

INVASIVE MENINGOCOCCAL DISEASE (IMD), BACTERIAL/VIRAL MENINGITIS & *HAEMOPHILUS INFLUENZAE* INFECTIONS IN IRELAND

A REPORT BY THE HEALTH PROTECTION SURVEILLANCE CENTRE IN COLLABORATION WITH THE IRISH MENINGITIS & SEPSIS REFERENCE LABORATORY AND THE NATIONAL VIRUS REFERENCE LABORATORY



Q4-2017

12th March 2018

Provisional Figures

Summary

- 18 invasive meningococcal disease cases (IMD) were notified in Q4-2017, including six serogroup B, seven serogroup C, three serogroup W135, one non-groupable and one not specified. Of the seven serogroup C cases, one was a total vaccine failure (3 doses, age 1-4 years), four were unvaccinated (three aged <1 year and one aged 65+ years), the two others had an unknown vaccination status (aged 15-19 years). Two deaths were reported, both with a serogroup B infection and aged 55-69 years. No imported cases were identified in this quarter.
- Nine cases of invasive *Streptococcus pneumoniae* infections presenting as meningitis were notified (range <1 to 80-84 years), two of whom died. One other meningitis-related infection was reported, a *Mycobacterium bovis* infection (aged 10-14 years). Four cases of bacterial meningitis due to pathogens not otherwise specified (NOS) were also notified, including one that had *Escherichia coli* as their causative organism (age 1 month), and one that had a *Pseudomonas stutzeri* infection (aged 55-59 years). No imported cases were reported.
- 39 cases of viral meningitis NOS, were reported, 28 (71.8%) of which were enterovirus (two enterovirus group A, 21 enterovirus group B, and five not specified). Other causative organisms identified were three human herpes virus type 6, two parechovirus and six not specified. No deaths or imported cases were reported in this quarter.
- Six cases of *Haemophilus influenzae* were reported, none of which was associated with meningitis. Five of the cases were non-typeable and one was not typed. No deaths were reported during this quarter, nor were there any imported cases.

Introduction

Meningococcal disease became a notifiable disease on the 1st January 2004. Prior to this, it was notifiable under the category bacterial meningitis (including meningococcal septicaemia).

Most forms of bacterial meningitis are now notifiable under the specific disease pathogen name as listed in the legislation. For bacterial meningitis pathogens not listed, these forms of meningitis are notifiable under the disease termed 'bacterial meningitis (not otherwise specified)'. Since 1st January 2012, revised versions of the case definitions of meningococcal disease, bacterial and viral meningitis have come into effect and are detailed in the HPSC Case Definitions for Notifiable Diseases booklet on the HPSC website (www.hpsc.ie).

An enhanced surveillance system is in place for [IMD and other forms of bacterial meningitis, not otherwise specified](#). Details of this surveillance system are described in the meningococcal disease chapter of the [HPSC Annual Report 2005](#).

In October 2000, the Meningococcal C conjugate (MCC) vaccine was introduced in Ireland to the primary childhood immunisation (PCI) schedule at 2, 4 and 6 months of age. A catch-up campaign targeting those < 23 years of age was also run

at the time. In September 2008 the MenC vaccination schedule was changed for the administration of the vaccine at 4, 6 and 13 months of age.

In August 2014, NIAC recommended an adolescent MenC booster at 12-13 years to be offered in the first year of secondary level school. This dose was introduced into the HSE schools immunisation programme in September 2014. This was done in response to an increase in MenC cases and the emerging international evidence of waning immunity in populations that had received MCC vaccine in early childhood in the United Kingdom. Further changes occurred in 2015 when NIAC recommended that all babies born on or after July 1st 2015 should receive a single dose of MCC at 4 months, 13 months and at 12-13 years (if not previously vaccinated at >10 years of age). The PCI schedule was again updated in July 2016 following agreement to include meningococcal B vaccine (MenB) into the primary immunisation programme. All babies born on or after 1st October 2016 are now offered MenB vaccine at 2, 4 and 12 months of age. The programme started on 1st December 2016. The MenB vaccine cannot be given at same time as MenC vaccine (which is given at 6 and 13 months of age).

An enhanced surveillance system is also in place for *Haemophilus influenzae (invasive) disease*, but not for viral meningitis, not otherwise specified. Both the enhanced surveillance forms for IMD (including other forms of bacterial meningitis) and *Haemophilus influenzae (invasive) disease* were updated in early December 2015. Data presented in this report were extracted from CIDR on 12th March 2018. **These figures are provisional.** Incidence rates for 2017 were calculated using the 2016 Census of Population as denominator data.

Results

Meningococcal Disease (invasive) (IMD)

IMD Cases by Serogroup & Case Classification

In Q4-2017, 18 cases of IMD were notified, all but four were confirmed. Six were serogroup B, seven serogroup C, three serogroup W135, one non-groupable and one not specified (Table 1). This quarter represents the second time that the number of MenC cases has exceeded that of MenB cases. Details of the number of doses of the meningococcal C conjugate vaccine received, age group and outcome of the seven serogroup C cases are presented in Table 2. (Only one reported case of a MenB vaccination failure under one year of age was reported in 2017). In Q4-2017 serogroup B disease accounted for 33% (n=6/18; 95%CI 11.6-55.1%) of all IMD notifications (Figure 1, Appendix 1). Figure 2 presents the annual number of cases each year between 2002 and 2017 with the percentage of cases attributable to serogroup B with 95% confidence intervals: in 2017 the annual percentage of cases attributable to serogroups other than B exceeded that of serogroup B for the first time. No imported cases were identified in this quarter.

Table 1. Classification of IMD cases notified by Serogroup in Q4-2017

Case Classification	B	C	W135	Y	NG	29E	No organism detected	Total
Confirmed	6	5	3	0	0	0	0	14
Probable	0	0	0	0	0	0	0	0
Possible	0	2*	0	0	1*	0	1	4
Not specified	0	0	0	0	0	0	0	0
Total	6	7	3	0	1	0	1	18

*Isolated from a conjunctival swab in a clinically compatible case

Table 2. Details of the MenC cases notified in Q4-2017 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	Recovering	Unvaccinated	0	.
2	<1	Not known	Unvaccinated	0	.
3	<1	Not Specified	Unvaccinated	0	.
4	1-4	Recovering	Complete	3	1.1 years
5	15-19	Recovering	Unknown		.
6	15-19	Recovered	Unknown		.
7	60-64	Still ill	Unvaccinated	0	.

IMD Trends & Outbreaks

The number of IMD cases reported in Q4-2017 (n=18) was less than the average number reported in the same quarter over the previous three years (average=25, 95% %CI 18.5-31.5); for serogroup B the average was 16.7 and for serogroup C it was 3.7 (Figure 1; Appendix 1). Fourth quarterly IMD cases have fallen by 69% since 2002 (Appendix 2). Also since 2002, Q4 serogroup B cases have also declined by 87.2%, but the percentage of serogroup C cases increased by 600% (from one to seven cases) in that time (Appendix 1).

All but three meningococcal confirmed cases were reported on CIDR in Q4-2017 were also included in the electronic listing of laboratory tested *N. meningitidis* isolates/specimens provided to the HPSC on January 30th 2018 by the Irish Meningitis and Sepsis Reference Laboratory (IMSRL).

IMD Cases by HSE Area and Age Group

The crude incidence rate in Q4-2017 was 0.4 cases per 100,000 population, ranging from the lowest (0.0/100,000) in HSE M and HSE-NW to the highest (1.3/100,000) in HSE MW (Appendix 3). The burden of IMD disease is typically highest in the <1 year of age group and in Q4-2017 the incidence rate in this age group was 6.4 cases per 100,000 population, followed by 1.3 cases/100,000 in the 15-19 year age group (Appendix 4). Figure 3 presents the annual percentage of cases by age group and serogroup each year between 2013 and 2017: the percentage of cases in the 20+ year age group among serogroup B cases appears to be much lower than that of serogroup C and other serogroups combined.

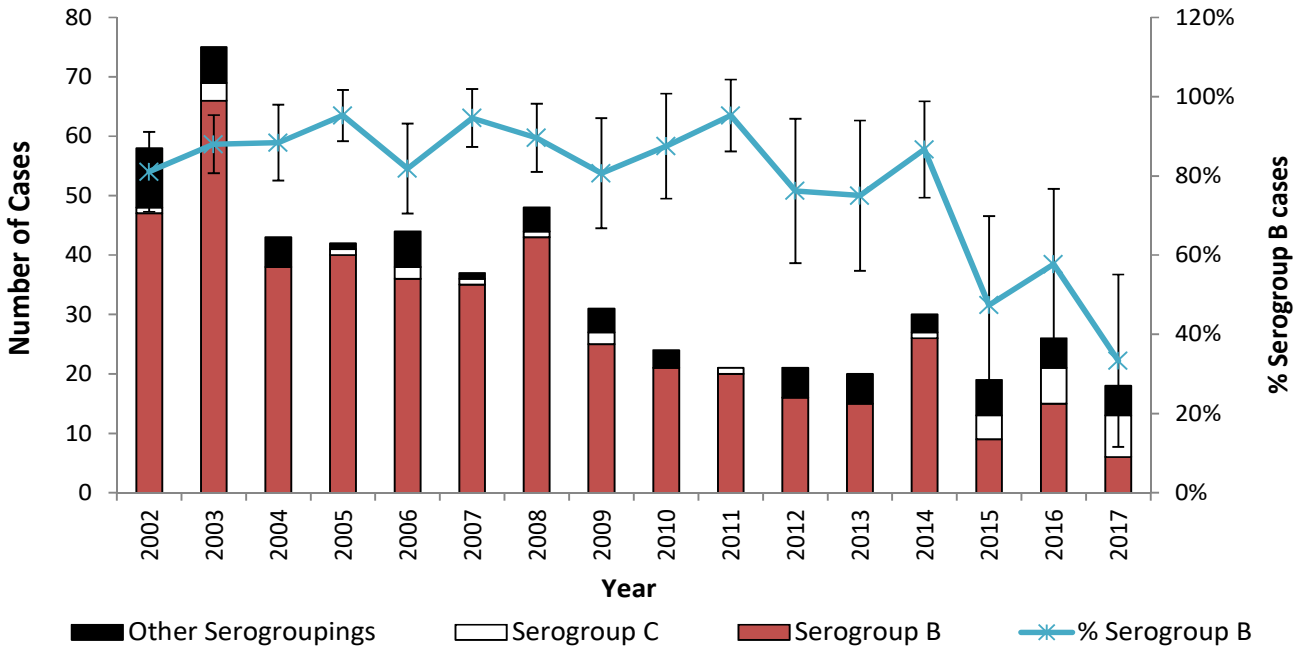


Figure 1. Number of IMD cases notified in Ireland by serogroup in Q4 of each year between 2002 and 2017 with percentage of quarterly cases attributable to serogroup B with 95% confidence intervals

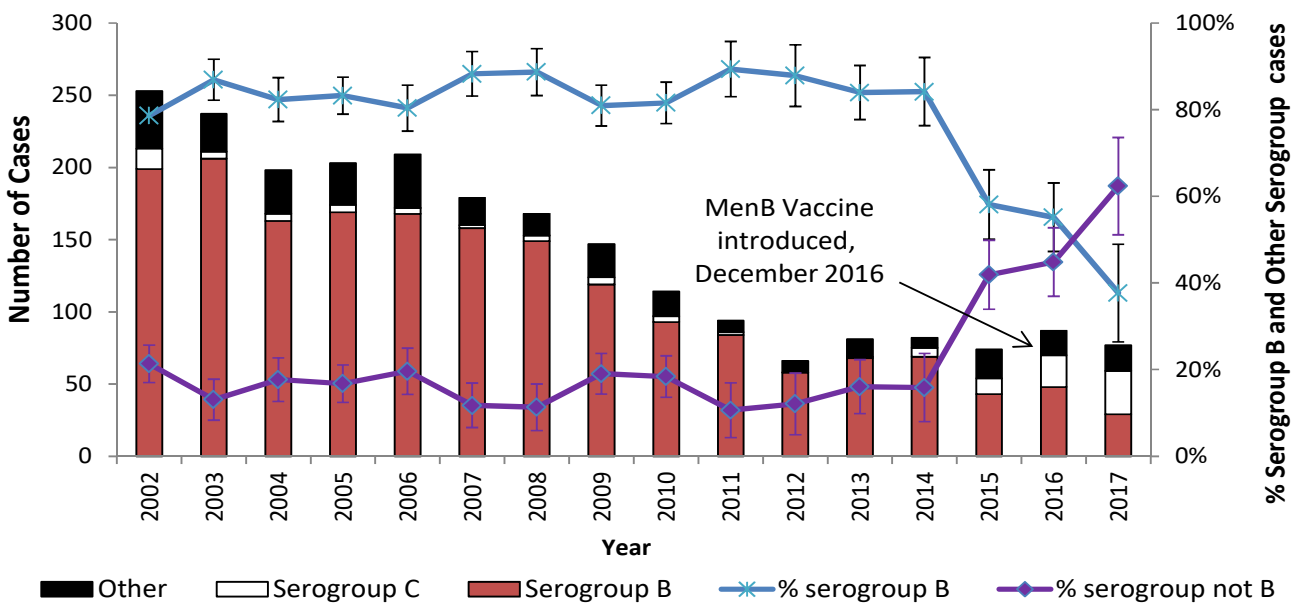


Figure 2. Annual number of IMD cases notified in Ireland by serogroup each year between 2002 and 2017 with percentage of cases attributable to serogroup B with 95% confidence intervals

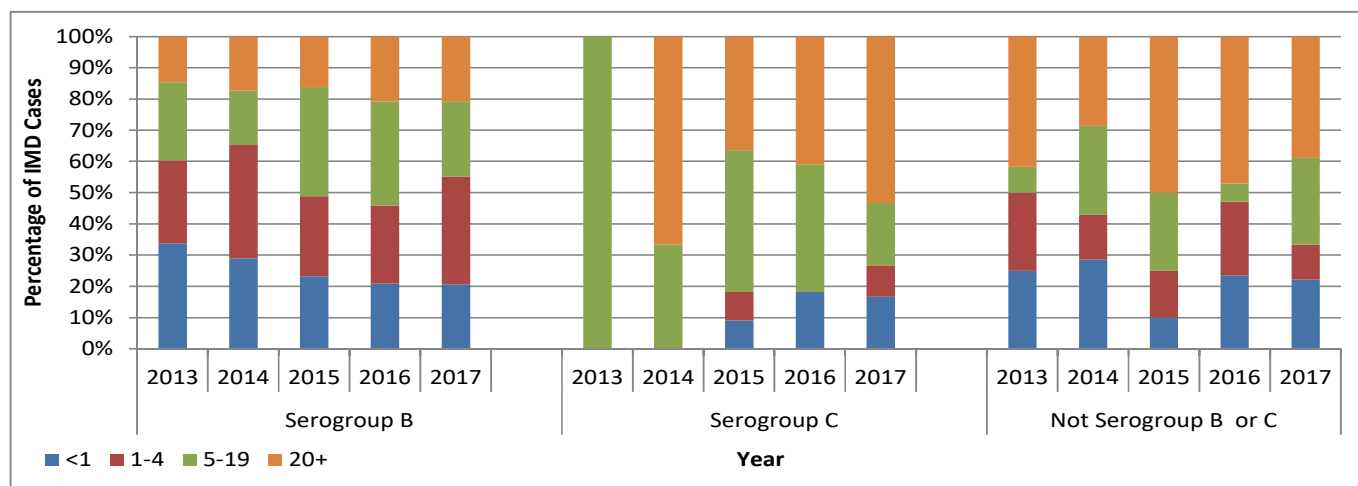


Figure 3. Annual percentage of cases between 2013 and 2017 by serogroup and age group (years)

IMD associated deaths

Two deaths were reported in Q4-2017, both with a serogroup B infection and aged 55-69 years (Appendix 5). This compares to an average of 1.7 deaths in the same quarter between 2014 and 2016.

Other Forms of Bacterial Meningitis

Streptococcus pneumoniae meningitis

In Q4-2017, nine cases of invasive *S. pneumoniae* infections (IPD) presenting as meningitis were notified. The age range was <1 and 80-84 years (Appendix 6). Two IPD meningitis-related deaths were reported in this quarter. Five patients had a risk factor recorded. Details of the vaccination status, age group, risk factor and serotype of these nine cases are presented in Table 3 below.

Table 3. Vaccination status, age and risk factors and serotype details of the *Streptococcus pneumoniae* meningitis cases reported in Q4-2017

Case No.	Age Group	Risk factors	PCV vaccination status	PPV vaccination status	Serotype
1	<1	No	Incompletely vaccinated (1 dose)	Unknown	.
2	<1	No	Incompletely vaccinated (1 dose)	Unvaccinated	.
3	35-39	Yes	Unvaccinated	Vaccinated (1 dose)	.
4	35-39	Yes	Unvaccinated	Unknown	10A
5	40-44	Yes	Unvaccinated	Unvaccinated	.
6	55-59	No	Unvaccinated	Unvaccinated	.
7	55-59	Unknown	Unvaccinated	Unvaccinated	.
8	60-64	Yes	Unvaccinated	Unknown	22F
9	80-84	Yes	Unvaccinated	Unvaccinated	19F

For further information on *Streptococcus pneumoniae* notifications please refer to the latest report available at <http://www.hpsc.ie/A-Z/VaccinePreventable/PneumococcalDisease/Publications/QuarterlyReportsonInvasivePneumococcalDisease/>

Bacterial meningitis by other specified notifiable diseases (excluding *Haemophilus influenzae* and *S. pneumoniae*)

One case of meningitis-related tuberculosis (*Mycobacterium bovis*) (aged 10-14 years) was reported in this quarter. Two CSF PCR positive case of *Streptococcus agalactiae* (aged <=2 weeks) was also reported in this quarter; the latter cases however, were not labelled as having clinical meningitis or any other clinical description. No deaths or imported cases were reported.

Bacterial meningitis (not otherwise specified)

Four cases of bacterial meningitis due to pathogens not otherwise specified (NOS) were notified during Q4-2017. These included one that was case classified as confirmed, one as probable and two as possible. Of the four cases, two had their causative organism identified: *Escherichia coli* (aged 1 month) and *Pseudomonas stutzeri* (aged 55-59 years) (Appendix 6). No deaths or imported cases were reported in this quarter.

Viral Meningitis (Specified and Not Otherwise Specified)

Thirty-nine viral meningitis notifications (NOS) (aged 1 week to 47 years; median 4.3 months) were reported in Q4-2017 (Figure 4), all but six had their causative organism identified: 28 enterovirus (aged 1 week to <40 years; median 10.6 years); three human herpes virus type 6 (HHV 6) (aged 1 month to 47 years); and two parechovirus (aged 1-2 months). No deaths or imported cases were reported in this quarter.

All but five CIDR events in Q4 of 2017 were matched to NVRL viral meningitis enterovirus typing records (Figures 5, 6) provided to the HPSC on the February 2nd 2018.

In Q4-2017, the highest frequency of cases occurred in children <1 year of age (n=22/39; 56.4%) and in adults aged 15-39 years (n=11/39; 28.2%) (Figure 4). Of the 22 cases <1 year of age reported in this quarter, 13 (59.1%) were attributable to enterovirus, two each (9.1%) to HHV 6 and to parechovirus and five with no causative organism identified. Caution is recommended regarding the detection of HHV 6 DNA in cerebral spinal fluid (CSF) specimens, especially in those aged less than three months (of which there was one in Q4-2017), 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. Figure 5 presents both the total number of viral meningitis NOS cases and those not caused by enterovirus by year and by quarter since 2007. The average Q4 percentage of all viral meningitis NOS cases attributable to enterovirus since 2010 to date has been 73.4%. Details of enterovirus serotypes by age group in Q4-2017 are presented in Table 4 and shows that the numbers of cases are highest in the <1 and 15-39 year age groups.

Haemophilus influenzae (invasive) infections

H. influenzae Cases by Type, Case Classification

In Q4-2017, six cases of invasive *H. influenzae* (all case classified as confirmed) were notified (Figure 7): five of the cases were non-typeable and one was not typed. This total compares to an average of 12.7 cases for the same quarter in 2014 to 2016 (Table 5, Appendices 8, 9). Of all the Q4 cases reported between 2015 and 2017, 35.7% (n=10/28) had no clinical diagnosis reported (Table 6). There were no imported cases during this quarter were reported. In 2017, non-typeable cases accounted for 62.2% of all cases, slightly more than the average of 61.8% recorded between 2007 and 2016 (Figure 8).

In the electronic listing provided by the Irish Meningitis and Sepsis Reference Laboratory (IMSRL) in Temple Street Children's Hospital to the HPSC on January 30th 2018, all but two classified confirmed *H. influenzae* events on CIDR in Q4-2017 were included on it.

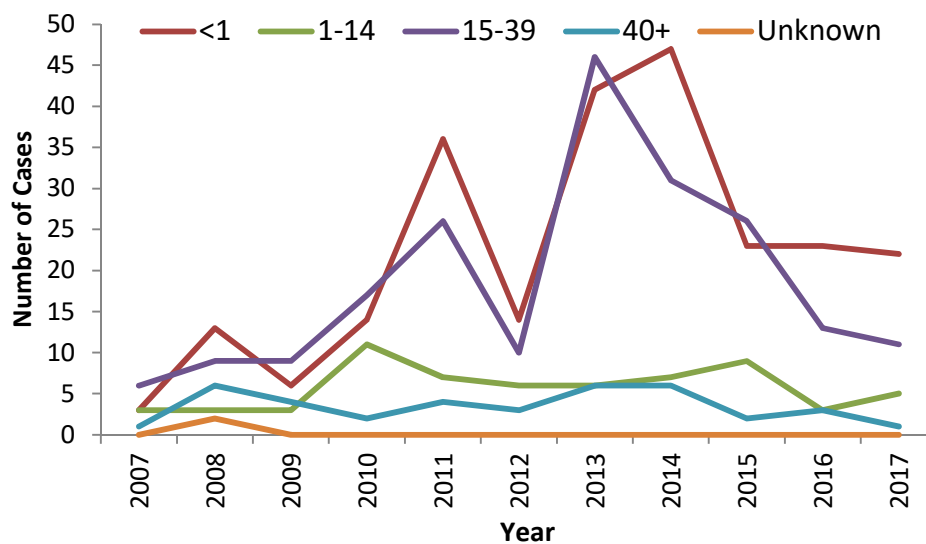


Figure 4. Quarter 4 number of viral meningitis (NOS) cases in Ireland by age group (years), 2007-2017

H. influenzae associated deaths

No deaths occurred among the six *H. influenzae* cases reported during this quarter.

H. influenzae meningitis

No meningitis-related *H. influenzae* cases were reported in Q4-2017 (Table 7).

H. influenzae type b (Hib)

A true vaccine failure (TVF) is the occurrence of invasive Hib infection in an individual, despite having been fully vaccinated against Hib disease in the past. No Hib cases were reported in Q4-2017. The last reported TVF however was in Q4-2010, the only one in over ten years between Q3-2007 and Q4-2017: an indication of the continuing positive impact of the Hib immunisation catch-up booster campaign launched in November 2005 and introduction of a routine Hib booster for all children in the second year of life since 2006 (Figures 9, 10). Ensuring high uptake of the Hib vaccine during infancy and a booster in the second year of life is recommended to provide continued protection of the population from invasive Hib disease. Individuals with risk conditions for Hib, regardless of age are also recommended the Hib vaccine.

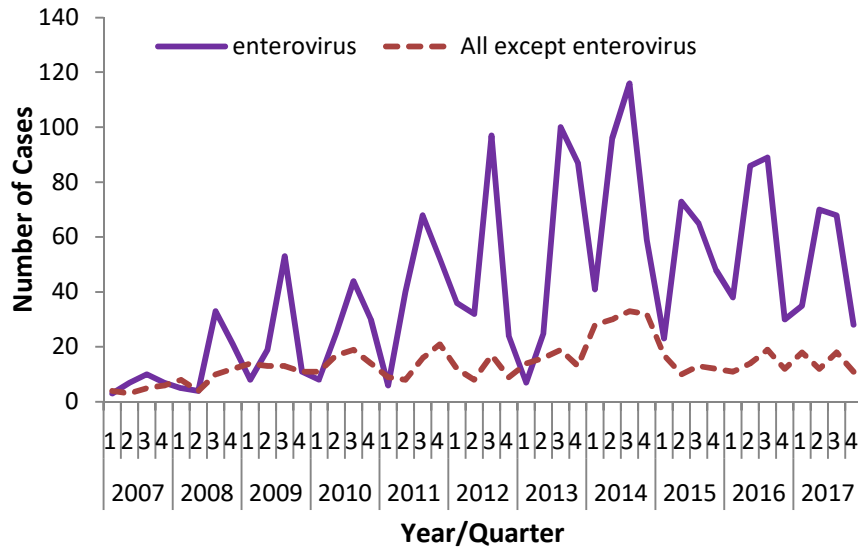


Figure 5. Number of viral meningitis (NOS) cases caused by enterovirus and not by enterovirus by quarter and year, 2007-2017

Table 4. Enterovirus genotypes by age group (years) on CIDR in Q4-2017 (Enterovirus genotyping targets the VP1 gene of the virus)

Genus	Species	Type	Age Group (years)					Total
			<1	1-4	5-14	15-39	40+	
Enterovirus	Enterovirus A	Coxsackievirus A16	2	0	0	0	0	2
		Coxsackievirus A9	0	0	0	1	0	1
	Enterovirus B	Coxsackievirus B3	1	0	0	0	0	1
		Coxsackievirus B4	4	0	0	0	0	4
		Coxsackievirus B5	1	0	0	1	0	2
		Echovirus 5	1	0	0	1	0	2
		Echovirus 9	1	0	0	1	0	2
		Echovirus 25	0	0	0	1	0	1
		Echovirus 30	0	0	4	4	0	8
	Enterovirus C		0	0	0	0	0	0
	Enterovirus D		0	0	0	0	0	0
	Rhinovirus A	Not specified	0	0	0	0	0	0
Not specified		3	0	0	2	0	5	
Total			13	0	4	11	0	28

Non-typeable/non-capsulated *H. influenzae*

In Q4-2017 the number of non-typeable cases reported was five (aged 1 to 85+ years), less than the average of eight cases in the same quarter between 2014 and 2016 (Figure 9).

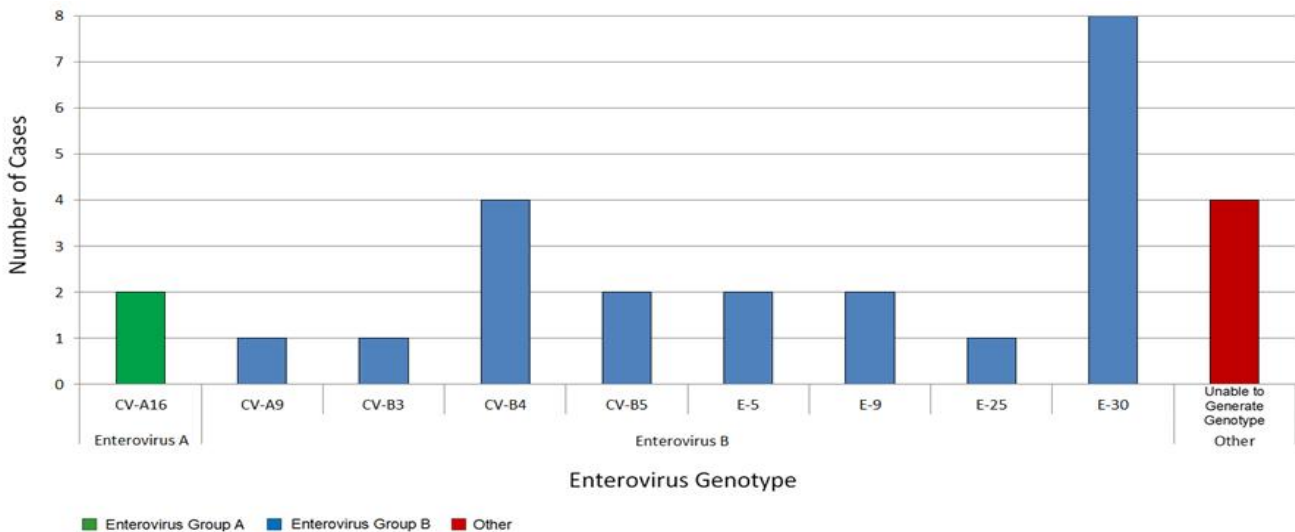


Figure 6. Breakdown of enterovirus genotypes reported by NVRL in Q4-2017

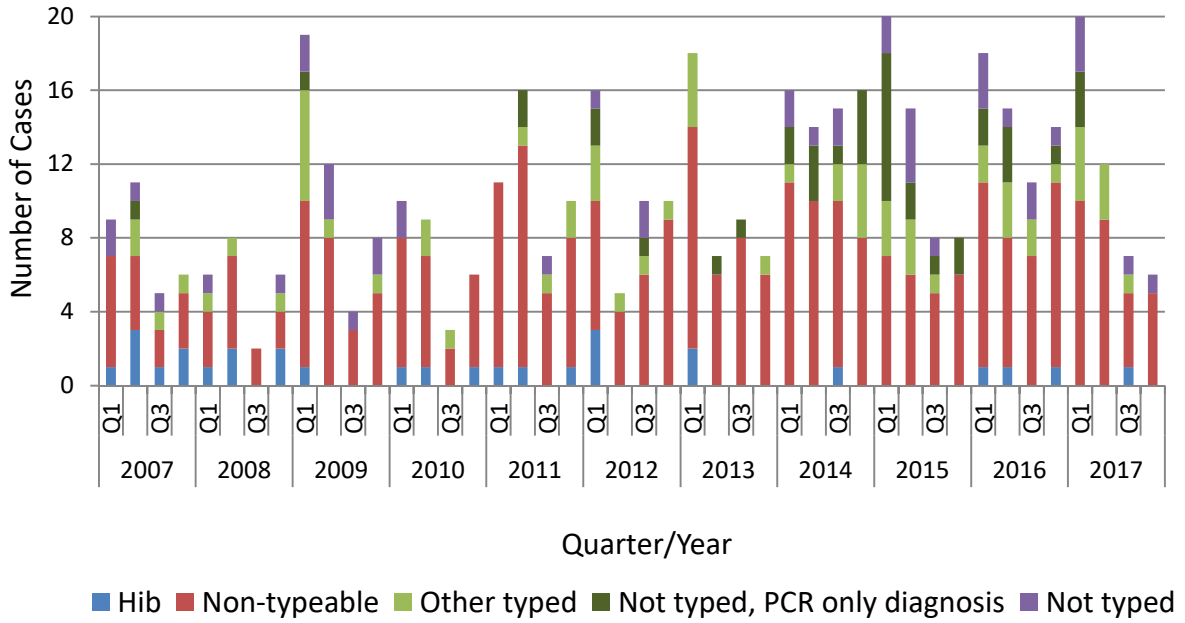


Figure 7. Quarterly number of *H. influenzae* cases by type since 2007

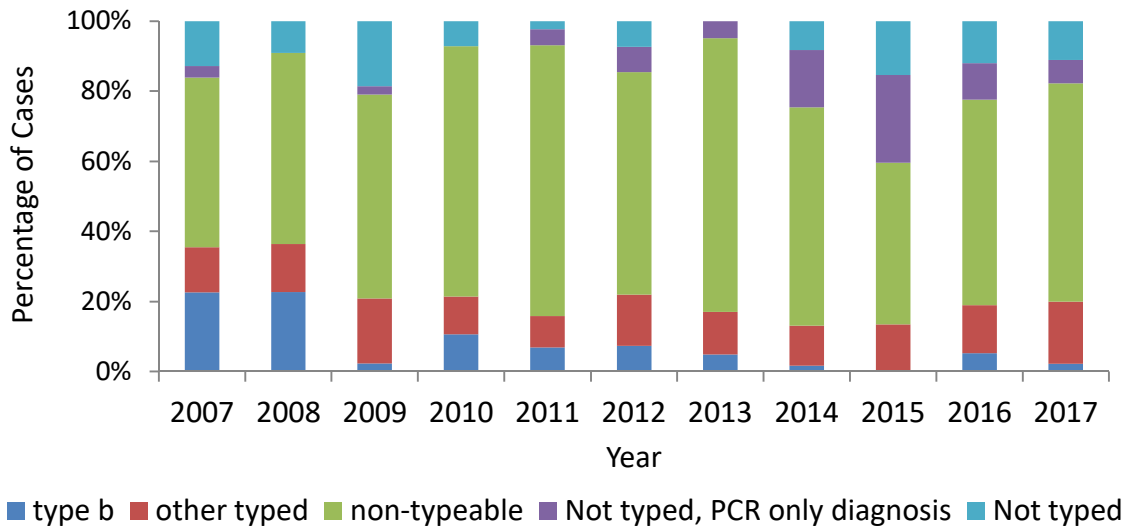


Figure 8. Annual proportion of *H. influenzae* cases by type since 2007

Table 5. Number of *H. influenzae* cases notified in the fourth quarter of 2015, 2016 and 2017

Number of cases	Q4-2015	Q4-2016	Q4-2017
All <i>H. influenzae</i>	8	14	6
All <i>H. influenzae</i> <5yrs	1	1	1
All <i>H. influenzae</i> ≥65yrs	3	8	4
<i>H. influenzae</i> type b	0	1	0
<i>H. influenzae</i> type b <5yrs	0	0	0
<i>H. influenzae</i> type b ≥65yrs	0	0	0
<i>H. influenzae</i> non-typeable	6	10	5
<i>H. influenzae</i> non-typeable <5yrs	0	1	1
<i>H. influenzae</i> non-typeable ≥65yrs	3	6	3

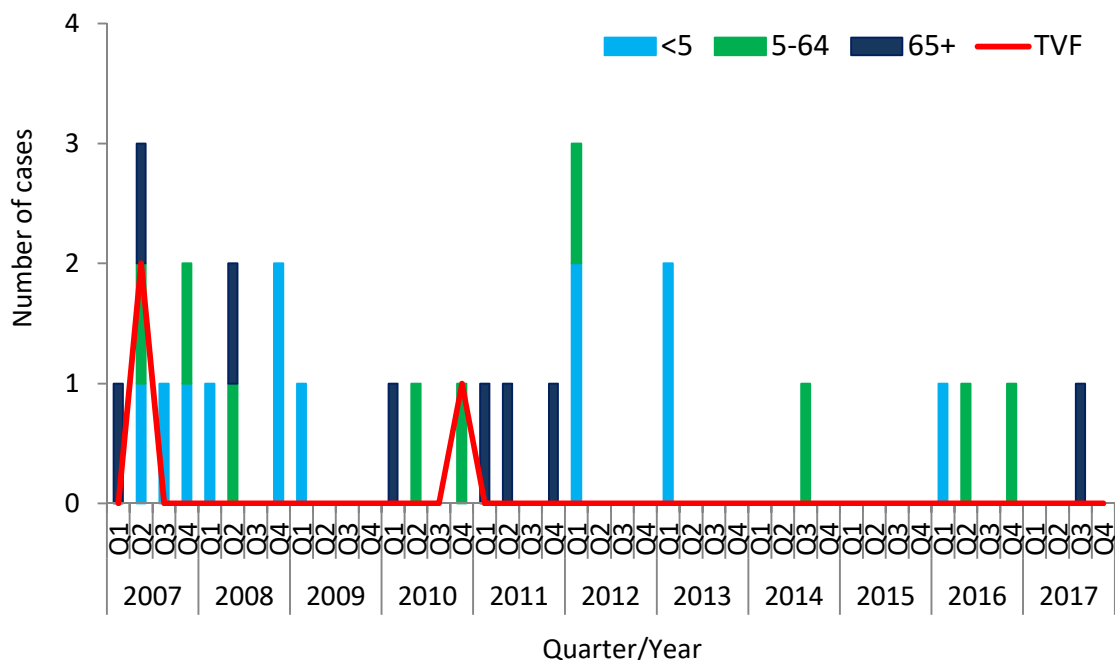
Table 6. Number of *H. influenzae* cases by clinical diagnosis notified in the fourth quarter of 2015, 2016 and 2017

Number of cases	Q4-2015	Q4-2016	Q4-2017	Total	Total (%)
Septicaemia	1	3	2	6	21.4
Bacteraemia (without focus)	0	0	0	0	0.0
Pneumonia	2	6	0	8	28.6
Meningitis	0	1	0	1	3.6
Meningitis & septicaemia and/or other	0	0	0	0	0.0
Other	0	2	0	2	7.1
Cellulitis	0	0	0	0	0.0
Epiglottitis	0	1	0	1	3.6
Osteomyelitis	0	0	0	0	0.0
Septic arthritis	0	0	0	0	0.0
Clinical diagnosis not reported	5	1	4	10	35.7
Total	8	14	6	28	100

Table 7. Number of *H. influenzae* cases by clinical diagnosis and type of infection, Q4-2017

Number of cases	Typed (b, d, e, f, d or not-b)	Non-typeable	Not typed*	Total
Septicaemia	0	2	0	2
Bacteraemia (without focus)	0	0	0	0
Pneumonia	0	0	0	0
Meningitis	0	0	0	0
Meningitis & septicaemia and/or other	0	0	0	0
Other	0	0	0	0
Cellulitis	0	0	0	0
Epiglottitis	0	0	0	0
Osteomyelitis	0	0	0	0
Septic arthritis	0	0	0	0
Clinical diagnosis not reported	0	3	1	4
Total	0	5	1	6

*including not typed, PCR diagnosis only (if any)

**Figure 9.** Quarterly number of Hib cases by age group and of true Hib vaccine failures (TVFs), since 2007

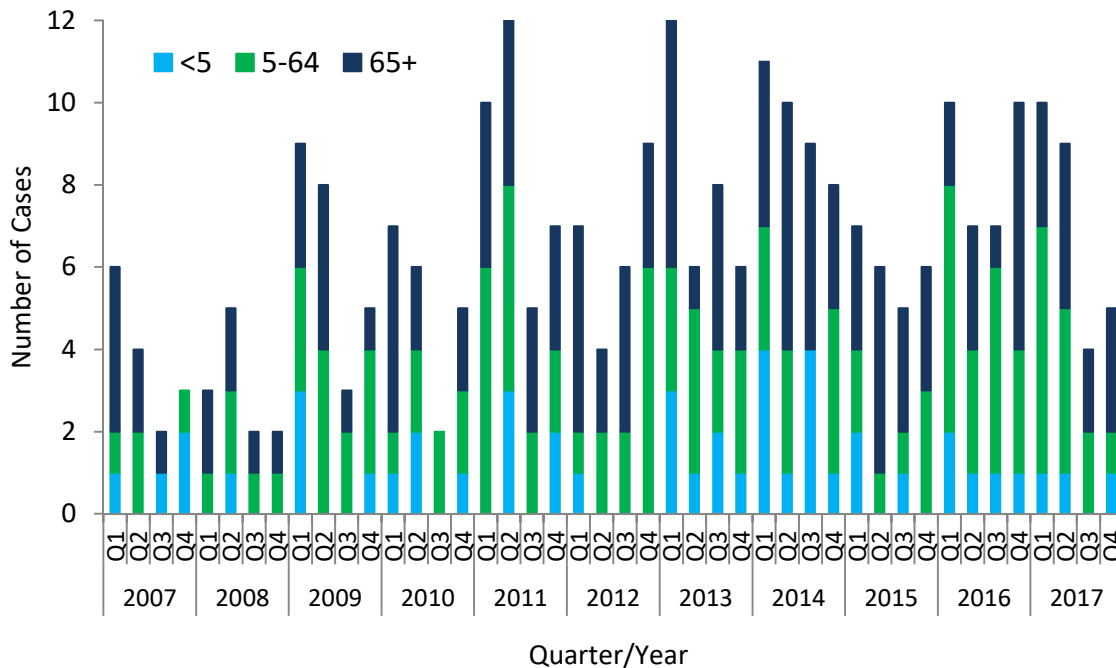


Figure 10. Quarterly number of non-typeable/non-capsulated cases by age group, since 2007

Acknowledgements

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NOTES

Invasive IMD and other bacterial meningitis notifications:

- The collection of specimens for all bacterial meningitis diagnostic testing should be performed as per recommendations outlined in the HPSC's 'Guidelines for the Early Clinical and Public Health Management of Bacterial Meningitis (including Meningococcal Disease). Report of the Scientific Advisory Committee of HPSC' published in January 2012, a copy of which is available at: <http://www.hpsc.ie/a-z/vaccinepreventable/bacterialmeningitis/guidance/HPSC%20BacMen%202017%20Web.pdf>
- An enhanced surveillance form should be completed for each notification. A copy is available at: <http://www.hpsc.ie/A-Z/VaccinePreventable/BacterialMeningitis/SurveillanceForms/File,1832.en.pdf>.
- **All suspected/confirmed *Neisseria meningitidis* isolates recovered from any site (blood/CSF/other sterile-site or nose/throat) from an individual with suspected or confirmed IMD should be forwarded by laboratories to the IMSRL for confirmation of identity and epidemiological typing. If an isolate is not available, please forward residual sample or PCR extract for confirmation/typing. Details are available at <http://www.cuh.ie/healthcare-professionals/departments/laboratory/> and at <http://www.cuh.ie/healthcare-professionals/departments/irish-meningitis-sepsis-reference-laboratory-imsrl/>**

Invasive viral meningitis notifications:

- The collection of specimens for viral meningitis diagnostic testing should be performed as per recommendations in the NVRL's user manual, which is available at: https://nvrl.ucd.ie/sites/default/files/uploads/pdfs/UCD_NVRL_User_Manual_17.0.pdf

Invasive *H. influenzae* notifications:

- Serotype should be determined for all isolates, regardless of patient age, and the results reported to HPSC.
- For all type b cases born since 1987, Hib vaccination status should be ascertained and the vaccine details reported to HPSC.
- On time Hib vaccinations (at 2, 4, 6 and 13 months of age) are strongly recommended to prevent unnecessary Hib disease occurring in children. Older children/adults with risk conditions (asplenia/hyposplenism/complement deficiency) are recommended the Hib vaccine (two doses, at least two months apart).
- An enhanced surveillance form should be completed for each Hib notification. A copy is available at: <https://www.hpsc.ie/a-z/vaccinepreventable/haemophilusinfluenzae/surveillanceforms/File,1847.en.pdf>. Details of the clinical diagnosis of each case should also be provided when completing this form.
- **All suspected/confirmed *H. influenzae* isolates recovered from any site from an individual with suspected or confirmed invasive *Haemophilus* infection should be forwarded by laboratories to the IMSRL for confirmation of identity and epidemiological typing. Details are available at <http://www.cuh.ie/healthcare-professionals/departments/laboratory/> and at <http://www.cuh.ie/healthcare-professionals/departments/irish-meningitis-sepsis-reference-laboratory-imsrl/>**

APPENDICES

Appendix 1. IMD Cases by Serogroup in Quarter 4, 2002-2017

Serogroup	Q4-2002	Q4-2003	Q4-2004	Q4-2005	Q4-2006	Q4-2007	Q4-2008	Q4-2009	Q4-2010	Q4-2011	Q4-2012	Q4-2013	Q4-2014	Q4-2015	Q4-2016	Q4-2017
B	47	66	38	40	36	35	43	25	21	20	16	15	26	9	15	6
C	1	3	0	1	2	1	1	2	0	1	0	0	1	4	6	7
W135	0	1	1	0	0	1	0	0	1	0	0	0	0	1	1	3
Y	1	1	1	0	1	0	1	0	0	0	1	0	2	2	4	0
Non-groupable (NG)	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	1
29E	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
No organism detected	8	2	2	1	5	0	3	4	2	0	4	5	1	2	0	1
Total	58	75	43	42	44	37	48	31	24	21	21	20	30	19	26	18

Appendix 2. IMD Cases by Quarter, 2002-2017

Qr	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2002-2017 change
Q1	82	73	66	72	73	57	55	52	52	35	24	23	24	22	23	27	-67.1%
Q2	60	38	47	57	55	44	31	33	23	24	13	25	21	17	18	20	-66.7%
Q3	53	51	42	31	37	41	34	31	15	14	8	13	7	16	20	12	-77.4%
Q4	58	75	43	42	44	37	48	31	24	21	21	20	30	19	26	18	-68.9%
Total	253	237	198	202	209	179	168	147	114	94	66	81	82	74	87	77	-69.6%

Appendix 3. IMD Cases by HSE Area in Quarter 4, 2002-2017

HSE Area	Q4-2002	Q4-2003	Q4-2004	Q4-2005	Q4-2006	Q4-2007	Q4-2008	Q4-2009	Q4-2010	Q4-2011	Q4-2012	Q4-2013	Q4-2014	Q4-2015	Q4-2016	Q4-2017	Q4-2017 CIR*
E	15	29	16	11	11	16	12	11	13	10	4	5	12	3	7	6	0.35
M	3	5	1	3	1	5	2	1	1	3	0	3	4	3	2	0	0.00
MW	12	6	4	3	7	4	2	2	2	3	2	2	0	2	1	5	1.30
NE	6	4	3	7	5	4	5	3	0	0	0	1	6	3	3	2	0.43
NW	3	2	6	3	3	0	2	4	2	3	0	0	0	1	2	0	0.00
SE	5	6	4	2	8	3	9	3	3	0	9	5	1	2	4	1	0.14
S	11	16	7	8	8	3	11	3	3	1	2	3	2	3	6	1	0.20
W	3	7	2	5	1	2	5	4	0	1	4	1	5	2	1	3	0.66
Total	58	75	43	42	44	37	48	31	24	21	21	20	30	19	26	18	0.38

* CIR, crude incidence rate per 100,000

Appendix 4. IMD Cases by Age Group in Quarter 4, 2002-2017

Age Group (Yrs)	Q4-2002	Q4-2003	Q4-2004	Q4-2005	Q4-2006	Q4-2007	Q4-2008	Q4-2009	Q4-2010	Q4-2011	Q4-2012	Q4-2013	Q4-2014	Q4-2015	Q4-2016	Q4-2017	Q4-2017 CIR*
<1	13	19	9	10	11	6	9	8	6	7	5	5	10	3	4	4	6.42
1-4	18	25	21	12	8	11	21	9	8	7	9	6	9	3	5	3	1.11
5-9	7	7	3	4	0	7	1	3	1	2	1	3	2	3	0	1	0.28
10-14	4	1	1	3	4	2	3	1	1	2	1	0	2	1	2	1	0.31
15-19	7	12	6	7	10	3	6	4	5	1	3	2	1	3	6	4	1.32
20-24	1	6	2	2	3	3	5	2	0	0	0	0	1	0	1	0	0.00
25-34	1	2	0	1	1	4	2	1	1	0	2	0	2	0	1	0	0.00
35-44	1	0	1	1	0	0	0	2	0	0	0	2	1	3	2	0	0.00
45-54	1	2	0	0	3	0	1	0	0	2	0	0	0	0	2	0	0.00
55-64	3	1	0	2	2	0	0	0	0	0	0	1	0	2	0	3	0.59
65+	2	0	0	0	2	1	0	1	2	0	0	1	2	1	3	2	0.31
Total	58	75	43	42	44	37	48	31	24	21	21	20	30	19	26	18	0.38

* CIR, crude incidence rate per 100,000

Appendix 5. Deaths associated with IMD by Serogroup in Quarter 4, 2002-2017

Serogroup	Q4-2002	Q4-2003	Q4-2004	Q4-2005	Q4-2006	Q4-2007	Q4-2008	Q4-2009	Q4-2010	Q4-2011	Q4-2012	Q4-2013	Q4-2014	Q4-2015	Q4-2016	Q4-2017
B	2	3	1	0	0	1	1	2	0	0	0	0	2	0	1	2
C	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
W135	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non-groupable (NG)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
No organism detected	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	2	3	1	0	0	1	1	2	0	0	0	0	3	0	2	2
%CFR* (Total)	3.4	4.0	2.3	0.0	0.0	2.7	2.1	6.5	0.0	0.0	0.0	0.0	10.0	0.0	7.7	11.1

* %CFR, case fatality ratio

Appendix 6. Other Bacterial Meningitis Cases by Causative Organism (Specified and Not Otherwise Specified) in Quarter 4, 2007-2017 (excluding IMD and *Haemophilus influenzae*)

	Causative organism	Q4-2007	Q4-2008	Q4-2009	Q4-2010	Q4-2011	Q4-2012	Q4-2013	Q4-2014	Q4-2015	Q4-2016	Q4-2017	Q4:2007-2017
Specified	<i>Leptospira</i> spp.	0	1	1	0	0	0	0	0	0	0	0	2
	<i>Listeria</i> spp.	0	1	0	0	0	1	1	0	1	0	0	4
	<i>Mycobacterium tuberculosis</i> #	1	1	4	1	1	1	0	0	0	0	1	10
	<i>Streptococcus pneumoniae</i>	n/a	5	9	4	5	9	11	14	6	9	9	81
	<i>Streptococcus agalactiae</i> *	na	na	na	na	na	4	1	0	1	0	0	6
	<i>Streptococcus pyogenes</i>	0	0	0	1	0	0	0	0	1	0	0	2
	<i>Salmonella</i> spp	0	0	1	0	0	0	0	0	0	0	0	1
Not specified	<i>Enterococcus species</i>	0	0	0	0	0	0	0	1	0	0	0	1
	<i>Escherichia coli</i>	0	6	2	2	0	2	3	3	6	1	1	26
	Group C Streptococcus	0	0	0	0	0	1	0	0	0	0	0	1
	<i>Klebsiella oxytoca</i>	0	0	0	0	1	0	0	0	0	0	0	1
	<i>Mycoplasma pneumoniae</i>	0	0	0	1	0	0	0	0	0	0	0	1
	<i>Proteus mirabilis</i>	1	0	0	0	0	0	0	0	0	0	0	1
	<i>Pseudomonas stutzeri</i>	0	0	0	0	0	0	0	0	0	0	1	1
	<i>Serratia liquefaciens</i>	0	1	0	0	0	0	0	0	0	0	0	1
	<i>Staphylococcus aureus</i>	0	1	0	1	1	0	0	0	0	0	0	3
	<i>Streptococcus agalactiae</i>	4	2	1	4	2	0	1	1	0	0	0	15
	Unknown/Not specified	5	9	5	5	4	5	6	2	4	4	2	51
Total	11	27	23	19	14	23	23	21	19	14	14	208	

#TB meningitis figures for 2016 and 2017 are provisional

**Streptococcus agalactiae* causing meningitis aged <90 days old notifiable under the disease category Streptococcus Group B infection (invasive) after 01/01/2012

†All *Streptococcus agalactiae* causing meningitis cases notifiable under the disease category Bacterial Meningitis (NOS) except after 01/01/2012 when cases aged >=90 days old only notifiable

n/a not available-details of meningitis-related *Streptococcus pneumoniae* currently not complete on CIDR for the year 2007

na not applicable for the years prior to 2012

§Meningitis-related Lyme neuroborreliosis cases are not included in this report

Appendix 7. Viral Meningitis Cases, Not Otherwise Specified, by Causative Organism in Quarter 4, 2007-2017

Causative Organism	Q4-2007	Q4-2008	Q4-2009	Q4-2010	Q4-2011	Q4-2012	Q4-2013	Q4-2014	Q4-2015	Q4-2016	Q4-2017
enterovirus group A	0	0	0	0	0	0	0	0	0	0	2
enterovirus group B	0	0	0	0	0	0	0	0	2	0	21
enterovirus group C	0	0	0	0	0	0	0	0	0	0	0
enterovirus group D	0	0	0	0	0	0	0	0	0	0	0
rhinovirus A	0	0	0	0	0	0	0	0	0	0	0
enterovirus group not specified	7	20	11	30	51	24	87	59	46	30	5
human herpes virus type 6	0	0	3	3	13	3	6	5	9	0	3
varicella/herpes zoster virus	0	2	2	1	1	3	0	4	1	2	0
herpes simplex virus	2	3	1	3	3	0	3	4	0	2	0
parechovirus	0	0	0	0	0	0	0	12	0	4	2
adenovirus	0	0	0	0	0	1	0	0	0	0	0
not specified	4	7	5	7	4	2	4	7	2	4	6
Total	13	32	22	44	72	33	100	91	60	42	39

Appendix 8. *H. influenzae* Cases by Type in Quarter 4, 2007-2017

Type	Q4-2007	Q4-2008	Q4-2009	Q4-2010	Q4-2011	Q4-2012	Q4-2013	Q4-2014	Q4-2015	Q4-2016	Q4-2017
b	2	2	0	1	1	0	0	0	0	1	0
d	1	0	0	0	0	0	0	0	0	0	0
e	0	1	0	0	1	1	1	2	0	1	0
f	0	0	1	0	1	0	0	2	0	0	0
not type-b	3	2	5	5	7	9	6	8	6	10	5
non-typeable/non-capsulated	0	0	0	0	0	0	0	4	2	1	0
not typed*	0	1	2	0	0	0	0	0	0	1	1
Total	6	6	8	6	10	10	7	16	8	14	6

*including not typed, PCR diagnosis only (if any)

Appendix 9. *H. influenzae* Cases by Quarter, 2007-2017

Qr	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2007-2017 change
Q1	9	6	19	10	11	16	18	16	21	18	20	+122.2%
Q2	11	8	12	9	16	5	7	14	15	15	12	+9.1%
Q3	5	2	4	3	7	10	9	15	8	11	7	+40.0%
Q4	6	6	8	6	10	10	7	16	8	14	6	0.0%
Total	31	22	43	28	44	41	41	61	52	58	45	+45.2%
<i>Meningitis</i>	2	3	3	2	4	3	2	7	5	1	1	-50.0%
<i>Type b meningitis</i>	1	1	0	1	0	1	0	0	0	0	0	-100.0%

Appendix 10. *H. influenzae* Cases by HSE Area in Quarter 4, 2007-2017

HSE Area	Q4-2007	Q4-2008	Q4-2009	Q4-2010	Q4-2011	Q4-2012	Q4-2013	Q4-2014	Q4-2015	Q4-2016	Q4-2017	Q4-2017 CIR*
E	1	4	1	2	3	6	4	5	6	2	4	0.23
M	1	0	0	0	0	0	1	1	0	1	0	0.00
MW	2	0	2	1	1	1	0	3	1	3	0	0.00
NE	0	0	1	1	1	0	1	0	0	2	1	0.22
NW	0	0	0	0	1	0	0	1	0	1	0	0.00
SE	1	0	1	1	1	2	0	3	0	2	1	0.14
S	0	1	0	1	1	1	1	2	1	1	0	0.00
W	1	1	3	0	2	0	0	1	0	2	0	0.00
Total	6	6	8	6	10	10	7	16	8	14	6	0.13

* CIR, crude incidence rate per 100,000

Appendix 11. *H. influenzae* Cases by Age Group in Quarter 4, 2007-2017

Age Grp (Yrs)	Q4-2007	Q4-2008	Q4-2009	Q4-2010	Q4-2011	Q4-2012	Q4-2013	Q4-2014	Q4-2015	Q4-2016	Q4-2017	Q4-2017 CIR*
<1	1	3	2	0	1	0	1	2	0	1	0	0.00
1-4	3	0	0	1	1	1	0	3	1	0	1	0.37
5-9	0	1	1	0	1	1	0	0	1	0	0	0.00
10-14	0	0	1	1	0	0	0	1	0	0	0	0.00
15-19	0	0	0	0	0	2	0	1	0	1	0	0.00
20-24	0	0	0	0	0	0	0	0	0	0	0	0.00
25-34	2	0	1	0	0	0	1	1	1	0	0	0.00
35-44	0	0	0	0	1	1	0	2	1	2	1	0.13
45-54	0	0	0	2	0	0	0	1	1	1	0	0.00
55-64	0	1	1	0	1	2	3	2	0	1	0	0.00
65+	0	1	2	2	5	3	2	3	3	8	4	0.63
Total	6	6	8	6	10	10	7	16	8	14	6	0.13

* CIR, crude incidence rate per 100,000