**	**87.3%**	**N/A**	**5**
CHO8	Laois/Offaly	2358	2140	90.8%	N/A	2
	Longford/Westmeath	2178	2006	92.1%	N/A	0
	Louth	2135	1838	86.1%	N/A	0
	Meath	2815	2445	86.9%	N/A	3
	CHO8 Total	**9486**	**8429**	**88.9%**	**N/A**	**5**
CHO9	Dublin North West	2719	2161	79.5%	N/A	5
	Dublin North Central	1503	1221	81.2%	N/A	0
	Dublin North	3151	2572	81.6%	N/A	15
	CHO9 Total	**7373**	**5954**	**80.8%**	**N/A**	**20**
Home schooled		100	3	3.0%	N/A	3
Total of LHOs and home schooled		**63749**	**55298**	**86.7%**	**N/A**	**131**
Out of school		N\A	0	N\A	N\A	5
Total of LHOs and home schooled and out of school		N\A	55298	N\A	N\A	136

*Age equivalents are those born between 01/09/2003 and 31/08/2004.
Outside cohort refers to those who were vaccinated but who were outside the routine cohort for vaccination.
Local health office (LHO) refers to the LHO of the school. Therefore, in reports the LHOs of home schooled and out of school children do not appear.
The denominator for second level schools was defined as the number of children on the school roll on 30th September 2015 for first year. The denominator for age equivalent to first years in second level schools was defined as children born between 01/09/2003 and 31/08/2004 on the school roll of special schools or registered with the Child and Family Agency Education Welfare Services on 30th September 2015. All the denominator data was entered onto the School Immunisation System (SIS) by the relevant System Administrator.
N/A-Not applicable
Home schooled refers to children registered with the Child and Family Agency Education Welfare Services to be educated at home. These children were recorded on SIS and reported here as home schooled.
Out of school refers to vaccinated children who were neither enrolled in a second level school, special school nor registered with the Child and Family Agency Education Welfare Services as home schooled.

Table 3. Tdap vaccine uptake data, provided through the school immunisation programme, among children in the academic year 2015/2016 (data extracted from the School Immunisation System 24/01/2017)

Community Healthcare Organisation (CHO)	Local Health Office/Community Healthcare Organisation (CHO)	2015/2016				
		Children in first year in second level schools and age equivalent* in special schools, home schooled and out of school			Outside cohort	
		Denominator	Numbers vaccinated with Tdap	% Vaccinated with Tdap	Denominator	Numbers vaccinated with Tdap
CHO1	Cavan/Monaghan	1850	1566	84.6%	N/A	2
	Donegal	2238	2058	92.0%	N/A	0
	Sligo/Leitrim	1321	1220	92.4%	N/A	3
	CHO1 Total	**5409**	**4844**	**89.6%**	**N/A**	**5**
CHO2	Galway	3398	2934	86.3%	N/A	3
	Mayo	1694	1583	93.4%	N/A	1
	Roscommon	574	520	90.6%	N/A	0
	CHO2 Total	**5666**	**5037**	**88.9%**	**N/A**	**4**
CHO3	Clare	1533	1378	89.9%	N/A	5
	Limerick	1959	1737	88.7%	N/A	2
	Tipperary NR/East Limerick	1949	1738	89.2%	N/A	5
	CHO3 Total	**5441**	**4853**	**89.2%**	**N/A**	**12**
CHO4	North Cork	1196	1108	92.6%	N/A	0
	North Lee - Cork	2698	2426	89.9%	N/A	0
	South Lee - Cork	2565	2318	90.4%	N/A	0
	West Cork	695	601	86.5%	N/A	1
	Kerry	1983	1709	86.2%	N/A	0
	CHO4 Total	**9137**	**8162**	**89.3%**	**N/A**	**1**
CHO5	Carlow/Kilkenny	2092	1951	93.3%	N/A	12
	South Tipperary	1159	1032	89.0%	N/A	7
	Waterford	1715	1615	94.2%	N/A	0
	Wexford	2311	2026	87.7%	N/A	1
	CHO5 Total	**7277**	**6624**	**91.0%**	**N/A**	**20**
CHO6	Dublin South	1928	1686	87.4%	N/A	26
	Dublin South East	1182	1120	94.8%	N/A	1
	Wicklow	1515	1366	90.2%	N/A	2
	CHO6 Total	**4625**	**4172**	**90.2%**	**N/A**	**29**
CHO7	Dublin South City	1482	1377	92.9%	N/A	1
	Dublin South West	1828	1515	82.9%	N/A	5
	Dublin West	2167	1867	86.2%	N/A	1
	Kildare/West Wicklow	3661	3479	95.0%	N/A	1
	CHO7 Total	**9138**	**8238**	**90.2%**	**N/A**	**8**
CHO8	Laois/Offaly	2358	2164	91.8%	N/A	2
	Longford/Westmeath	2211	2061	93.2%	N/A	0
	Louth	2135	1884	88.2%	N/A	1
	Meath	2815	2497	88.7%	N/A	12
	CHO8 Total	**9519**	**8606**	**90.4%**	**N/A**	**15**
CHO9	Dublin North West	2719	2295	84.4%	N/A	6
	Dublin North Central	1503	1287	85.6%	N/A	1
	Dublin North	3151	2660	84.4%	N/A	12
	CHO9 Total	**7373**	**6242**	**84.7%**	**N/A**	**19**
Home schooled		100	6	6.0%	N/A	2
Total of LHOs and home schooled		**63685**	**56784**	**89.2%**	**N/A**	**115**
Out of school		N\A	0	N\A	N\A	7
Total of LHOs and home schooled and out of school		N\A	56784	N\A	N\A	122

*Age equivalents are those born between 01/09/2003 and 31/08/2004
Outside cohort refers to those who were vaccinated but who were outside the routine cohort for vaccination.
Local health office (LHO) refers to the LHO of the school. Therefore, in reports the LHOs of home schooled and out of school children do not appear.
The denominator for second level schools was defined as the number of children on the school roll on 30th September 2015 for first year. The denominator for age equivalent to first years in second level schools was defined as children born between 01/09/2003 and 31/08/2004 on the school roll of special schools or registered with the Child and Family Agency Education Welfare Services on 30th September 2015. All the denominator data was entered onto the School Immunisation System (SIS) by the relevant System Administrator.
N/A-Not applicable
Home schooled refers to children registered with the Child and Family Agency Education Welfare Services to be educated at home. These children were recorded on SIS and reported here as home schooled.
Out of school refers to vaccinated children who were neither enrolled in a second level school, special school nor registered with the Child and Family Agency Education Welfare Services as home schooled.

8.4 Seasonal influenza vaccine uptake in hospitals & Long Term Care Facilities (LTCFs) in 2016-2017 influenza season

Summary

Influenza Vaccine Uptake in Hospitals, 2016-2017

- Of the 61 hospitals[1], 53 provided sufficient data for complete analysis, 5 of which were privately run
- 98.0% (48/49) of HSE funded and staffed hospitals participated in the 2016-2017 survey
- Based on 48 complete returns:
  - Average uptake among all categories of hospital HCWs was 31.9%
  - 14 (29.2%) hospitals exceeded the 40% national uptake target
  - Average uptake varied by Hospital Group (range 21.5-56.2%)
  - Highest average uptake was reported in Acute Paediatric Services Hospital Group
  - Average uptake varied by HSE staff category (26.4-53.6%), the highest uptake was reported among 'medical and dental' professionals and lowest among nursing and 'other patient & client care' staff
  - In general, the more staff eligible (employed) in a hospital the higher the uptake

Influenza Vaccine Uptake in LTCFs, 2015-2016

- 142 LTCFs participated
- 122 provided sufficient data for complete analysis, 20 of which were privately run
- Based on 102[2] HSE funded and staffed LTCFs:
  - Average uptake among all categories of LTCF-based HCWs was 28.1%
  - 24 (23.5%) LTCFs exceeded the 40% national uptake threshold
  - Average uptake varied by Community Health Organisation (CHO) (range 19.5-44.5%)
  - Highest average uptake was reported in CHO 3 (Clare; Limerick; North Tipperary/East Limerick)
  - At national level, average uptake varied by HSE staff category (28.1-50.7%), the highest value was reported among 'health & social care' professionals and lowest among nursing staff
  - No association was observed between average uptake and number of eligible staff in a LTCF
  - Uptake among long stay residents since the beginning of the season was 93.5%
  - Uptake among respite residents vaccinated within LTCFs since the beginning of the season was 19.1%
  - Uptake among respite residents vaccinated before admission to LTCFs since the beginning of the season was 14.1%

The National Immunisation Advisory Committee (NIAC) of the RCPI and the HSE recommends annual seasonal influenza vaccination to individuals at risk of severe influenza disease (those who are aged 65 and older, pregnant, morbidly obese and those with specified chronic medical conditions requiring regular follow up), to certain occupational groups (those working with poultry, wild fowl and pigs), health care workers (HCWs) and to those likely to transmit influenza to those at high risk of influenza complications. HSE provides the seasonal influenza vaccine free of charge to all health care facilities or to the occupational health departments of these facilities.

Implementation of the vaccination programme is, for the most part, organised by the health care facility management or the relevant occupational health provider.

Influenza can cause severe disease in both patients and staff and infection can spread rapidly in health care settings. Achieving a high uptake of influenza vaccination among HCWs is therefore recognised as an important infection control intervention and occupational health issue. The HSE Leadership Team has recommended a national influenza vaccination target of 40% among HCWs since October 2013.

1 Currently there are 61 acute hospitals in Ireland, 49 of which are HSE funded and staffed and 11 are privately run

2 excludes two LTCFs that provided a survey return but with no details of vaccine uptake among its HCWs: St. Ita's Psychiatric Hospital, Portrane, Co. Dublin and St. Oliver Plunkett Hospital, Drogheda, Co. Louth

HPSC has collected data on seasonal influenza vaccination coverage among hospitals and long term care facilities (LTCFs) since the 2011-2012 influenza season. A protocol has also been provided to all facilities outlining the rationale and methodology for data collection each year since then. For the 2016-2017 season, a similar protocol as used for previous years was distributed to all facilities and posted on the HPSC website. Separate online survey forms for hospitals and LTCFs were designed to capture aggregate data on eligible and vaccinated staff and were based on six categories of HSE staff: management & administration; medical & dental; nursing; health & social care professionals; other patient & client care; and general support staff.

For hospitals, occupational health departments were asked to provide data on the number and category of HCWs vaccinated by the service (numerator). The human resource (HR) departments were requested to provide data on the numbers of staff employed (denominator). For LTCFs, uptake details were sought from nominated coordinators (or other named contacts) on the number of staff, residents and respite care patients present and vaccinated during the influenza season.

For the 2016-2017 season, a link to an online form was emailed to each nominated coordinator (or contact person) in 61 known hospitals (including 11 private ones) and separately to 262 currently active LTCFs[3] on 1st November 2016. Each coordinator was asked to complete the online form using aggregate uptake data since the beginning of October 2015. A second and final survey seeking aggregate data for the entire season was sent on 25th April 2017. Reminders were sent to non-responders in mid-November 2016 (for mid-season data) and mid-May 2017 (for end of year data).

This report presents a summary of key data relating to the influenza vaccination uptake programme for 2016-2017, which is now available on the HPSC website. For this report, in order to present trends over all six seasons since 2011-2012, average uptake results (rather than overall figures) were calculated. This was done for two reasons: 1) the average is a measure that takes account of the different number of reporting healthcare units each season and 2) because the numbers of participating hospitals and LTCFs that have provided complete data in each of the six seasons since 2011-2012 are relatively low.

3 These also include privately funded facilities, some of which are approved by the HSE, are registered with HIQA or avail of the Nursing Home Support Scheme

*Table 1. Details of seasonal influenza vaccine uptake among hospital-based HCWs by influenza season**

Season	Total No. Eligible HCWs**	Total No. Vaccinated HCWs	Average % Uptake	Average % Uptake 95% CIs	Median % Uptake	Range % Uptake	No. Participating Hospitals
2011-2012	45058.0	8157	19.1	15.8-22.3	16.6	5.0-40.0	36
2012-2013	41490.2	7293	15.3	12.1-18.4	12.2	3.5-38.8	32
2013-2014	47760.4	11517	20.7	17.6-23.9	18.1	2.6-45.9	41
2014-2015	49917.2	11723	22.0	18.0-26.0	20.1	1.1-47.5	39
2015-2016	57493.5	14474	22.6	19.2-26.0	19.8	6.9-47.0	46
2016-2017	62396.4	21020	31.9	28.1-36.0	29.6	6.4-63.7	48

*based on complete returns only from HSE funded and staffed hospitals; **figures include decimal places because some hospitals reported whole time equivalent staff numbers rather than their actual numbers of staff

*Table 2. Details of seasonal influenza vaccine uptake among LTCF-based HCWs by influenza season**

Season	Total No. Eligible HCWs**	Total No. Vaccinated HCWs	Average % Uptake	Average % Uptake 95% CIs	Median % Uptake	Range % Uptake	No. Participating LTCFs
2011-2012	4159.0	733	17.3	12.0-22.6	10.3	0.0-90.4	57
2012-2013	10823.0	1327	14.9	12.3-17.5	11.1	0.0-76.0	108
2013-2014	8967.4	1745	21.6	18.1-25.0	18.3	0.0-80.0	88
2014-2015	7280.0	1766	26.9	22.8-31.00	25.0	0.0-77.1	67
2015-2016	7057.6	1625	24.4	20.3-28.4	22.2	0.0-100	81
2016-2017	9916.1	2690	28.1	24.8-31.3	24.7	0.0-75.0	102

*based on complete returns only from HSE funded and staffed LTCFs; **some figures include decimal places because some LTCFs reported whole time equivalent staff numbers rather than their actual numbers of staff

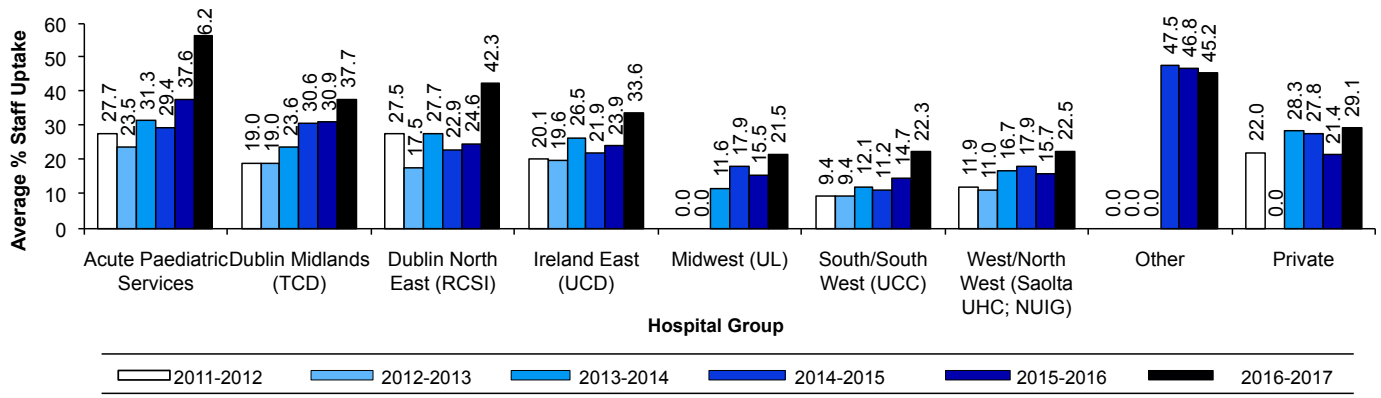

Figure 1. Hospital staff uptake by HSE region by season

Please also note that uptake figures for previous seasons' annual summaries here will differ from those previously presented due to updating and re-analysis of data, but also because many of the results will apply only to hospitals and LTCFs that are both HSE funded and staffed, unless otherwise specified. Some returns from previous seasons were excluded as some hospitals were wrongly reported as LTCFs, are closed or were not part of the current HSE Hospital Grouping, with the exception of the National Rehabilitation Hospital. Among the hospitals and LTCFs that were not considered both HSE funded and staffed were those described as 'private', 'public & private', 'section 38 agency', 'section 39 agency' or whose funding source or status could not be verified at the time of writing.

Figures 1 to 4 below give details of vaccine uptake among HCWs based in hospitals and LTCFs that reported over the past six seasons by category of staff and HSE Hospital Group or Community Health Organisation.

Hospitals

Fifty-three hospitals participated in the 2016-2017 survey and all provided complete returns, of which five were privately run. Based on 48 HSE funded and staffed hospitals uptake for all HCW was 31.9%, up from 22.6% from the previous season when 46 hospitals provided complete returns, an increase that was statistically significant (Table 1). Fourteen HSE funded and staffed hospitals (29.2%) exceeded the 40% national uptake target, compared to seven (15.2%) in 2015-2016. In 2016-2017, both hospitals in the acute paediatric service group exceeded the 40% national uptake target, as did the National Rehabilitation Hospital. No hospital in either the West/North West (Saolta UHC; NUIG) or Midwest (UL) hospital groups reached this target (Figure 1).

At national level, the average uptake in HSE funded and staffed hospitals varied by HSE staff category (26.4-53.6%), with the highest value reported among 'medical and dental' professionals and lowest among 'other patient & client care staff' and nurses. Between 2015-2016 and 2016-2017 average uptake increased among all HCWs: medical and dental professionals (53.6%, +16.6%); health and social care professionals (42.2%, +13.4%); nursing staff (26.4%, +9.5%); management and administration (29.6%, +7.4%); general support staff (35.6%, +7.4%); and other patient and client care staff (26.4%, +4.6%) (Figure 2).

When HSE funded and staffed hospitals were categorised in groups in terms of the overall staff numbers, average uptake increased as staff size increased: average uptake was lowest where staff size was <250 HCWs at 23.6% and highest when staff size was >=2,000 HCWs at 34.8%.

Long term care facilities

Of the 142 LTCFs that submitted data in 2016-2017, 122

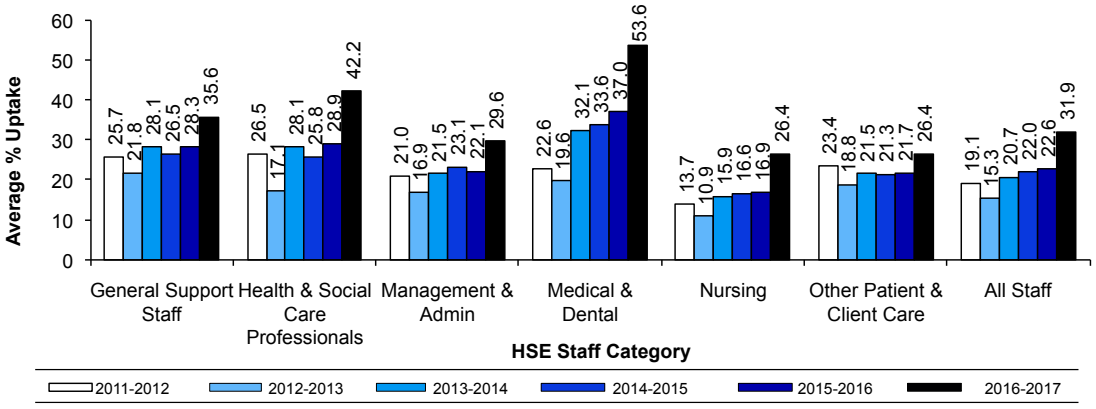

Figure 2. Hospital staff uptake by HSE grade category by season

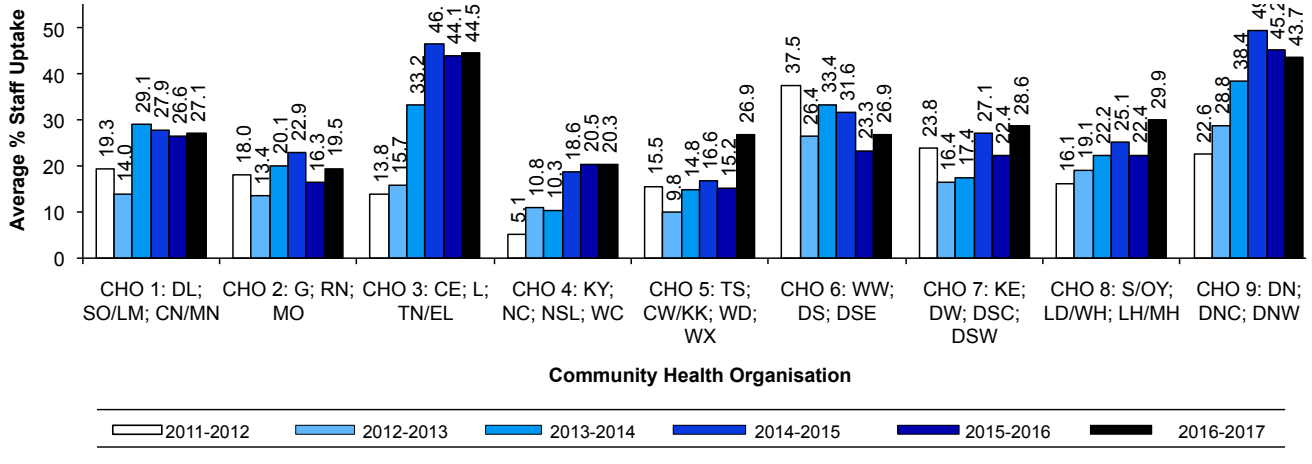

Figure 3. LTCF staff uptake by HSE region by season

LTCFs (85.9%) provided complete staff vaccine uptake returns, of which 102 were from HSE funded and staffed. Of the latter 102 LTCFs, average influenza vaccine uptake for all staff was 28.1%, up from 24.4% in the previous season. Twenty-four (23.5%) of 102 LTCFs in 2016-2017 exceeded the 40% national uptake target compared to seven (8.6%) of the 81 LTCFs in 2015-2016. CHO3 had the highest average uptake (44.5%) of LTCFs, the lowest was CHO2 with 19.5% (Figure 3).

Between 2015-2016 and 2016-2017 average uptake in HSE funded and staffed LTCFs increased uptake across all staff grades: health and social care professionals (50.7%, +17.9%), other patient and client care professional (28.2%, +7.1%); general support staff (33.7%, +5.7%), medical and dental staff (46.1%, +4.6%), nursing (28.1%, +4.1%); management and administration staff (41.4%, +3.3%) (Figure 4).

When staff sizes were categorised according to number of staff employed in HSE funded and staffed LTCFs, average uptake did not increase according to facility staff number, on the contrary average uptake was highest when staff size was <50 HCWs at 30.8% in 2016-2017.

After a decline to 8.6% in 2015-2016 the percentage of participating HSE funded and staffed LTCFs reporting uptake in excess of 40% in 2016-2017 rose to 23.5%. Uptake among long stay residents in HSE funded and staffed LTCFs since the beginning of the season increased from 90.7% among 82 LTCFs in the previous season to 93.5% among 102 LTCFs in 2016-2017. The percentage of respite residents vaccinated prior to admission in 2016-2017 was 14.1% among 102 reporting HSE funded and staffed LTCFs, a decline from 25.1% from the previous season. In contrast, over the same period, the percentage of respite residents vaccinated in-house among the same LTCFs increase from 10.8% to 19.1%.

The cumulative number of HSE funded and staffed LTCFs that reported having a policy recommending that respite residents are vaccinated before being admitted was 56, a 27.3% increase on the previous season. Similarly, the cumulative number of HSE funded and staffed LTCFs that reported having a staff vaccination policy (before taking up a position) during 2016-2017 was 25, an increase of 13.6% since 2015-2016.

Target uptake

Overall, the average uptake of the seasonal influenza vaccine among HCWs in both hospitals and LTCFs in 2016-2017 again fell short of the 40% target, despite some marked improvements, particularly in hospitals. Participation by hospitals and LTCFs was very high, the latter showing a marked increase compared to the previous season.

However, more work is needed if the 75% target goal for influenza vaccination coverage in all at-risk groups, including HCWs as recommended by the European Council in December 2009[1], is to be reached. The low numbers of LTCFs that have a staff vaccination policy in place, despite the updating of national recommendations in September 2013[2-4], remains a cause for concern. The absence of LTCF

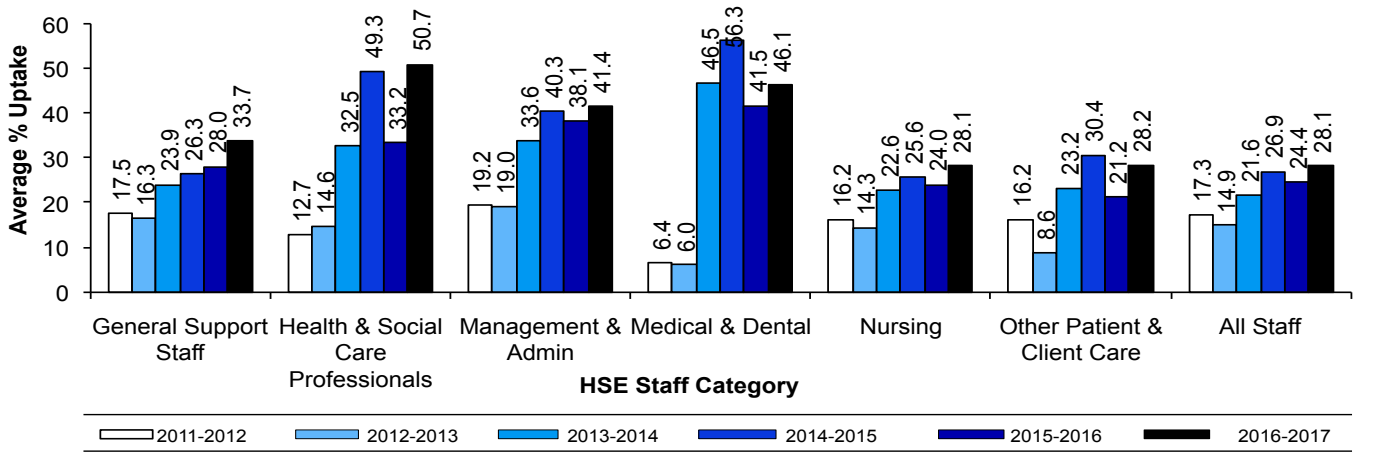

Figure 4. LTCF staff uptake by HSE grade category by season

vaccination policies and of staff vaccination policies in particular may reflect insufficient awareness at senior management of their responsibility in infection control and reducing the risk of outbreaks and disease among their residents and staff.

Other countries have already achieved uptake rates well above our target. For example, in England vaccination uptake among those HCWs with direct patient contact is monitored (compared to Ireland where uptake among all HCWs is monitored). During the 2016-2017 season, influenza vaccine uptake among frontline HCWs was 63.2%, an increase of 12.6% from 50.6% for the previous season[5].

Overall vaccination uptake levels among HCWs were reported by 15 member states as part of the European Union-funded Venice study in 2014-2015[6]. A wide range of results were reported with the highest uptake reported by England (54.9%), Wales (44.3%) and Scotland (36.2%) and the lowest in Poland (5%). Apart from Ireland, the only other member state that reported HCW uptake in LTCFs was Portugal with a similar (overall) uptake of 22%[6].

In the United States, the Centre for Disease Control and Prevention analysed data from an internet panel survey of HCWs conducted from October 27th through November 13th, 2016. Early-season 2016–2017 influenza vaccination coverage among HCWs was 68.5%, similar to early-season coverage during the 2015–2016 season (66.7%). Vaccination coverage among HCWs was found to be highest in hospitals (80.8%) and lowest in LTCFs (55.1%). Early-season influenza vaccination coverage was higher among HCWs whose employers required (89.3%) or recommended (69.4%) that they be vaccinated compared with HCWs whose employer did not have a requirement or a recommendation regarding flu vaccination (26.0%)[7].

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2016

ANNUAL
EPIDEMIOLOGICAL
REPORT

09

HEALTHCARE-ASSOCIATED INFECTIONS
ANTIMICROBIAL CONSUMPTION
ANTIMICROBIAL RESISTANCE

9.1 *Clostridium difficile* Infection

Key Points

- In 2016, 1,871 cases of *Clostridium difficile* infection (CDI) were notified to Public Health Departments via the Computerised Infectious Disease Reporting (CIDR) System, representing a national crude incidence rate (CIR) of 40.4 cases per 100,000 population, a 1% reduction on 2015 (41.4). The majority of CDI occurred in patients aged ≥65 years (1,237; 66%). When further divided by case type, there were 1,483 new cases (79%), 174 recurrent (9%) and for 214 cases (11%) it was not known whether the patient had new or recurrent CDI
- There were 1,877 CDI cases reported to the CDI enhanced surveillance scheme from 54 hospitals. Healthcare-associated (HCA) CDI accounted for 60% of cases (n=1,116), representing a national combined incidence rate for new and recurrent HCA CDI of 2.2 per 10,000 bed days used in 2016, a reduction from 2.5 in 2015
- Enhanced surveillance collects data on patient location at symptom onset and shows that CDI is not confined to hospitals. In 2016, CDI was commonly encountered in long-term care facilities (LTCF) (10% of all CDI) and in the community (39% of all CDI)
- Of 300 *C. difficile* isolates with available ribotyping data (16% of all cases) reported from 16 hospitals, the most frequent ribotypes reported in 2016 were: 078 (n=51, 17%), 014 (n=33, 11%) and 002 (n=29, 10%)

Background

In May 2008, new cases of CDI in persons two years or older became notifiable in Ireland under the disease category "acute infectious gastroenteritis" (AIG). Since January 2012, CDI has been a notifiable infection in its own category, with both new and recurrent CDI cases notifiable to Public Health Departments via the Computerised Infectious Disease Reporting (CIDR) system.

Although notifiable CDI data provides important preliminary information on the burden of CDI in Ireland, it does not capture information on the origin, onset or severity of CDI. National CDI enhanced surveillance commenced on a voluntary basis on 1st August 2009. Information on case type, origin, onset and infection severity is collected using European CDI case definitions.

Notifiable *C. difficile* infection

In total, 1,871 cases of *Clostridium difficile* infection (CDI) were notified to Public Health Departments via the Computerised Infectious Disease Reporting (CIDR) System, representing an overall national crude incidence rate (CIR) of 40.4 cases per 100,000 population, a 1% reduction on 2015 (41.4). The national CIR of new CDI cases alone was 32 (2016), a 3.9% reduction on 2015 (35.9). The majority of CDI occurred in patients aged ≥65 years (1,237; 66%). When further divided by case type, there were 1,483 new cases (79%), 174 recurrent (9%) and for 214 cases (11%) it was not known whether the patient had new or recurrent CDI. All cases were laboratory-confirmed.

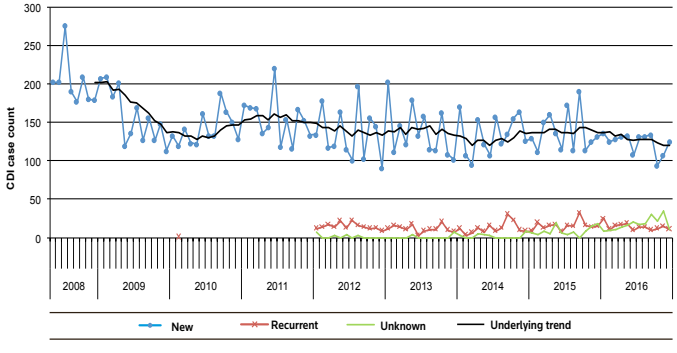

Figure 1. Numbers of CDI notifications by month and case type (2008 – 2016).

Since surveillance began in 2008, there has been an overall decrease in the incidence of CDI in Ireland, with the rate remaining relatively stable since 2012 (**Figure 1**). There was a slight decrease in the number of recurrent cases notified in 2016 than in 2015 (n=174 versus n=192) and an increase in the number of cases of unknown type for the same period (n=214 versus n=104). Identification of seasonal patterns from CIDR notification data is hindered by delayed and batched laboratory notifications.

Figure 2 displays the gender and age breakdown of patients with CDI. The majority were female (60%). The mean age was 66.9 years (range: 2 – 103), with the majority of cases (n=1,237; 66%) reported in patients ≥65 years.

Notifiable *C. difficile* infection: Outbreaks

In 2016, seven CDI outbreaks, all of which were healthcare-associated and involving 24 patients were notified to Public Health Departments, as displayed in **Table 1**. Four were linked to nursing homes, two to hospitals and one to a residential institution.

Enhanced surveillance of *C. difficile* infection

To the end of 2016, 54 acute hospitals participated in enhanced CDI surveillance, comprising 45 public hospitals (96% of all public hospitals). Public hospitals were further categorised into: general (n=27; 100%), tertiary (n=9; 100%) and specialist (n=9; 75%), with nine private hospitals (75%) also participating.

In 2016, 1,877 CDI cases were reported to the enhanced surveillance scheme. Of those, 1,566 (83%) were classified as new, 191 (10%) as recurrent and 120 (7%) of unknown CDI case type.

Of the reported cases, 44% (n=830) originated within the reporting hospital. The overall HCA CDI rate is based on the total number of CDI cases that originated in the participating hospital (i.e., new, recurrent and unknown combined). The bed days used data for acute public hospitals was sourced from the HSE Business Information Unit, with private hospital activity data provided directly by participating hospitals. In 2016, the overall HCA CDI rate was 2.2 cases per 10,000 bed days used (BDU), a decrease from 2.5 in 2015 and the lowest recorded annual rate since surveillance began in 2009 (3.1), as shown in **Figure 3**. The 2016 incidence rate of new HCA CDI was 1.9, a reduction from 2.3 in 2015. The incidence rate of recurrent HCA CDI remained stable at 0.3, as found in 2015.

Caution should be taken when interpreting national CDI trends, particularly prior to 2012 due to:

(i) Changes in the numbers of participating hospitals, as displayed in **Figure 3.** Throughout 2012, the total number

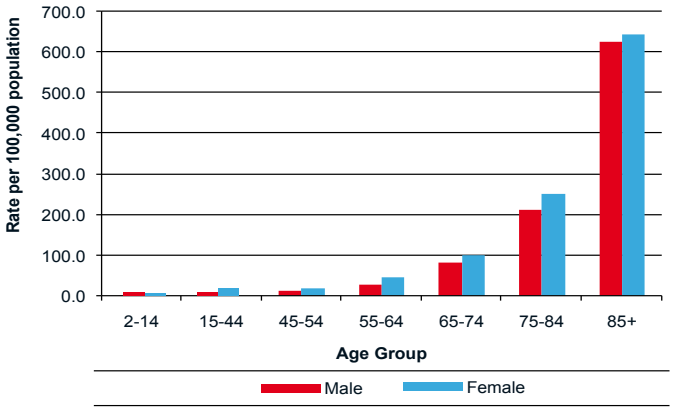

Figure 2: Age and gender distribution of CDI in Ireland, 2016 (Source: CIDR).

* Rates calculated using 2016 census of the population data

Table 1. CDI outbreaks reported in Ireland in 2016 by public health region (Source: CIDR)

Public Health Region	Outbreak location	Total number ill
MWHB	Nursing home	2
MWHB	Nursing home	8
NEHB	Nursing home	3
NEHB	Nursing home	3
NEHB	Hospital	5
WHB	Residential institution	4
WHB	Hospital	3

Table 2. Origin and onset of CDI, 2014 – 2016

	2014 %	2015 %	2016 %
ORIGIN: Location of where infection was acquired			
Healthcare-associated	64	62	60
Hospital	48	47	44
NH/LTCF	11	9	10
Other	5	6	5
Community-associated	18	22	25
Indeterminate	5	6	7
Unknown	13	10	9
ONSET: Location of where patient symptoms occurred			
Healthcare-onset	59	59	56
Hospital	44	45	41
NH/LTCF	11	9	10
Other	4	5	4
Community-onset	34	34	39
Unknown	7	7	5

of hospitals participating in enhanced CDI surveillance stabilised. Since 2012, there has been a complete participation in CDI enhanced surveillance by all tertiary and general hospitals

(ii) Changes in *C. difficile* laboratory testing protocols: From 2014 to 2016, most hospitals have participated in the scheme and a similar profile of testing is evident over time with more hospitals incorporating molecular methods (Please also refer to the section on laboratory testing for *C. difficile)*

In 2016, a wide range in the CDI incidence rate in participating hospitals was observed (range = 0 – 5.0; median = 1.3). The median rate was higher in nine tertiary hospitals (2.9; range = 1.3 – 3.9) than in 27 general hospitals (1.6; range = 0 – 5.0). Since 2012, the overall trend for general hospitals has declined slightly (median CDI rate from 1.9 to 1.6). However, in the same period, the overall trend for tertiary hospitals increased, although the median CDI rate of 2.9 in 2016 was slightly lower than that of 3.2 (2015).

The differences in CDI median incidence rates may reflect inter-hospital variation with regard to patient case mix, *C. difficile* ribotypes, laboratory testing protocols, antimicrobial prescribing policies, antimicrobial stewardship interventions, infrastructure and access to *en suite* isolation rooms and surveillance resources. No obvious seasonal trend for CDI is distinguishable from enhanced surveillance data in 2016.

The percentage coverage of acute hospital activity was calculated using bed days data from participating hospitals as a percentage of total acute hospital bed day activity in Ireland.

Severe CDI

A severe case of CDI is defined as (i) a patient requiring admission to an intensive care unit (ICU) for treatment of CDI or its complications, (ii) a patient requiring colectomy or (iii) death within 30 days after diagnosis, if CDI is either the primary or contributory cause of death. The enhanced CDI surveillance scheme does not collect information on patient outcome. Therefore, surgery and ICU admission for CDI are the two markers of severity captured. In 2016, 30 (1.6%) severe CDI cases were reported, similar to 2015 (1.5%). Five patients required both surgery and ICU admission, eight required surgery only and 17 required ICU admission without surgery.

Onset & Origin of CDI

Onset: Patient location when symptoms of CDI commenced

CDI symptom onset occurred in a healthcare facility for 56% of patients (n=1,047; healthcare-onset), while 39% had symptom onset in the community (n=735; community-onset) and for 5% (n=95), location at CDI onset was unknown (**Table 2**).

Of the 1,047 patients with healthcare onset CDI, 74% (n=772) had onset in the reporting hospital, 5% (n=50) in another hospital, 18% (n=192) in a long term care facility (LTCF) and for the remaining 3% (n=33) onset location was unknown. Between 2014 and 2016, there was a slight reduction in the proportion of patients with CDI symptom onset in a healthcare facility (59 to 56%). Over the same period, community-onset CDI increased from 34% to 39% (**Table 2**).

Origin: Location where the patient acquired the CDI

For the majority of CDI cases, the infection was acquired in a healthcare setting (healthcare-associated; HCA) (n=1,116; 60%). Community-associated; CA accounted for 25% (n=459) and in 7% (n = 133) the origin was indeterminate and could not be assigned as either HCA or CA, as the patient had been discharged from a healthcare facility between four and 12 weeks prior to the CDI onset date. For the remaining 9% (n = 169) of cases, the origin was unknown (**Table 2**).

Of the 1,116 healthcare-associated CDI cases, 74% (n=830) originated in the reporting hospital, 7% (n=74) originated in a hospital other than the reporting hospital, 17% (n=186) originated in a LTCF and 2% (n=24) originated in another unspecified healthcare facility or were of unknown origin.

Between 2014 and 2016, there was a decrease in the proportion of cases associated with a healthcare facility (64 to 60%), which was demonstrated primarily in the reporting hospital. The proportion of cases associated with the community increased from 18% to 25%, and there was a slight increase in cases classified as indeterminate (from 5% to 7%). Cases classified as 'unknown' decreased from 13% to 9% between 2014 and 2016 (**Table 2**).

Of the 1,116 cases of healthcare-associated CDI:

- Healthcare-onset, healthcare-associated: 86.7% (n=968) experienced onset of CDI symptoms at least 48 hours following admission to a healthcare facility
- Community-onset, healthcare-associated: 12.5% (n=139) experienced symptom onset in the community, within four weeks of discharge from a healthcare facility
- No information on symptom onset provided for 0.8% (n = 9)

Table 3. National reporting of C. difficile ribotyping data: 2012 - 2016

Year	Total number of CDI cases reported	Number (%) of cases with ribotype data	Number of hospitals providing ribotype data
2012	1735	263 (15%)	14
2013	1801	258 (14%)	19
2014	1780	290 (16%)	20
2015	1955	219 (11%)	22
2016	1877	300 (16%)	16

Of the 459 cases of community-associated CDI:

- Community-onset, community-associated: 91.7% (n=421) experienced CDI symptom onset while outside a healthcare facility and without a history of discharge from a healthcare facility within the previous 12 weeks
- Healthcare-onset, community-associated: 7.4% (n=34) experienced symptom onset within the first 48 hours of admission to a healthcare facility, without a history of admission to or residence in a healthcare facility within the previous 12 weeks
- No information on symptom onset provided for 0.9% (n=4)

Information was also captured on the location where the patient's faeces specimen was taken. The reporting hospital accounted for the majority (76%) of specimens (n=1,434), with 13% (n=241) taken in the GP surgery, 7% (n=137) in a LTCF and 3% (n=47) in a hospital other than the reporting hospital. For the remaining 1% (n=18), no information was provided.

Discussion

The collation of national data on *C. difficile* through CIDR notifications and the enhanced CDI surveillance system has provided a valuable insight into the burden of CDI in Ireland. Both surveillance systems present a decreasing trend since 2009. The notifiable surveillance system, which reflects total burden of disease, shows that the CDI rate remained stable between 2012 and 2016, while the enhanced surveillance system shows a decrease in the CDI rate between 2012 and 2016. For the second consecutive year, cases reported to enhanced CDI surveillance in 2016 exceeded those notified to public health departments.

In 2016, recurrent CDI accounted for 10% of notifications through the enhanced surveillance scheme, which is a slight decrease from 11% in 2015. Recurrent CDI places a further burden on limited hospital isolation resources and results in significant patient morbidity.

CDI is not confined to acute healthcare settings and is increasingly common in LTCF and the community. In 2016, 10% of cases had onset in a LTCF, with 39% having onset in the community; a 5% increase since 2015 (34%). Of the 459 community-associated cases reported in 2016, 92% experienced CDI symptom onset in the community, without a history of discharge from a healthcare facility within the previous 12 weeks. It is important to consider CDI in the differential diagnosis of all patients presenting with diarrhoea of potentially infectious origin, regardless of patient location and to send a faeces specimen in a timely fashion for laboratory diagnosis, which should routinely include testing for *C. difficile* in patients aged over two years, in keeping with national CDI guidelines.

C. difficile PCR ribotyping

As part of the voluntary *C. difficile* enhanced surveillance scheme, participating hospitals are asked to provide *C. difficile* PCR ribotyping information, where available. Ireland does not yet have a national *C. difficile* reference laboratory or ribotyping service. Therefore, laboratories submit specimens abroad for ribotyping. In 2016, ribotyping data was provided for 300 *C. difficile* isolates (16% of all samples) from 16 hospitals (**Table 3)**. The most frequent ribotypes reported in 2016 were: 078 (n=50, 17%), 014 (n=33, 11%) and 002 (n=29, 10%) (**Figure 4**).

Laboratory Testing of _C. difficile_ in Ireland

Since 2010, information on *C. difficile* testing has been collected quarterly as part of the enhanced surveillance system. In Q1 2010, the majority of hospitals participating in the enhanced surveillance project were using a one-step Toxin EIA (60%). By Q4 2016, this had reduced to 0%, with all hospitals participating in the enhanced surveillance system using a method compliant with recommendations in the latest update of the Irish *C. difficile* guidelines. This includes either a PCR test for detection of toxin genes (43%, n=23) or a two-step testing method (57%, n=31) (**Figure 5**). Owing to variations in current Irish laboratory *C. difficile* testing methodologies, inter-hospital comparison of CDI rates is not recommended where testing methods differ, as the data in the national quarterly enhanced surveillance reports are not adjusted for differences in the sensitivities of the different diagnostic methodologies.

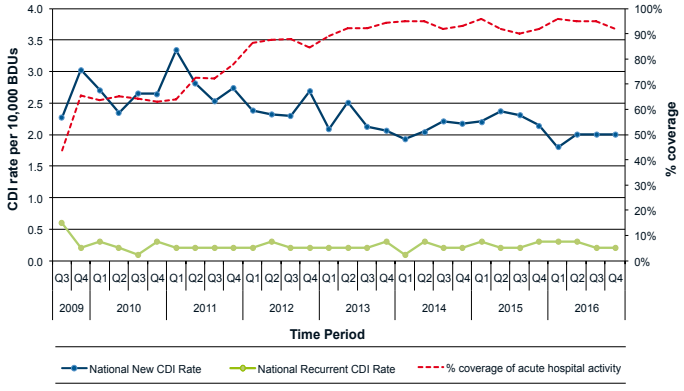

Figure 3. Quarterly national rate of healthcare-associated HCA CDI (new and recurrent): 2009 – 2016

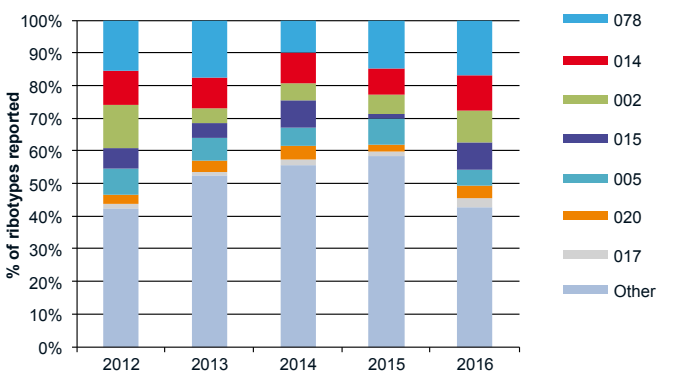

Figure 4. Most frequently reported C. difficile ribotypes in Ireland: 2012 – 2016

Conclusion

The continued excellent participation in the voluntary CDI enhanced surveillance scheme ensures that a significant amount of information is collected regarding the burden of CDI in Ireland. The National Clinical Guidelines on the Surveillance, Diagnosis and Management of CDI in Ireland were updated in 2013 and endorsed by the National Clinical Effectiveness Committee in 2014. The updated guidelines may be accessed on the HPSC website at: http://www.hpsc.ie/A-Z/Gastroenteric/Clostridiumdifficile/Guidelines/

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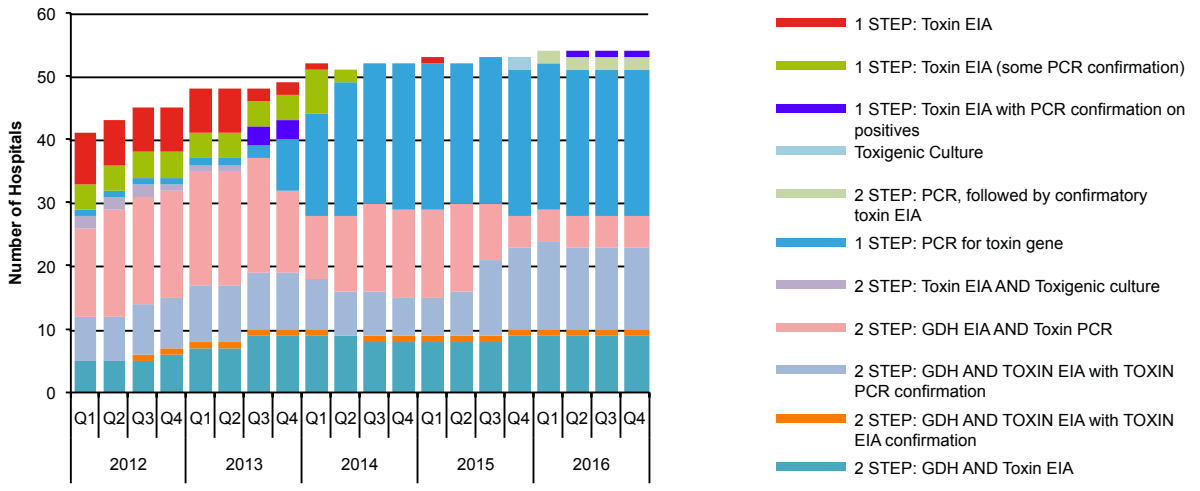


Figure 5. Changes in C. difficile laboratory testing protocols: 2012 - 2016

1 STEP: Toxin EIA: EIA for the detection of *C. difficile* TcdA and/or TcdB. **1 STEP: PCR for toxin gene:** Polymerase chain reaction (PCR) for the detection of TcdA and/or TcdB genes; **2 STEP: GDH AND TOXIN EIA:** Enzyme immunoassay (EIA) for the detection of glutamate dehydrogenase (GDH) of *C. difficile* as well as or followed by an EIA for the detection of *C. difficile* TcdA and/or TcdB.; **2 STEP: GDH EIA AND Toxin PCR:** EIA for the detection of GDH of *C. difficile* as a first screening test, followed by PCR for the detection of TcdA and/or TcdB genes;

9.2 Hand Hygiene in Acute Hospitals

a) Biannual Audit of Hand Hygiene Compliance

Summary

- On a background of on-going hand hygiene compliance audits in acute hospitals, national data were collated and reported for two audit periods during 2016
- For both periods (Period 11: May/June and Period 12: October/November), 53 hospitals participated (HSE; 44, private; 9)
  - **Period 11:** In total, 11,089 opportunities for hand hygiene were observed and an average compliance of 90.5% was reported (range = 81.4 – 96.7)
  - **Period 12:** In total, 11,111 opportunities for hand hygiene were observed; and an average compliance of 91.2% was reported (range = 70.5 - 98.1)
- The overall compliance for periods 11 and 12 combined for HSE hospitals was 90.5%, just above the HSE target (90%). However, compliance for private hospitals was higher at 92.5%

Background

In Ireland, public reporting of biannual hand hygiene compliance audit data from acute hospitals commenced in 2011. Healthcare workers (HCWs) are observed for their compliance against the '5 moments of hand hygiene' by trained auditors using the WHO methodology for hand hygiene audits. Each hospital is required to measure HCW compliance against 30 hand hygiene opportunities for each of seven randomly-selected wards, resulting in a maximum of 210 opportunities per hospital per period.

Results

For both periods (Period 11: May/June and Period 12: October/November), 53 hospitals participated (HSE; 44, private; 9):

- **Period 11:** In total, 11,089 opportunities for hand hygiene were observed and an average compliance of 90.5% was reported (range = 81.4 – 96.7)
- **Period 12:** In total, 11,111 opportunities for hand hygiene were observed; and an average compliance of 91.2% was reported (range = 70.5 - 98.1)

Table 1. 2016 hand hygiene compliance audit findings (combined for two periods). Analysis by staff category and WHO 5 moments is provided for HSE hospitals only.

	Hand Hygiene Opportunities	Hand Hygiene Actions	% Compliance	Lower 95% Confidence Interval	Upper 95% Confidence Interval
Overall	22,200	20,170	90.9	90.5	91.3
HSE Hospitals	18,427	16,679	90.5	90.1	91.0
Private Hospitals	3,773	3,491	92.5	91.7	93.4
Nurse/Midwife	10,518	9,843	93.6	93.1	94.1
Auxiliary	2,915	2,580	88.5	87.3	89.7
Medical	3,442	2,832	82.3	80.9	83.7
Allied health/Other	1,552	1,424	91.8	90.3	93.2
Moment 1	4,890	4,500	92.0	91.2	92.8
Moment 2	1,023	905	88.5	86.4	90.5
Moment 3	1,326	1,204	90.8	89.2	92.4
Moment 4	6,465	6,017	93.1	92.4	93.7
Moment 5	5,382	4,667	86.7	85.7	87.7

Staff category: Auxiliary = healthcare assistants, porters, catering and household services; Allied health/Other = physiotherapists, radiographer, dieticians, social workers and pharmacists
Five moments for hand hygiene: (1) Before touching a patient; (2) Before clean/aseptic procedure; (3) After body fluid exposure; (4) After touching a patient; (5) After touching patient surroundings

Results for the two periods combined are displayed in Table 1 and Figure 1. At 90.5%, compliance for HSE hospitals was just above the HSE target of 90%, with a trend of increasing compliance observed over time (Figure 2). Private hospitals reported an overall compliance of 92.5% in 2016.
Table 1 and Figure 1 also display further analysis of hand hygiene compliance for participating HSE hospitals only, by HCW category and breakdown by the WHO five moments for hand hygiene. In 2016, medical staff had the lowest compliance (82.3%), while nurses/midwives had the highest compliance (93.8%). Compliance for moment 5 (after touching patient surroundings) was the lowest at 86.7% and highest for moment 4 (after touching a patient) at 93.1%. Alcohol-based hand rub (ABHR) was used for 76.1% of hand hygiene actions, with the remainder using soap and water (23.9%).

Limitations of current methodology

- While standardised hand hygiene auditor training and validation (with inter-rater reliability testing) should ensure that measurement of hand hygiene is comparable, these results have not been validated by external auditors
- All auditors measured hand hygiene compliance in the facility in which they work. Therefore, there may be an element of bias in the results
- It is possible that hand hygiene auditing may not have been performed in a comparable fashion in all hospitals and these results may not reflect HCW compliance at all times
- Compliance with hand hygiene is measured by auditors observing HCW undertaking patient care and who may change their behaviour if aware that they are being observed (Hawthorne effect). However, it is also known that this diminishes over time and HCWs under observation may not be aware of the presence of the auditor due to the many competing demands on their attention.
- Auditors are requested to give immediate feedback to ward staff following an audit, thereby increasing awareness and knowledge of hand hygiene. This risk of bias should be balanced by the benefits of increasing local staff's knowledge and awareness of hand hygiene.

Further information on acute hospital hand hygiene compliance audit in Ireland is available on the HPSC website: http://www.hpsc.ie/a-z/microbiologyantimicrobialresistance/europeansurveillanceofantimicrobialconsumptionesac/publicmicrobreports/

b) Surveillance of Alcohol-Based Hand Rub Consumption

2016 Summary

- Thirty-seven hospitals participated in ABHR surveillance, a reduction from 39 in 2015
- A 9% reduction in the national median rate of alcohol-based hand rub (ABHR) consumption expressed as litres per 1,000 bed days used (L/1,000 BDU) in acute hospitals in Ireland was observed (29.7 versus 32.5)

Background

National and international guidelines recommend alcohol-based hand rub (ABHR) as the recommended product for hand hygiene where hands are not visibly soiled. Measurement of hospital-level ABHR consumption, inclusive of gel and foam formulations, is expressed as a rate: volume in litres per 1,000 bed days used (L/1,000 BDU). ABHR consumption is a recommended process measure of hand hygiene activity by both the World Health Organization (WHO) and the US Centers for Disease Control & Prevention (CDC).

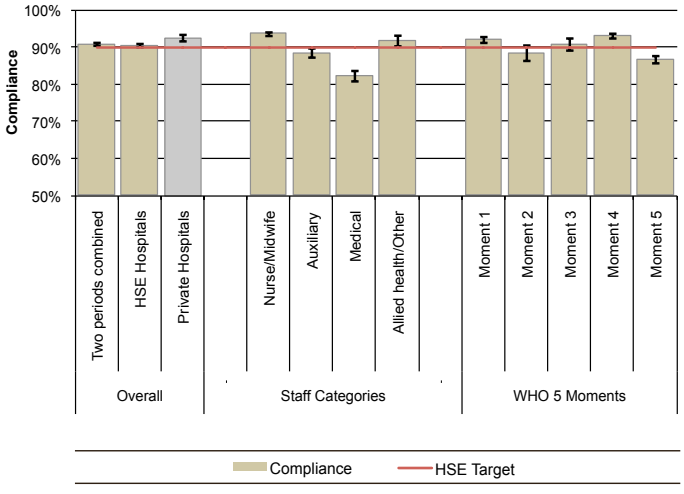


Figure 1. Summary of hand hygiene compliance 2016 (combined for two audit periods). 95% CI shown in black bars and HSE 2016 target of 90% shown as red line. Analysis by staff category and WHO 5 moments is provided for HSE hospitals only.

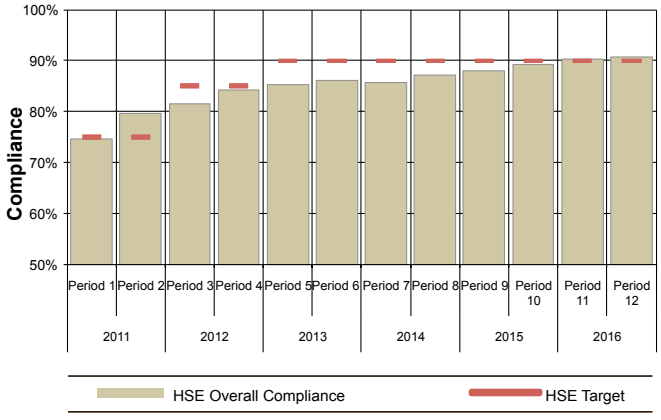


Figure 2. Overall hand hygiene audit compliance in HSE acute hospitals: 2011 – 2016. HSE target for each year shown as red line.

ABHR consumption data in acute public hospitals in Ireland has been collated by HPSC since 2006. The data are collected quarterly from participating hospitals. Depending on the hospital, ABHR consumption data originates from one of two sources:

1. Pharmacy: The total volume of ABHR dispensed to wards, clinics and other hospital areas
2. Supplies Department: The total volume of ABHR purchased by the hospital

Quantities used for pre-operative surgical hand hygiene were excluded.

In 2016, a 9% reduction in the national median rate of alcohol-based hand rub (ABHR) consumption expressed as litres per 1,000 bed days used (L/1,000 BDU) in acute hospitals in Ireland was observed (29.7 versus 32.5) (Table 1). While any observed decrease is undesirable, the underlying trend over three years has remained relatively stable. Using the median ABHR consumption figure provides a stable indicator of the national rate over time. However, the volume of ABHR consumed remains a crude measure of hand hygiene activity at individual hospital level and must be viewed in conjunction with other indicators, such as direct observation of hand hygiene compliance. As ABHR is the recommended product for the vast majority of hand hygiene opportunities in hospital settings, surveillance of ABHR consumption remains a useful process measure for hand hygiene activity.

Caveats to the ABHR surveillance system

- The inter-hospital variation in ABHR consumption rates (14.7 – 74.0), although not as wide as observed in past years may be explained by different local methods for data collection and reporting, along with differences in the type and range of hand hygiene agents used
- This surveillance system includes ABHR only, and does not include other hand hygiene agents (e.g., liquid soap)
- ABHR consumption data does not capture information on a hospital's hand hygiene frequency, opportunities or technique, nor does it distinguish between who has used the ABHR (visitor, patient or healthcare worker)
- The data are prone to reporting artefacts, particularly for hospitals that report supplies (rather than pharmacy dispensing) data. For example, the hospital with the highest reported rate in past years had undergone a change in suppliers and the products had been restocked in all areas of the hospital over a relatively short period of time. It is expected that there will be occasional outliers of this nature.

Further information on acute hospital ABHR consumption in Ireland is available on the HPSC website: http://www.hpsc.ie/A-Z/Gastroenteric/Handwashing/

Acknowledgements:
Sincere thanks to colleagues working in acute hospital infection prevention and control teams, pharmacy and stores departments across Ireland for submitting hand hygiene compliance audit and ABHR consumption data.

Table 1. Annual national ABHR consumption rates in acute public hospitals in Ireland: 2006 – 2016.

	Number of participating hospitals	National consumption rate*	Range for participating hospitals
2006	52	10	0.5 - 29.0
2007	50	15	5.2 - 47.1
2008	50	18.1	5.9 - 67.0
2009	49	20.3	4.1 - 47.7
2010	45	18.8	4.2 - 36.4
2011	43	21.3	10.9 - 130.0
2012	44	23.8	9.6 - 160.0
2013	44	26.3	16.4 - 132.5
2014	43	27.7	4.3 - 72.1
2015	39	32.5	10.1 - 96.8
2016	37	29.7	14.7 - 74.0

* The consumption rate is the total volume of ABHR consumed in the defined time period in litres per 1,000 bed-days used. The national consumption rate represents the median of the national sample for each time period.

9.3 Surveillance of Antimicrobial Consumption in Outpatient and Acute Hospital Settings

Key Points

2016 Summary

- The overall outpatient antimicrobial consumption was 24.0 defined daily doses (DDD) per 1,000 inhabitants per day (DID), a 4% reduction on the updated 2015 rate of 25.0 DID. This rate is mid-to-high in comparison with other European countries
- In 2016, 42 acute public hospitals contributed data, with a median rate of hospital antimicrobial consumption of 84.8 DDD per 100 bed days used (DBD) (range = 26.8 – 114.8), representing a 3.7% increase on 2015. This rate is mid-range in comparison with other European countries

Background

Ireland participates in the European Surveillance of Antimicrobial Consumption Network (ESAC-Net), which is coordinated by the European Centre for Disease Prevention and Control (ECDC), with the aim of collecting systemic antimicrobial usage data from outpatient (ambulatory, community or primary care) and hospital (inpatient) settings. Antimicrobial consumption is measured in defined daily dose (DDD), which is the assumed average maintenance dose per day for a drug used for its main indication in adults. Rates are calculated in DDD per 1,000 inhabitants per day (DID) for outpatients and DDD per 100 bed-days used (DBD) for inpatients. Please refer to "Antimicrobial consumption" and "Denominator data" parts of the explanatory notes section for further details.

2016 Results

Outpatient Antimicrobial Consumption

The overall outpatient antimicrobial consumption was 24.0 DID, a 4% reduction on the updated 2015 rate of 25.0 DID. In the 2016 ESAC-Net report, the reported use of systemic antibacterial agents (termed outpatient J01) among European countries ranged from 10.5 to 36.3 DID; the median for 30 European countries with reliable data was 20.3 DID.

The underlying outpatient antimicrobial consumption trend for Ireland has increased since 2000. (Figure 1) There is a marked seasonal fluctuation in usage, with the highest consumption contemporaneous with periods of increased influenza activity.

The penicillin class accounted for majority of use (58%; 13.9 DID), followed by macrolides (18%; 4.3 DID), tetracyclines (10%; 2.5 DID), cephalosporins (5%; 1.2 DID), sulphonamides/trimethoprim (5%, 1.1 DID) and fluoroquinolones (4%, 0.9 DID).

Beta lactam-beta-lactamase inhibitor combinations [e.g., co-amoxiclav] accounted for the largest proportion of all penicillins (49%; 6.8 DID), followed by broad-spectrum penicillin [e.g., amoxicillin] (33%; 4.6 DID). Table 1 displays the breakdown by pharmacological drug groups.

There was considerable variability in the overall outpatient antimicrobial usage at county level (19.5 to 32.2 DID), as shown in Figure 2.

Hospital Antimicrobial Consumption

In 2016, 42 acute public hospitals provided antimicrobial usage data. The median rate of antimicrobial consumption was 84.8 DBD (mean = 86; range = 26.8 – 114.8), a 3.7% increase on the updated 2015 median rate of 81.8 DBD. These levels are mid-to-high in Europe.

Penicillins accounted for 50% of all hospital antimicrobial usage (43.2 DBD), followed by cephalosporins, monobactams and carbapenems combined (10%; 8.7 DBD), glycopeptides [e.g., vancomycin], imidazoles [e.g., metronidazole] and nitrofurans combined (10%; 8.4 DBD), fluoroquinolones [e.g., ciprofloxacin] at 6%; 5.1 DBD and macrolides [e.g., clarithromycin] (3%; 2.3 DBD). Tetracyclines, sulfonamides/trimethoprim, aminoglycosides and other systemic antimicrobials collectively accounted for <10% of antimicrobial use (Figure 3).

While antimicrobial consumption data in Ireland are comprehensive, gaps remain. Consumption data from

private hospitals are missing. All hospitals dispense to outpatients, day cases and may also serve external long term facilities. The data representing these groups is excluded from national hospital consumption analyses. Outpatient data is incomplete, representing 95% of wholesale-to-retail pharmacy transactions. Collectively, these gaps represent about 10% of the total antimicrobial consumption for Ireland.

While HPSC provides antifungal consumption data to ESAC-Net, this report focuses on antibacterial consumption only. ESAC-Net also collects data on antiviral and antiprotozoal agents in Europe, which are not currently analysed in Ireland.

Quarterly hospital antimicrobial consumption surveillance does not indicate whether or not the level of antimicrobial use is appropriate for a given patient population. For example, higher levels of antimicrobial consumption among tertiary hospitals may be appropriate depending on the patient case mix. Furthermore, DDD calculations are based on adult dosing and may therefore under-estimate antimicrobial consumption in paediatric settings.

In September and October 2016, the national annual antimicrobial point prevalence survey (PPS) was undertaken, using a protocol and data entry form developed in conjunction with the Irish Antimicrobial Pharmacists Group, with 41 hospitals participating (including three private and

Table 1. Annual breakdown by pharmacological drug groups for outpatient antimicrobial use in Ireland: 2015 and 2016.

Penicillins	2015 15.1	Percent of 2015 60.6%	**2016** 13.9	Percent of 2016 58.0%	Percent Change 2015 to 2016 -8.1%
Narrow spectrum penicillins	1.0	4.1%	1.1	4.5%	5.0%
Beta-lactamase resistant penicillins	2.2	8.9%	1.5	6.3%	-32.1%
Broad spectrum penicillins	5.3	21.1%	4.6	19.1%	-13.1%
Penicillin with beta-lactamase inhibitor	6.6	26.5%	6.8	28.2%	1.9%
Macrolides and related drugs	4.1	16.5%	4.3	18.1%	4.9%
Tetracyclines	2.5	10.1%	2.5	10.5%	-0.7%
Cephalosporins and other beta-lactam drugs	1.1	4.6%	1.2	4.8%	0.8%
First-generation cephalosporins	0.3	1.1%	0.3	1.3%	15.3%
Second-generation cephalosporins	0.8	3.3%	0.8	3.3%	-3.5%
Third-generation cephalosporins	0.0	0.2%	0.0	0.1%	-11.9%
Quinolones	0.9	3.6%	0.9	3.6%	-4.5%
Sulfonamides and Trimethoprim	1.0	4.1%	1.1	4.6%	7.0%
Other antibiotics	0.1	0.4%	0.1	0.4%	-1.9%
TOTAL	**25.0**	**100.0%**	**24.0**	**100.0%**	**-4.0%**

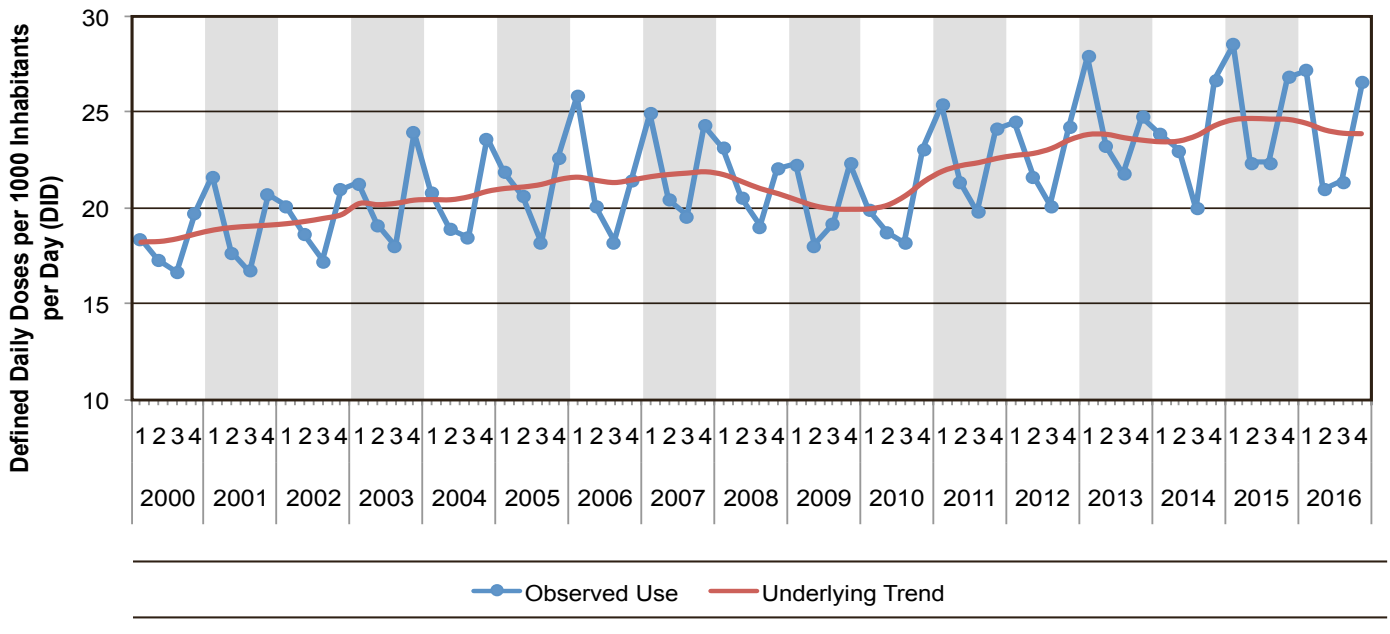


Figure 1. Quarterly outpatient antimicrobial consumption in Ireland: 2000 – 2016.

one non-acute hospital) and representing a 51% increase in participation since the first PPS in 2009. Results were similar to previous surveys. The overall antimicrobial use prevalence was 37.8%, compliance with choice was 81.6%, with dose was 94.3%, with overall restricted policy was 85.7% and specifically with meropenem restriction was 73%.

More detailed analyses of antimicrobial usage data can be found on the www.hpsc.ie website, through "Topics A-Z", under "Antibiotic Consumption Surveillance". Details of the WHO ATC/DDD system of classifying and measuring drug consumption can be found at www.whocc.no/atc_ddd_index/. The figures presented in this report may vary from previously published levels owing to methodological changes.

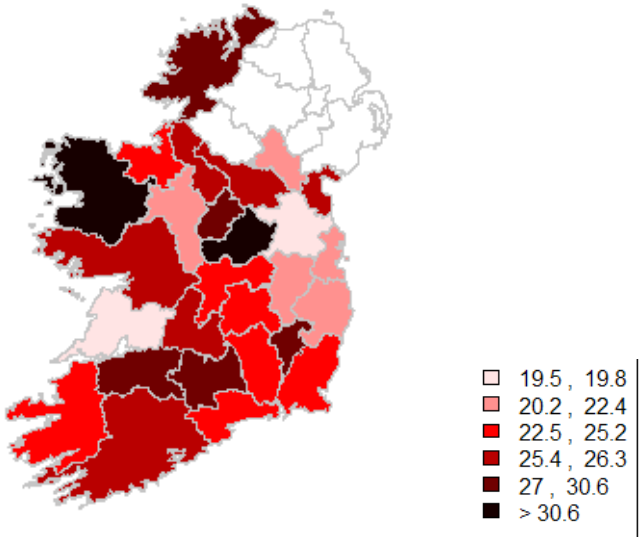


Figure 2. County-level outpatient antimicrobial consumption in Ireland in DDD per 1000 inhabitants per day (DID): 2016.

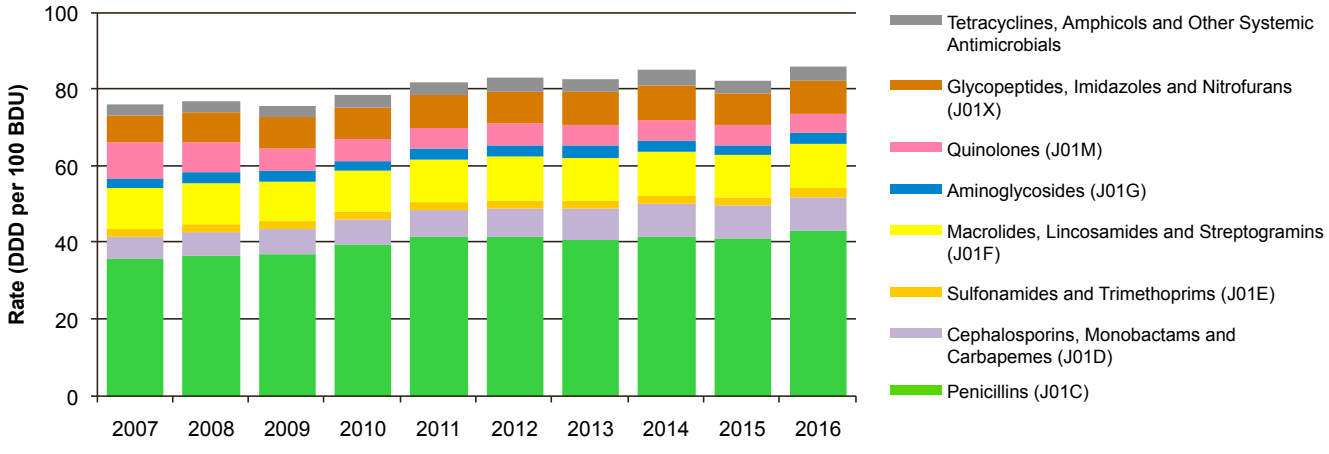


Figure 3. Annual national hospital antimicrobial consumption rate (DDD per 100 BDU) by pharmacological subgroup (ATC level 3).

9.4 Antimicrobial Resistance

a) Key Pathogens causing Bloodstream Infections

2016 Summary

- Estimated 99% coverage of the Irish population versus 97% in 2015
- There were 3,057 reports of invasive *E. coli* infection, an increase from 2,697 in 2015:
  - The proportion of invasive *E. coli* that were ESBL-producers (11.1%) was at its highest levels since surveillance began
  - One invasive *E. coli* isolate was a carbapenemase-producer, also known as carbapenem-resistant *Enterobacteriaceae* (CRE or CPE)
- There were 1,168 reports of *S. aureus* bloodstream infection (BSI), an increase from 1,082 in 2015:
  - Of those, 172 (14.7%) were meticillin-resistant *S. aureus* (MRSA). Compared with 2015, there was a 13.6% reduction in the number of MRSA BSI in 2016

    For acute hospitals, the rate of MRSA BSI was 0.043 cases per 1,000 bed days used (BDU), a decrease from 0.050 in 2015. An increase was observed in both the number (12.7% on 2015) and rate of meticillin-susceptible *S. aureus* (MSSA) BSI to 0.245 from 0.223 (2015)
  - The number, proportion and rate of MRSA BSI are at their lowest level since surveillance began; while the number and rate of MSSA BSI are at their highest level
- There were 431 reports of *E. faecium* BSI, an increase from 421 in 2015:
  - Vancomycin-resistant *E. faecium* (VREfm) accounted for 44.4%, one of the highest annual proportions reported to date
- There were 469 reports of invasive *K. pneumoniae* infection, an increase from 401 in 2015:
  - Resistance to all indicator antimicrobials decreased
  - In 2013, a multi-drug resistant *K. pneumoniae* (MDRKP) outbreak control team was established. The specific case definition for MDRKP is simultaneously an ESBL-producer and non-susceptible to both ciprofloxacin and gentamicin.

    The proportion of MDRKP causing invasive infections subsequently decreased to 7.1% (2016) from 12.3% (2013)
  - Four invasive *K. pneumoniae* isolates were carbapenemase-producers (CRE/CPE)
- There were 365 reports of invasive *S. pneumoniae* infection, an increase from 304 in 2015:
  - Of those, 60 (16.5%) were penicillin non-susceptible *S. pneumoniae* (PNSP), a decrease from 17.5% in 2015
  - The national rate of invasive pneumococcal infection increased compared with 2015 (7.7 per 100,000 population versus 6.6)
  - Serotype data were available for 341 (93.3%) of 365 invasive *S. pneumoniae* isolates. Results indicate good coverage (71.2%) for the 23-valent pneumococcal polysaccharide vaccine (PPV23) in its target population (adults ≥65 years)
- There were 250 reports of invasive *P. aeruginosa* infection, an increase from 201 in 2015, and resistance to all indicator antimicrobials, except for carbapenems, increased
- The data in this report was extracted from the EARS-Net database on **23rd October 2017**
- Enhanced surveillance data were provided on 2,593 records (cases or isolates under the EARS-Net definition) from 21 laboratories, representing 43% of all reported cases in 2016

Background

The European Antimicrobial Resistance Surveillance Network (EARS-Net), formerly known as the European Antimicrobial Resistance Surveillance System (EARSS), collects routinely-generated antimicrobial susceptibility testing (AST) data on seven important bacterial pathogens using the EARS-Net case definition. Participating laboratories in Ireland submit data on the "primary" or first isolate from blood or cerebrospinal fluid (CSF) per patient per quarter. EARS-Net does not distinguish clinically significant isolates from contaminants, nor does it distinguish between hospital-

Table 1. Summary of EARS-Net data by pathogen and year, 2010-2016

Pathogen	2010	2011	2012	2013	2014	2015	2016
Number laboratories by year-end	**40**	**41**	**41**	**41**	**39**	**38**	***37***
%Coverage of population	***100***	***100***	***100***	***100***	***100***	***97***	***99***
E. coli							
Number of isolates	**2170**	**2210**	**2450**	**2530**	**2771**	**2697**	***3057***
%Ampicillin-R*	*68.4*	*71.9*	*69.6*	*70.9*	*69.9*	*66.7*	***68.4***
%3GC-R*	*8.0*	*9.1*	*10.3*	*12.3*	*12.0*	*12.5*	***12.3***
%ESBL-producers*	*6.1*	*7.5*	*8.8*	*10.5*	*10.2*	*10.6*	***11.1***
%Ciprofloxacin-R*	*23.6*	*23.8*	*25.2*	*25.3*	*26.2*	*24.4*	***24.1***
%Gentamicin-R*	*9.4*	*8.7*	*9.7*	*9.8*	*11.2*	*11.0*	***10.2***
%Gentamicin/Amikacin/Tobramycin-R*	*11.9*	*12.4*	*12.8*	*12.9*	*14.5*	*13.4*	***13.2***
%Carbapenem[1]-R*	*0.0*	*0.0*	*0.1*	*0.1*	*0.1*	*0.2*	***0.2***
%MDR*	*11.8*	*13.2*	*13.6*	*14.6*	*15.0*	*14.5*	***14.3***
S. aureus							
Number of isolates	**1251**	**1095**	**1060**	**1094**	**1117**	**1082**	***1168***
Number Meticillin-R (or MRSA)	**305**	**263**	**242**	**222**	**217**	**199**	***172***
%Meticillin-R (or MRSA)	*24.4*	*24.0*	*22.8*	*20.3*	*19.4*	*18.4*	***14.7***
K. pneumoniae							
Number of isolates	**326**	**312**	**345**	**326**	**358**	**401**	***469***
%Ampicillin-R*	*99.1*	*100.0*	*98.5*	*99.1*	*100.0*	*99.3*	***99.4***
%3GC-R*	*10.2*	*8.0*	*11.9*	*21.2*	*13.1*	*17.5*	***16.8***
%ESBL-producers*	*5.1*	*5.6*	*8.8*	*18.4*	*11.0*	*13.3*	***12.9***
%Ciprofloxacin-R*	*10.5*	*13.2*	*11.9*	*20.9*	*17.3*	*21.6*	***16.6***
%Gentamicin-R*	*6.8*	*7.4*	*9.6*	*16.9*	*12.6*	*17.0*	***11.5***
%Gentamicin/Amikacin/Tobramycin-R*	*7.1*	*8.3*	*9.9*	*17.8*	*13.2*	*18.0*	***12.6***
%Carbapenem[1]-R*	*0.0*	*1.9*	*0.3*	*1.2*	*1.1*	*2.2*	***1.1***
%MDRKP[2]*	*2.2*	*4.6*	*5.3*	*12.3*	*8.2*	*9.8*	***7.1***
%MDR*	*8.0*	*9.0*	*10.2*	*19.7*	*13.7*	*19.8*	***14.7***
E. faecium							
Number of isolates	**392**	**364**	**392**	**409**	**405**	**421**	***431***
%Ampicillin-R*	*95.6*	*95.9*	*92.9*	*93.2*	*95.3*	*94.3*	***94.6***
%Vancomycin-R (VREfm)	*39.3*	*37.4*	*45.4*	*43.1*	*45.9*	*45.6*	***44.4***
%HLG-R*	*39.6*	*36.8*	*39.3*	*41.4*	*44.3*	*49.5*	***58.3***
%Linezolid-R*	*2.2*	*1.1*	*1.5*	*1.2*	*2.0*	*0.7*	***0.2***
%MDR*	*25.0*	*21.1*	*20.3*	*19.6*	*22.1*	*21.3*	***28.2***
S. pneumoniae							
Number of isolates	**314**	**327**	**321**	**311**	**331**	**304**	***365***
%Penicillin-NS*	*18.2*	*19.6*	*19.6*	*20.7*	*17.1*	*17.5*	***16.5***
of which: %HLR	*4.8*	*6.1*	*4.7*	*2.6*	*2.4*	*0.3*	***0.0***
%Int	*12.7*	*13.5*	*15.0*	*18.0*	*14.5*	*17.2*	***16.5***
%Erythromycin-R*	*15.7*	*18.9*	*16.9*	*17.9*	*13.8*	*15.2*	***13.2***
%Penicillin-NS/Erythromycin-R	*12.6*	*13.8*	*12.5*	*13.0*	*11.0*	*10.8*	***9.9***
E. faecalis							
Number of isolates	**298**	**265**	**298**	**336**	**315**	**294**	***296***
%Ampicillin-R*	*0.7*	*0.8*	*4.0*	*2.7*	*1.6*	*0.7*	***0.7***
%Vancomycin-R (VREfa)	*0.3*	*4.9*	*3.0*	*2.1*	*2.9*	*1.4*	***1.0***
%HLG-R*	*29.7*	*29.1*	*32.9*	*33.6*	*32.8*	*28.0*	***29.5***
%Linezolid-R*	*2.5*	*1.2*	*0.0*	*0.6*	*1.0*	*0.4*	***0.0***
P. aeruginosa							
Number of isolates	**222**	**184**	**219**	**207**	**182**	**201**	***250***
%Piperacillin/tazobactam-R*	*10.0*	*2.8*	*17.4*	*15.7*	*16.5*	*14.0*	***17.2***
%Ceftazidime-R*	*9.2*	*8.2*	*15.2*	*10.7*	*8.9*	*8.5*	***13.2***
%Imipenem/meropenem-R*	*8.3*	*12.0*	*19.4*	*13.1*	*11.6*	*16.4*	***13.2***
%Ciprofloxacin-R*	*13.2*	*12.6*	*20.6*	*15.0*	*13.7*	*13.5*	***16.4***
%Gentamicin-R*	*8.7*	*6.5*	*11.9*	*11.6*	*4.9*	*3.5*	***11.2***
%Gentamicin/Amikacin/Tobramycin-R*	*8.6*	*6.5*	*11.9*	*11.6*	*5.5*	*7.0*	***12.4***
%MDR*	*6.5*	*4.0*	*13.0*	*9.4*	*6.7*	*7.5*	***13.2***
***Acinetobacter* spp.**							
Number of isolates	*No data*	*No data*	*No data*	**91**	**93**	**87**	***69***
%Ciprofloxacin-R*				*3*	*8*	*7*	***1***
%Gentamicin-R*				*0*	*3*	*4*	***2***
%Gentamicin/Amikacin/Tobramycin-R*				*1*	*3*	*5*	***3***
%Imipenem/meropenem-R*				*4*	*4*	*6*	***0***
%MDR*				*0*	*2*	*3*	***0***

* Not all isolates tested
Number of isolates presented in **bold**; proportions (%) presented in *italics*
R, Resistant; NS, Non-Susceptible [includes isolates with intermediate (Int) and high-level resistance (HLR)]
MRSA, Meticillin-Resistant *S. aureus*; VREfm, Vancomycin-Resistant *E. faecium;* VREfa, Vancomycin-Resistant *E. faecalis*
HLG, High-Level Gentamicin; 3GC, 3rd-Generation Cephalosporin (includes cefotaxime, ceftriaxone, ceftazidime)
ESBL, Extended-Spectrum Beta-Lactamase; MDR, Multi-Drug Resistant
[1] Carbapenems include imipenem, meropenem and ertapenem; [2] MDRKP, MDR K. pneumoniae phenotype (ESBL-producer plus non-susceptibility to Ciprofloxacin and Gentamicin) OR carbapenemase-producer (e.g. KPC, OXA-48)

acquired, healthcare-associated and community-acquired infections. EARS-Net primarily serves as a surveillance system to measure national levels of antimicrobial resistance (AMR). In 2016, two of the 39 microbiology laboratories suspended their participation in EARS-Net, one in Q3 and one in Q4, resulting in an estimated 99% coverage of the Irish population. Overall, coverage has remained at over 95% since 2004.

EARS-Net encourages the use of EUCAST guidelines and clinical breakpoints for AST in line with the EU case definitions. By the end of 2016, 35 of the 39 Irish clinical microbiology laboratories had switched to EUCAST, with just four laboratories still using CLSI guidelines.

2016 Results

Escherichia coli

There were 3,057 reports (blood; 3,055 and CSF; 2) from 2,985 patients, an increase of 13% compared with 2,697 reports in 2015. **Table 1** displays the annual trends since 2008 in the proportion of *E. coli* isolates resistant to the five "indicator" antimicrobials/antimicrobial classes [ampicillin, third-generation cephalosporins (3GCs; cefotaxime, ceftriaxone or ceftazidime), fluoroquinolones (ciprofloxacin), aminoglycosides (gentamicin, amikacin or tobramycin) and carbapenems (meropenem or ertapenem)]:

- Of 3,055 isolates, 376 (12.3%) were resistant to 3GCs and of those, 324 were extended-spectrum beta-lactamase (ESBL)-positive and 51 ESBL-negative
- Of 3,056 isolates, 736 (24.1%) were resistant to ciprofloxacin
- Of 3,057 isolates, 311 (10.2%) were resistant to gentamicin [404 (13.2%) of 3,057 were aminoglycoside-resistant (i.e. resistant to gentamicin, tobramycin or amikacin)]
- Five (0.2%) of 3,047 isolates were resistant to carbapenems, one of which was confirmed to be a carbapenemase-producer (NDM)

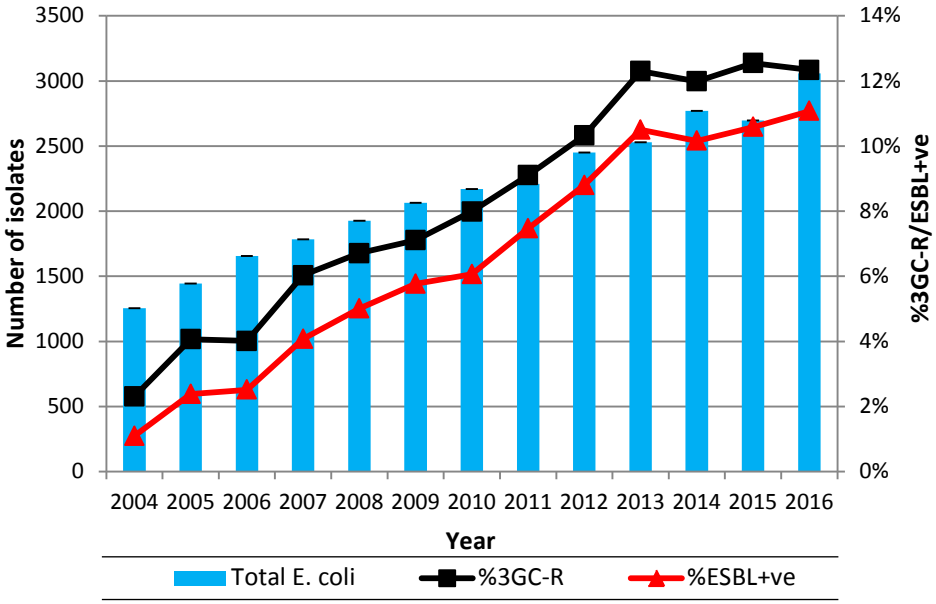


Figure 1. Trends for E. coli – total numbers of E. coli and percentage resistance to 3rd generation cephalosporins (3GC)/ESBL-positive

Table 2. Age and gender breakdown of patients by organism with major resistance profiles (data from laboratories participating in enhanced surveillance for 2016). The proportion of isolates detected <48 hours and >5 days post-admission is also shown

		Total for 2016	Percent female	Mean age in years	Detected <48 hours after admission	Detected >5 days after admission
Staphylococcus aureus	Meticillin Resistant (MRSA)	**95**	31%	68	64%	28%
	Meticillin Susceptible	**533**	39%	61.7	68%	21%
Streptococcus pneumoniae	Penicillin non-Susceptible	**18**	28%	71.3	89%	6%
	Penicillin Susceptible	**129**	51%	62.6	92%	6%
Enterococci	Vancomycin Resistant	**67**	39%	65.7	4%	84%
	Vancomycin Susceptible	**204**	40%	65.6	43%	49%
Escherichia coli	Fluoroquinolone Resistant	**307**	47%	73.4	72%	21%
	Fluoroquinolone Susceptible	**961**	56%	67.5	80%	17%
Klebsiella pneumoniae		**168**	38%	67	60%	33%
Pseudomonas aeruginosa		**111**	36%	68.2	59%	32%

The trend in resistance to 3GCs has stabilised at 12.0-12.5% since 2013 (**Figure 1**). Resistance to ciprofloxacin and aminoglycosides decreased in 2016 compared with 2015.

In 2016, Ireland had moderately high levels (10 to <25%) of resistance to 3GCs (**Figure 2**), ciprofloxacin and aminoglycosides (ranking 18th, 18th and 14th, respectively, out of 30 countries reporting to EARS-Net). The median proportions for resistance among EARS-Net countries were 14.3% for 3GCs, 26.5% for ciprofloxacin and 12.5% for aminoglycosides.

ESBLs are enzymes that confer resistance to most penicillins and cephalosporins (including 3GCs). ESBL-producing bacteria (including *E. coli* and *K. pneumoniae*) are also often resistant to other classes of antimicrobials and have emerged as important causes of healthcare-associated infection (HCAI). In 2016, ESBL producing invasive *E. coli* isolates were at the highest level since surveillance began (11.1%).

Of 3,055 isolates tested against all five "indicator" antimicrobials, 436 (14.3%) reported from 50 hospitals/institutions were identified as multi-drug resistant (MDR) *E. coli*, defined as resistance to three or more of the indicator antimicrobials OR any isolate with resistance to carbapenems, similar to 2015 (14.5%).

Staphylococcus aureus

There were 1,168 reports of *S. aureus* BSI from 1,143 patients, compared with 1,082 reports in 2015. Of those, 172 (14.7%) were MRSA, which represents the lowest annual proportion since surveillance began in 1999 (**Table 1** shows data from 2010 - 2016). In 2010, the proportion was 24.4%, the first year that MRSA accounted for <25% of *S. aureus* BSI in Ireland, thus changing from red to orange on the EARS-Net map and 2016 was the tenth successive year in which a decrease was observed (**Figure 3**). Overall, there was a 13.6% reduction in the number of reported MRSA BSI compared with 2015 (172 versus 199). In contrast, the total number of MSSA BSI increased by 12.7% compared with 2015 (996 versus 883).

Despite the decrease in numbers and proportion of MRSA BSI in 2016, Ireland still had one of the higher proportions of MRSA in Europe (see http://ecdc.europa.eu/en/healthtopics/antimicrobial_resistance/database/Pages/database.aspx for more detailed European data, including EARS-Net tables, charts and maps) (**Figure 4**). Ireland ranked 12th out of 30 countries reporting to EARS-Net (compared to 11th of 30 countries in 2015), with the median proportion of MRSA BSI at 13.8%. All countries with MRSA proportions higher than Ireland are located in Southern and Central/Eastern Europe.

The MRSA rate for all acute hospitals in 2016 was 0.043 cases per 1,000 BDU, a decrease from 0.050 in 2015, while the MSSA rate increased from 0.223 to 0.245 [rates are calculated from denominator data (BDU) obtained from the HSE's Business Information Unit for all acute public hospitals; and directly from private hospitals where available, where both numerator (*S. aureus* numbers) and denominator data have been provided].

Klebsiella pneumoniae

There were 469 reports of invasive *K. pneumoniae* infection (all from blood) from 453 patients, an increase of 17% from 2015 (n=401). **Table 1** displays annual trends since 2010 in the proportion of *K. pneumoniae* isolates resistant to the five "indicator" antimicrobials (as for *E. coli* above):

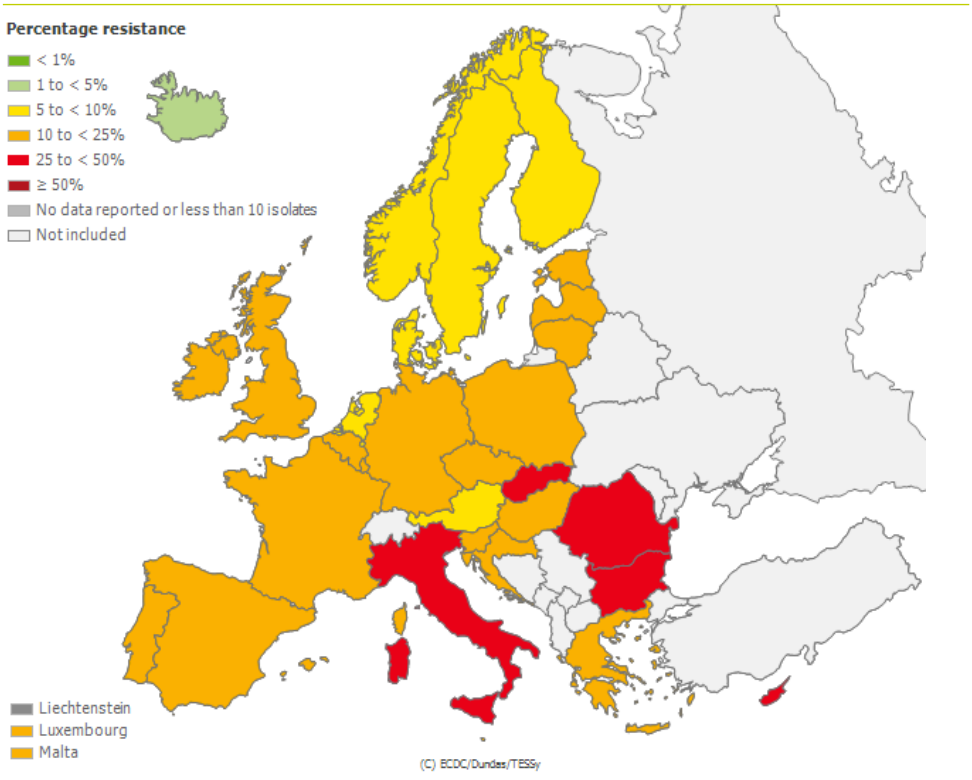


Figure 2. Distribution of 3rd-generation cephalosporin resistant E. coli in EARS-Net countries in 2016
Map downloaded from ECDC's TESSy database on 13/10/2017:
http://ecdc.europa.eu/en/healthtopics/antimicrobial_resistance/database/Pages/database.aspx

- Of 469 isolates, 79 (16.8%) were resistant to 3GCs, of which 58 were ESBL-producers and 21 were ESBL-negative
- Of 469 isolates, 78 (16.6%) were resistant to ciprofloxacin
- Of 469 isolates, 54 (11.5%) were resistant to gentamicin [59 (12.6%) of 469 were aminoglycoside-resistant (i.e. resistant to gentamicin, tobramycin or amikacin)]
- Of 467 isolates, five (1.1%) were resistant to carbapenems, with four confirmed to be carbapenemase-producers reported from two hospitals (KPC; 3 and OXA-48; 1) and one confirmed not to be a carbapenemase-producer. This compares with seven in 2015 (OXA-48; 6 and KPC; 1), two in 2014 (OXA-48; 1 and KPC; 1), two in 2013 (both OXA-48) and four in 2011 (OXA-48; 3 and KPC; 1)

Three invasive *K. pneumoniae* isolates were reported as susceptible to ampicillin, which is suggestive of misidentification of species or misclassification, as *K. pneumoniae* are inherently resistant to ampicillin.

Resistance to 3GCs (**Figure 7**), ciprofloxacin and gentamicin/aminoglycosides all decreased in 2016 compared with 2015.

ESBLs were detected in 60 (12.9%) of 464 isolates tested. This represents a slight decrease from 13.3% in 2015.

Of 468 isolates, 69 (14.7%) reported by 25 hospitals/institutions that were tested against all five "indicator" antimicrobials were identified as MDR *Klebsiella pneumoniae*, a decrease from 19.8% in 2015.

In 2013, the Antimicrobial Resistance and Microbial Ecology (ARME) group at NUI Galway alerted HPSC to the presence of two predominant *K. pneumoniae* clones implicated in both patient infection and colonisation in a number of Irish hospitals. Both clones were simultaneously ESBL-positive and non-susceptible to ciprofloxacin and gentamicin. Some were also found to produce carbapenemases. Isolates meeting the definition are termed multi-drug resistant *K. pneumoniae* (MDRKP). From 2012 to 2013, the proportion of invasive *K. pneumoniae* that were MDRKP increased from 5.3% (18 of 342 isolates) to 12.3% (40 of 325 isolates), as displayed in Figure 8. An outbreak control team was established in October 2013 to evaluate this emerging threat and the proportion of MDRKP has subsequently decreased to 7.1% (33 of 464 isolates) in 2016.

In 2016, Ireland ranked 21st for 3GC, fluoroquinolone and aminoglycoside resistance in invasive *K. pneumoniae* among 30 countries reporting to EARS-Net. The median proportions among EARS-Net countries were 31.1%, 34.5% and 23.8%, respectively. With four reports of invasive carbapenem-resistant *K. pneumoniae* (0.9%), Ireland ranked joint 17th of 30 countries in 2016, with the median proportion among EARS-Net countries being 1.0% (**Figure 9**).

Enterococcus faecium

There were 431 reports of *E. faecium* BSI from 422 patients, an increase of 2.4% from 2015 (n=421). **Table 1** displays the annual trends since 2010 in the proportion of *E. faecium* isolates resistant to the three "indicator" antimicrobials (ampicillin, vancomycin and high-level gentamicin):

- Of 430 isolates, 191 (44.4%) were resistant to vancomycin *E. faecium* (VREfm), which is a slight decrease from 45.6% in 2015 (**Figure 5**)
- Of 410 isolates, 239 (58.3%) were resistant to high-level gentamicin, which is the highest proportion reported to date (**Figure 5**)
- Of 426 isolates, one (0.2%) was resistant to linezolid
- Of 404 isolates tested against the three "indicator" antimicrobials, 114 (28.2%) reported from 25 hospitals/institutions [with the majority (88; or 77%) coming from the nine tertiary hospitals] were resistant to all three and termed MDR *E. faecium*, which represents an increase from 21.3% in 2015

The proportion of VREfm first exceeded 40% in 2012 and appears to have levelled off at 43-45% since then.

Between 2008 and 2015, Ireland had the highest proportion of VREfm in Europe. In 2016, Ireland ranked second

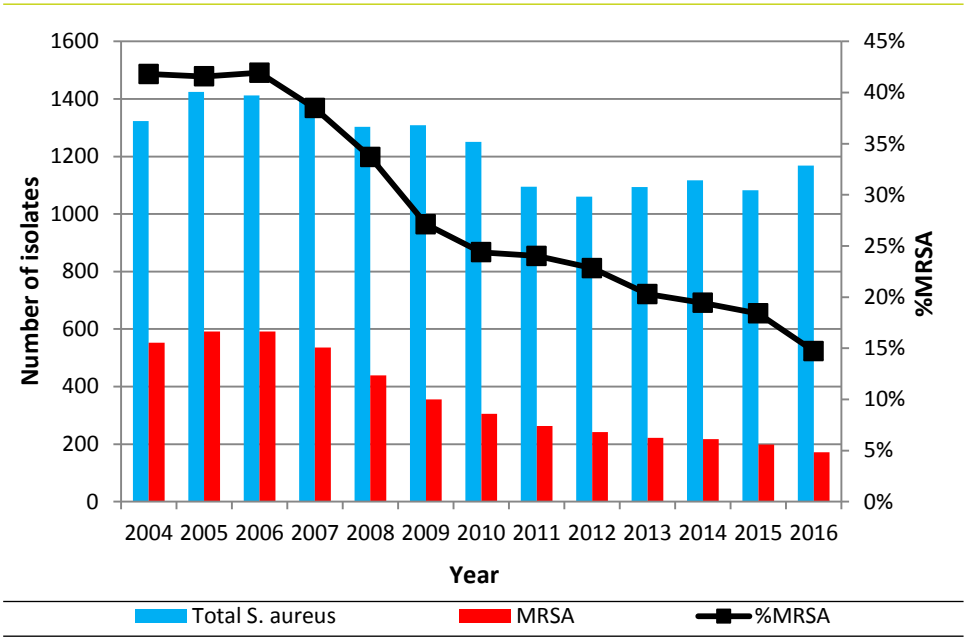


Figure 3. Trends for S. aureus – total numbers of S. aureus/MRSA and percentage MRSA

after Cyprus (46.3%; note: overall numbers were low). In addition, five other countries reported proportions over 25%: Romania, Latvia, Greece, Slovakia and Poland (**Figure 6**). The median proportion of VREfm in EARS-Net countries was 8.1%, a decrease from 9.9% in 2015.

Streptococcus pneumoniae

There were 365 reports of invasive *S. pneumoniae* infection (360 from blood and five from CSF) from 364 patients, a 20% increase on 2015 (n=304). **Table 1** displays annual trends since 2010 in the proportions of *S. pneumoniae* isolates non-susceptible/resistant to penicillin and erythromycin.

Penicillin non-susceptible *S. pneumoniae* (PNSP) accounted for 16.5% (n=60) of all isolates tested against penicillin (n=364) (**Figure 10)**, a reduction from 17.5% (2015). Of the PNSP isolates, all were intermediately-resistant (Int; MIC = 0.1 – 1mg/L) for laboratories following the Clinical Laboratory Standards Institute (CLSI) guidelines (for non-meningitis syndrome via oral administration) and (MIC = 0.1 – 2 mg/L) for those following European Committee on Antimicrobial Susceptibility Testing (EUCAST) non-meningitis guidelines. Penicillin susceptibility was not determined for one isolate. Forty-seven (13.2% of 355) isolates were resistant to erythromycin.

Ireland remained among European countries with the highest proportions of PNSP ranking 8th of 29 countries in 2016 (median proportion, 10.5%). Moderately high levels of erythromycin resistance were seen, with Ireland ranking 14th of 29 countries (median proportion, 13.8%). This is similar

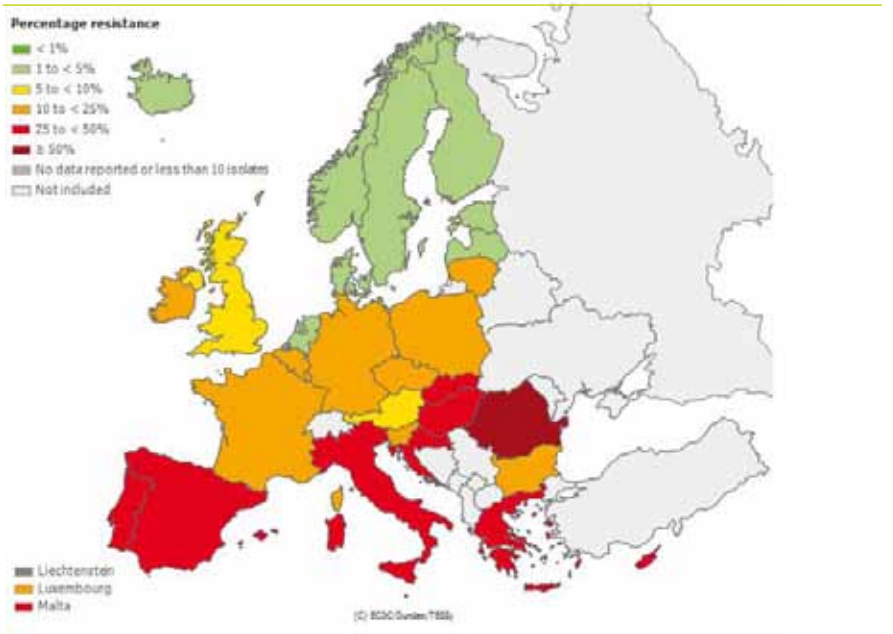


Figure 4. Distribution of MRSA in EARS-Net countries in 2016
Map obtained from ECDC on 13/10/2017:
http://ecdc.europa.eu/en/healthtopics/antimicrobial_resistance/database/Pages/database.aspx

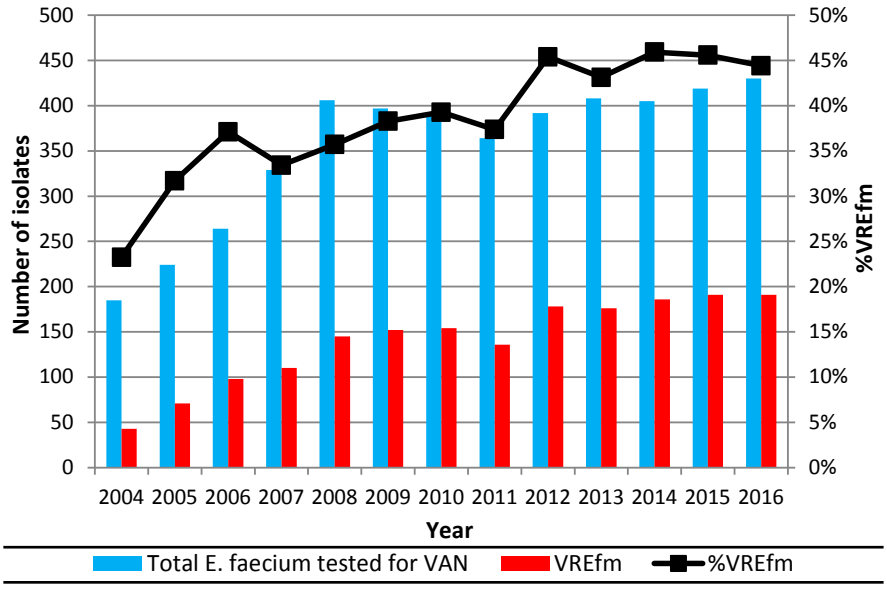


Figure 5. Trends for E. faecium – total numbers of E. faecium and percentage resistance to vancomycin (VREfm)

to the situation observed in much of Southern and Central/ Eastern Europe.

Of 354 isolates tested against both penicillin and erythromycin in 2016, 35 (9.9%) were simultaneously PNSP (all intermediately resistant) and erythromycin-resistant, which is a decrease from 2015 (10.8%).

In 2007, a national pilot project was established as a collaborative initiative between RCSI/Beaumont Hospital, Children's University Hospital, Temple St and HPSC, with the aim of providing baseline serotyping data on invasive *S. pneumoniae* isolates. This project pre-dates the introduction of the 7-valent pneumococcal conjugate vaccine (PCV7) into the childhood immunisation schedule in September 2008. PCV13 replaced PCV7 from September 2010.

In 2016, serotype data were available for 341 pneumococcal isolates reported by 30 of the 31 laboratories reporting pneumococcal isolates to EARS-Net, representing 93.4% of all pneumococcal isolates reported:

- Of 184 isolates from patients aged ≥65 years, 131 (71.2%) belonged to serotypes included in the PPV23 vaccine
- Twenty isolates were referred for typing from patients aged <2 years (the target population for the PCV13 vaccine) and three of these were serotypes included in the vaccine

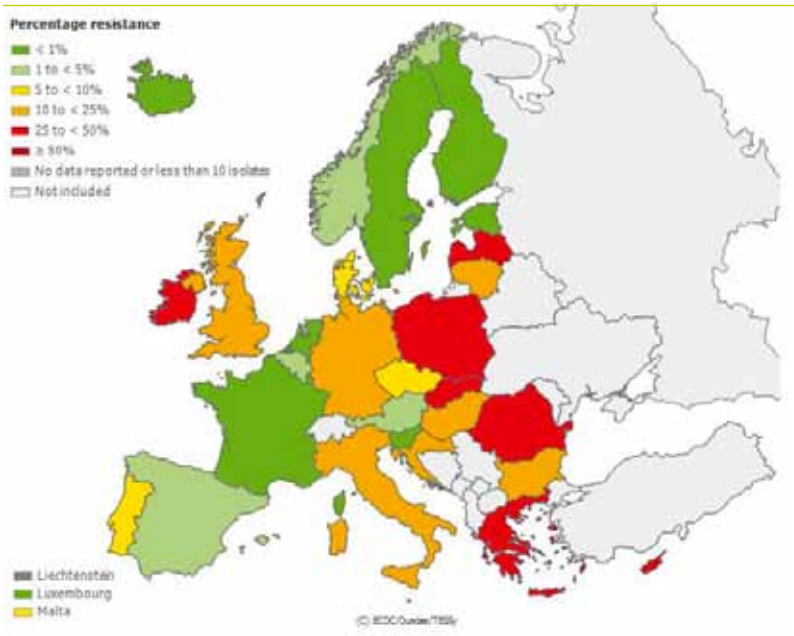


Figure 6. Distribution of vancomycin-resistant E. faecium (VREfm) in EARS-Net countries in 2016. Map downloaded from ECDC's TESSy database on 13/10/2017: http://ecdc.europa.eu/en/healthtopics/antimicrobial_resistance/database/Pages/database.aspx

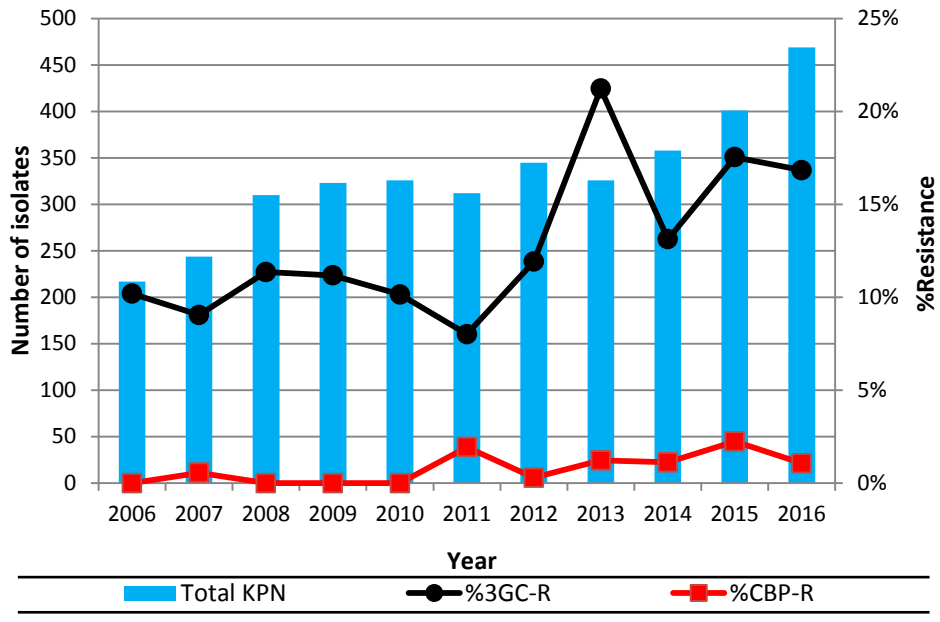


Figure 7. Trends for K. pneumoniae – total numbers of K. pneumoniae and percentage resistance to 3rd generation cephalosporins (3GCs) and carbapenems (CBP)

The most common serotypes identified were: 8 and 12F (n=39), 3 (n=30), 19A (n=27), 22F (n=25), 33F (n=23), 9N (n=19), 15F (n=14) and 24F (n=11) representing 66.6% of all isolates typed.

Of the 60 PNSP isolates, 56 (93%) were serotyped:
- Of 18 isolates from patients age ≥65 years, 16 (89%) belonged to serotypes included in the pneumococcal polysaccharide vaccine (PPV23) vaccine
- Of five isolates from children <2 years, one belonged to a serotype included in the PCV13 vaccine

The most common serotypes identified were: 19A (n=17), 15A (n=10) and 5B (n=5) representing 57% of all PNSP isolates typed.

Ongoing surveillance of the predominant serotypes is required, as strains with non-vaccine serotypes have been reported to increase in prevalence following the introduction of conjugate vaccines in other countries. Hence the need for a fully-resourced Irish pneumococcal reference laboratory. The separate chapter on invasive pneumococcal disease (IPD) in Ireland in 2016 contains additional information on pneumococcal serotyping.

In 2016, the rate of IPD in Ireland was estimated at 7.7 cases per 100,000 population, a decrease compared with 6.6 in 2015 [note that both rates were calculated using 2016 Census data; with the rates adjusted to account for the reduced population coverage by EARS-Net in each year].

Enterococcus faecalis
There were 296 reports of *E. faecalis* BSI from 289 patients, compared with 294 reports in 2015. **Table 1** displays annual trends since 2010 in the proportions of *E. faecalis* isolates resistant to the three "indicator" antimicrobials (as for *E. faecium*):
- Of 295 isolates, three (1.0%) were resistant to vancomycin (VREfa), with Ireland ranking 9th amongst European countries for resistance. The proportion of VREfa in Ireland has decreased from the highest reported proportion of 4.9% in 2011. In 2016, the median proportion in Europe was 0.1%
- Of 271 isolates, 80 (29.5%) were resistant to high-level gentamicin
- Of 292 isolates, none were resistant to linezolid

Two isolates were reported resistant to ampicillin, which is suggestive of misidentification of species or misclassification, as resistance to ampicillin is rare in *E. faecalis*.

Pseudomonas aeruginosa
There were 250 reports of invasive *P. aeruginosa* infection (blood; 245 and CSF; 5) from 243 patients, a 24.3% increase on 2015 (n=201). **Table 1** displays annual trends since 2010 in the proportion of the 250 *P. aeruginosa* isolates resistant to the five "indicator" antimicrobials/antimicrobial classes [piperacillin-tazobactam, ceftazidime, carbapenems (meropenem or imipenem), fluoroquinolones (ciprofloxacin) and aminoglycosides (gentamicin, amikacin or tobramycin)]:
- 43 (17.2%) were resistant to piperacillin-tazobactam
- 33 (13.2%) were resistant to ceftazidime
- 33 (13.2%) were resistant to imipenem or meropenem
- 42 (16.8%) were resistant to ciprofloxacin
- 28 (11.2%) were resistant to gentamicin [31 (12.4%) of 250 were aminoglycoside-resistant (i.e. resistant to gentamicin, tobramycin or amikacin)]

In 2016, resistance to all but one of the indicator antimicrobials (imipenem/meropenem) increased compared with 2015.

Thirty-three (13.2%) of 250 isolates reported from 18 hospitals that were tested against all five "indicator"

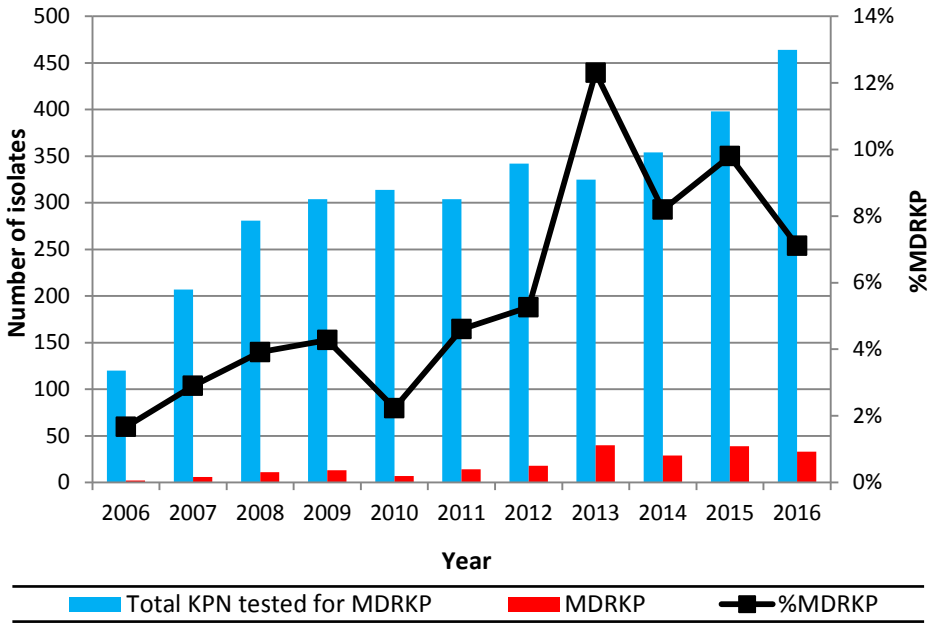


Figure 8. Trends for K. pneumoniae isolates with the MDRKP phenotype (simultaneously ESBL-producers and non-susceptible to both ciprofloxacin and gentamicin and/or a carbapenemase-producer) –– numbers and percentage with MDRKP phenotype

antimicrobials were identified as MDR *Pseudomonas aeruginosa*, defined as resistance to three or more of the indicator antimicrobials. This is the highest proportion of MDR *Pseudomonas aeruginosa* since surveillance began in 2006.

Antimicrobial resistance levels amongst *P. aeruginosa* isolates in Ireland are at moderately low levels in comparison with other European countries, with Ireland ranking between 16th and 24th of 30 countries for all five indicator antimicrobials.

Acinetobacter spp.
There were 69 reports of invasive infection caused by *Acinetobacter spp.* (blood; 67 and CSF; 2) from 68 patients, a reduction on 87 reports in 2015. **Table 1** displays annual trends since 2013 in the proportion of *Acinetobacter spp.* isolates resistant to the three "indicator" antimicrobials/ antimicrobial classes [carbapenems (meropenem or imipenem), fluoroquinolones (ciprofloxacin) and gentamicin]:

- Of 65 isolates, none were resistant to imipenem or meropenem
- Of 68 isolates, one was resistant to ciprofloxacin
- Of 63 isolates, one was resistant to gentamicin [two of 65 were aminoglycoside-resistant (i.e. resistant to gentamicin, tobramycin or amikacin)]

Of 63 isolates, none were identified as MDR *Acinetobacter spp.*, i.e. resistant to all three "indicator" antimicrobials.

Enhanced Surveillance
The voluntary EARS-Net enhanced surveillance programme was established in 2004. Laboratories participating in EARS-Net are invited to provide additional demographic and clinical data on invasive pathogens causing BSI.

In 2016, enhanced surveillance data on 2,593 individual records (cases or isolates under the EARS-Net definition) were submitted from 21 participating laboratories, representing 43% of all reports to EARS-Net. **Table 2** displays demographic and other basic data for the major resistance profiles of pathogens reported to EARS-Net enhanced surveillance.

- *S. aureus* BSI
  - 54% of MRSA and 45% of MSSA BSIs were healthcare-associated
  - 24% of MRSA BSIs were device-associated with
    - 5% CVC/CVC-PICC-associated, 8% PVC-associated
  - 20% of MSSA BSIs were device-associated with
    - 10% CVC/CVC-PICC-associated, 5% PVC-associated

- Enterococcal BSI
  - 91% of VRE and 61% of vancomycin-susceptible enterococcus (VSE) BSIs were healthcare-associated
  - 30% of VRE BSIs were device-associated with
    - 24% CVC/CVC-PICC-associated
  - 18% of VSE BSIs were device-associated with
    - 11% CVC/CVC-PICC-associated

- *E. coli* BSI
  - 39% of fluoroquinolone-resistant *E. coli* (FQREC) and 27% of fluoroquinolone-susceptible *E. coli (FQSEC)* BSIs were healthcare-associated
  - The most common source of *E. coli* bloodstream infection was urinary tract infection, with 48% FQREC BSI and 44% FQSEC urinary catheter-associated

Conclusion
For the tenth consecutive year, the proportion of *S. aureus* BSI attributable to MRSA further declined to 14.7%, the lowest reported level since Ireland joined EARS-Net in 1999. The decline may be partly attributable to improvements in infection prevention and control interventions, such as improved healthcare worker awareness of the importance of hand hygiene, standard and contact precautions,

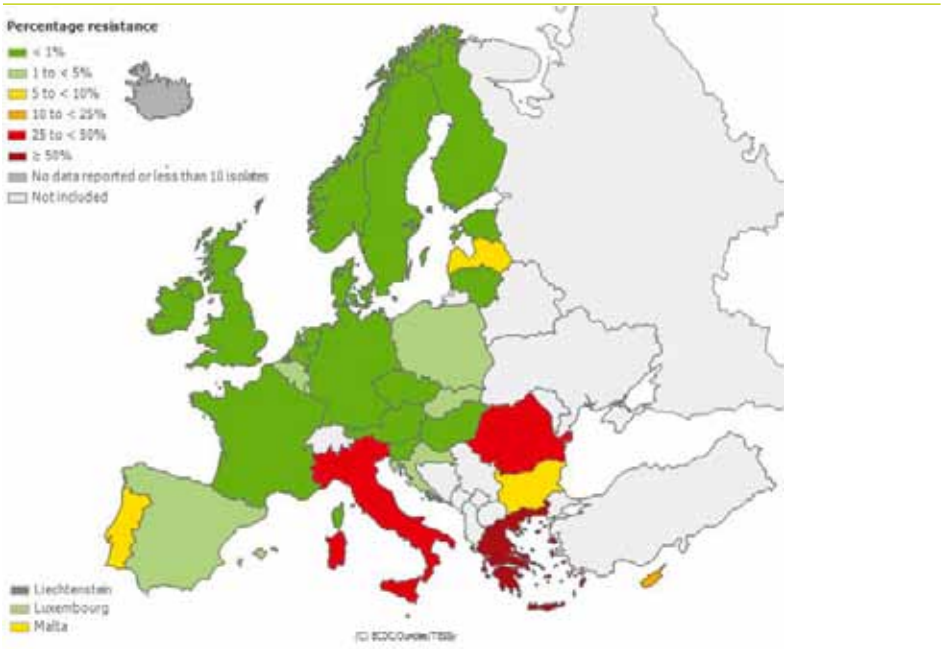


Figure 9. Distribution of carbapenem-resistant K. pneumoniae in EARS-Net countries in 2016
Map downloaded from ECDC's TESSy database on 13/10/2017:
http://ecdc.europa.eu/en/healthtopics/antimicrobial_resistance/database/Pages/database.aspx

screening of patients for MRSA carriage and the availability of decolonisation regimens to eradicate MRSA carriage. The development of and strengthening of hospital invasive device insertion and maintenance protocols (e.g., care bundles), antimicrobial stewardship programmes and restricted prescribing of certain broad spectrum antimicrobials, particularly in response to other healthcare associated infections, such as *Clostridium difficile* infection, may also have positively contributed to the decreasing proportion of MRSA BSI.

Unfortunately, antimicrobial resistance in other important BSI causative pathogens increased further and remains a cause for concern.

In 2016, Ireland had the second highest proportion of VREfm BSI (44.4%) in Europe after Cyprus (46.3%; but note low numbers). Five other countries also reported proportions over 25% and therefore appeared red on the map.

Following the establishment of the national multi-drug resistant *K. pneumoniae* (MDRKP) outbreak control team (OCT) in 2013 to look at the emerging problem of MDRKP, initial recommendations were made to try to control the spread of MDRKP strains in healthcare settings. Due to the wide-reaching nature of this outbreak and the growing threat posed by antimicrobial resistance, the OCT proposed that a national task force should be established with greater powers to influence and implement changes in policy and infrastructure needed. In 2016, there were five reported cases of invasive carbapenemase-producing *K. pneumoniae* (CRE) infection in Ireland.

Infections caused by antimicrobial-resistant bacteria result in excess patient mortality, morbidity and costs to the healthcare system. Rising levels of AMR threaten many aspects of healthcare that we currently take for granted. It is critical that comprehensive infection prevention and control and antimicrobial stewardship programmes continue to be developed and maintained at all levels and settings within the Irish health service. To this end, it is vital that recommendations and guidelines produced by the HSE RCPI Clinical Advisory Group on HCAI and AMR are implemented. HPSC thanks all the microbiology laboratories for their continued participation and enthusiasm for the EARS-Net project.

See http://www.hpsc.ie for further details of EARS-Net, antimicrobial resistance and enhanced BSI surveillance in Ireland

European data are available at: http://ecdc.europa.eu/en/healthtopics/antimicrobial_resistance/database/Pages/database.aspx

b) Enhanced surveillance of Carbapenemase-Producing Carbapenem Resistant Enterobacteriaceae (CRE/CPE)

2016 Summary

Number of cases of colonisation or infection with enhanced data = 107. This represented an increase compared with 98 (2015) and 63 (2014). In contrast, the National Carbapenemase Producing *Enterobacteriaceae* Reference Laboratory Service (CPEaRLS) at Galway University Hospital confirmed carbapenemase production in 362 *Enterobacteriaceae* isolates in 2016 compared to 139 (2015)

The clinical significance of the CRE isolate was reported for 100 patients, representing colonisation in the majority (n=78; 78%). CRE infection was reported for 22 patients

Background

Carbapenem-resistant *Enterobacteriaceae* (CRE) are multi-drug resistant Gram-negative bacteria and includes

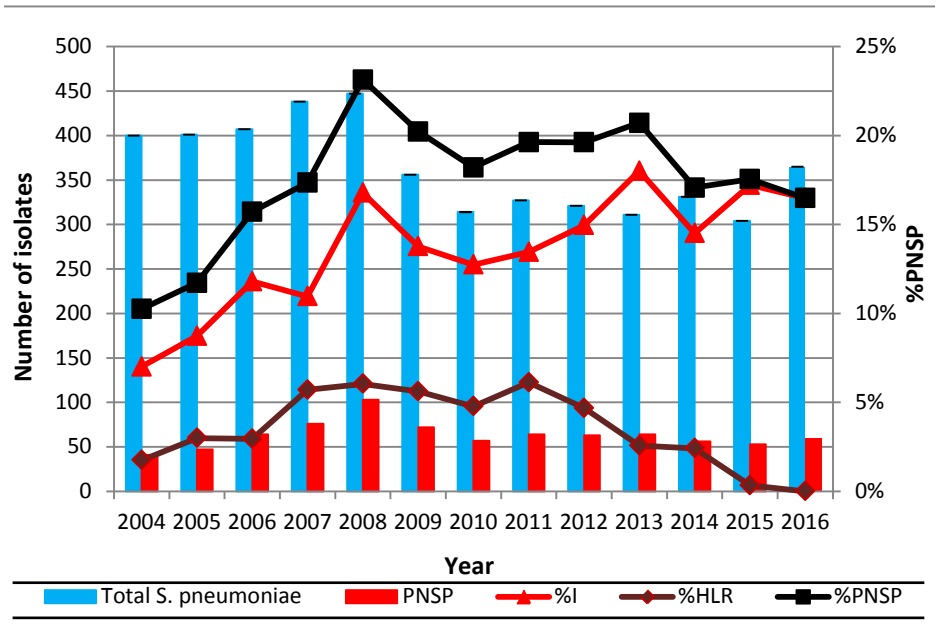


Figure 10. Trends for S. pneumoniae – total numbers of S. pneumoniae/PNSP and percentage PNSP HLR, High-level resistant; I, Intermediately resistant

carbapenemase enzyme producers and those bacteria that are resistant to carbapenems (e.g. imipenem, meropenem) as a result of a combination of resistance mechanisms (such as broad-spectrum β-lactamases and bacterial cell porin loss). These bacteria can be easily spread between patients in healthcare settings and have the ability to cause infections for which effective antimicrobial therapy may be lacking.

Detection of confirmed carbapenemase-producing CRE, hereafter known as CRE, became notifiable in Ireland in March 2011 under the category of 'unusual cluster or changing pattern of illness'. Upon amendment to the Infectious Diseases Regulations in September 2011, invasive CRE infection (blood, CSF or normally sterile site) became notifiable in its own category. A voluntary CRE enhanced surveillance scheme was established in June 2011 and reporting of isolates from any site, whether colonisation or infection is encouraged.

Enhanced surveillance data

Data was received on 107 confirmed CRE cases from 14 laboratories. Five CRE outbreaks from three acute hospitals and one nursing home were reported in 2016 (OXA-48; 3, OXA-48 and VIM CRE combined; 1 and NDM; 1). **Figure 1** displays annual trends in CRE cases and types reported to enhanced surveillance since 2011. Of 104 patients, 68 were male (65%). The median age was 75 years (range: 8 months – 99 years).

Patient location

At the time of CRE detection, 73 patients (77%) were hospitalised, 18 (19%) were in long-term care facilities (vs. three in 2015) and four (4%) were in the community. Of the 73 hospitalised patients, 47 (64%) had been admitted from home, 14 (19%) were transfers from another acute hospital, seven had been admitted from long-term care/ nursing homes (10%) and the source of admission was not provided for the remaining four patients (5%). Of the 14 patients who had been transferred from another acute hospital, one was repatriated from a hospital abroad (Guatemala).

Time to CRE colonisation/infection (interval between admission to first detection of CRE) could be calculated for 65 patients (89%), with a median interval of 10 days (range: 0 – 181).

Presence of other multi-drug resistant organisms (MDROs)

At the time of CRE detection, 50 patients (47%) were already known to be colonised or infected with at least one other MDROs, including MRSA; 22, VRE; 25, ESBL-producing *Enterobacteriaceae*; 11, *C. difficile* infection; 2 and MDR *K. pneumoniae;* 1 (note: 10 patients were colonised with two other MDROs and one with three others), and 35 of those were inpatients.

Travel history

Foreign travel in the past 12 months was reported for seven patients (7%) to six countries (Cyprus, Guatemala, India, Moldova, Morocco, Spain and UK) and 45 (42%) reported no foreign travel. The travel history was unknown for the remaining 55 (51%).

Risk factors

Risk factor data were reported on 96 patients; 53 (50%) had more than one risk factor. Hospitalisation in the past 12 months (75; 70%); history of admission to intensive care in the last 12 months (22; 21%) and history of surgery in the past six months (18; 17%). Risk factor data was unknown or not provided for 11 patients and five had no identifiable risk factors (5%).

Reported underlying co-morbidities included: diabetes mellitus (18); chronic lung disease (17); immunocompromise (11); renal disease (11); urological abnormality (10) and liver disease (2).

Prior antimicrobial exposure

Antimicrobial exposure history prior to isolation of CRE was provided for 55 patients (53%), 46 of whom were hospitalised and 22 of whom received more than one antimicrobial class:

- β-lactam/β-lactamase inhibitor combination agents - 41 (75%)
- Carbapenems - 16 (29%)
- Cephalosporins - 10 (18%)
- Fluoroquinolones - 10 (18%)
- Aminoglycosides - 9 (16%)
- Co-trimoxazole - 4 (7%)
- Colistin - 2 (4%)

Clinical significance and source of infection

The clinical significance of the CRE isolate was reported for 100 patients, representing colonisation in the majority (n=78). CRE infection was reported for 22 patients; urinary tract infection (n=7), respiratory tract infection (n=5), skin/ soft tissue infection (n=3), two cases of intra-abdominal infection (n=2) and BSI (n=1).

Specimen type

The majority of CRE (n=69; 66%) were isolated from screening swabs (rectal or stoma) or faeces. Blood accounted for six (6%), one from gall bladder, 17 from urine (16%), five from sputum (5%) and seven from various other wound swabs and tips. Specimen type was unknown for two isolates.

Outcome

Outcome was reported for 54 of the 73 hospitalised patients (74%):

- Discharged = 35 (65%)
- Still inpatient at the time the surveillance form was returned (n=11; 20%, six of whom had already had CRE infection. However, it is not known if the remaining five CRE colonised patients subsequently went on to develop CRE infection later in the hospital admission)
- Death (n=8; 15%). For one death, CRE detection represented infection. However, the potential contribution of CRE infection to patient death was not collected. Date of death was provided for all patients, with a median interval from detection of CRE to death of 13.5 days (range = 2 – 99)
- Outcome was also reported for fifteen non-hospitalised patients, five of whom survived, all of whom were residents in a long-term care facility: two of these were reported to have had CRE infection and these patients died 10 and 39 days post-diagnosis, respectively. The interval to death for

the remaining three patients was greater than 200 days.

Enterobacteriaceae species
Klebsiella pneumoniae accounted for the majority (n=44; 41%) of CRE isolates (compared with 33% of isolates in 2015). In addition, there were nine *K. oxytoca*, 16 *Escherichia coli*, 22 *Citrobacter* spp., 11 *Enterobacter* spp., two *Serratia marcescens* and one *Raoultella* spp.

Carbapenemase types reported
The carbapenemases were: OXA-48 (44; 41%), KPC (37; 35%), NDM (18; 17%), VIM (5) and IMP (1), with two not specified.

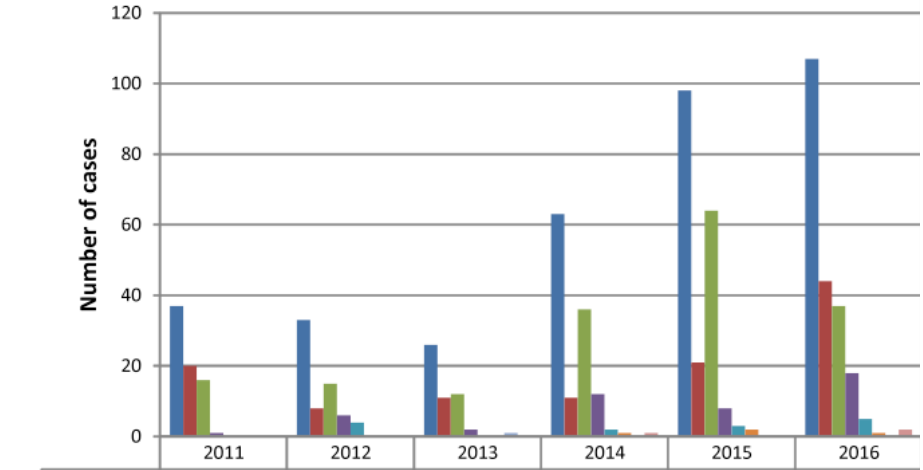
Susceptibility of isolates
Susceptibility testing data was provided on 104 of 107 isolates (97%):

- Carbapenems
  - Meropenem: reported on 94 isolates, with 73 resistant (77%); minimum inhibitory concentrations (MIC) ranged from 0.064 to >256 mg/L
  - Ertapenem: reported on all 96 isolates, with 87 resistant (91%); MIC ranged from 0.094 to >256 mg/L
- Aminoglycosides: reported on 104 isolates, with 62 (60%) resistant to one or more of the aminoglycosides listed below
  - Gentamicin: 103 isolates; 55 resistant (53%)
  - Tobramycin: 60 isolates; 33 resistant (55%)
  - Amikacin: 93 isolates; 11 resistant (12%)
- Fluoroquinolones: 93 isolates; 66 resistant (71%)
- Tigecycline: 70 isolates; 24 resistant (34%)
- Colistin: 58 isolates; one resistant

Conclusion
In 2016, 107 cases reflected a 9% increase on 98 cases in 2015. However, reference laboratory data indicated there were at least three-times (314%) more confirmed cases. In response to the emergence of CRE and suboptimal participation in voluntary enhanced surveillance, it was decided to replace voluntary with mandatory reporting by microbiology laboratories from January 2017.

Acknowledgements:
Sincere thanks to colleagues working in microbiology laboratories and infection prevention and control teams across Ireland for submitting enhanced surveillance data on patients with CRE.

Sincere thanks also to colleagues in the CPEaRLS, Galway University Hospital for data on confirmed carbapenemase-producing *Enterobacteriaceae* in 2016 (Source: CPEaRLS annual report 2016).



	2011	2012	2013	2014	2015	2016
TOTAL	37	33	26	63	98	107
OXA	20	8	11	11	21	44
KPC	16	15	12	36	64	37
NDM	1	6	2	12	8	18
VIM		4		2	3	5
IMP				1	2	1
IMI			1			
Other/Unk				1		2

Figure 1. Annual trends in CRE cases and carbapenemase types reported to voluntary enhanced surveillance (2011 – 2016)

Please note that the reduction in reported cases between 2012 and 2013 reflects under-reporting rather than a true decline in CRE. Almost twice as many isolates were confirmed by the CPEaRLS, Galway University Hospital in 2013 (n=50), approximately one-third as many isolates in 2014 (n=87) and 2015 (n=143) and over three-times as many isolates in 2016 (n=362) than were reported to the voluntary CRE enhanced surveillance scheme

c) Enhanced Surveillance of Multi-Drug Resistant K. pneumoniae (MDRKP)

2016 Summary

- Comparing 2016 with 2015, there was a 19% increase in the total numbers of MDRKP reported
- The MDRKP/CRE phenotype increased by approximately two-fold (195%): with 119 cases reported, compared with 61 cases in 2015

Background

A national increase in multi-drug-resistant *Klebsiella pneumoniae* (MDRKP) was first identified by the Antimicrobial Resistance and Microbial Ecology (ARME) Group at NUI Galway in the autumn of 2013. Following this, an increase in BSI caused by MDRKP was also confirmed through the Irish EARS-Net data reported to the HPSC. An outbreak control team (OCT) was established at HPSC in October 2013 to review existing surveillance data and request additional data from hospital laboratories. Following this, prospective mandatory national surveillance for MDRKP commenced in January 2014.

Case definition

The first isolate per patient per quarter of *K. pneumoniae* derived from any specimen type (both clinical and screening) that are (1) ESBL-producers and non-susceptible to both ciprofloxacin and gentamicin OR non-susceptible to 3rd generation cephalosporins (3GC) and ciprofloxacin and gentamicin, where investigation for ESBLs is not routinely carried out **[MDRKP/Non-CRE]** AND/OR (2) carbapenemase-producers **[MDRKP/CRE]**.

Results (2014 – 2016)

For the three years of surveillance, 1,449 MDRKP cases were reported by 53 (88%) of 60 acute hospitals in Ireland (Table 1). Seven acute hospitals; specialty (n=5), general (n=1) and private (n=1) did not report any cases.

MDRKP/Non-CRE accounted for 1,215 (84%) and MDRKP/CRE for 234 (16%). Of the MDRKP/CRE cases, 23% also fulfilled the MDRKP/Non-CRE criteria, but were categorised as MDRKP/CRE for the purposes of this report

Clinical specimens accounted for the majority of MDRKP isolates (n=1,171; 81%). However, an upward trend is evident in the proportion detected from screening specimens (rectal swabs/faeces); 25% in 2016 versus 16% in both 2014 and 2015

While two-thirds of cases were associated with patients admitted to or attending an acute hospital, one-third of cases were detected in patients attending general practice or residents of long-term care facilities (LTCF)

Of 804 MDRKP cases from hospital inpatients:

- Information on antimicrobial therapy for MDRKP infection was provided for 484 (58%), of whom 282 (58%) had required antimicrobial therapy for MDRKP infection prior to case notification
- Information on patient isolation was provided for 553 (66%), of whom 465 (84%) were isolated within 24 hours of the laboratory reporting MDRKP detection. Therefore, 16% were not isolated and the isolation status of 34% was either not provided or unavailable

Trends (2016 versus 2015)

In 2016, there were 534 cases of MDRKP (415 MDRKP/Non-CRE and 119 MDRKP/CRE) from 480 patients, with some previously known patients with MDRKP reported again in a different quarter. This reflects **an increase of 19%** from 449 cases (388 MDRKP/Non-CRE and 61 MDRKP/CRE) from 385 patients in 2015. Excluding repeat notifications from the same patient, defined as **one isolate per patient over the 12-month period**, there was **an increase of 25%** from 385 cases in 2015 to 480 cases in 2016 (Table 1).

In 2016, the number of MDRKP/CRE cases **increased by almost two-fold (or 195%),** with 119 cases (representing 22% of all MDRKP cases) reported (Table 1) compared with 61 cases in 2015 (14% of all MDRKP cases).

By the end of 2016, it was evident that MDRKP was widely distributed across the Irish healthcare system, with rapid and concerning increases in the proportion that were also carbapenem resistant. In light of these findings, it was decided to step down mandatory national enhanced MDRKP surveillance at the end of Q4 2016 and to replace it with mandatory national enhanced surveillance for carbapenemase-producing carbapenem resistant *Enterobacteriaceae* (CRE/CPE) effective Q1 2017.

Table 1. Annual summary of MDRKP cases: 2014 to 2016

	TIME PERIOD								
	2014		2015		2016		TOTAL		
	Jan-Dec		Jan-Dec		Jan-Dec		Jan 2014-Dec 2016		COMMENT ON TOTAL DATA
	n	%	n	%	n	%	n	%	
MDRKP (based on case definition of 1st isolate per patient per quarter, see Table 1 above)	466		449		534		1449		of which 976 cases (67%) associated with 53 (of 60) acute hospitals (including outpatients)
Patients with MDRKP (based on one isolate per patient per year)	411		385		480		1276		of which 876 cases (69%) associated with 53 (of 60) acute hospitals (including outpatients)
of which: MDRKP/Non-CRE	363	88%	332	86%	379	79%	1074	84%	
MDRKP/CRE	48	12%	53	14%	101	21%	202	16%	71 KPC, 88 OXA-48, 42 NDM, 1 NDM/OXA-48

Further information on MDRKP in Ireland is available on the HPSC website at:
http://www.hpsc.ie/a-z/microbiologyantimicrobialresistance/europeanantimicrobialresistancesurveillancesystemearss/referenceandeducationalresourcematerial/klebsiellapneumoniae/dataonmultidrugresistantkpneumoniae/MDRKP%20Update_Jan2014-Dec2016%20data_Final.pdf

Acknowledgements:
Sincere thanks to colleagues working in microbiology laboratories and infection prevention and control teams across Ireland for submitting enhanced surveillance data on patients with MDRKP.

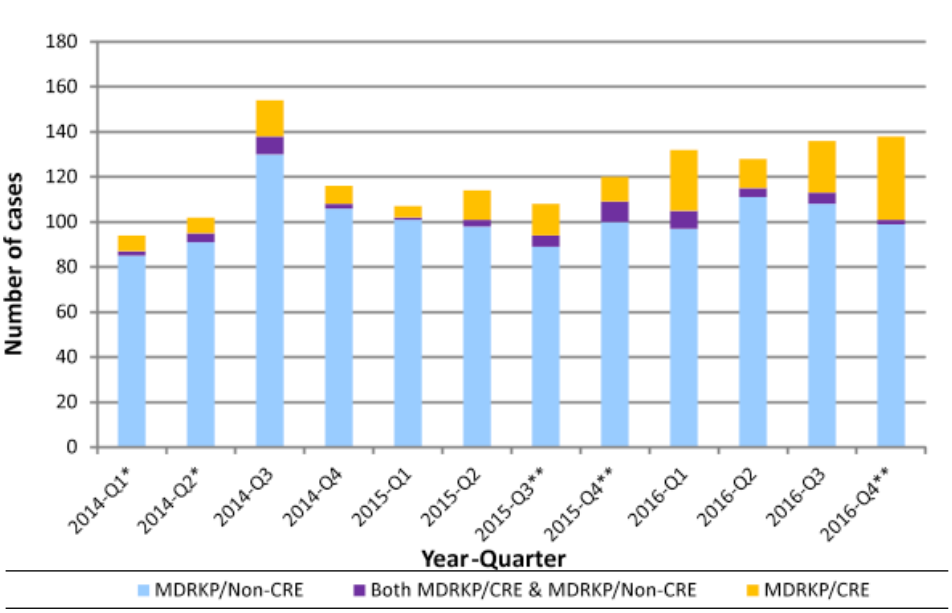


Figure 1. Quarterly MDRKP cases (CRE and Non-CRE): Q1 2014 – Q4 2016
*No data from one tertiary hospital for Q1-2 2014; ** No data from one general hospital for Q3-4 2015 and Q4 2016

9.5. Point Prevalence Survey of Healthcare-Associated Infections & Antimicrobial Use in Long-Term Care Facilities (HALT): May 2016

In May 2016, 10,044 residents in 224 Irish long-term care facilities (LTCF) were included in a European point prevalence survey (PPS) of healthcare-associated infections (HCAI) and antimicrobial use. The survey is also known as the HALT survey.

Table 1 summarises the characteristics of participating LTCF by ownership and by care type. LTCF were stratified into eight main care type categories, with some also based on the estimated duration of residence for the majority of residents (short stay <12 months, long stay >12 months)

- Of the 224 LTCF, the majority were owned by the HSE [n=136; 61%], followed by private [n=54; 24%] and voluntary services [n=34; 15%]
- The median capacity of participating LTCF was 42 beds (range = 5 – 176) and the median bed occupancy on the HALT survey date was 93%
- Overall, single room accommodation accounted for a median of 71% of available beds. The proportion of single room accommodation in HSE-owned (52%) was lower than that of private (83%) and voluntary (87%) LTCF

Nurse and healthcare assistant staffing, medical care and coordination, infection prevention & control & antimicrobial stewardship

- Overall, resident medical care was provided by the resident's own general practitioner (GP) in 49.5%, by a directly-employed doctor in 28.5% and by a mix of GP plus directly-employed doctor care in 22% of LTCF. However, when LTCF were stratified by ownership, GP-led medical care was 96% in private LTCF versus 33% in HSE LTCF
- A designated coordinating physician, with responsibility for coordination and standardisation of policies/practices for resident medical care within the LTCF was available for 65% of LTCF overall and for 56% of private LTCF
- An active local infection prevention and control committee (IPCC) was reported by 61% of LTCF
- Access to a staff member with infection prevention and control (IPC) training was reported by 76% of LTCF overall and by 57% of private LTCF. For the vast majority of LTCF with a trained IPC staff member, that person was an infection prevention and control nurse (IPCN) (93.5%). However, for the majority of LTCF (58%), the IPCN was not based in the LTCF on a day-to-day basis

Table 1. Breakdown of participating LTCF, by ownership and care type.

Category	No. of LTCF	Size of facility			Total residents Surveyed	Median proportion of single rooms	Median percentage of beds occupied
	n	median	min	max	n	%	%
by Ownership							
HSE	136	33	5	167	5213	52	91
Private	54	59	19	140	3031	83	95
Voluntary	34	51	10	176	1800	87	94
by Care Type							
General nursing >12 months	88	55	18	167	4722	73	98
Mixed >12 months	46	50	20	142	2499	61	91
LTCF <12 months	14	35	16	72	441	52	87
Intellectually disabled	31	28	5	176	1251	92	96
Psychiatric	23	22	10	86	505	57	86
Palliative care	7	19	8	48	134	80	79
Physically disabled	1	14	14	14	13	100	93
Rehabilitation	5	64	14	72	245	44	90
Other	9	27	13	60	234	53	85
National	**224**	**42**	**5**	**176**	**10044**	**71**	**93**

- A written local hand hygiene policy was available in 95% of LTCF, with provision of a staff hand hygiene training session in the past 12 months reported by 83% of LTCF. The available products for hand hygiene were alcohol-based hand rub (ABHR) and liquid soap in 96% and 95% of LTCF, respectively
- Compliance with hand hygiene opportunities was not collected in HALT 2016
- The provision of seasonal influenza vaccination for residents was not universal, with 9% of LTCF overall reporting this was not routine local practice
- The vast majority (98%) reported having no active local antimicrobial stewardship committee (ASC). Training on antimicrobial prescribing was not provided by 94% and 56% of LTCF reported having no local antimicrobial prescribing guidelines
- Prescriber feedback regarding local antimicrobial consumption was available in just 14% of LTCF
- LTCF with a designated coordinating physician were significantly more likely to demonstrate positive local antimicrobial stewardship practices such as; an active ASC, training for prescribers and local prescribing guidelines

Resident demographics, nursing care requirements and HCAI risk factors

- Female residents predominated in most care types, other than psychiatric and palliative LTCF. The proportion of residents aged ≥85 years was highest in GN>12m (49%), Mixed>12m (47%) and LTCF<12m (41%). In contrast, 1% of intellectually disabled LTCF residents were aged ≥85 years
- Selected indicators of resident nursing care requirements (incontinence, disorientation and impaired mobility) were evident in all care types, but most prevalent in GN>12m, Mixed>12m and LTCF<12m
- HCAI risk factors (presence of urinary or vascular catheter, pressure ulcers or 'other' wounds) were most prevalent in palliative care LTCF
- Almost two percent (n=170) of residents with an infection or taking antimicrobials, had a history of hospitalisation within three months of the survey

LTCF-acquired infections (LAI)

- For infections acquired in long-term care, the national crude prevalence was 4.4% and the median prevalence was 3.4%. The median prevalence was higher in LTCF<12m (6.6%), rehabilitation (4.9%) and mixed>12m (4.5%). The highest prevalence was reported in palliative care LTCF (8.3%), which may reflect underlying illness and the prevalence of HCAI risk factors encountered in that unique resident cohort
- The most prevalent LAI types were: respiratory tract infections (RTI), urinary tract infections (UTI) and skin infections; affecting 1.5%, 1.5% and 1.1% of all residents, respectively
- A relevant microbiological specimen had been obtained for 37% of infections, with microorganisms isolated in 14%. *Escherichia coli* (35%) and *Staphylococcus aureus* (29%) were the most frequently reported microorganisms. Of those with available antimicrobial susceptibility results, 4% of *E. coli* were resistant to 3rd generation cephalosporins and 16% of *S. aureus* were meticillin/flucloxacillin resistant (i.e., MRSA). There were no LAI associated with carbapenem resistant *Enterobacteriaceae* (CRE) reported during the HALT survey

Hospital-acquired infections (HAI)

- Data was collected on hospital-acquired infections (HAI), whereby the resident was transferred to the LTCF with an active HAI or developed a HAI on day one or day two following transfer to the LTCF. No HAI were reported by 88% of LTCF. The crude national prevalence of HAI in Irish LTCF was 0.4%. Therefore, the vast majority of HCAI in LTCF in Ireland are acquired within the LTCF

Antimicrobial use and antimicrobial resistance

- The national crude antimicrobial use prevalence was 9.8%, with a median antimicrobial use prevalence of 8.3%. The median prevalence was higher in LTCF<12m (12.1%) and rehabilitation LTCF (10.9%). At 30.8%, the prevalence in palliative care LTCF was more similar to that reported in acute hospitals
- The majority of antimicrobials were prescribed within the LTCF (83%)
- Overall, 59% of antimicrobials were prescribed to treat infection. However, antimicrobial prophylaxis accounted for the majority of prescriptions in intellectually disabled LTCF (54%)
- During HALT 2016, 3.4% of Mixed>12m and 3.1% of GN>12m residents were prescribed antimicrobials for UTI prophylaxis. Prophylaxis against RTI was most prevalent in intellectually disabled (2.0%) and palliative care (1.5%) LTCF

The 2016 HALT national report is available on the HPSC website: http://www.hpsc.ie/a-z/microbiologyantimicrobialresistance/infectioncontrolandhai/surveillance/hcaiinlongtermcarefacilities/haltreports/2016report/

2016

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10

COMPUTERISED INFECTIOUS DISEASE REPORTING SYSTEM (CIDR)

10. Computerised Infectious Disease Reporting (CIDR)

Summary

- The highest ever annual number of notifications was recorded on CIDR in 2016 (n=33,170). Zika virus infection became notifiable in May 2016 and was added to the diseases notified via CIDR, bringing the total to 77 diseases of all 84 notifiable diseases
- The average number of active CIDR users in 2016 was 269
- A full IS27001 Information Security re-accreditation audit was performed and certification was retained
- 47 new users were trained and 6 existing users received advanced training during 2016
- 3 CIDR Web application releases were deployed during 2016
- CIDR was available for 99.8% of core working hours during 2016
- A failover / failback test of the CIDR Disaster Recovery / Business Continuity infrastructure completed successfully
- Phase 1 of a project to develop a STI / HIV Clinic Module on CIDR was completed

CIDR OPERATIONS

INFORMATION SECURITY ACCREDITATION

The HPSC Information Security Management System (ISMS) which includes CIDR was fully re-accredited in April 2016 to ISO 27001:2013 standard.

The HPSC Information Governance Framework, which includes CIDR, provides re-assurance to users and partners of the CIDR system, the Data Protection Commissioner and the data subjects relating to sensitive data stored and managed by the system. Maintenance of this accreditation standard is vital to information security.

CIDR USER TRAINING

Forty-seven new CIDR users were trained during 2016. There were 35 public health users and 12 laboratory users trained. Six existing public health users received advanced application training during 2016.

CIDR APPLICATION SOFTWARE UPDATES AND SYSTEM AVAILABILITY

Three functional releases of the CIDR Web Application software were deployed during 2016 - in February, June and July. These were made to improve performance, browser compatibility, session management and security.

CIDR availability was 99.8% during core working hours in

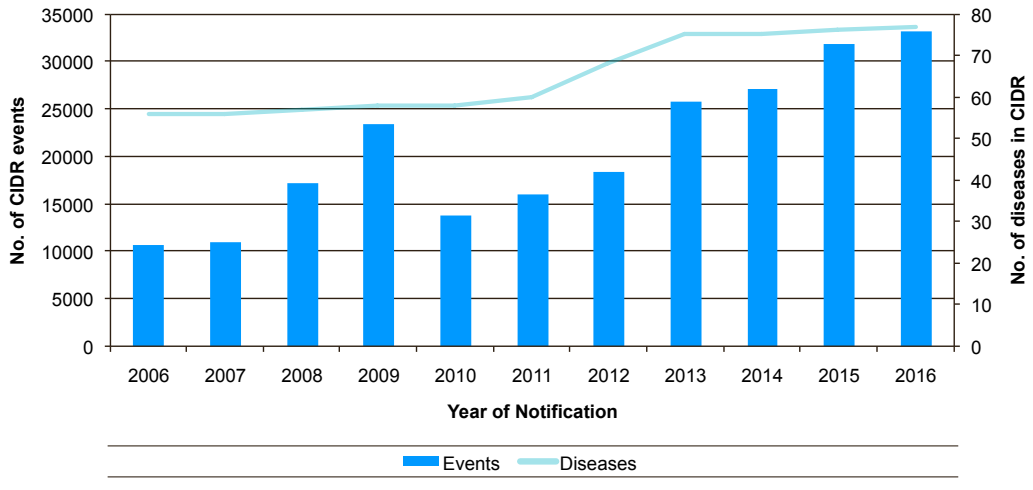

Figure 1. The volume of statutory infectious disease notifications and corresponding number of diseases in CIDR per year, since 2006 when national implementation commenced (as of 21st August, 2017)

2016. 71% of down-time was scheduled; either between 13:00 and 14:00 or outside core working hours; with users aware in advance of service interruptions. Un-scheduled down-time amounted to 4 hours of service unavailability during core working hours over the year.

CIDR DISASTER RECOVERY / BUSINESS CONTINUITY

A successful failover / failback test to the off-premises CIDR disaster recovery infrastructure was completed in February 2016. The test confirmed that the system may be failed over, continue to operate, and failed back to the main infrastructure in the event of unexpected or prolonged unavailability.

CIDR STI / HIV CLINIC MODULE DEVELOPMENT PROJECT

In conjunction with the Sexual Health and Crisis Pregnancy Programme (SHCPP), a project team was assembled in July 2016 to address phase one of a multi-phase project intended to contribute to successful implementation of the Sexual Health Strategy by delivering a major improvement in the quality of the information available for monitoring sexual ill-health. The objectives of Phase 1 of the project were:

- To complete a feasibility assessment of the capacity for electronic surveillance based on an analysis of existing STI/HIV clinics and systems in Ireland, documenting existing processes and the capabilities of the systems to provide data for surveillance
- To define the dataset(s) feasible for extraction for surveillance
- To complete Requirements and Functional Specifications for the development of a STI/HIV clinic module on CIDR

This project was completed in 2016 and pending funding approval, will move to phase 2, to include system development in 2017.

GOVERNANCE AND COMMUNICATIONS

The National CIDR Steering Group continued to provide guidance and oversight of CIDR through 2016 and met by teleconference on four occasions during the year. The National CIDR User Group convened on four occasions throughout the year, also by teleconference, to discuss the on-going use of CIDR and associated developments.

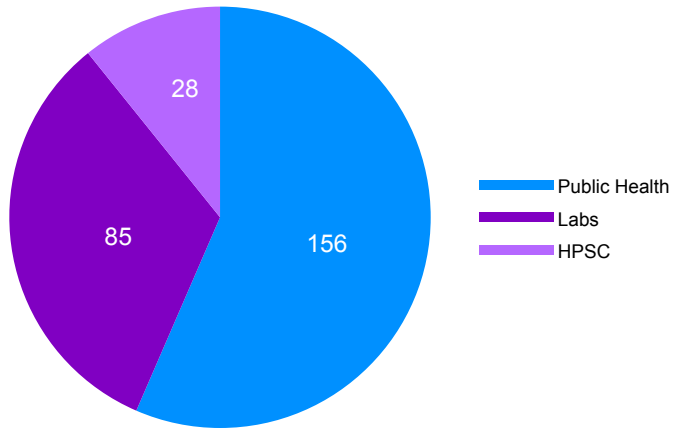

Figure 2. The number of users of the CIDR system in Departments of Public Health, in diagnostic and reference laboratories and in HPSC in 2016 (total=269)

2016

ANNUAL EPIDEMIOLOGICAL REPORT

APPENDIX 1
NOTIFIABLE INFECTIOUS DISEASES IN IRELAND

Notes:

Figures for the year 2016 presented in this appendix were extracted from the Computerised Infectious Disease Reporting (CIDR) system on the 22nd November, 2017. Please note that some figures may differ from figures published previously or other chapters in this report, due to ongoing updating of notification data on CIDR.

Figures for the EARS-Net pathogens (*Escherichia coli*, Enterococci, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa* and *Staphylococcus aureus*) and certain sexually transmitted infections (specifically, ano-genital warts and non-specific urethritis) are not provided here, as these diseases were not notified via the CIDR system during the above period.

Table A1.1. List of notifiable infectious diseases and their respective causative pathogens (relevant to 2016) under Infectious Diseases (Amendment) Regulations 2016 (S.I. No.276 of 2016) (May 2016)

Infectious Disease	Causative Pathogen(s)
Acute anterior poliomyelitis	Polio virus
Ano-genital warts	Human papilloma virus
Anthrax	*Bacillus anthracis*
Bacillus cereus food-borne infection/intoxication	*Bacillus cereus*
Bacterial meningitis (not otherwise specified)	
Botulism	*Clostridium botulinum*
Brucellosis	*Brucella* spp.
Campylobacter infection	*Campylobacter* spp.
Carbapenem-resistant *Enterobacteriaceae* infection (invasive)	Carbapenem-resistant *Enterobacteriaceae* (blood, CSF or other normally sterile site)
Chancroid	*Haemophilus ducreyi*
Chickenpox – hospitalised cases	Varicella-zoster virus
Chikungunya disease	Chikungunya virus
Chlamydia trachomatis infection (genital)	*Chlamydia trachomatis*
Cholera	*Vibrio cholerae*
Clostridium difficile infection	*Clostridium difficile*
Clostridium perfringens (type A) food-borne disease	*Clostridium perfringens*
Creutzfeldt Jakob disease	
variant Creutzfeldt Jakob disease	
Cryptosporidiosis	*Cryptosporidium parvum, hominis*
Cytomegalovirus infection (congenital)	Cytomegalovirus
Dengue fever	Dengue virus
Diphtheria	*Corynebacterium diphtheriae* or *ulcerans* (toxin producing)
Echinococcosis	*Echinococcus* spp.
Enterococcal bacteraemia	*Enterococcus* spp. (blood)
Escherichia coli infection (invasive)	*Escherichia coli* (blood, CSF)
Giardiasis	*Giardia lamblia*
Gonorrhoea	*Neisseria gonorrhoeae*
Granuloma inguinale	*Klebsiella granulomatis*
Haemophilus influenzae disease (invasive)	*Haemophilus influenzae* (blood, CSF or other normally sterile site)
Hepatitis A (acute) infection	Hepatitis A virus
Hepatitis B (acute and chronic) infection	Hepatitis B virus
Hepatitis C infection	Hepatitis C virus
Hepatitis E infection	Hepatitis E virus
Herpes simplex (genital)	Herpes simplex virus
Human immunodeficiency virus infection	Human immunodeficiency virus
Influenza	Influenza A and B virus
Klebsiella pneumoniae infection (invasive)	*Klebsiella pneumoniae* (blood or CSF)
Legionellosis	*Legionella* spp.
Leprosy	*Mycobacterium leprae*
Leptospirosis	*Leptospira* spp.
Listeriosis	*Listeria monocytogenes*
Lyme disease (neuroborreliosis)	*Borrelia burgdorferi*
Lymphogranuloma venereum	*Chlamydia trachomatis*
Malaria	*Plasmodium falciparum, vivax, knowlesi, ovale, malariae*
Measles	Measles virus
Meningococcal disease	*Neisseria meningitidis*
Mumps	Mumps virus
Non-specific urethritis	
Noroviral infection	Norovirus
Paratyphoid	*Salmonella* Paratyphi
Pertussis	*Bordetella pertussis*
Plague	*Yersinia pestis*
Pseudomonas aeruginosa infection (invasive)	*Pseudomonas aeruginosa* (blood or CSF)
Q Fever	*Coxiella burnetii*
Rabies	Rabies virus
Respiratory syncytial virus infection	Respiratory syncytial virus
Rotavirus infection	Rotavirus
Rubella	Rubella virus
Salmonellosis	*Salmonella* spp. other than S. Typhi and S. Paratyphi
Severe Acute Respiratory Syndrome (SARS)	SARS-associated coronavirus
Shigellosis	*Shigella* spp.

Table A1.1. List of notifiable infectious diseases and their respective causative pathogens (relevant to 2016) under Infectious Diseases (Amendment) Regulations 2016 (S.I. No.276 of 2016) (May 2016) Continued.

Infectious Disease	Causative Pathogen(s)
Smallpox	Variola virus
Staphylococcal food poisoning	Enterotoxigenic *Staphylococcus aureus*
Staphylococcus aureus bacteraemia	*Staphylococcus aureus* (blood)
Streptococcus group A infection (invasive)	*Streptococcus pyogenes* (blood, CSF or other normally sterile site)
Streptococcus group B infection (invasive)	*Streptococcus agalactiae* (blood, CSF or other normally sterile site)
Streptococcus pneumoniae infection (invasive)	*Streptococcus pneumoniae* (blood, CSF or other normally sterile site)
Syphilis	*Treponema pallidum*
Tetanus	*Clostridium tetani*
Toxoplasmosis	*Toxoplasma gondii*
Trichinosis	*Trichinella* spp.
Trichomoniasis	*Trichomonas vaginalis*
Tuberculosis	*Mycobacterium tuberculosis* complex
Tularemia	*Francisella tularensis*
Typhoid	*Salmonella* Typhi
Typhus	*Rickettsia prowazekii*
Verotoxigenic *Escherichia coli* infection	Verotoxin producing *Escherichia coli*
Viral encephalitis	
Viral haemorrhagic fevers	
Viral meningitis	
West Nile fever	West Nile virus
Yellow fever	Yellow fever virus
Yersiniosis	*Yersinia enterocolitica,Yersinia pseudotuberculosis*
Zika virus infection	Zika virus

Table A1.2 Number of notifiable infectious diseases, 2014-2016 and crude incidence rates of diseases, 2016

Infectious Disease	2014	2015	2016	CIR 2016
Acute anterior poliomyelitis	0	0	0	0.00
Anthrax	0	0	0	0.00
Bacillus cereus food-borne infection or intoxication	0	1	0	0.00
Bacterial meningitis (not otherwise specified)	23	32	15	0.32
Botulism	1	0	0	0.00
Brucellosis	3	0	2	0.04
Campylobacter infection	2611	2448	2513	52.77
Carbapenem-resistant *Enterobacteriaceae* infection (invasive)	5	8	14	0.29
Chancroid	0	0	0	0.00
Chickenpox - hospitalised cases	61	69	106	2.22
Chikungunya disease	1	1	1	0.02
Chlamydia trachomatis infection (genital)^	6687	6786	6893	144.75
Cholera	0	0	0	0.00
*Clostridium difficile infection**	1801	1943	1871	40.36##
Clostridium perfringens (type A) food-borne disease	0	1	0	0.00
Creutzfeldt Jakob disease	2	5	5	0.11
Creutzfeldt Jakob disease (variant)	0	0	0	0.00
Cryptosporidiosis	394	439	561	11.78
Cytomegalovirus infection (congenital)	12	15	20	0.42
Dengue fever	21	8	18	0.38
Diphtheria	0	1	1	0.02
Echinococcosis	0	0	2	0.04
Giardiasis	71	145	202	4.24
Gonorrhoea	1309	1294	1956	41.08
Granuloma inguinale	0	0	0	0.00
Haemophilus influenzae disease (invasive)	61	52	58	1.22
Hepatitis A (acute)	21	36	38	0.80
Hepatitis B (acute and chronic)	442	548	488	10.25
Hepatitis C	692	674	645	13.55
Hepatitis E#	NA	3	90	1.89
Herpes simplex (genital)	1234	1274	1369	28.75
Human immunodeficiency virus infection	377	483	508	10.67
Influenza	1757	2680	4764	100.04
Legionellosis††	8	12	10	0.21
Leprosy	0	0	1	0.02
Leptospirosis	23	16	26	0.55
Listeriosis	15	19	13	0.27
Lyme disease	18	11	21	0.44
Lymphogranuloma venereum	35	20	48	1.01
Malaria	80	81	88	1.85
Measles	33	2	43	0.90
Meningococcal disease	82	74	87	1.83
Mumps	742	2014	491	10.31
Noroviral infection^	807	1262	1832	38.47
Paratyphoid	5	1	7	0.15
Pertussis	73	117	213	4.47
Plague	0	0	0	0.00
Q fever	0	4	6	0.13
Rabies	0	0	0	0.00
Respiratory syncytial virus infection^	2479	2201	2690	56.49
Rotavirus infection^	2061	4157	2371	49.79
Rubella	3	2	1	0.02
Salmonellosis	260	269	302	6.34
Severe Acute Respiratory Syndrome (SARS)	0	0	0	0.00
Shigellosis	57	90	84	1.76
Smallpox	0	0	0	0.00
Staphylococcal food poisoning	0	0	0	0.00
Streptococcus group A infection (invasive)	164	107	148	3.11
Streptococcus group B infection (invasive) ‖	68	69	65	-
Streptococcus pneumoniae infection (invasive)**	679	549	381	8.00
Syphilis*^	273	421	446	9.37

Table A1.2 Number of notifiable infectious diseases, 2014-2016 and crude incidence rates of diseases, 2016. Continued.

Infectious Disease	2014	2015	2016	CIR 2016
Tetanus	1	1	0	0.00
Toxoplasmosis	20	25	24	0.50
Trichinosis	0	0	0	0.00
Trichomoniasis	92	56	79	1.66
Tuberculosis	313	283	318	6.68
Tularemia	0	0	0	0.00
Typhoid	7	9	10	0.21
Typhus	0	0	0	0.00
Verotoxigenic *Escherichia coli* infection	706	730	839	17.62
Viral encephalitis	67	47	61	1.28
Viral haemorrhagic fevers	0	0	0	0.00
Viral meningitis	435	261	299	6.28
West Nile fever	0	0	0	0.00
Yellow fever	0	0	0	0.00
Yersiniosis	5	13	3	0.06
Zika virus infection†	NA	NA	13	0.27
Total	27197	31869	33160	

Notes

1. NA: Indicates that data not available in CIDR for the diseases and years indicated above

2. CIR, Crude incidence rate per 100,000 total population

*Since 01/01/2012, both new and recurrent cases of *Clostridium difficile* infection are notifiable.##The CIR was calculated for the population aged 2 years and above

#Hepatitis E became notifiable on the 15/12/2015.

***Streptococcus pneumoniae* infection (invasive) figures relate to confirmed cases only since 01/07/2015.

*^From 1st July, 2016, laboratory criteria for the notification of syphilis cases have been updated further to reduce the volume of latent or treated cases being notified. Direct comparison of 2016 syphilis notification data with notification data for previous years (which includes non-infectious cases) is not valid

^Since 17/03/2013, figures for *Chlamydia trachomatis*, noroviral infection, respiratory syncytial virus infection and rotavirus infection may refer to notifications from HSE E rather than events. Such notifications from HSE E may also refer to area of laboratory testing rather than patient's area of residence

††Legionellosis figures include both Legionnaires' disease and Pontiac fever cases

||Streptococcus group B (*Streptococcus agalactiae*) infection (invasive) in infants <90 days old or stillborn infants

†Zika virus became notifiable in May 2016

For more information on notifiable infectious diseases please see HPSC's Case Definitions document available at http://www.hpsc.ie

Table A1.3 Number of notifiable infectious diseases by HSE area, 2016

Infectious Disease	HSE E	HSE M	HSE MW	HSE NE	HSE NW	HSE SE	HSE S	HSE W	Total
Bacterial meningitis (not otherwise specified)	4	0	1	0	1	4	3	2	15
Brucellosis	*	*	*	*	*	*	*	*	2
Campylobacter infection	787	204	229	169	92	341	394	297	2513
Carbapenem-resistant *Enterobacteriaceae* infection (invasive)	7	0	0	2	0	1	0	4	14
Chickenpox - hospitalised cases	54	7	2	14	3	8	13	5	106
Chikungunya disease	*	*	*	*	*	*	*	*	1
Chlamydia trachomatis infection (genital)^	3497	184	551	308	244	636	901	572	6893
Clostridium difficile infection‡	715	72	163	117	112	207	251	234	1871
Creutzfeldt Jakob disease	1	0	0	0	0	2	2	0	5
Cryptosporidiosis	69	58	58	38	41	117	94	86	561
Cytomegalovirus infection (congenital)	14	0	1	2	1	0	2	0	20
Dengue fever	11	1	1	1	0	1	2	1	18
Diphtheria	*	*	*	*	*	*	*	*	1
Echinococcosis	*	*	*	*	*	*	*	*	2
Giardiasis	63	7	5	4	2	53	35	33	202
Gonorrhoea	1389	40	99	54	37	95	133	109	1956
Haemophilus influenzae disease (invasive)	19	6	5	5	5	5	7	6	58
Hepatitis A (acute)	10	3	3	4	0	5	8	5	38
Hepatitis B (acute and chronic)	295	20	26	45	5	33	35	29	488
Hepatitis C	450	30	21	37	11	25	41	30	645
Hepatitis E#	43	5	7	8	3	5	11	8	90
Herpes simplex (genital)	792	32	84	36	39	113	153	120	1369
Human immunodeficiency virus infection	360	14	22	23	5	13	51	20	508
Influenza	1518	244	568	345	148	942	556	443	4764
Legionellosis‡	3	2	0	3	1	0	0	1	10
Leprosy	*	*	*	*	*	*	*	*	1
Leptospirosis	10	0	7	3	0	2	2	2	26
Listeriosis	4	0	2	1	2	1	2	1	13
Lyme disease	3	2	5	0	1	0	8	2	21
Lymphogranuloma venereum	42	-	2	2	-	1	-	1	48
Malaria	46	5	1	13	2	5	10	6	88
Measles	4	0	4	1	0	5	27	2	43
Meningococcal disease	24	6	5	8	12	8	18	6	87
Mumps	140	45	31	21	19	66	111	58	491
Noroviral infection^	1020	75	117	210	79	58	187	86	1832
Paratyphoid	1	1	2	0	1	0	1	1	7
Pertussis	110	6	3	12	5	29	35	13	213
Q fever	0	0	1	2	0	1	0	2	6
Respiratory syncytial virus infection^	1427	94	216	160	187	198	253	155	2690
Rotavirus infection^	831	207	172	196	99	290	332	244	2371
Rubella	*	*	*	*	*	*	*	*	1
Salmonellosis	118	26	24	21	17	27	39	30	302
Shigellosis	42	4	4	6	2	8	9	9	84
Streptococcus group A infection (invasive)	68	10	12	15	3	15	12	13	148
Streptococcus group B infection (invasive)	25	1	7	9	4	5	11	3	65
Streptococcus group B infection (invasive)‖	153	21	31	29	17	51	52	27	381
Syphilis	315	15	19	16	4	15	48	14	446
Toxoplasmosis	8	1	1	0	1	1	6	6	24
Trichomoniasis	47	-	15	2	5	3	5	2	79
Tuberculosis	136	16	26	22	5	31	52	30	318
Typhoid	4	0	1	0	0	0	2	3	10
Verotoxigenic *Escherichia coli* infection	131	92	124	52	31	131	159	119	839
Viral encephalitis	32	4	3	4	4	4	7	3	61
Viral meningitis	149	17	20	24	13	27	27	22	299
Yersiniosis	*	*	*	*	*	*	*	*	3
Zika virus infection†	9	0	0	2	1	0	0	1	13

Notes:

1. This table does not include details of diseases for which a zero number of cases were notified; see Table A1.1 for details of these diseases in 2016

*Data not reported to HSE area level when total number in Ireland <5 cases

#Hepatitis E became notifiable on the 15/12/2015.

^Since 17/03/2013, figures for *Chlamydia trachomatis*, noroviral infection, respiratory syncytial virus infection and rotavirus infection may refer to notifications from HSE E rather than events. Such notifications from HSE E may also refer to area of laboratory testing rather than patient's area of residence

‡*C. difficile* figures in the *C. difficile* chapter are presented by quarter rather than using the 2016 epidemiological calendar year as shown here

‡Legionellosis figures include both Legionnaires' disease and Pontiac fever cases

‖Streptococcus group B (*Streptococcus agalactiae*) infection (invasive) in infants <90 days old or stillborn infants

†Zika virus became notifiable in May 2016

Table A1.4 Number of notifiable infectious diseases by age group (years), 2016

Infectious Disease	0-4	5-9	10-14	15-19	20-24	25-34	35-44	45-54	55-64	65+	Unknown	Total
Bacterial meningitis (not otherwise specified)	4	1	1	1	1	3	0	1	1	2	0	15
Brucellosis	0	0	0	0	0	0	0	1	0	1	0	2
Campylobacter infection	552	158	69	83	159	302	248	260	255	423	4	2513
Carbapenem-resistant *Enterobacteriaceae* infection (invasive)	0	1	0	0	0	0	2	0	1	10	0	14
Chickenpox - hospitalised cases	55	14	7	3	4	7	6	2	2	6	0	106
Chikungunya disease	*	*	*	0	0	0	1	0	0	0	0	1
Chlamydia trachomatis infection (genital)^	*	*	*	608	2754	2679	616	163	40	15	3	6893
Clostridium difficile infection†	31	24	10	27	28	106	108	104	196	1237	0	1871
Creutzfeldt Jakob disease	0	0	0	0	0	0	0	0	2	3	0	5
Cryptosporidiosis	247	132	58	24	24	43	17	7	2	7	0	561
Cytomegalovirus infection (congenital)	19	0	0	0	0	0	1	0	0	0	0	20
Dengue fever	0	0	1	2	2	6	2	5	0	0	0	18
Diphtheria	0	0	0	0	0	0	0	1	0	0	0	1
Echinococcosis	0	1	0	1	0	0	0	0	0	0	0	2
Giardiasis	27	11	5	5	16	41	32	24	14	27	0	202
Gonorrhoea	*	*	*	208	524	750	331	95	32	10	1	1956
Haemophilus influenzae disease (invasive)	11	1	1	1	3	6	6	4	4	21	0	58
Hepatitis A (acute)	8	6	6	0	0	6	9	1	2	0	0	38
Hepatitis B (acute and chronic)	2	0	0	14	32	205	126	65	22	22	0	488
Hepatitis C	2	1	0	2	22	172	232	115	76	23	0	645
Hepatitis E#	0	0	0	3	9	7	20	19	18	14	0	90
Herpes simplex (genital)	*	*	*	173	410	477	189	84	25	10	1	1369
Human immunodeficiency virus infection	1	0	0	4	36	200	169	78	14	6	0	508
Influenza	851	461	169	175	189	640	577	418	379	901	4	4764
Legionellosis‡	0	0	0	0	0	2	1	1	2	4	0	10
Leprosy	0	0	0	0	0	1	0	0	0	0	0	1
Leptospirosis	0	1	0	2	2	4	6	6	3	2	0	26
Listeriosis	2	0	0	0	0	1	0	1	4	5	0	13
Lyme disease	0	4	0	0	1	2	5	3	3	3	0	21
Lymphogranuloma venereum	*	*	*	0	3	21	16	8	0	0	0	48
Malaria	3	7	4	5	4	21	23	12	6	3	0	88
Measles	14	8	4	6	2	7	2	0	0	0	0	43
Meningococcal disease	34	4	8	14	6	2	2	5	4	8	0	87
Mumps	34	23	31	103	89	81	51	41	21	16	1	491
Noroviral infection^	516	42	17	23	27	67	65	78	110	885	2	1832
Paratyphoid	0	0	1	0	0	2	2	0	0	2	0	7
Pertussis	112	18	12	6	9	13	16	14	6	7	0	213
Q fever	0	0	0	0	0	0	2	1	3	0	0	6
Respiratory syncytial virus infection^	2349	35	22	12	6	19	30	52	38	126	1	2690
Rotavirus infection^	2177	79	9	4	4	10	11	7	16	52	2	2371
Rubella	1	0	0	0	0	0	0	0	0	0	0	1
Salmonellosis	66	22	18	11	26	43	25	25	28	38	0	302
Shigellosis	7	5	6	0	8	24	11	14	4	5	0	84
Streptococcus group A infection (invasive)	20	18	2	1	2	14	19	11	9	52	0	148
Streptococcus group B infection (invasive)‖	64	0	0	0	0	0	0	0	0	0	1	65
Streptococcus pneumoniae infection (invasive)	42	10	4	4	2	9	40	24	59	187	0	381
Syphilis	*	*	*	7	43	202	104	59	27	3	0	446
Toxoplasmosis	0	1	1	2	3	7	8	2	0	0	0	24
Trichomoniasis	*	*	*	3	11	31	22	10	1	1	0	79
Tuberculosis	4	5	8	8	21	80	52	45	38	56	1	318
Typhoid	3	1	0	0	1	1	3	1	0	0	0	10
Verotoxigenic *Escherichia coli* infection	314	62	34	35	37	76	52	40	50	139	0	839
Viral encephalitis	12	1	1	3	4	10	6	2	7	15	0	61
Viral meningitis	206	4	5	9	7	35	19	5	3	6	0	299
Yersiniosis	0	0	0	0	0	1	0	0	1	1	0	3
Zika virus infection†	1	0	0	0	1	4	6	1	0	0	0	13

Notes:

1. This table does not include details of diseases for which a zero number of cases were notified; see Table A1.1 for details of these diseases in 2016

*Data for the age groups 0-4 years, 5-9 years and 10-14 years are not presented here, but data for the age group 0-14 years are available in the STI annual slide-set at http://www.hpsc.ie

#Hepatitis E became notifiable on the 15/12/2015.

^Since 17/03/2013, figures for *Chlamydia trachomatis*, noroviral infection, respiratory syncytial virus infection and rotavirus infection may refer to notifications from HSE E rather than events. Such notifications from HSE E may also refer to area of laboratory testing rather than patient's area of residence

†*C. difficile* figures in the *C. difficile* chapter are presented by quarter rather than using the 2016 epidemiological calendar year as shown here

‡Legionellosis figures include both Legionnaires' disease and Pontiac fever cases

‖Streptococcus group B (*Streptococcus agalactiae*) infection (invasive) in infants <90 days old or stillborn infants

†Zika virus became notifiable in May 2016

Table A1.5 Number of notifiable infectious diseases by gender, 2016

Infectious Disease	Male	Female	Unknown	Total
Bacterial meningitis (not otherwise specified)	5	10	0	15
Brucellosis	1	1	0	2
Campylobacter infection	1338	1170	5	2513
Carbapenem-resistant *Enterobacteriaceae* infection (invasive)	10	4	0	14
Chickenpox - hospitalised cases	51	54	1	106
Chikungunya disease	1	0	0	1
Chlamydia trachomatis infection (genital)^	3388	3484	21	6893
Clostridium difficile infection†	741	1130	0	1871
Creutzfeldt Jakob disease	1	4	0	5
Cryptosporidiosis	298	263	0	561
Cytomegalovirus infection (congenital)	10	8	2	20
Dengue fever	6	12	0	18
Diphtheria	1	0	0	1
Echinococcosis	1	1	0	2
Giardiasis	114	88	0	202
Gonorrhoea	1709	243	4	1956
Haemophilus influenzae disease (invasive)	18	39	1	58
Hepatitis A (acute)	16	22	0	38
Hepatitis B (acute and chronic)	283	196	9	488
Hepatitis C	460	182	3	645
Hepatitis E#	57	33	0	90
Herpes simplex (genital)	369	995	5	1369
Human immunodeficiency virus infection	393	115	0	508
Influenza	2184	2569	11	4764
Legionellosis‡	6	4	0	10
Leprosy	0	1	0	1
Leptospirosis	21	5	0	26
Listeriosis	8	5	0	13
Lyme disease	13	8	0	21
Lymphogranuloma venereum	48	0	0	48
Malaria	60	27	1	88
Measles	24	19	0	43
Meningococcal disease	49	38	0	87
Mumps	237	248	6	491
Noroviral infection^	867	963	2	1832
Paratyphoid	3	4	0	7
Pertussis	99	114	0	213
Q fever	5	1	0	6
Respiratory syncytial virus infection^	1448	1238	4	2690
Rotavirus infection^	1268	1100	3	2371
Rubella	1	0	0	1
Salmonellosis	142	160	0	302
Shigellosis	51	33	0	84
Streptococcus group A infection (invasive)	77	71	0	148
Streptococcus group B infection (invasive)‖	32	28	5	65
Streptococcus pneumoniae infection (invasive)	207	174	0	381
Syphilis	422	22	2	446
Toxoplasmosis	8	16	0	24
Trichomoniasis	0	79	0	79
Tuberculosis	194	124	0	318
Typhoid	6	4	0	10
Verotoxigenic *Escherichia coli* infection	394	444	1	839
Viral encephalitis	23	35	3	61
Viral meningitis	162	132	5	299
Yersiniosis	0	3	0	3
Zika virus infection†	6	7	0	13
Total	17336	15730	94	33160

Notes:

1. This table does not include details of diseases for which a zero number of cases were notified; see Table A1.1 for details of these diseases in 2016

#Hepatitis E became notifiable on the 15/12/2015.

^Since 17/03/2013, figures for *Chlamydia trachomatis*, noroviral infection, respiratory syncytial virus infection and rotavirus infection may refer to notifications from HSE E rather than events. Such notifications from HSE E may also refer to area of laboratory testing rather than patient's area of residence

†*C. difficile* figures in the *C. difficile* chapter are presented by quarter rather than using the 2016 epidemiological calendar year as shown here

‡Legionellosis figures include both Legionnaires' disease and Pontiac fever cases

‖Streptococcus group B (*Streptococcus agalactiae*) infection (invasive) in infants <90 days old or stillborn infants

†Zika virus became notifiable in May 2016

Table A1.6 Number of notifiable infectious diseases by case classification, 2016

Infectious Disease	Confirmed	Probable	Possible	Total
Bacterial meningitis (not otherwise specified)	5	5	5	15
Brucellosis	2	0	0	2
Campylobacter infection	2513	0	0	2513
Carbapenem-resistant *Enterobacteriaceae* infection (invasive)	14	0	0	14
Chickenpox - hospitalised cases	72	5	29	106
Chikungunya disease	1	0	0	1
Chlamydia trachomatis infection (genital)^	6893	0	0	6893
Clostridium difficile infection†	1871	0	0	1871
Creutzfeldt Jakob disease	5	0	0	5
Cryptosporidiosis	558	3	0	561
Cytomegalovirus infection (congenital)	20	0	0	20
Dengue fever	18	0	0	18
Diphtheria	1	0	0	1
Echinococcosis	2	0	0	2
Giardiasis	202	0	0	202
Gonorrhoea	1956	0	0	1956
Haemophilus influenzae disease (invasive)	58	0	0	58
Hepatitis A (acute)	37	1	0	38
Hepatitis B (acute and chronic)	488	0	0	488
Hepatitis C	645	0	0	645
Hepatitis E#	90	0	0	90
Herpes simplex (genital)	1347	22	0	1369
Human immunodeficiency virus infection	508	0	0	508
Influenza	4753	2	9	4764
Legionellosis‡	10	0	0	10
Leprosy	1	0	0	1
Leptospirosis	26	0	0	26
Listeriosis	13	0	0	13
Lyme disease	21	0	0	21
Lymphogranuloma venereum	48	0	0	48
Malaria	88	0	0	88
Measles	43	0	0	43
Meningococcal disease	85	0	2	87
Mumps	253	41	197	491
Noroviral infection^	1830	2	0	1832
Paratyphoid	7	0	0	7
Pertussis	169	14	30	213
Q fever	6	0	0	6
Respiratory syncytial virus infection^	2690	0	0	2690
Rotavirus infection^	2371	0	0	2371
Rubella	0	0	1	1
Salmonellosis	300	2	0	302
Shigellosis	84	0	0	84
Streptococcus group A infection (invasive)	147	1	0	148
Streptococcus group B infection (invasive)‖	65	0	0	65
Streptococcus pneumoniae infection (invasive)	381	0	0	381
Syphilis	431	0	15	446
Toxoplasmosis	24	0	0	24
Trichomoniasis	79	0	0	79
Tuberculosis	242	40	36	318
Typhoid	10	0	0	10
Verotoxigenic *Escherichia coli* infection	740	97	2	839
Viral encephalitis	61	0	0	61
Viral meningitis	297	1	1	299
Yersiniosis	3	0	0	3
Zika virus infection†	13	0	0	13
Total	32597	236	327	33160

Notes:
1. This table does not include details of diseases for which a zero number of cases were notified; see Table A1.1 for details of these diseases in 2016
2. The case definitions booklet, available at http://www.hpsc.ie has been updated since 2016; case classifications are assigned to notifications as per the Case Definitions for Notifiable Diseases during 2016

^Since 17/03/2013, figures for *Chlamydia trachomatis*, noroviral infection, respiratory syncytial virus infection and rotavirus infection may refer to notifications from HSE E rather than events. Such notifications from HSE E may also refer to area of laboratory testing rather than patient's area of residence

†*C. difficile* figures in the *C. difficile* chapter are presented by quarter rather than using the 2016 epidemiological calendar year as shown her

‡Legionellosis figures include both Legionnaires' disease and Pontiac fever cases

‖Streptococcus group B (*Streptococcus agalactiae*) infection (invasive) in infants <90 days old or stillborn infants

†Zika virus became notifiable in May 2016

2016

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EXPLANATORY NOTES
GLOSSARY OF TERMS

Explanatory Notes

Notifiable Infectious Diseases

Computerised Infectious Disease Reporting (CIDR) system

For the majority of the notifiable infectious diseases (see Appendix 1), data were collated using the Computerised Infectious Disease Reporting (CIDR) system. Notification data were inputted directly by areas using the system. Enhanced surveillance was undertaken for certain diseases and these data are collated on CIDR. Outbreak data were also collated on CIDR using the same process outlined above. Weekly Reports on infectious disease notifications (including a separate report for *Clostridium difficile associated disease,* HIV & STIs) and outbreaks were produced by HPSC and published on the HPSC website, www.hpsc.ie. Throughout the year data were cleaned and validated on an ongoing basis and final data checks and cleaning were undertaken following year end by HPSC and the Departments of Public Health. Data analysis was performed using CIDR Business Objects Reporting and MS Access and Excel. Figures for the relevant chapters within this report were extracted from CIDR between February and November 2017. These figures may differ from those previously published due to ongoing updating of data on CIDR.

HIV

HIV was made a notifiable disease in Ireland in September 2011. Since 1st January 2012, CIDR has been used to record notifications of HIV, thereby allowing the replacement of HIV case based reporting. Since 1st January 2012, AIDS diagnoses are only reported if they occur at the time of HIV diagnoses. In January 2015, there was a change to the surveillance case definition for HIV in HSE East (Dublin, Kildare and Wicklow). Previously, confirmatory testing by the National Virus Reference Laboratory (NVRL) was required on two separate samples prior to notification. From January 2015 onwards, confirmatory testing by NVRL on one sample was sufficient prior to notification. This change has resulted in increased notifications and more timely notifications.

Sexually Transmitted Infections (STIs)

Data on ano-genital warts (AG) and non-specific urethritis (NSU) are not collated using the CIDR system. Instead, clinicians notified their respective Departments of Public Health of cases of ano-genital warts and non-specific urethritis. Data were collated and analysed by Departments of Public Health and aggregated data were reported quarterly to HPSC. National data were collated on an MS Excel database, analysis preformed and reports produced by HPSC.

Data on all other STIs are collated using the CIDR system, including: chancroid, *Chlamydia trachomatis* infection, gonorrhoea, granuloma inguinale, herpes simplex (genital), lymphogranuloma venereum, syphilis and trichomoniasis.

Other Surveillance Systems

Influenza/Influenza-like illness Surveillance Systems

Since 2000, HPSC has worked in collaboration with the National Virus Reference Laboratory (NVRL), the Irish College of General Practitioners (ICGP) and the Departments of Public Health on the influenza sentinel surveillance project. Sixty-one general practices (located in all HSE-Areas and representing 6.2% of the Irish population) were recruited to report electronically, on a weekly basis, the number of patients who consulted with influenza-like illness (ILI). ILI is defined using the Irish case definition for ILI which is sudden onset of symptoms AND at least one of the following four systemic symptoms: fever, malaise, headache, myalgia; AND at least one of the following three respiratory symptoms: cough, sore throat, shortness of breath. Sentinel GPs were requested to send combined nasal and throat swabs on ILI patients each week to the NVRL. The NVRL routinely tested sentinel GP and non-sentinel respiratory specimens (including specimens from hospitals, non-sentinel GPs, nursing homes and other institutions) for influenza and a panel of other seasonal respiratory viruses. Other surveillance systems set up to monitor influenza/ILI activity include a network of sentinel hospitals reporting admissions data. The Departments of Public Health also notified HPSC of all cases of influenza (including hospitalisation status), all acute respiratory infection and influenza outbreaks and enhanced surveillance data on all hospitalised cases of confirmed influenza in 0-14 year olds. HPSC was notified of all registered deaths on a daily basis from the General Register Office.

Other influenza surveillance systems included:

- Surveillance of all calls to GP out-of-hours (OOHs) centres monitored for self-reported influenza. These data were provided by HSE-NE.
- Intensive Care Society of Ireland (ICSI) and the Critical Care Programme (CCP) enhanced surveillance of all critical care patients with confirmed influenza in all critical care units.
- Enhanced surveillance of all confirmed influenza deaths.
- All-cause excess mortality monitoring associated with the European mortality monitoring group (EuroMOMO).
- Monitoring influenza vaccine effectiveness (I-MOVE study)

Other routine surveillance include the monitoring of the uptake of the seasonal influenza vaccine among residents in long term care facilities (LTCFs) and that of the health care workers in both LTCFs and hospitals since the 2011/2012 season. Uptake levels by different categories of staff over time, along with other details are presented in the influenza chapter of this report.

At HPSC, data were collated from the various sources, analysed and routine reports were produced. Influenza surveillance reports were posted on the HPSC website www.hpsc.ie. Aggregated clinical and virological sentinel and non-sentinel data, genetic and antigenic data from the NVRL and anonymised data on confirmed influenza cases admitted to hospital were routinely reported to the European Centre for Disease Prevention and Control (ECDC) during the influenza season.

Immunisation Uptake

- **Immunisation uptake among children at 12 and 24 months of age**
  Each HSE Area maintains a childhood immunisation database. HSE Areas provided HPSC with immunisation uptake data for their area and for each of the Local Health Offices in their area on a quarterly basis. National data were collated and analysed at HPSC using a MS Excel database. Quarterly reports were produced and are available on the HPSC website. For further details on methods used, please see the immunisation uptake chapter within this report.
- **HPV, MenC booster and Tdap vaccine uptake**
  HPV, MenC booster and Tdap vaccinations provided through the schools immunisation programme are collated on the national School Immunisation System (SIS). Uptake of these vaccines, provided through the school immunisation programme per academic year and recorded on the database, are reported in the chapter within this report. Further details are provided within the chapter.
- **DTaP/IPV and MMR vaccine uptake**
  Since the 2011/2012 academic year, the uptake of the DTaP/IPV and MMR vaccines in 4-5 year old schoolchildren (at Junior Infant level) has been monitored across all Local Health Offices (LHOs) each year. Each LHO provides details of the cohort size and the number of vaccinated children and the returns collated to calculate uptake levels which are also presented in maps in the 'DTaP/IPV and MMR vaccine uptake 2015/2016' chapter.

European Antimicrobial Resistance Surveillance Network (EARS-Net)

Data were collected by participating EARS-Net (formerly the European Antimicrobial Resistance Surveillance System, EARSS) laboratories on the first invasive isolate per patient per quarter on *Staphylococcus aureus, Enterococcus faecium* and *Enterococcus faecalis* from blood only and on *Streptococcus pneumoniae*, *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa and Acinetobacter* spp. from blood and/or cerebrospinal fluid (CSF). Data were reported quarterly to HPSC, via WHONET software, and collated in an MS Access database. Quarterly and annual reports were produced.

Antimicrobial consumption

Community (outpatient) consumption data were obtained from IMS Health and represent wholesaler to retail pharmacy sales figures for Ireland. Hospital (inpatient) consumption data were obtained directly from clinical pharmacies and validated with the support of the Irish Antimicrobial Pharmacists Association. Quarterly and annual consumption trends by named public acute hospitals are published on the HPSC website. All data were interpreted using the WHO Anatomical Therapeutic Chemicals index (www.whocc.no/atcddd/) in line with European Surveillance of Antimicrobial Consumption (ESAC-Net) methodology, which is now managed by the ECDC. See relevant section for notes on the denominator data.

Healthcare associated infections

- ***Clostridium difficile:*** Data on *C. difficile* enhanced surveillance were collected by participating hospitals, reported quarterly to the HPSC and stored in an MS Access database. Quarterly and annual reports were produced.
- Data were also collected on the total volume of alcohol-based hand rub used per hospital per year/quarter, excluding that used for pre-operative surgical "scrub". See relevant section for notes on the denominator data. The rate of usage per hospital was calculated as the total volume of hand rub consumed (in litres) per 1000 bed days used, and quarterly and annual reports were produced for publication on the HPSC website.

Denominator Data

To calculate disease incidence rates, Census of Population data were used as the denominator (available from the Central Statistics Office, http://www.cso.ie). Population figures were applied as follows:

- Census 2016 for analysis of 2014-2016 data unless otherwise specified
- Census 2011 for analysis of 2009-2013 data
- Census 2006 for analysis of 2004-2008 data
- Census 2002 for 2000-2003 data
- Census 1996 for 1999 data

Monthly population changes were estimated between 1993 and 2014 using a curve interpolation method for the calculation of outpatient antibiotic consumption rate.

Bed-days used and other activity data for public acute hospitals were provided by the Business Information Unit of the HSE and used to calculate rates of MRSA, hospital antibiotic consumption and rates used in other hospital-based surveillance systems. Similar activity data were obtained directly from private acute hospitals.

HSE Areas

Although organisational changes have taken place in the Health Services, the term HSE Areas are used in this report when analysing and presenting data by geographical area (equating to the eight former health board regions/areas). This is because operationally the surveillance, prevention and control of infectious diseases are still managed by eight Departments of Public Health, one in each HSE Area.

Regional Directors of Operations (RDO's)

The range of health and personal social services provided by the HSE and its funded agencies were managed within four regions known as RDOs. Details of the four RDOs and their relationship with the eight HSE areas are shown below.

1. Dublin Mid Leinster (HSE-Midland plus CCA1-5 and CCA9-10 of HSE-East)
2. Dublin North East (HSE-North East plus CCA6-8 of HSE-East)
3. South (HSE-South and HSE-South East)
4. West (HSE-Midwest, HSE-North West and HSE-West)

Community Healthcare Organisations

Community Healthcare Services are the broad range of services that are provided outside of the acute hospital system and includes Primary Care, Social Care, Mental Health and Health & Wellbeing Services. These services are delivered through the HSE and its funded agencies to people in local communities, as close as possible to people's homes. The document Community Healthcare Organisations – Report and Recommendations of the Integrated Service Area Review Group, published in October 2014, sets out how health services, outside of acute hospitals, will be organised and managed. This document is available at http://www.hse.ie/eng/services/publications/corporate/CHOReport.html

Glossary of Terms

ABHR	Alcohol-based hand rub
BDU	Bed-days used
CDI	*Clostridium difficile* infection
CIDR	Computerised Infectious Disease Reporting
CIR	Crude incidence rate
DoH	Department of Health
EARS-Net	European Antimicrobial Resistance Surveillance Network
ECDC	European Centre for Disease Prevention and Control
EISN	European Influenza Surveillance Network
ESAC-Net	European Surveillance of Antimicrobial Consumption Network
HCAI	Healthcare associated infections
HCWs	Healthcare Workers
HPSC	Health Protection Surveillance Centre
HPV	Human papilloma virus
HSE	Health Service Executive
HSE E	HSE Eastern Region
HSE M	HSE Midland Area
HSE MW	HSE Mid-Western Area
HSE NE	HSE North Eastern Area
HSE NW	HSE North Western Area
HSE SE	HSE South Eastern Area
HSE S	HSE Southern Area
HSE W	HSE Western Area
ICGP	Irish College of General Practitioners
ILI	Influenza-like illness
IMSRL	Irish Meningitis and Sepsis Reference Laboratory
IPD	Invasive pneumococcal disease
LTCFs	Long term care facilities
MRSA	Meticillin Resistance *Staphylococcus aureus*
MSM	Men who have sex with men
NSSLRL	National Salmonella, Shigella and Listeria Reference Laboratory
NIAC	National Immunisation Advisory Committee
NIO	National Immunisation Office
NVRL	National Virus Reference Laboratory
PWID	People who inject drugs
SIS	School Immunisation System
STIs	Sexually Transmitted Infections
TB	Tuberculosis
WHO	World Health Organization

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This report is also available to download on the HPSC website at www.hpsc.ie