

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)



Q4-2018

4th April 2019

Provisional Figures

Summary

- **Invasive meningococcal disease (IMD)**
 - 12 IMD cases were notified in Q4-2018; six serogroup B, four serogroup C and one each of serogroups W135 and Y
 - Of the four serogroup C cases, three were unvaccinated (two aged <1 year and one aged 70-74 years) and one incompletely vaccinated (aged 10-14 years, three doses received, last dose given at seven months of age)
 - One serogroup B case <1 year of age was age appropriately vaccinated (single dose received at two months of age)
 - Two deaths were reported (case fatality rate of 16.7%); one (aged 15-19 years) due to serogroup Y and the other (aged 85+ years) due to serogroup W135
 - No outbreaks were reported
- **Other bacterial meningitis**
 - Two cases of invasive *Streptococcus pneumoniae* infections (IPD) presenting as meningitis were notified (age range 60-69 years)
 - Three cases of meningitis-related Group B Strep (*Streptococcus agalactiae*) (aged 1 week) and one case of *tuberculosis* (aged 80-84 years) were also reported
 - Six cases of bacterial meningitis due to pathogens not otherwise specified (NOS) were notified, among which were one case each of *Escherichia coli* (aged <6 months), *Klebsiella pneumoniae* (aged 4 months, died, but cause of death not specified) and *Streptococcus agalactiae* (aged 75-74 years) and three cases whose causative pathogen was not identified
 - No outbreaks were reported
- ***Haemophilus influenzae***
 - Eleven cases of *H. influenzae* were reported (one of which was associated with meningitis, aged 65+ years): one type each of a and e and nine non-typeable cases
 - This quarter is the first time that a type a case has been reported in Ireland
 - No outbreaks or deaths were reported
- **Viral meningitis**
 - 105 cases of viral meningitis NOS, were reported, all but one had their causative organism identified: 29 enterovirus, 14 human herpes virus type 6 (HHV 6), 57 parechovirus, three varicella/herpes zoster virus and one herpes simplex virus (aged 20-24 years)
 - 49 of the 57 reported parechovirus VM cases were late notifications from 2015 and 2017
 - No outbreaks or deaths 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 from the **4th April 2019**. **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 Q4-2018, 12 cases of IMD were notified, all of which were classified as confirmed. Six were serogroup B, four were serogroup C, and one each of serogroups W135 and Y (Table 2).

Details of the number of vaccine doses of the one meningococcal B cases <1 year and of the four meningococcal C cases by age group and outcome of are presented in Table 3.

In Q4-2018 serogroup B disease accounted for 50% (n=6/12) of all IMD notifications, 33.3% (n=4) for serogroup C and 8.3% (n=1) each for serogroups W135 and Y (Figure 1, Appendix 1).

Table 2. Classification of IMD cases notified by Serogroup in Q4-2018

Case Classification	B	C	W135	Y	NG	29E	No organism detected	Total
Confirmed	6	4	1	1	0	0	0	12
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	6	4	1	1	0	0	0	12

Table 3. Details of the serogroup B and C cases notified in Q4-2018 including age group, outcome and age at last vaccination dose

Case No.	Serogroup /Age Grp	Outcome	Vaccination Status	No. doses given	Age at (Last) Vaccination (Months)
1	B/<1 yrs	Recovering	Age appropriately vaccinated	1	2
2	C/<1 yrs	Recovering	Unvaccinated	0	0
3	C/<1 yrs	Not specified	Unvaccinated	0	0
4	C/10-14 yrs	Recovering	Incompletely vaccinated	3	7
5	C/70-74 yrs	Recovered	Unvaccinated	0	0

IMD Trends & Outbreaks

The number of IMD cases reported in Q4-2018 (n=12) was significantly lower than the average number reported in the same quarter over the previous three years (average=20.7, 95% %CI 15.2-26.2); for serogroup B the average was 10.0 and for serogroup C it was 5.7 (Figure 1; Appendix 1). Fourth quarterly IMD cases have fallen by 84.2% since 2001 (from 76 to 12 cases) (Appendix 2). Also, since 2001, Q4 serogroup B cases have also declined by 91.2% (from 68 to 6 cases), the percentage of serogroup C cases decreased by 20.0% (from five to four cases) in that time (Appendix 1). No outbreaks of IMD were reported in Q4-2018. Figure 2 presents full year IMD case numbers between 2013 and 2018 and Table 4 features a breakdown of 2018 cases by serogroup and age group.

In the electronic listing provided by the Irish Meningitis and Sepsis Reference Laboratory (IMSRL) in Temple Street Children’s University Hospital to the HPSC on March 12th, 2019, all 12 classified confirmed IMD events on CIDR in Q4-2018 were included on it.

IMD Cases by HSE Area and Age Group

The crude incidence rate in Q4-2018 was 0.25 cases per 100,000 population, ranging from the lowest (0.0/100,000) in HSE M, SE and S to the highest (0.47/100,000) in HSE E (Appendix 3). The burden of IMD disease is typically highest in the <1 year of age group, and in Q4-2018 the incidence rate was highest in this age group was 4.8 cases per 100,000 population, followed by 0.66 cases/100,000 in the 15-19 year age group (Appendix 4).

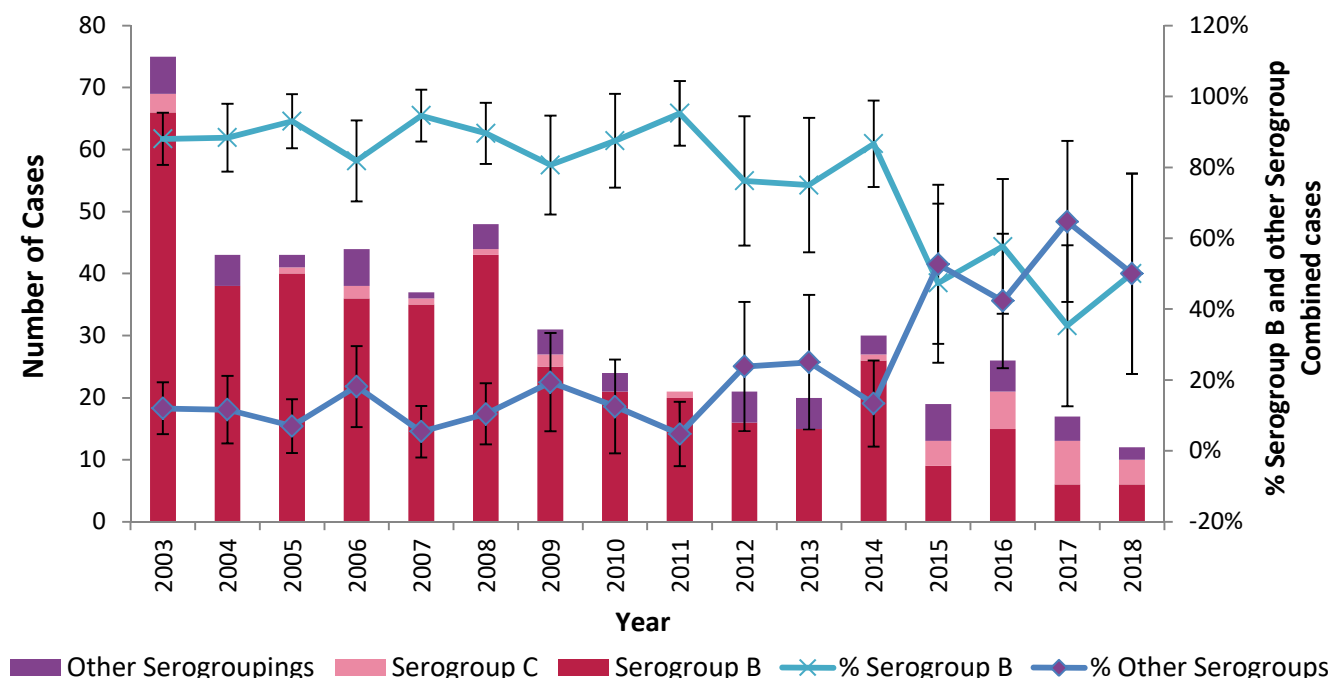


Figure 1. Number of IMD cases notified in Ireland by serogroup in Q4 of each year and percentage (with 95% confidence intervals) attributable to serogroup B and other serogroups (2003 and 2018)

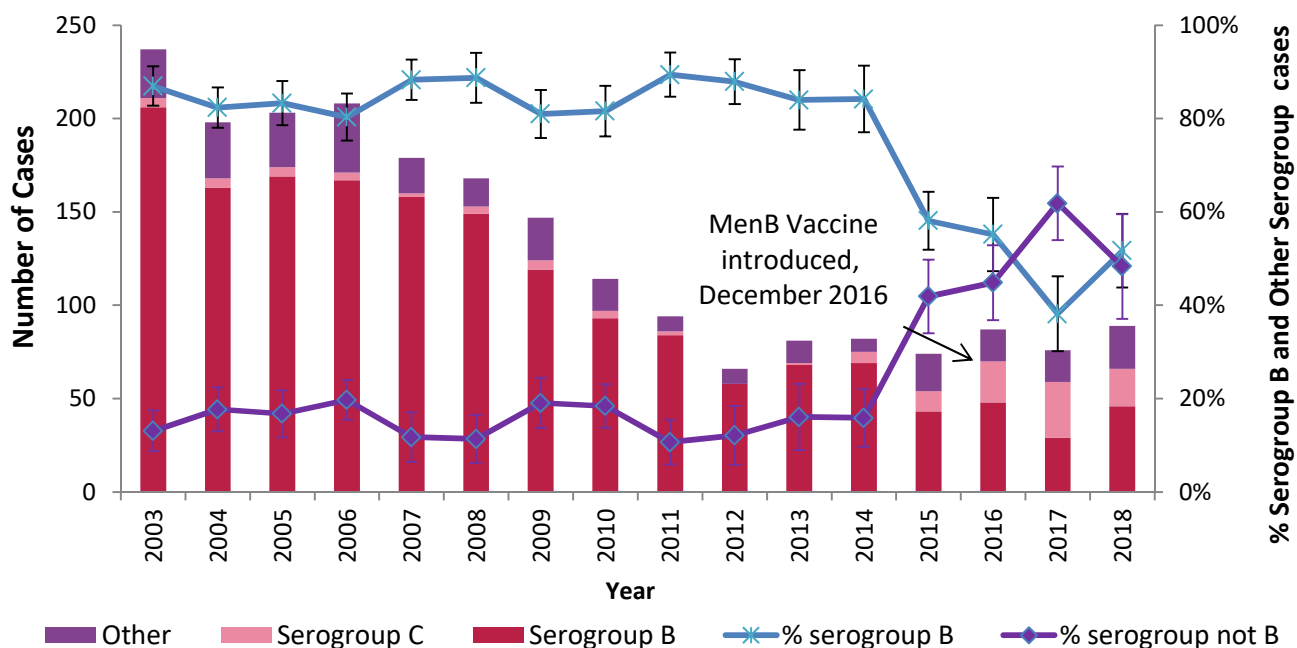


Figure 2. Number of IMD cases notified in Ireland by serogroup, year, and percentage (with 95% confidence intervals) attributable to serogroup B and other serogroups (2003 and 2018)

Table 4. IMD cases by serogroup and age group, 2018

Age Group	B	% B	C	% C	W135	% W135	Y	% Y	Other	% Other	Total	%Total
<1	6	13.0	4	20.0	1	8.3	0	0.0	0	0.0	11	12.4
1-4	13	28.3	3	15.0	2	16.7	0	0.0	1	33.3	19	21.3
5-9	5	10.9	0	0.0	1	8.3	1	12.5	0	0.0	7	7.9
10-14	4	8.7	2	10.0	1	8.3	0	0.0	0	0.0	7	7.9
15-19	7	15.2	3	15.0	2	16.7	3	37.5	0	0.0	15	16.9
20-24	0	0.0	2	10.0	1	8.3	1	12.5	0	0.0	4	4.5
25-34	2	4.3	0	0.0	0	0.0	0	0.0	0	0.0	2	2.2
35-44	2	4.3	0	0.0	0	0.0	0	0.0	0	0.0	2	2.2
45-54	1	2.2	0	0.0	0	0.0	1	12.5	1	33.3	3	3.4
55-64	1	2.2	2	10.0	1	8.3	0	0.0	0	0.0	4	4.5
65+	5	10.9	4	20.0	3	25.0	2	25.0	1	33.3	15	16.9
Unknown	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Total (n)	46		20		12		8		3		89	

IMD associated deaths

Two deaths were reported in Q4-2018 (case fatality rate of 16.7%), compared to 11.8% (n=2/17) in Q4-2017. Both deaths were due to their infections: one (aged 15-19 years) due to serogroup Y and the other (aged 85+ years) due to serogroup W135 (Appendix 5). The average number of deaths was 1.3 in the same quarter between 2015 and 2017.

Other Forms of Bacterial Meningitis

Streptococcus pneumoniae meningitis

In Q4-2018, two cases of invasive *S. pneumoniae* infections (IPD) presenting as meningitis were notified. The age range was 60-69 years (Appendix 6). No deaths were reported. Both patients had a risk factor recorded and both were unvaccinated.

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

Three cases of meningitis-related Group B Strep (*Streptococcus agalactiae*) (aged 1 week), along with two other CSF PCR positive cases of *S. agalactiae* (aged 1 month) were reported during Q4-2018; the latter two cases, however, were not labelled as having clinical meningitis or any other clinical description. One case of tuberculosis-related meningitis (aged 80-84 years) was also reported. No deaths were reported in this quarter.

Bacterial meningitis (not otherwise specified)

Six cases of bacterial meningitis due to pathogens not otherwise specified (NOS) were notified during Q4-2018. Among these cases were one each of *Escherichia coli* (aged <6 months), *Streptococcus agalactiae* (aged 75-74 years) and *Klebsiella pneumoniae* (aged 4 months, died, cause of death not specified) (Appendix 6). There were also two probable cases (aged 65-69 years) and one possible case (aged 1-2 years) reported. No imported cases were reported during this period.

Haemophilus influenzae (invasive) infections

H. influenzae Cases by Type, Case Classification

In Q4-2018, 11 cases of *H. influenzae* (all case classified as confirmed) were notified (Figure 2): one case each of types a and e and nine non-typeable cases. This quarter is the first time that a type a case has been reported in Ireland. This total compares to an average of 9.3 cases for the same quarter in 2015 to 2017 (Table 5, Appendices 7, 8).

Of all the Q4 cases reported between 2016 and 2018, 22.6% (n=7/31) had no clinical diagnosis reported (Table 6). In Q4-2018, non-typeable cases accounted for nine of the 11 cases (81.8%), considerably higher than the average of 71.8% recorded during the same quarter between 2008 and 2017 (Figure 4).

In the electronic listing by the Irish Meningitis and Sepsis Reference Laboratory (IMSRL) in Temple Street Children's University Hospital to the HPSC on March 12th, 2019, all confirmed *H. influenzae* events on CIDR in Q4-2018 were included on it.

H. influenzae associated deaths

No deaths were reported in this quarter.

H. influenzae meningitis

One meningitis-related *H. influenzae* case was reported in Q4-2018 in a patient aged 65+ years (Table 6).

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 Q4-2018. The last reported TVF however was in Q4-2010, eight years ago: 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 Q4-2018 nine non-typeable cases was reported (aged 4 to 91 years), more than the average of 7.0 cases in the same quarter between 2015 and 2017 (Figure 5).

Table 5. Number of *H. influenzae* cases notified in the fourth quarter of 2016, 2017 and 2018

Number of cases	Q4-2016	Q4-2017	Q4-2018
All <i>H. influenzae</i>	14	6	11
All <i>H. influenzae</i> <5yrs	1	1	1
All <i>H. influenzae</i> ≥65yrs	8	4	6
<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	0
<i>H. influenzae</i> non-typeable	10	5	9
<i>H. influenzae</i> non-typeable <5yrs	1	1	1
<i>H. influenzae</i> non-typeable ≥65yrs	6	3	3

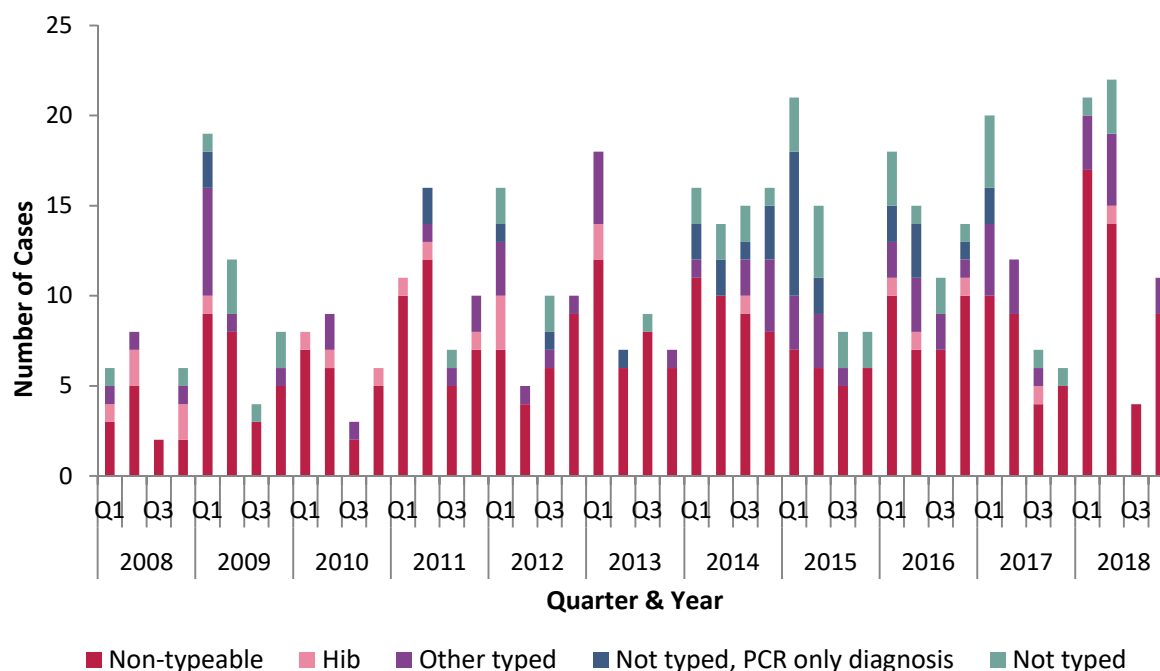


Figure 3. Quarterly number of *H. influenzae* cases by type since 2008

Table 6. Number of *H. influenzae* cases by clinical diagnosis notified in Q4 of 2016, 2017 and 2018

Number of cases	Q4-2016	Q4-2017	Q4-2018	Q4-2016 to 2018 Total	Q4-2016 to 2018 Total (%)
Septicaemia	3	2	4	9	29.0
Bacteraemia (without focus)	0	0	1	1	3.2
Pneumonia	6	0	2	8	25.8
Meningitis	1	0	1	2	6.5
Meningitis & septicaemia and/or other	0	0	0	0	0.0
Other	2	0	1	3	9.7
Cellulitis	0	0	0	0	0.0
Epiglottitis	1	0	0	1	3.2
Osteomyelitis	0	0	0	0	0.0
Septic arthritis	0	0	0	0	0.0
Clinical diagnosis not reported	1	4	2	7	22.6
Total	14	6	11	31	100

Table 7. Number of *H. influenzae* cases by clinical diagnosis and type of infection, Q4-2018

Number of cases	Typed (b, d, e, f, d or not-b)	Non-typeable	Not typed*	Total
Septicaemia	1	3	0	4
Bacteraemia (without focus)	1	0	0	1
Pneumonia	0	2	0	2
Meningitis	0	1	0	1
Meningitis & septicaemia and/or other	0	0	0	0
Other	0	1	0	1
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	2	0	2
Total	2	9	0	11

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

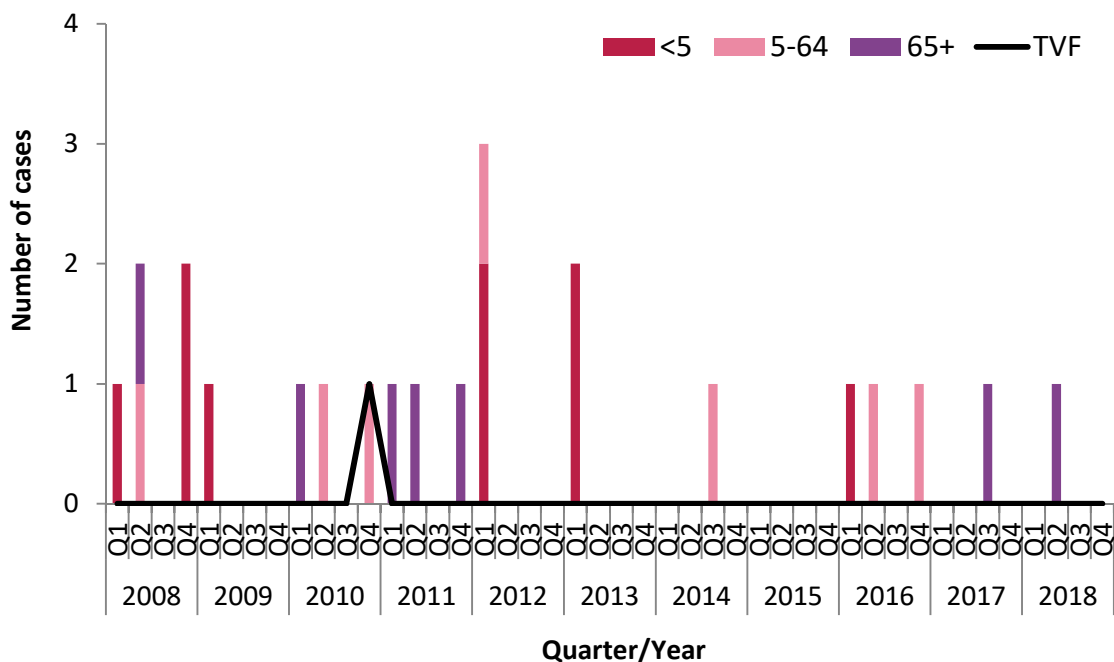


Figure 4. Quarterly number of Hib cases by age group and of true Hib vaccine failures (TVFs), since 2008

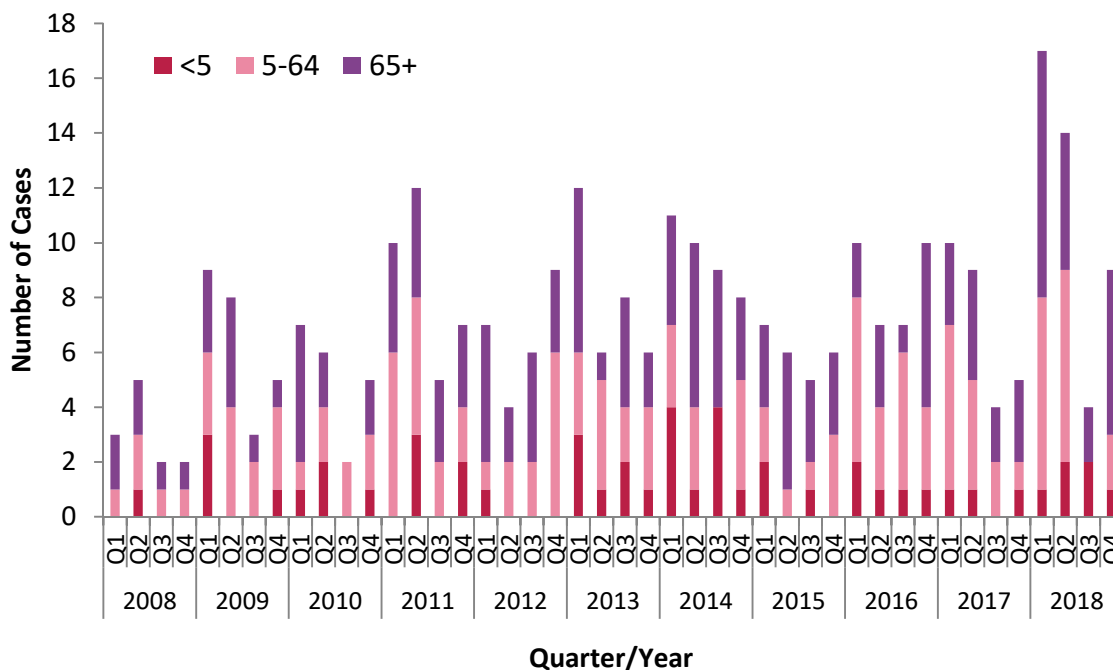


Figure 5. Quarterly number of non-typeable/non-capsulated cases by age group, since 2008

Viral Meningitis (Specified and Not Otherwise Specified)

In Q4-2018, three cases of meningitis-related mumps were reported, all aged between 15-24 years, the first since Q4-2015. All three cases were vaccinated with two doses of the MMR vaccine, the second dose received when they were aged 4-5 years.

One hundred and five viral meningitis notifications (NOS) (aged 1 week to 85 years; median 2.1 years) were reported in Q4-2018 (Figures 6, 7). All but one had their causative organism identified: 57 (54.2%) parechovirus (aged one month to 71 years); 29 (27.6%) enterovirus (aged 1 week to 42 years; median 5.7 years); 14 (13.3%) human herpes virus type 6 (HHV 6) (aged two months to 85 years); three (2.9%) varicella/herpes zoster virus (aged 37 to 48 years) and one herpes simplex virus type 2 (aged 20-24 years).

Of the 57 parechovirus cases in this quarter, 49 (86.0%) were retrospective/late notifications from 2015 to 2017. No viral-meningitis outbreaks or deaths were reported in this quarter.

In Q4-2018, the highest frequency of cases occurred in children 1-4 years of age (n=54/105; 51.4%) and in infants aged <1 year (n=30/105; 28.6%) (Figure 6). Of the 54 cases aged 1-4 years, 49 (90.7%) were attributable to parechovirus, four (7.4%) to HHV6 and one (1.9%) to enterovirus. In contrast, of the 30 cases <1 year of age, 13 (43.3%) were attributable to enterovirus, nine (30.0%) to HHV 6 and seven (23.3%) to parechovirus.

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 three in Q4-2018), 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 7 presents both the total number of viral meningitis NOS cases and those not caused by enterovirus by year and by quarter since 2008.

The average Q4 percentage of all viral meningitis (VM) cases attributable to enterovirus since 2014 to date has been 63.6%, this value would have been higher were it not for the presence of 49 retrospective/late notifications of parechovirus from 2015 to 2017 reported in Q4-2018. Details of enterovirus serotypes by age group in Q4-2018 are presented in Table 8 and shows that the numbers of cases are highest in the <1 and 15-39 year age groups.

All of the Q4-2018 enterovirus related viral meningitis events in CIDR were matched to NVRL enterovirus typing records provided to the HPSC on March 5th, 2019.

Table 8. Enterovirus genotypes by age group (years) on CIDR in Q4-2018
(Enterovirus genotyping targets the VP1 gene of the virus)

Genus	Species	Type	Age Group (years)					Total
			<1	1-4	5-14	15-39	40+	
Enterovirus	Enterovirus A	Coxsackievirus A16	3	0	0	0	0	3
		Coxsackievirus B3	1	0	0	0	0	1
		Coxsackievirus B4	1	0	0	0	0	1
		Coxsackievirus B5	1	0	0	0	0	1
	Enterovirus B	Echovirus 6	3	0	0	1	0	4
		Echovirus 18	4	0	0	3	0	7
		Echovirus 25	0	0	0	2	0	2
		Echovirus 30	0	0	0	5	0	5
	Enterovirus C		0	0	0	0	0	0
	Enterovirus D		0	0	0	0	0	0
Unable to generate sequence		0	1	1	1	1	4	
Not specified		0	0	0	1	0	1	
Total			13	1	1	13	1	29

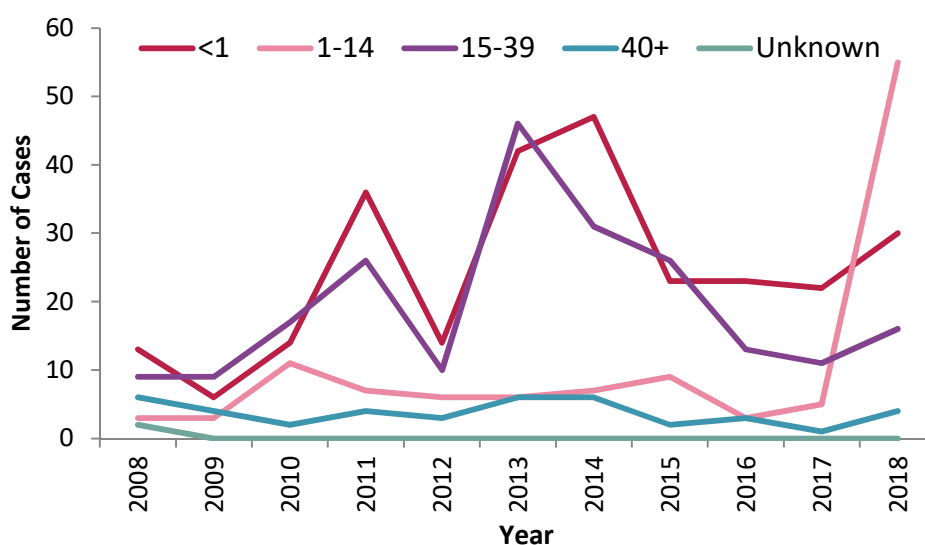


Figure 6. Quarter 4 number of viral meningitis (NOS) cases in Ireland by age group (years), 2008-2018*
*Includes 52 late retrospective/late notifications of parechovirus in Q3 to Q4 in 2018, three in Q3 and 49 in Q4

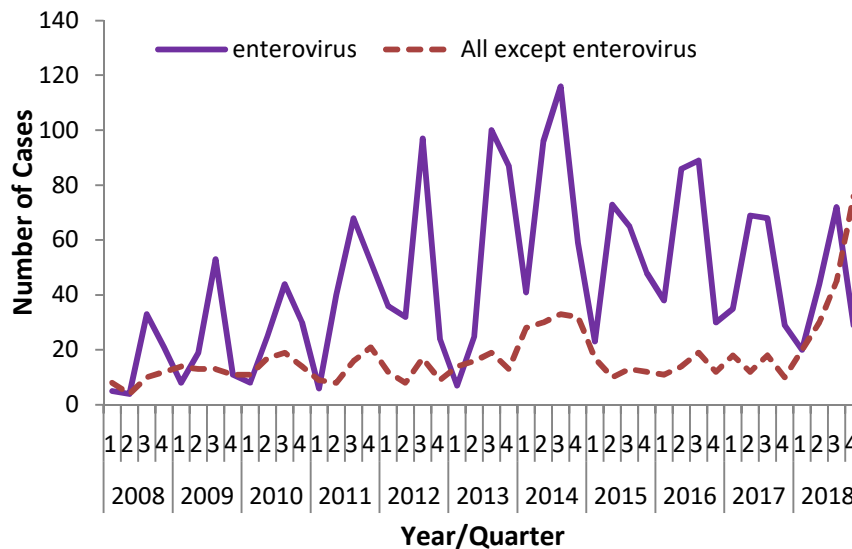


Figure 7. Number of viral meningitis (NOS) cases caused by enterovirus and all except enterovirus by quarter and year, 2008-2018*

*Includes 52 late retrospective/late notifications of parechovirus in Q3 to Q4 in 2018, three in Q3 and 49 in Q4

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 4, 2003-2018

Serogroup	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	Q4-2018
B	66	38	40	36	35	43	25	21	20	16	15	26	9	15	6	6
C	3	0	1	2	1	1	2	0	1	0	0	1	4	6	7	4
W135	1	1	0	0	1	0	0	1	0	0	0	0	1	1	3	1
Y	1	1	0	1	0	1	0	0	0	1	0	2	2	4	0	1
Non-groupable (NG)	2	1	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	1	0	0	0
No organism detected	2	2	2	5	0	3	4	2	0	4	5	1	2	0	1	0
Total	75	43	43	44	37	48	31	24	21	21	20	30	19	26	17	12

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	18	-64.7%
Q4	75	43	43	44	37	48	31	24	21	21	20	30	19	26	17	12	-84.0%
Total	237	198	203	208	179	168	147	114	94	66	81	82	74	87	76	89	-62.4%

Appendix 3. IMD Cases by HSE Area in Quarter 4, 2003-2018

HSE Area	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	Q4-2018	Q4-2018 CIR*
E	29	16	12	11	16	12	11	13	10	4	5	12	3	7	5	8	0.47
M	5	1	3	1	5	2	1	1	3	0	3	4	3	2	0	0	0.00
MW	6	4	3	7	4	2	2	2	3	2	2	0	2	1	5	1	0.26
NE	4	3	7	5	4	5	3	0	0	0	1	6	3	3	2	1	0.22
NW	2	6	3	3	0	2	4	2	3	0	0	0	1	2	0	1	0.39
SE	6	4	2	8	3	9	3	3	0	9	5	1	2	4	1	0	0.00
S	16	7	8	8	3	11	3	3	1	2	3	2	3	6	1	0	0.00
W	7	2	5	1	2	5	4	0	1	4	1	5	2	1	3	1	0.22
Total	75	43	43	44	37	48	31	24	21	21	20	30	19	26	17	12	0.25

* CIR, crude incidence rate per 100,000

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

Age Group (Yrs)	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	Q4-2018	Q4-2018 CIR*
<1	19	9	10	11	6	9	8	6	7	5	5	10	3	4	4	3	4.82
1-4	25	21	12	8	11	21	9	8	7	9	6	9	3	5	3	0	0.00
5-9	7	3	4	0	7	1	3	1	2	1	3	2	3	0	1	1	0.28
10-14	1	1	3	4	2	3	1	1	2	1	0	2	1	2	1	1	0.31
15-19	12	6	7	10	3	6	4	5	1	3	2	1	3	6	4	2	0.66
20-24	6	2	2	3	3	5	2	0	0	0	0	1	0	1	0	0	0.00
25-34	2	0	1	1	4	2	1	1	0	2	0	2	0	1	0	1	0.15
35-44	0	1	1	0	0	0	2	0	0	0	2	1	3	2	0	0	0.00
45-54	2	0	0	3	0	1	0	0	2	0	0	0	0	2	0	0	0.00
55-64	1	0	2	2	0	0	0	0	0	0	1	0	2	0	3	0	0.00
65+	0	0	0	2	1	0	1	2	0	0	1	2	1	3	1	4	0.63
Total	75	43	43	44	37	48	31	24	21	21	20	30	19	26	17	12	0.25

* CIR, crude incidence rate per 100,000

Appendix 5. Deaths associated with IMD by Serogroup in Quarter 4, 2003-2018

Serogroup	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	Q4-2018
B	3	1	0	0	1	1	2	0	0	0	0	2	0	1	2	0
C	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
W135	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Y	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
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	3	1	0	0	1	1	2	0	0	0	0	3	0	2	2	2
%CFR* (Total)	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	11.8	16.7

* %CFR, case fatality ratio; NG=non-groupable

Appendix 6. Other Bacterial Meningitis Cases by Causative Organism (Specified and Not Otherwise Specified) in Quarter 4, 2008-2018 (excluding IMD and *Haemophilus influenzae*)

	Causative organism	Q4-2008	Q4-2009	Q4-2010	Q4-2011	Q4-2012	Q4-2013	Q4-2014	Q4-2015	Q4-2016	Q4-2017	Q4-2018	Q4:2008-2018
Specified	<i>Leptospira</i> spp.	1	1	0	0	0	0	0	0	0	0	0	2
	<i>Listeria</i> spp.	1	0	0	0	1	1	0	1	0	0	0	4
	<i>Mycobacterium tuberculosis</i> #	1	4	1	1	1	0	0	0	0	1	1	10
	<i>Streptococcus pneumoniae</i>	3	7	2	4	1	4	6	3	2	1	2	35
	<i>Streptococcus agalactiae</i> *	na	na	na	na	4	1	0	1	0	0	3	9
	<i>Streptococcus pyogenes</i>	0	0	1	0	0	0	0	1	0	0	0	2
Not otherwise specified	<i>Salmonella</i> spp.	0	1	0	0	0	0	0	0	0	0	0	1
	<i>Enterococcus</i> species	0	0	0	0	0	0	1	0	0	0	0	1
	<i>Escherichia coli</i>	6	2	2	0	2	3	3	6	1	1	1	27
	Group C <i>Streptococcus</i>	0	0	0	0	1	0	0	0	0	0	0	1
	<i>Klebsiella oxytoca</i>	0	0	0	1	0	0	0	0	0	0	0	1
	<i>Klebsiella pneumoniae</i>	0	0	0	0	0	0	0	0	0	0	1	1
	<i>Mycoplasma pneumoniae</i>	0	0	1	0	0	0	0	0	0	0	0	1
	<i>Pseudomonas stutzeri</i>	0	0	0	0	0	0	0	0	0	1	0	1
	<i>Serratia liquefaciens</i>	1	0	0	0	0	0	0	0	0	0	0	1
	<i>Staphylococcus aureus</i>	1	0	1	1	0	0	0	0	0	0	0	3
	<i>Streptococcus agalactiae</i> †	2	1	4	2	0	1	1	0	0	0	1	12
	Unknown/Not specified	9	5	5	4	5	6	2	4	4	2	3	49
	Total	25	21	17	13	15	16	13	16	7	6	12	161

#TB meningitis figures for 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 cases reported here are based on the difference between CIDR event creation date and date of birth, not the difference between onset date and date of birth

†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 4, 2008-2018

Type	Q4-2008	Q4-2009	Q4-2010	Q4-2011	Q4-2012	Q4-2013	Q4-2014	Q4-2015	Q4-2016	Q4-2017	Q4-2018
a	0	0	0	0	0	0	0	0	0	0	1
b	2	0	1	1	0	0	0	0	1	0	0
d	0	0	0	0	0	0	0	0	0	0	0
e	0	0	0	0	0	0	0	0	0	0	1
f	1	0	0	1	1	1	2	0	1	0	0
not type-b	0	1	0	1	0	0	2	0	0	0	0
non-typeable/non-capsulated	2	5	5	7	9	6	8	6	10	5	9
not typed*	1	2	0	0	0	0	4	2	2	1	0
Total	6	8	6	10	10	7	16	8	14	6	11

*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	4	+100%
Q4	6	8	6	10	10	7	16	8	14	6	11	+83.3%
Total	22	43	28	44	41	41	61	52	58	45	58	+163.6%
<i>Meningitis</i>	3	3	2	4	3	2	7	5	1	1	4	+33.3%
<i>Type b meningitis</i>	1	0	1	0	1	0	0	0	0	0	0	100%

Appendix 9. *H. influenzae* Cases by HSE Area in Quarter 4, 2008-2018

HSE Area	Q4-2008	Q4-2009	Q4-2010	Q4-2011	Q4-2012	Q4-2013	Q4-2014	Q4-2015	Q4-2016	Q4-2017	Q4-2018	Q4-2018 CIR*
E	4	1	2	3	6	4	5	6	2	4	4	0.23
M	0	0	0	0	0	1	1	0	1	0	1	0.34
MW	0	2	1	1	1	0	3	1	3	0	1	0.26
NE	0	1	1	1	0	1	0	0	2	1	0	0.00
NW	0	0	0	1	0	0	1	0	1	0	2	0.78
SE	0	1	1	1	2	0	3	0	2	1	0	0.00
S	1	0	1	1	1	1	2	1	1	0	3	0.59
W	1	3	0	2	0	0	1	0	2	0	0	0.00
Total	6	8	6	10	10	7	16	8	14	6	11	0.23

* CIR, crude incidence rate per 100,000

Appendix 10. *H. influenzae* Cases by Age Group in Quarter 4, 2008-2018

Age Grp (Yrs)	Q4-2008	Q4-2009	Q4-2010	Q4-2011	Q4-2012	Q4-2013	Q4-2014	Q4-2015	Q4-2016	Q4-2017	Q4-2018	Q4-2018 CIR*
<1	3	2	0	1	0	1	2	0	1	0	0	0.00
1-4	0	0	1	1	1	0	3	1	0	1	1	0.37
5-9	1	1	0	1	1	0	0	1	0	0	0	0.00
10-14	0	1	1	0	0	0	1	0	0	0	1	0.31
15-19	0	0	0	0	2	0	1	0	1	0	2	0.66
20-24	0	0	0	0	0	0	0	0	0	0	0	0.00
25-34	0	1	0	0	0	1	1	1	0	0	0	0.00
35-44	0	0	0	1	1	0	2	1	2	1	0	0.00
45-54	0	0	2	0	0	0	1	1	1	0	0	0.00
55-64	1	1	0	1	2	3	2	0	1	0	1	0.20
65+	1	2	2	5	3	2	3	3	8	4	6	0.94
Total	6	8	6	10	10	7	16	8	14	6	11	0.23

* CIR, crude incidence rate per 100,000

Appendix 11. Viral Meningitis Cases, Not Otherwise Specified, by Causative Organism in Quarter 4 2008-2018

Causative Organism	Q4-2008	Q4-2009	Q4-2010	Q4-2011	Q4-2012	Q4-2013	Q4-2014	Q4-2015	Q4-2016	Q4-2017	Q4-2018
enterovirus group A	0	0	0	0	0	0	0	0	0	2	3
enterovirus group B	0	0	0	0	0	0	0	2	0	21	20
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	21	11	30	52	24	87	59	46	30	6	6
human herpes virus type 6	0	3	3	13	3	6	5	9	0	3	14
varicella/herpes zoster virus	2	2	1	1	3	0	4	1	2	0	3
herpes simplex virus*	3	1	3	3	0	3	4	0	2	0	1
parechovirus	0	0	0	0	0	0	12	0	4	2	57**
adenovirus	0	0	0	0	1	0	0	0	0	0	0
not specified	7	5	7	4	2	4	7	2	4	5	1
Total	33	22	44	73	33	100	91	60	42	39	105
% known causative organism	79	77.3	84.1	94.5	93.9	96.0	92.3	96.7	90.5	87.2	99.0

*Includes types 1 and 2; not included in this report are meningitis-related cases of neonatal (aged < 42 days) herpes simplex virus on or after 18/12/2019, if any

**includes 49 retrospective/late notifications from 2015 to 2017