

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

A REPORT BY THE HEALTH PROTECTION SURVEILLANCE CENTRE (HPSC)
IN COLLABORATION WITH
THE IRISH MENINGITIS & SEPSIS REFERENCE LABORATORY (IMSRL) &
THE NATIONAL VIRUS REFERENCE LABORATORY (NVRL)



Q2-2018

21st September 2018

Provisional Figures

Summary

- **Invasive meningococcal disease (IMD)**
 - 17 IMD cases were notified in Q2-2018; eight serogroup B, four serogroup C, three serogroup W135 and two serogroup Y
 - Of the four serogroup C cases, one was a total vaccine failure (3 doses, aged 10-14 years), one was incompletely vaccinated (one dose, aged 20-24 years), one was unvaccinated (aged 85+ years) and one had an unknown vaccination status (aged 55-59 years)
 - Four deaths were reported (a case fatality rate of 23.5%); two were due to their infection and final attribution of cause of death is awaited for two. Two had a serogroup B infection, (age <6 months), one had a W135 infection (aged 15-19 years) and one had a serogroup C infection (aged 85+ years with a comorbidity risk)
 - Three of the eight serogroup B cases were <1 year of age: outcome was reported for two of these cases one of whom died. One was reported to have received one dose of the MenB vaccine at two months of age (age appropriately vaccinated), and the other fatal infant case had no vaccination history recorded
 - No outbreaks were reported
- **Other bacterial meningitis**
 - Nine cases of invasive *Streptococcus pneumoniae* infections presenting as meningitis were notified (range <1 to 79 years)
 - Two cases of meningitis-related Group B Strep (*Streptococcus agalactiae*) (aged 1 week) were reported
 - Two other meningitis-related infections were reported, one case each of *Listeria monocytogenes* (aged 80-84 years) and tuberculosis (aged 15-19 years)
 - Three cases of bacterial meningitis due to pathogens not otherwise specified (NOS) were also notified, including two that had *Escherichia coli* (aged 1-2 months) and one with *S. agalactiae* (aged 70-74 years)
 - No deaths were reported
- ***Haemophilus influenzae***
 - 22 cases of *H. influenzae* were reported (one of which was associated with meningitis), is the highest quarterly number ever recorded since this disease was made notifiable in 2004
 - Fourteen of the cases were non-typeable, there was one case each of types b, e and f and there were four not typed
 - One death was reported: a 10-14 year old with a non-typeable infection, the actual cause of death, however, was not known at the time of writing
 - No outbreaks were reported

- **Viral meningitis**
 - 74 cases of viral meningitis NOS, were reported, 44 (59.5%) of which were enterovirus (three were enterovirus group A, 28 were enterovirus B and 13 were not specified/genotype could not be generated)
 - Other causative organisms were identified including 18 human herpes virus type 6, six parechovirus, two varicella /herpes zoster virus and one herpes simplex virus
 - One death was reported: a patient with parechovirus-related meningitis, but the actual cause of death was unknown at the time of reporting
 - No outbreaks were reported

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](#) and for [Haemophilus influenzae \(invasive\) disease](#), but not for viral meningitis, not otherwise specified. Details of these surveillance systems are described in the [HPSC Annual Report 2005](#). Both the enhanced surveillance forms for IMD (including other forms of bacterial meningitis) and *Haemophilus influenzae* (invasive) disease were updated in early December 2015.

Table 1. Summary of meningococcal C and B vaccine schedules in Ireland from their introduction

Schedule	No. doses	MenC			MenB	
		Oct '00-Jun '08	Jul'08-Jun '15	Jul'15-Sept '16	Oct '16-Present	
Routine	1 st dose	2 Months	4 Months	4 Months	6 Months	2 Months
	2 nd dose	4 Months	6 Months	13 Months	13 Months	4 Months
	3 rd dose	6 Months	13 Months	12 - 13 Years	12 - 13 Years	12 Months
	4 th dose	-	12 -13 Years [†]	-	-	-
Catch up*	1 dose	1 -22 years	NA	NA	NA	None

*The MenC catch-up campaign was implemented over the 18-month period, October 2000 to March 2002, targeting those <23 years of age

[†]Adolescent dose introduced in 2014

NA: Not applicable

Data presented in this reported were extracted from CIDR on **21st September 2018**. **These figures are provisional**. Incidence rates for 2018 were calculated using the **2016** Census of Population as denominator data.

Results

Meningococcal Disease (invasive) (IMD)

IMD Cases by Serogroup & Case Classification

In Q2-2018, 17 cases of IMD were notified, all of which were confirmed. Eight were serogroup B, four serogroup C, three serogroup W135 and two serogroup Y (Table 2).

Three of the eight serogroup B cases were <1 year of age: one was reported to have received one dose of the MenB vaccine at two months of age (and therefore was age appropriately vaccinated), but died at three months of age and a coroner's report is awaited. Of the two other two cases, one had no vaccination history recorded, died, and a coroner's report is awaited and the outcome of the remaining case was not reported.

Details of the number of doses of the meningococcal C conjugate vaccine received, age group and outcome of the four serogroup C cases are presented in Table 3.

In Q2-2018 serogroup B disease accounted for 47.1% (n=8/17) of all IMD notifications and 23.5% (n=4/17) for serogroup C (Figure 1, Appendix 1).

Figure 2 presents the quarterly number of cases between 2008 and 2018.

Table 2. Classification of IMD cases notified by Serogroup in Q2-2018

Case Classification	B	C	W135	Y	NG	29E	No organism detected	Total
Confirmed	8	4	3	2	0	0	0	17
Probable	0	0	0	0	0	0	0	0
Possible	0	0	0	0	0	0	0	0
Not specified	0	0	0	0	0	0	0	0
Total	8	4	3	2	0	0	0	17

Table 3. Details of the serogroup C cases notified in Q2-2018 including age group, outcome and age at vaccination

Case No.	Age Grp	Outcome	Vaccination Status	No. MenC doses given	Age at (Last) Vaccination (Yrs)
1	20-24	Recovered	Incomplete	1	16.8
2	10-14	Recovering	Complete	3	Not specified
3	55-59	Not known	Unknown	-	-
4	85+	Died*	Unvaccinated	0	-

*Died due to this ID

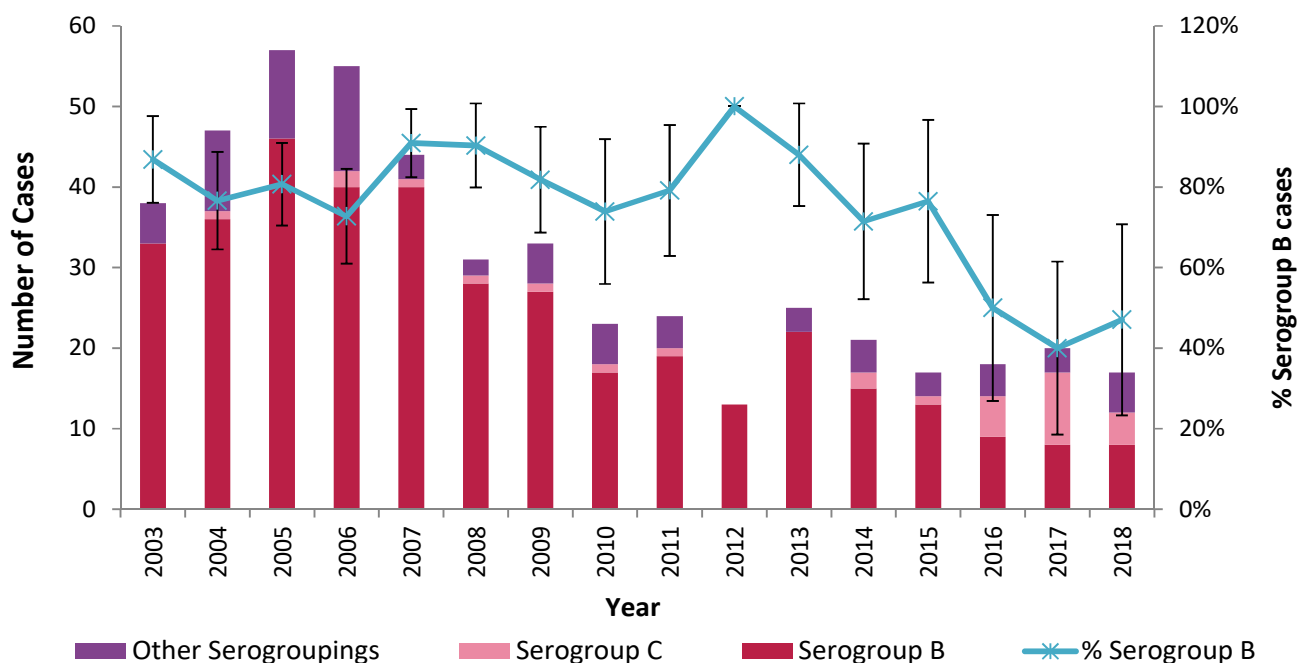
IMD Trends & Outbreaks

The number of IMD cases reported in Q2-2018 (n=17) was similar to the average number reported in the same quarter over the previous three years (average=18.3, 95% %CI 16.6-20.1); for serogroup B the average was 10.0 and for serogroup C it was 5.0 (Figure 1; Appendix 1). Second quarterly IMD cases have fallen by 55.3% since 2003 (from 38 to 17 cases) (Appendix 2). Also, since 2003, Q2 serogroup B cases have also declined by 75.8% (from 33 to 8 cases), but the percentage of serogroup C cases increased by 400% (from one to 4 cases) in that time (Appendix 1). No outbreaks of IMD were reported in Q2-2018.

In the electronic listing provided by the Irish Meningitis and Sepsis Reference Laboratory (IMSRL).in Temple Street Children's Hospital to the HPSC on September 10th 2018, all 17 classified confirmed IMD events on CIDR in Q2-2018 were included on it.

IMD Cases by HSE Area and Age Group

The crude incidence rate in Q2-2018 was 0.4 cases per 100,000 population, ranging from the lowest (0.0/100,000) in HSE NE to the highest (1.2/100,000) in HSE NW (Appendix 3). The burden of IMD disease is typically highest in the <1 year of age group and in Q2-2018 the incidence rate in this age group was 4.8 cases per 100,000 population, followed by 0.9 cases/100,000 in the 10-14 year age group (Appendix 4).

**Figure 1. Number of IMD cases notified in Ireland by serogroup in Q2 of each year between 2003 and 2018 with percentage of quarterly cases attributable to serogroup B with 95% confidence intervals**

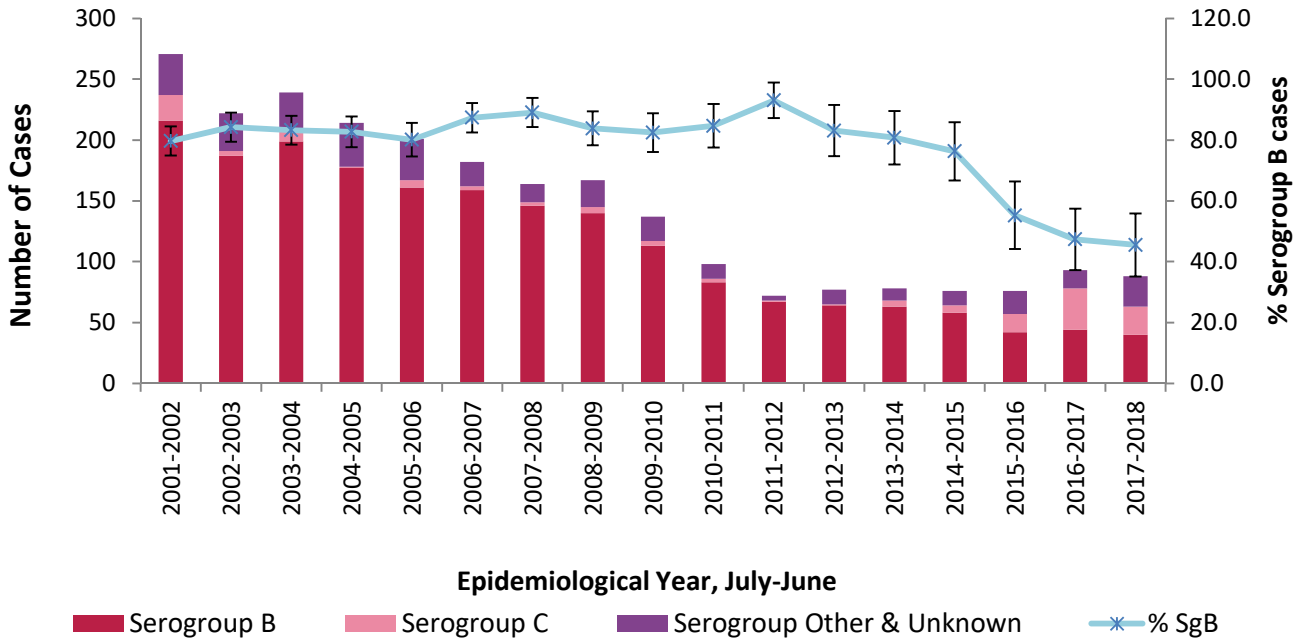


Figure 2. Number of IMD cases notified in Ireland by serogroup by epidemiological year with percentage of cases attributable to serogroup B with 95% confidence intervals, 2001-2002 to 2017-2018

IMD associated deaths

Four deaths were reported in Q2-2018 (case fatality rate of 23.5%), compared to 0% in Q2-2017. Two of the deaths were due to their infection and two others are awaiting a coroner’s report at the time of writing. Two had a serogroup B infection, (aged <6 months), one had a W135 infection (aged 15-19 years) and one had a serogroup C infection (aged 85+ years with a comorbidity risk) (Figure 3, Appendix 5). One of the serogroup B deaths was vaccinated with one dose of the MenB vaccine. Because this vaccine only covers about 70% of strain types in Ireland, this death may not be the result of an (incomplete) vaccine failure, even if they had been fully vaccinated/age appropriately vaccinated. The vaccination status of the other serogroup B death was not reported. The average number of deaths was 0.7 deaths in the same quarter between 2015 and 2017.

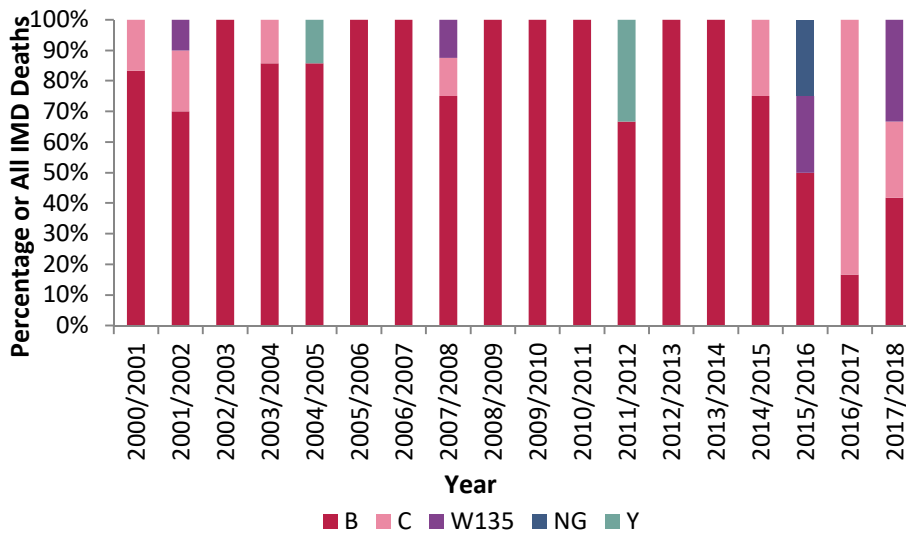


Figure 3. Percentage of all IMD deaths by serogroup by epidemiological year, 2001-2002 to 2017-2018

Other Forms of Bacterial Meningitis

Streptococcus pneumoniae meningitis

In Q2-2018, nine cases of invasive *S. pneumoniae* infections (IPD) presenting as meningitis were notified. The age range was <1 and 75-79 years (Appendix 6). No deaths were reported. Four 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 4 below.

Table 4. Vaccination status, age and risk factors and serotype details of the *Streptococcus pneumoniae* meningitis cases reported in Q2-2018

Case No.	Age Group	Risk factors	PCV vaccination status	PPV vaccination status	Serotype
1	<1	Yes	Vaccinated	.	.
2	<1	Under investigation	Unvaccinated	Unvaccinated	.
3	40-44	Yes	Unknown	Unknown	.
4	55-59	No	.	.	.
5	60-64
6	60-64	Yes	Unvaccinated	Unvaccinated	.
7	65-69	No	Unvaccinated	.	.
8	70-74	Yes	Unvaccinated	Vaccinated (1 dose)	.
9	75-79	No	Unvaccinated	Vaccinated (1 dose)	.

* 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 *Streptococcus pneumoniae*)

Two cases of meningitis-related Group B Strep (*Streptococcus agalactiae*) (aged 1 week) was reported in this quarter. Two CSF PCR positive cases of *S. agalactiae* (aged 1 month) was also reported during this time; the latter case, however, was not labelled as having clinical meningitis or any other clinical description. One case each of *Listeria monocytogenes* (serotype not reported) (aged 80-84 years) and tuberculosis (aged 15-19 years, foreign-born) was also reported. No deaths were reported in this quarter.

Bacterial meningitis (not otherwise specified)

Three cases of bacterial meningitis due to pathogens not otherwise specified (NOS) were notified during Q2-2018. Among these confirmed cases were two *Escherichia coli* (aged 2 months) and one *S. agalactiae* (aged 70-74 years) (Appendix 6). No deaths or imported cases were reported during this period.

Haemophilus influenzae (invasive) infections

H. influenzae Cases by Type, Case Classification

In Q2-2018, 22 cases of invasive *H. influenzae* (all case classified as confirmed) were notified (Figure 4): 14 of the cases were non-typeable, there was one case each of types b, e and f and there were four not typed (three of which were PCR only diagnosis). This total compares to an average of 14.0 cases for the same quarter in 2015 to 2017 (Table 6, Appendices 7, 8). Of all the Q2 cases reported between 2016 and 2018, 28.6% (n=14/49) had no clinical diagnosis reported (Table 7). In Q2-2018, non-typeable cases accounted for 63.6% (n=14/22) of all cases, similar to the average of 66.1% recorded during the same quarter between 2008 and 2017 (Figure 4).

The numbers of cases reported in Q2-2018, 22, is the highest quarterly figure ever recorded since the disease was made notifiable back in 2004 and is unusual in that the peak quarterly number typically occurs in Q1 of any given year (Figure 4).

In the electronic listing provided by the Irish Meningitis and Sepsis Reference Laboratory (IMSRL).in Temple Street Children's Hospital to the HPSC on September 10th 2018, all but four classified confirmed *H. influenzae* events on CIDR in Q2-2018 were included on it.

H. influenzae associated deaths

One death was reported in this quarter: a 10-14 year old with a non-typeable infection, the actual cause of death, however, was not known at the time of writing.

H. influenzae meningitis

One meningitis-related *H. influenzae* case was reported in Q2-2018 in a child aged 1-2 years with a not type b infection (Table 8).

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. One Hib case was reported in Q2-2018, an unvaccinated 85+ year old. The last reported TVF however was in Q4-2010, the only one in 11 years between Q3-2007 and Q2-2018: 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 3, 4). 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.

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

In Q2-2018 the number of non-typeable cases reported was 14 (aged 1 to 85+ years), considerably higher than the average of 7.3 cases in the same quarter between 2015 and 2017 (Figure 6).

Table 6. Number of *H. influenzae* cases notified in the second quarter of 2016, 2017 and 2018

Number of cases	Q2-2016	Q2-2017	Q2-2018
All <i>H. influenzae</i>	15	12	22
All <i>H. influenzae</i> <5yrs	5	2	4
All <i>H. influenzae</i> ≥65yrs	4	5	9
<i>H. influenzae</i> type b	1	0	0
<i>H. influenzae</i> type b <5yrs	0	0	0
<i>H. influenzae</i> type b ≥65yrs	0	0	1
<i>H. influenzae</i> non-typeable	7	9	14
<i>H. influenzae</i> non-typeable <5yrs	1	1	2
<i>H. influenzae</i> non-typeable ≥65yrs	3	4	5

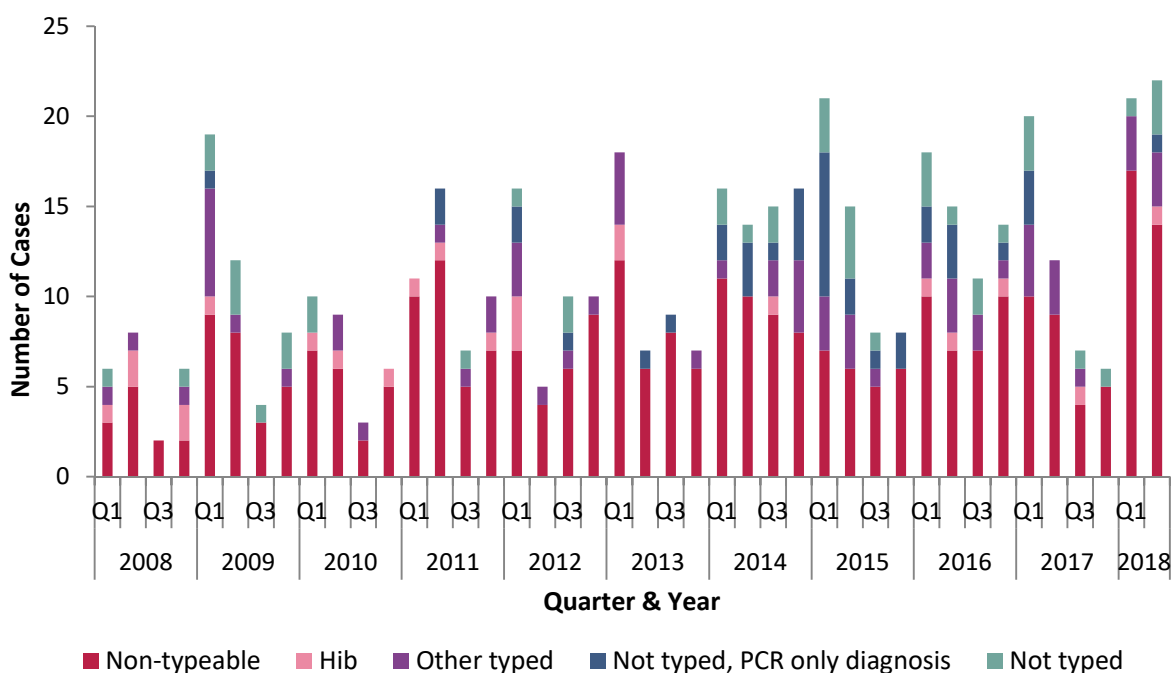


Figure 4. Quarterly number of *H. influenzae* cases by type since 2008

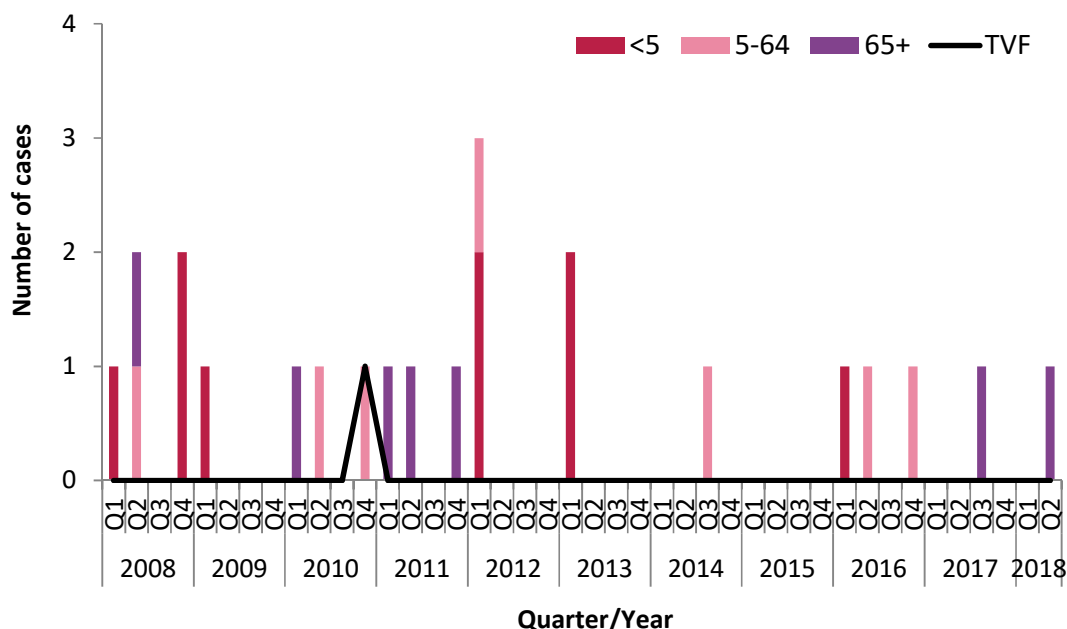
Table 7. Number of *H. influenzae* cases by clinical diagnosis notified in the second quarter of 2016, 2017 and 2018

Number of cases	Q2-2016	Q2-2017	Q2-2018	Total	Total (%)
Septicaemia	2	3	8	13	26.5
Bacteraemia (without focus)	4	0	1	5	10.2
Pneumonia	3	5	2	10	20.4
Meningitis	0	0	1	1	2.0
Meningitis & septicaemia and/or other	0	0	0	0	0.0
Other	3	1	1	5	10.2
Cellulitis	0	0	0	0	0.0
Epiglottitis	0	0	1	1	2.0
Osteomyelitis	0	0	0	0	0.0
Septic arthritis	0	0	0	0	0.0
Clinical diagnosis not reported	3	3	8	14	28.6
Total	15	12	22	49	100.0

Table 8. Number of *H. influenzae* cases by clinical diagnosis and type of infection, Q2-2018

Number of cases	Typed (b, d, e, f, d or not-b)	Non-typeable	Not typed*	Total	
Septicaemia		2	5	1	8
Bacteraemia (without focus)		0	1	0	1
Pneumonia		0	2	0	2
Meningitis		1	0	0	1
Meningitis & septicaemia and/or other		0	0	0	0
Other		0	0	1	1
Cellulitis		0	0	0	0
Epiglottitis		0	0	1	1
Osteomyelitis		0	0	0	0
Septic arthritis		0	0	0	0
Clinical diagnosis not reported		1	6	1	8
Total		4	14	4	22

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

**Figure 5. Quarterly number of Hib cases by age group and of true Hib vaccine failures (TVFs), since 2008**

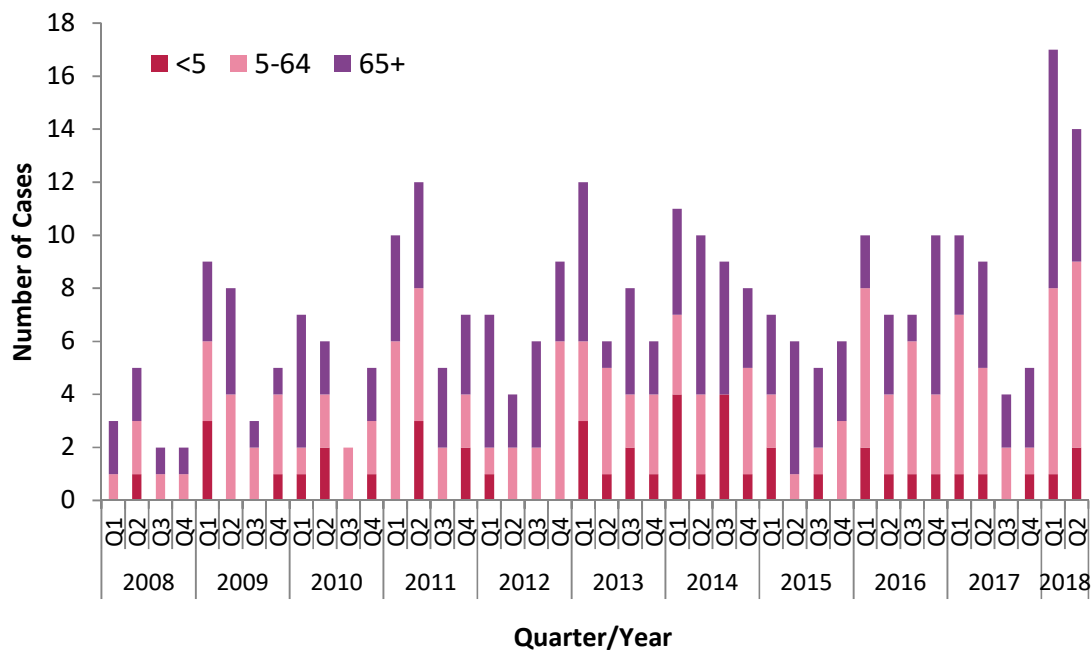


Figure 6. Quarterly number of non-typeable/non-capsulated cases by age group, since 2008

Viral Meningitis (Specified and Not Otherwise Specified)

Seventy-four viral meningitis notifications (NOS) (aged 1 week to 62 years; median 5.8 months; one enterovirus case had no date of birth) were reported in Q2-2018 (Figures 7, 8). All but three had their causative organism identified: 44 (59.5%) enterovirus (aged 1 week to 36 years; median 4.8 years); 18 (24.3%) human herpes virus type 6 (HHV 6) (aged 1 week to 50 years); six (8.1%) parechovirus (aged 1 to 2 months); two (2.7%) varicella/herpes zoster virus (aged 14 to 62 years) and one (1.4%) herpes simplex virus (aged 50-54 years). One death was reported in this quarter in a patient with parechovirus-related meningitis, but the actual cause of death was unknown at the time of reporting.

In Q2-2018, the highest frequency of cases occurred in children <1 year of age (n=41/74; 55.4%) and in adults aged 15-39 years (n=16/74; 21.6%) (Figure 7). Of the 41 cases <1 year of age reported in this quarter, 20 (48.8%) were attributable to enterovirus and 13 (31.7%) to HHV 6. 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 were seven in Q2-2018), 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 8 presents both the total number of viral meningitis NOS cases and those not caused by enterovirus by year and by quarter since 2008.

Figure 9, which presents the number of viral meningitis NOS cases by causative organism and epidemiological year since 2005-2006 to date shows that after a sharp increase in 2013-2014, there has been a steady, gradual decline in overall numbers since then, much of this trend being attributable to enterovirus.

The average Q2 percentage of all viral meningitis NOS cases attributable to enterovirus since 2014 to date has been 79.0%. Details of enterovirus serotypes by age group in Q2-2018 are presented in Table 9 and shows that the numbers of cases are highest in the <1 and 15-39 year age groups.

All but ten CIDR events in Q2 of 2018 were matched to NVRL viral meningitis enterovirus typing records provided to the HPSC on August 30th 2018; specimens for these ten cases were not sent to the NVRL, five of the unmatched cases were attributable to laboratory reports from University Hospital Waterford, four to Galway University Hospital and the remaining case to Mercy Hospital, Cork.

Table 9. Enterovirus genotypes by age group (years) on CIDR in Q2-2018
 (Enterovirus genotyping targets the VP1 gene of the virus)

Genus	Species	Type	Age Group (years)						Total
			<1	1-4	5-14	15-39	40+	Unk	
Enterovirus	Enterovirus A	Coxsackievirus A10	1	0	0	0	0	0	1
		Coxsackievirus A16	1	0	0	0	0	0	1
		Coxsackievirus A2	0	1	0	0	0	0	1
	Enterovirus B	Coxsackievirus B5	5	0	0	2	0	1	8
		Echovirus 18	1	0	2	3	0	0	6
		Echovirus 25	3	0	0	0	0	0	3
		Echovirus 3	0	0	1	1	0	0	2
		Echovirus 30	0	0	0	2	0	0	2
		Echovirus 6	0	0	1	1	0	0	2
		Echovirus 9	2	1	1	1	0	0	5
	Enterovirus C		0	0	0	0	0	0	0
	Enterovirus D		0	0	0	0	0	0	0
	Not specified	Unable to generate genotype.	2	0	0	1	0	0	3
		Enterovirus	5	1	1	3	0	0	10
Total			20	3	6	14	0	1	44

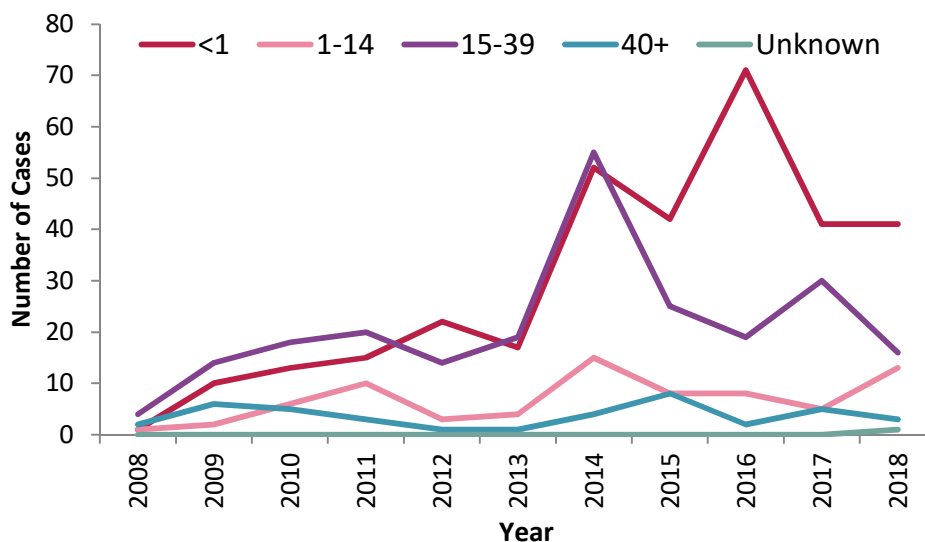


Figure 7. Quarter 2 number of viral meningitis (NOS) cases in Ireland by age group (years), 2008-2018

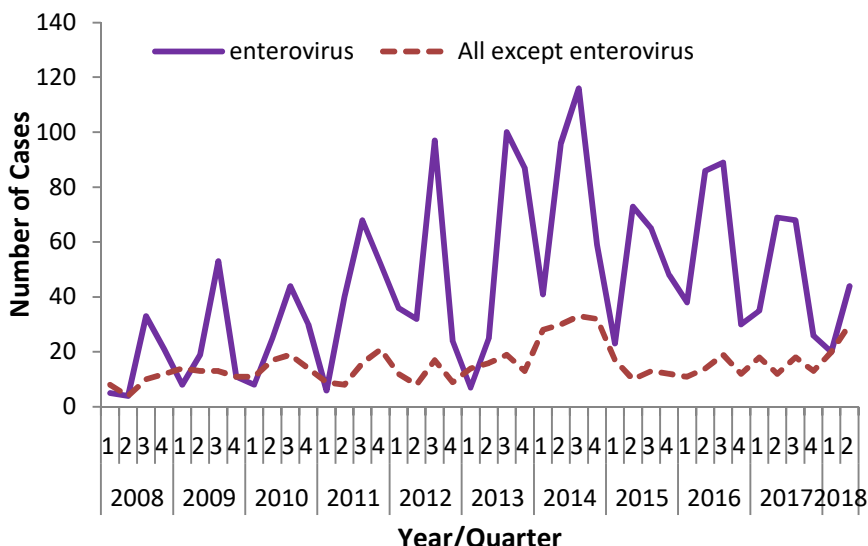


Figure 8. Number of viral meningitis (NOS) cases caused by enterovirus and all except enterovirus by quarter and year, 2008-2018

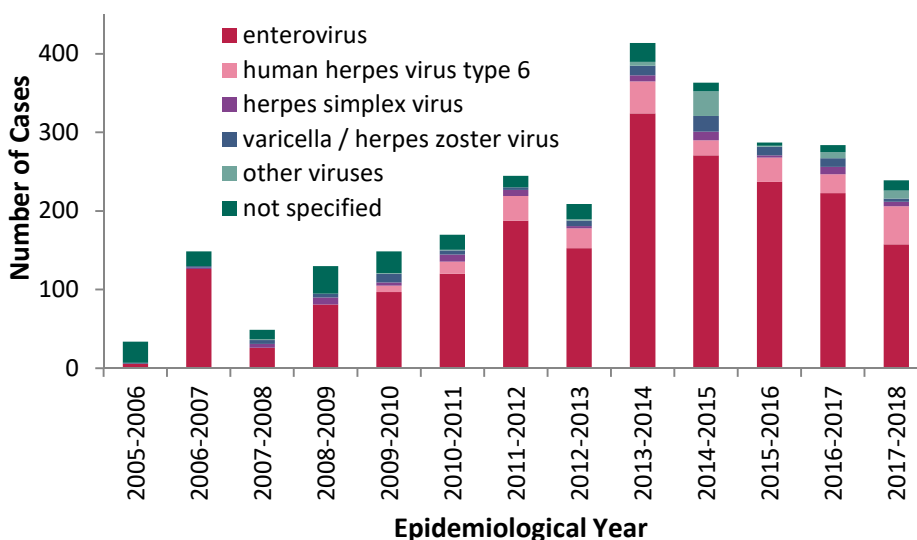


Figure 9. Number of viral meningitis (NOS) cases by causative organism by epidemiological year, 2005-2006 to 2017-2018

Acknowledgements

- HPSC wishes to thank all who provided data for this report: Departments of Public Health, the Irish Meningitis & Sepsis Reference Laboratory (IMSRL) in Temple Street Children’s Hospital, National Virus Reference Laboratory (NVRL) and other Microbiology Laboratories

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 2, 2003-2018

Serogroup	Q2-2003	Q2-2004	Q2-2005	Q2-2006	Q2-2007	Q2-2008	Q2-2009	Q2-2010	Q2-2011	Q2-2012	Q2-2013	Q2-2014	Q2-2015	Q2-2016	Q2-2017	Q2-2018
B	33	36	46	40	40	28	27	17	19	13	22	15	13	9	8	8
C	0	1	0	2	1	1	1	1	1	0	0	2	1	5	9	4
W135	0	0	2	1	0	0	0	0	1	0	0	1	2	3	3	3
Y	0	1	2	1	0	0	2	0	0	0	1	1	0	0	0	2
Non-groupable (NG)	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
29E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
No organism detected	4	9	7	11	3	2	3	5	3	0	2	1	1	1	0	0
Total	38	47	57	55	44	31	33	23	24	13	25	21	17	18	20	17

Appendix 2. IMD Cases by Quarter, 2003-2018

Qr	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2003-2018 change
Q1	73	66	72	72	57	55	52	52	35	24	23	24	22	23	27	42	-42.5%
Q2	38	47	57	55	44	31	33	23	24	13	25	21	17	18	20	17	-55.3%
Q3	51	42	31	37	41	34	31	15	14	8	13	7	16	20	12	-	-
Q4	75	43	43	44	37	48	31	24	21	21	20	30	19	26	17	-	-
Total	237	198	203	208	179	168	147	114	94	66	81	82	74	87	76	-	-

Appendix 3. IMD Cases by HSE Area in Quarter 2, 2003-2018

HSE Area	Q2-2003	Q2-2004	Q2-2005	Q2-2006	Q2-2007	Q2-2008	Q2-2009	Q2-2010	Q2-2011	Q2-2012	Q2-2013	Q2-2014	Q2-2015	Q2-2016	Q2-2017	Q2-2018	Q2-2018 CIR*
E	10	13	11	19	17	6	10	6	9	4	10	6	6	4	4	5	0.29
M	2	4	11	7	0	4	2	2	0	0	2	3	1	3	3	1	0.34
MW	7	4	5	7	3	3	6	0	3	1	1	0	6	1	5	1	0.26
NE	5	2	3	5	7	5	3	5	3	4	2	2	0	2	2	0	0.00
NW	4	3	1	3	4	2	0	2	1	0	1	1	0	3	0	3	1.17
SE	7	9	7	2	2	3	4	3	4	2	4	3	1	1	3	2	0.29
S	3	10	14	7	6	6	6	5	3	1	3	4	2	3	3	3	0.59
W	0	2	5	5	5	2	2	0	1	1	2	2	1	1	0	2	0.44
Total	38	47	57	55	44	31	33	23	24	13	25	21	17	18	20	17	0.36

* CIR, crude incidence rate per 100,000

Appendix 4. IMD Cases by Age Group in Quarter 2, 2003-2018

Age Group (Yrs)	Q2-2003	Q2-2004	Q2-2005	Q2-2006	Q2-2007	Q2-2008	Q2-2009	Q2-2010	Q2-2011	Q2-2012	Q2-2013	Q2-2014	Q2-2015	Q2-2016	Q2-2017	Q2-2018	Q2-2018 CIR*
<1	10	13	13	9	13	10	10	8	8	2	10	4	1	2	4	3	4.82
1-4	15	20	20	25	16	10	9	8	7	7	7	7	4	6	4	2	0.74
5-9	4	3	5	6	2	2	1	2	1	0	2	2	2	1	0	0	0.00
10-14	2	2	6	4	2	0	1	1	0	0	1	1	2	1	1	3	0.94
15-19	2	6	5	4	6	2	5	1	3	2	2	2	1	1	3	1	0.33
20-24	1	1	2	1	0	2	2	0	0	0	1	0	1	1	1	1	0.37
25-34	1	1	2	3	2	2	0	0	2	0	0	2	1	1	0	0	0.00
35-44	2	0	0	1	1	2	1	0	0	0	0	1	3	0	0	1	0.13
45-54	1	1	0	1	2	0	0	0	0	0	1	1	0	1	3	1	0.16
55-64	0	0	1	0	0	1	0	2	1	0	0	0	0	2	0	1	0.20
65+	0	0	3	1	0	0	4	1	2	2	1	1	2	2	4	4	0.63
Total	38	47	57	55	44	31	33	23	24	13	25	21	17	18	20	17	0.36

* CIR, crude incidence rate per 100,000

Appendix 5. Deaths associated with IMD by Serogroup in Quarter 2, 2003-2018

Serogroup	Q2-2003	Q2-2004	Q2-2005	Q2-2006	Q2-2007	Q2-2008	Q2-2009	Q2-2010	Q2-2011	Q2-2012	Q2-2013	Q2-2014	Q2-2015	Q2-2016	Q2-2017	Q2-2018
B	1	1	0	1	2	1	0	1	0	0	2	0	1	0	0	2
C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
W135	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Y	0	0	1	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	1	0	0	1	0	0	0	0	0	0	0	0
Total	1	1	1	1	3	1	0	2	0	0	2	0	1	1	0	4
%CFR* (Total)	2.6	2.1	1.8	1.8	6.8	3.2	0.0	8.7	0.0	0.0	8.0	0.0	5.9	5.6	0.0	23.5

* %CFR, case fatality ratio

Appendix 6. Other Bacterial Meningitis Cases by Causative Organism (Specified and Not Otherwise Specified) in Quarter 2, 2008-2018 (excluding *IMD* and *Haemophilus influenzae*)

Causative organism		Q2-2008	Q2-2009	Q2-2010	Q2-2011	Q2-2012	Q2-2013	Q2-2014	Q2-2015	Q2-2016	Q2-2017	Q2-2018
Specified	<i>Leptospira</i> spp.	0	0	0	0	0	0	0	0	0	0	0
	<i>Listeria</i> spp.	1	0	1	1	0	0	0	3	0	1	1
	<i>Mycobacterium tuberculosis</i> #	1	0	2	1	1	2	1	0	0	0	1
	<i>Streptococcus pneumoniae</i>	9	3	4	6	11	10	8	9	12	9	9
	<i>Streptococcus agalactiae</i> *	na	na	na	na	0	0	2	1	1	0	2
	<i>Streptococcus pyogenes</i>	1	0	0	0	1	1	0	0	0	1	0
	<i>Salmonella</i> spp.	0	0	0	0	0	0	0	0	0	0	0
Not specified	<i>Escherichia coli</i>	2	0	0	1	1	1	0	3	1	4	2
	<i>Micrococcus luteus</i>	0	0	0	0	0	0	1	0	0	0	0
	<i>Pasteurella multocida</i>	0	0	0	0	0	0	0	1	0	0	0
	<i>Staphylococcus aureus</i>	2	1	3	0	0	0	0	0	0	0	0
	<i>Streptococcus agalactiae</i> †	0	3	2	3	0	0	0	0	0	0	1
	<i>Streptococcus bovis</i> biotype II/2	0	1	0	0	0	0	0	0	0	0	0
	<i>Streptococcus constellatus</i>	0	0	0	0	0	0	0	0	0	1	0
	Unknown/Not specified	0	5	6	5	5	1	5	5	2	2	0
Total	16	13	18	17	19	15	17	22	16	18	16	244

#TB meningitis figures for 2016, 2017 and 2018 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

na not applicable for the years prior to 2012

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

Appendix 7. *H. influenzae* Cases by Type in Quarter 2, 2008-2018

Type	Q2-2008	Q2-2009	Q2-2010	Q2-2011	Q2-2012	Q2-2013	Q2-2014	Q2-2015	Q2-2016	Q2-2017	Q2-2018
b	2	0	1	1	0	0	0	0	1	0	1
d	0	0	0	0	0	0	0	0	0	0	0
e	0	1	0	1	0	0	0	0	0	1	1
f	1	0	2	0	1	0	0	1	2	2	1
not type-b	0	0	0	0	0	0	0	2	1	0	1
non-typeable/non-capsulated	5	8	6	12	4	6	10	6	7	9	14
not typed*	0	3	0	2	0	1	4	6	4	0	4
Total	8	12	9	16	5	7	14	15	15	12	22

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

Appendix 8. *H. influenzae* Cases by Quarter, 2008-2018

Qr	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2008-2018 change
Q1	6	19	10	11	16	18	16	21	18	20	21	+250%
Q2	8	12	9	16	5	7	14	15	15	12	22	+175%
Q3	2	4	3	7	10	9	15	8	11	7	-	-
Q4	6	8	6	10	10	7	16	8	14	6	-	-
Total	22	43	28	44	41	41	61	52	58	45	-	-
<i>Meningitis</i>	2	2	1	3	2	2	7	3	1	1	-	-
<i>Type b meningitis</i>	1	0	1	0	1	0	0	0	0	0	-	-

Appendix 9. *H. influenzae* Cases by HSE Area in Quarter 2, 2008-2018

HSE Area	Q2-2008	Q2-2009	Q2-2010	Q2-2011	Q2-2012	Q2-2013	Q2-2014	Q2-2015	Q2-2016	Q2-2017	Q2-2018	Q2-2018 CIR*
E	3	1	2	8	0	0	4	8	8	5	10	0.58
M	0	1	1	1	0	1	3	1	2	0	1	0.34
MW	2	2	0	0	0	2	1	1	1	3	1	0.26
NE	0	0	1	3	1	2	1	1	1	0	1	0.22
NW	0	1	1	0	0	0	0	0	1	0	2	0.78
SE	1	2	1	2	3	0	3	0	2	2	1	0.14
S	1	5	3	0	0	2	1	2	0	2	5	0.98
W	1	0	0	2	1	0	1	2	0	0	1	0.22
Total	8	12	9	16	5	7	14	15	15	12	22	0.46

* CIR, crude incidence rate per 100,000

Appendix 10. *H. influenzae* Cases by Age Group in Quarter 2, 2008-2018

Age Grp (Yrs)	Q2-2008	Q2-2009	Q2-2010	Q2-2011	Q2-2012	Q2-2013	Q2-2014	Q2-2015	Q2-2016	Q2-2017	Q2-2018	Q2-2018 CIR*
<1	2	0	2	3	0	0	3	2	4	0	1	1.61
1-4	0	0	0	2	0	1	1	3	1	2	3	1.11
5-9	1	1	1	0	0	0	0	0	0	1	1	0.28
10-14	0	0	0	0	0	0	0	0	0	0	1	0.31
15-19	0	0	0	1	1	0	0	0	0	0	1	0.33
20-24	1	0	1	0	0	1	0	2	1	0	0	0.00
25-34	0	0	1	2	0	1	0	1	1	2	1	0.15
35-44	0	1	2	0	2	2	2	0	0	0	2	0.27
45-54	1	0	0	0	0	0	0	1	2	2	2	0.32
55-64	0	3	0	2	0	1	2	0	2	0	1	0.20
65+	3	7	2	6	2	1	6	6	4	5	9	1.41
Total	8	12	9	16	5	7	14	15	15	12	22	0.46

* CIR, crude incidence rate per 100,000

Appendix 11. Viral Meningitis Cases, Not Otherwise Specified, by Causative Organism in Quarter 2, 2008-2018

Causative Organism	Q2-2008	Q2-2009	Q2-2010	Q2-2011	Q2-2012	Q2-2013	Q2-2014	Q2-2015	Q2-2016	Q2-2017	Q2-2018
enterovirus group A	0	0	0	0	0	0	0	0	0	1	3
enterovirus group B	0	0	0	0	0	0	0	0	0	49	28
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/genotype could not be generated	4	19	25	40	32	25	96	73	86	19	13
human herpes virus type 6	0	0	2	4	6	8	11	2	10	6	18
varicella/herpes zoster virus	3	0	5	1	0	1	2	6	3	4	2
herpes simplex virus*	0	2	1	2	0	0	1	1	0	1	1
parechovirus	0	0	0	0	0	0	5	0	0	0	6
adenovirus	0	0	0	0	0	0	0	0	0	0	0
not specified	1	11	9	1	2	7	11	1	1	1	3
Total	8	32	42	48	40	41	126	83	100	81	74
% known causative organism	87.5	65.6	78.6	97.9	95.0	82.9	91.3	98.8	99.0	98.8	95.9

*Includes types 1 and 2