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hpsc

Annual Epidemiological Report

December 2019

Influenza and Other Seasonal Respiratory Viruses in Ireland, 2018/2019

Key Facts – 2018/2019 Influenza Season

- The 2018/2019 influenza season was a moderate season but still had a high impact on the Irish health system.
- GP influenza-like illness (ILI) consultation rates went above baseline threshold levels (17.5/100,000 population) in week 1 2019 and remained above baseline for eight consecutive weeks, but never passed the medium threshold level (62.3/100,000 population).
- High levels of influenza hospitalisations and ICU admissions were reported.
- Influenza associated deaths and influenza outbreaks were reported throughout the season but at relatively low levels.
- The highest age-specific notification rates for all influenza cases, and for hospitalised cases, were in children aged under 5 years and adults aged 65 years and older.
- The highest mortality rates were in adults aged 65 years and older.
- Influenza A(H1N1)pdm09 was the dominant virus circulating, with smaller numbers of influenza A(H3N2) co-circulating and very few influenza B viruses detected. From mid-March 2019 there was a higher proportion of influenza A(H3N2) viruses circulating with very few A(H1N1)pdm09 viruses detected.
- High levels of hospitalisations for confirmed influenza cases resulted in a significant impact on the health system.
    - Sentinel GP ILI consultation peak rate: **53/100,000**
    - Number of notified influenza cases: **7,943**
    - Number of confirmed influenza cases hospitalised: **3,244**
    - Number of confirmed influenza cases admitted to ICU: **159**
    - Number of notified influenza cases that died: **97**
    - Number of acute respiratory infection/influenza outbreaks: **97**

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Background and Methods

HPSC has worked in collaboration with the National Virus Reference Laboratory (NVRL), the Irish College of General Practitioners (ICGP) and the Departments of Public Health on the influenza sentinel surveillance project since 2000. During the 2018/2019 influenza season, 60 general practices, with 152 general practitioners (located in all HSE-Areas) were recruited to report electronically, on a weekly basis, the number of patients who consulted with influenza-like illness (ILI). The combined patient population in these practices is over 6% of the national population. Sentinel GPs send combined nose and throat swabs to the NVRL from ILI patients each week. The NVRL routinely test sentinel GP and non-sentinel respiratory specimens for influenza and a panel of other seasonal respiratory viruses.

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

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

Influenza and Respiratory Syncytial Virus (RSV) are notifiable diseases in Ireland under the Infectious Disease Regulations and cases should be notified to the Medical Officer of Health. Notifications are reported using the Irish Computerised Infectious Disease Reporting system (CIDR) which is described here. Further information on the process of reporting notifiable infectious diseases is available here. The case definitions used for influenza and RSV in 2018/2019 are available here. For this report, data on cases of influenza and RSV notified to CIDR during the 2018/2019 season were extracted from CIDR on of 28th November 2019.

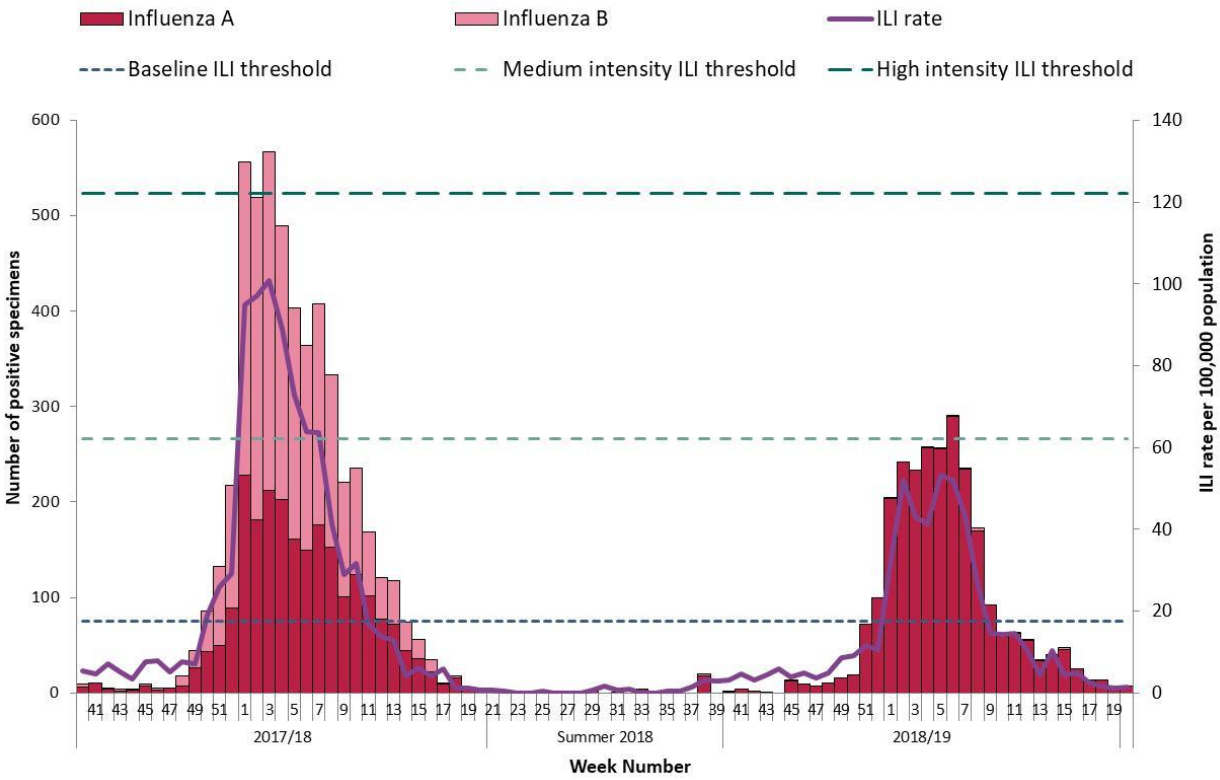
This report summarises influenza and other seasonal respiratory virus activity in Ireland during the 2018/2019 influenza season. The 2018/2019 season commenced on 1st October 2018 (week 40 2018) and ended on 19th May 2019 (week 20 2019). The data presented in this summary were based on all data reported to HPSC by the 28th November 2019.

Epidemiology of 2018/2019 Influenza Season

Sentinel GP Clinical ILI data

During the 2018/2019 influenza season, influenza-like illness (ILI) consultation rates reported from the sentinel GP network in Ireland exceeded baseline levels for eight consecutive weeks and did not pass the medium intensity threshold (figure 1). Sentinel GP ILI consultation rates peaked at 53 per 100,000 population during week 5 2019 (the fourth week in January), a much lower peak than that of 101 per 100,000 population seen during the 2017/2018 influenza season. ILI rates first increased above baseline levels (17.5 per 100,000) during week 1 2019 and remained above these levels until the last week of February 2019. The average length of time above baseline levels in Ireland is nine weeks, indicating that this season was slightly shorter than average. ILI rates for the under 15 year old age group were above medium intensity levels for two weeks at the end of January. ILI rates for those aged 65 years and older were above medium intensity levels for one week in January. ILI rates in the 15-64 year old age group remained below the medium intensity threshold all season. ILI age specific rates peaked at 61.3/100,000 population in those aged 0-15 years, 59.5/100,000 population in the 15-64 year age group and 41.2/100,000 in those aged 65 years and older.

Figure 1. ILI sentinel GP consultation rates per 100,000 population, baseline, medium and high intensity ILI thresholds[a] and number of positive influenza A and B specimens tested by the NVRL, by influenza week and season 2017/18 and 2018/19, in Ireland



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

Virological Data from National Virus Reference Laboratory

Sentinel GP virological data

The NVRL tested 859 specimens from sentinel GPs for influenza virus during the 2018/2019 season; 392 (46%) were positive for influenza. Ninety eight percent (n=386) were influenza A and 2% (n=6) were influenza B. Influenza A(H1N1)pdm09 was the dominant virus in circulation during the season. All of the influenza A positive sentinel specimens were subtyped, 78% (n=302) were positive for A(H1N1)pdm09 and 22% (n=84) were positive for A(H3N2).

Overall, 82% (680/827) of ILI patients, with known vaccination status, who were tested for influenza were ***not*** vaccinated with the 2018/2019 seasonal influenza vaccine. Vaccination status was known for 95% of ILI patients who tested positive for influenza; 88% had ***not*** been vaccinated. Of the 46 patients who had been vaccinated, 29 were infected with influenza A(H1N1)pdm09 and 17 with influenza A(H3N2).

Non-sentinel virological data[b]

The NVRL tested 15,546 non-sentinel respiratory specimens during the 2018/2019 season, 2,216 (14%) of which were positive for influenza. Ninety nine percent (n=2,205) were influenza A and <1% (n=11) were influenza B. Ninety eight percent of the influenza A positive specimens were subtyped, 76% (n=1,639) were positive for A(H1N1)pdm09 and 24% (n=518) were positive for A(H3N2).

Sentinel GP and Non-sentinel virological combined data

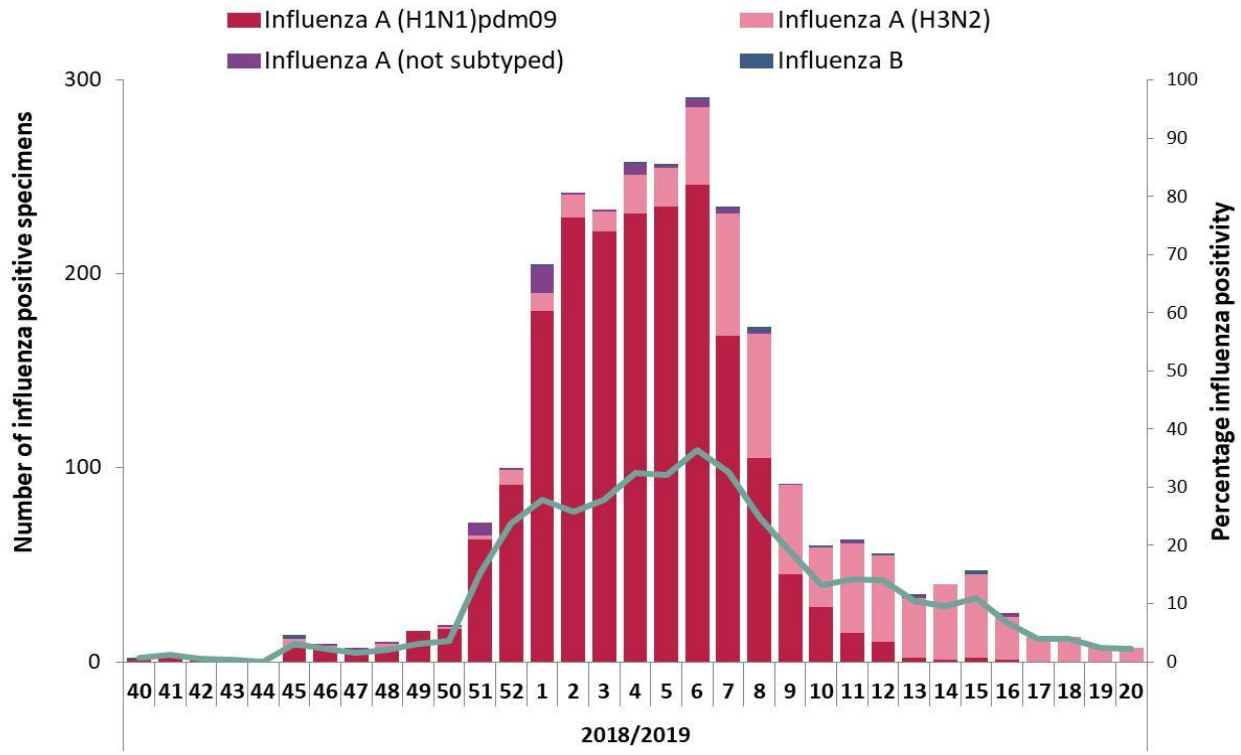
Influenza A(H1N1)pdm09 and influenza A(H3N2) co-circulated throughout the 2018/2019 influenza season, with very little influenza B circulating. The number and proportion of influenza A viruses fluctuated throughout the season with influenza A(H1N1)pdm09 dominating at the beginning of the season and influenza A(H3N2) seen at higher proportions towards the end of the season (from week 9 2019 to week 20 2019). The highest number of influenza positive viruses were detected in week 6 (n=290) after which the overall detection rate decreased rapidly. In total 16,405 samples were tested for respiratory viruses in the NVRL; 37% tested positive for a respiratory virus (n=6,107). Sixteen percent of all samples tested for a respiratory illness tested positive for influenza (n=2,608).

Influenza A accounted for 99% of all positive influenza detections (n=2,591/2,608). In comparison, during the 2017/2018 influenza season, influenza A accounted for 44% of all influenza positive specimens tested by the NVRL. Just over three quarters (76%) of the 2,543 subtyped influenza A positive sentinel and non-sentinel specimens were influenza A(H1N1)pdm09 and 24% were influenza A(H3N2). Further details are included in Table 1 and figure 2. The ILI rates and dominant circulating influenza types and subtypes for seasons 2009/2010 to 2018/2019 are shown in figure 3.

Table 1. Number of sentinel and non-sentinel[b] respiratory specimens tested by the NVRL and positive influenza results, for the 2018/2019 season, in Ireland

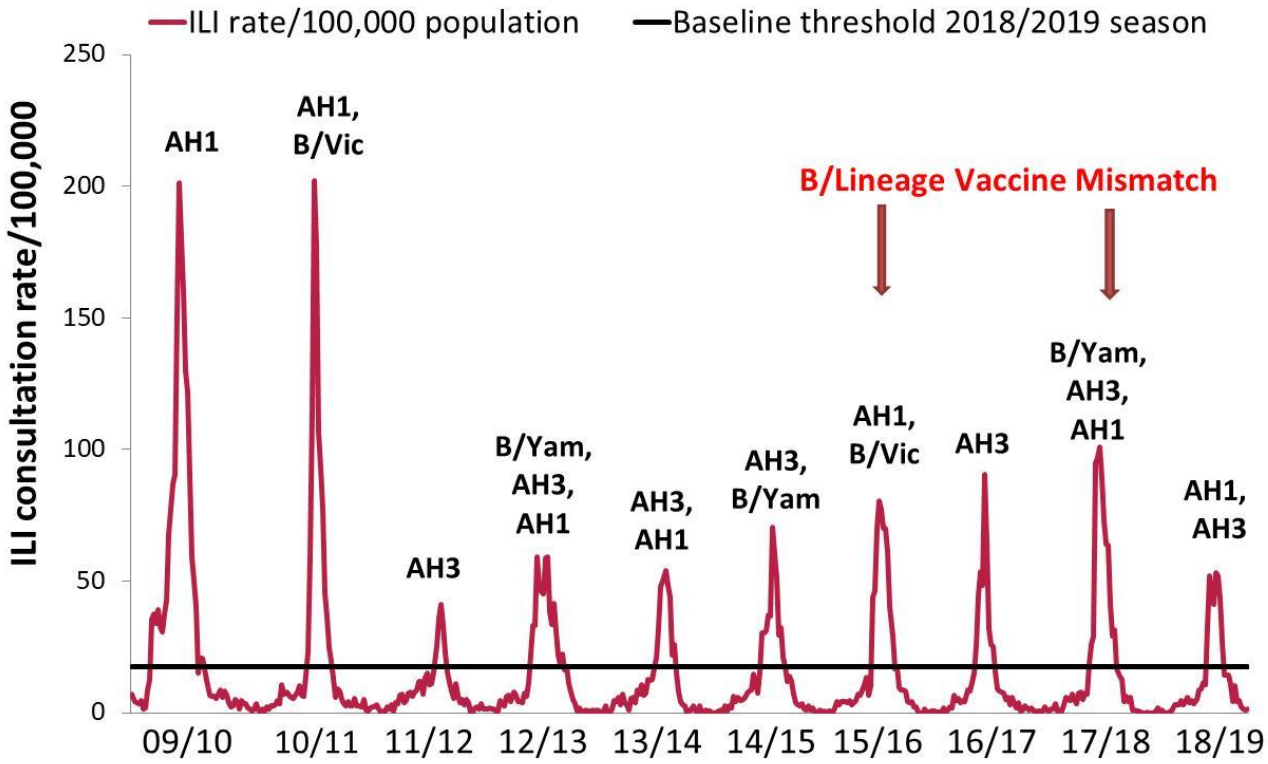
Specimen type	Total tested	Number influenza positive	% influenza positive	Influenza A				Influenza B
				A(H1) pdm09	A(H3)	A not subtyped	Total influenza A	
Sentinel	859	392	45.6	302	84	0	386	6
Non-sentinel	15546	2216	14.3	1639	518	48	2205	11
Total	**16405**	**2608**	**15.9**	**1941**	**602**	**48**	**2591**	**17**

Figure 2. Number of positive influenza specimens (from sentinel and non-sentinel sources) by influenza type/subtype tested by the NVRL and percentage influenza positive, by week for the 2018/2019 influenza season, in Ireland



[b] Non-sentinel respiratory specimens relate to specimens referred to the NVRL (other than sentinel GP specimens) from hospitals, primary care facilities not involved in sentinel surveillance, nursing homes and other institutions. Non-sentinel specimens may include more than one specimen from each case.

Figure 3. ILI sentinel GP consultation rates per 100,000 population, baseline ILI threshold[c] and dominant circulating influenza types/subtypes, by influenza week and season 2009/10 to 2018/19, in Ireland



Influenza Virus Characterisation

For the 2018/2019 influenza season, genetic characterisation of influenza viruses circulating in Ireland was carried out by the NVRL, on a selection of influenza positive specimens (n=191): 139 influenza A(H1N1)pdm09, 51 influenza A(H3N2), and 1 influenza B virus.

Influenza A(H1N1)pdm09

The hemagglutinin genes of influenza A(H1)pdm09 viruses characterised (n=139) since week 40 2018 were all found to be clade 6B.1 viruses, represented by A/Michigan/45/2015, the current vaccine strain. The majority of viruses had the characteristic amino acid mutations for this group along with S74R, S164T and I295V in their HA1.

This season, the A(H1)pdm09 viruses demonstrated increased genetic divergence and a number of genetic subgroups associated with key amino acid substitutions emerged. Most notably, the vast majority of viruses contained the S183P mutation (98.6%; n=137/139). A virus containing the S183P mutation has been recommended by the WHO for inclusion in the 2019/2020 vaccine. Within the S183P genetic subgroup, at least seven subclusters

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

have been identified in viruses detected in Europe this season (6B.1A1 – 6B.1A7). Six of these genetic subclusters have been identified in influenza A(H1)pdm09 viruses detected in Ireland, with the majority of A(H1)pdm09 viruses falling into 3 clusters associated with several distinct amino acid substitutions.

The largest group of influenza A(H1)pdm09 viruses characterised (38%; n=53/139) contained the amino acid substitution N260D and grouped phylogenetically with A/Ukraine/7993/2018 and A/Switzerland/3330/2017 reference sequences within the proposed 6B.1A5 subgroup. Within this cluster, the majority (91%; n=48/53) also had substitutions N129D and T185I.

A second cluster of viruses (29%; n=40/139) were most closely related to the A/Dnipro/409/2018 reference virus and possessed the amino acid substitutions K302T, I404M, N496S and E506D and cluster with proposed 6B.1A7 subgroup.

The third largest group of circulating viruses characterised in Ireland was associated with the key substitution T120A (n=19%; n=26/139) and fell within the proposed 6B.1A6 subgroup. These viruses clustered with the A/Norway/3221/2018 reference virus and contained additional substitutions H138L and T277A.

Similar viruses to clusters 6B.1A1 (n=3), 6B.1A2 (n=3) and 6B.1A3 (n=2) were also identified. Of note, four viruses carried the amino acid substitution D222G in their HA1, a mutation which has been associated with more severe infection.

Influenza A(H3N2)

The majority of influenza A(H3N2) viruses characterised in Ireland in the 2018/2019 season fell within the current vaccine component clade 3C.2a1, represented by A/Singapore/INFIMH-16-0019/2016 (74.5%, n=38/51). All of these viruses were in the 3C.2a1b subgroup, represented by A/Alsace/1746/2018. The 3C.2a variants have circulated in Ireland and Europe since the 2013/2014 season. In recent years, these viruses have evolved further into 3C.2a1a and 3C.2a1b subclades. As in Ireland, the 3C.2a1b subclade has dominated in Europe this season with continued evolution of the HA genes observed.

Within 3C.2a1b, two distinct subgroups dominated this season. One of the subgroups (n=17/38; 45%) was associated with the A/LaRioja/2202/2018 reference strain and contained a T128A mutation (resulting in the loss of a potential glycosylation site). Notably, a second subgroup emerged (n=17/38; 45%) that had the key amino acid substitutions T131K and K135T (resulting in re-establishment of a glycosylation site) and clustered with the A/Iceland/78/2018 virus and, in the latter part of the season, more viruses clustered with this subgroup.

Of note, 25.5% of A(H3) viruses characterised (n=13/51) were 3C.3a viruses, represented by A/England/538/2018. These viruses have evolved in recent seasons and all influenza A(H3N2) viruses characterised contained significant amino acid substitutions, present in

the reference strain A/England/538/2018. Influenza A(H3N2) 3C.3a viruses have been identified sporadically throughout Europe since 2013 and have continued to circulate in Ireland at low levels since this time, with HA gene sequences continuing to diverge. Midway through this season, an increase in 3C.3a viruses was noted globally and also in Ireland. This has been reflected in the recommendation by WHO that a 3C.3a virus be included in the 2019/2020 northern hemisphere influenza vaccine.

Influenza B

Seventeen influenza B viruses were detected by the NVRL during the 2018/2019 season. Three were suitable for further molecular characterisation. Of the three influenza B viruses, 1 B-Yamagata lineage and 2 B-Victoria lineage viruses were identified using real-time RT-PCR. Of the 2 B-Victoria lineage viruses detected, both fell into the B/Brisbane/60/2008 clade. One of these viruses contained the double deletion of AAs 162 and 163 (Δ162-163) in the HA gene, represented by B/Colorado/06/2017 virus, the current vaccine strain. This virus contained the characteristic amino acid substitutions for the group including N75K, N165K and S172P.

Antigenic Characterisation

A proportion of influenza real-time RT-PCR positive specimens were referred for antigenic characterisation (n=141). Specimens were inoculated in MDCK or MDCK-SIAT cells, as appropriate, and the isolates characterised by haemagglutination inhibition.

The vast majority of A(H1)pdm09 cultured from Irish patient samples (122/126) were recognised well by the antiserum raised against the current 2018/19 vaccine virus A/Michigan/45/2015. Despite some genetic variability within the circulating A(H1)pdm09 viruses, there was no evidence that these amino acid substitutions were associated with antigenic change. This demonstrates that, as reported in other European countries, the A(H1)pdm09 viruses circulating in Ireland were a good match for the 2018/2019 vaccine.

Influenza A(H3N2) viruses have become increasingly difficult to characterise antigenically by HI assay due to loss of the ability of viruses to agglutinate any red blood cells. Of the successfully propagated viruses, twelve had a sufficient titre to be analysed by HI. Six were recognised as current (2018/19) vaccine strain A Singapore/INFIMH-16-0019/2016 (H3N2)-like and six were reported as A(H3) not attributed to category.

Influenza B viruses circulated at very low levels this season, however, three influenza B viruses were cultured and subsequently characterised as one B-Yamagata virus B/Phuket/3073/2013-like and two B/Colorado/06/2017-like viruses (B/Victoria/2/87 (Δ162-163)-lineage).

Further information on the WHO recommendations on the composition of influenza virus vaccines is available on the WHO website.[1]

Other Seasonal Respiratory Viruses

During the 2018/2019 season, RSV detections were at high levels, with 1,476 (10%) RSV positive specimens reported by the NVRL from non-sentinel sources. RSV peaked in early December. Relatively high levels of human metapneumovirus (hMPV) (n=762, 5%), adenovirus (n=546, 4%), parainfluenza virus (PIV) type 3 (n=406, 3%) and PIV-4 (n=169, 1%) were also reported from non-sentinel sources during the 2018/2019 season. Lower levels of PIV-1 (n=6, <1%) and PIV-2 (n=39, <1%) were seen.

Of the 859 sentinel GP ILI specimens tested during the 2018/2019 season, 31 (4%) tested positive for RSV, 34 (4%) for hMPV, 15 (2%) for adenovirus, 11 (2%) for PIV-3, 2 for (0.2%) for PIV-1, and 2 for (0.2%) for PIV-4.

The total number of sentinel GP and non-sentinel specimens positive for seasonal respiratory viruses (including influenza, RSV, adenovirus, hMPV and parainfluenza virus types 1-4) peaked during week 2 2019 at 413, compared to 820 during week 1 2018. It should be noted that these data reported from the NVRL are analysed by the date the specimens were taken from patients.

Outbreaks

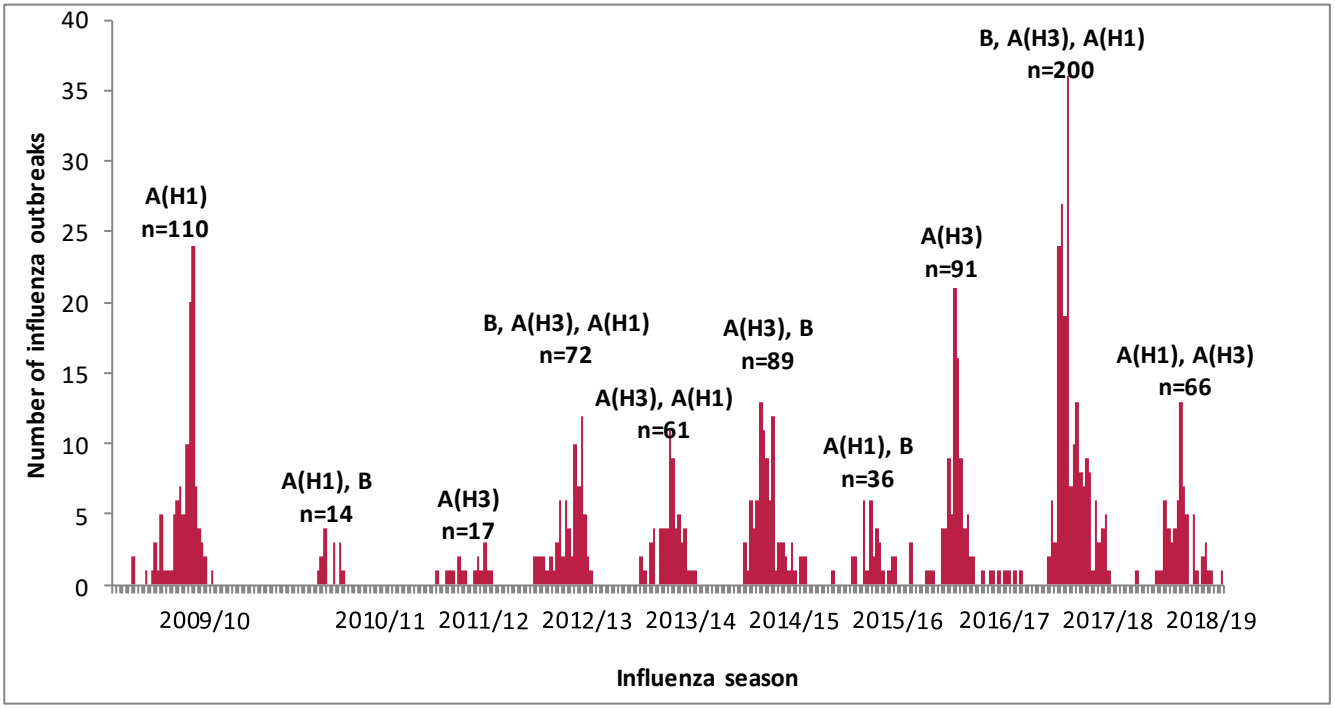
During the 2018/2019 season, 97 acute respiratory infection (ARI), influenza and RSV outbreaks were notified to HPSC (table 2 and figure 4). Of the 97 outbreaks notified, 66 were reported as influenza outbreaks, 8 were associated with RSV, four with coronavirus, four with human metapneumovirus (hMPV), two with picornavirus (which includes both rhinovirus and enterovirus), three parainfluenza virus and ten ARI outbreaks with no pathogens identified.

Of the 66 notified influenza outbreaks, 49% (n=32) were in a hospital setting, 47% (n=31) were in residential care facilities/other residential settings and 4% (n=3) were in other settings. Influenza outbreaks were reported by all HSE-Areas, with 44% (n=29) notified by the Eastern region (HSE-East). Eighteen (27%) outbreaks were associated with influenza A(H1N1)pdm09, 13 (20%) with influenza A(H3N2), 19 (29%) with influenza A (un-subtyped), one (1%) with influenza A(H1N1)pdm09 and A(H3N2) co-infection and 15 (23%) outbreaks did not have an influenza type or subtype reported.

Table 2. **Number of acute respiratory infection (ARI), influenza and respiratory syncytial virus (RSV) outbreaks notified by HSE-Area during the 2018/2019 season, in Ireland**

HSE area	Influenza	Respiratory syncytial virus infection	Acute respiratory infection	Total
HSE-E	29	2	3	34
HSE-M	5	0	2	7
HSE-MW	6	0	0	6
HSE-NE	3	1	2	6
HSE-NW	4	4	1	9
HSE-SE	10	0	4	14
HSE-S	6	0	9	15
HSE-W	3	1	2	6
Total	**66**	**8**	**23**	**97**

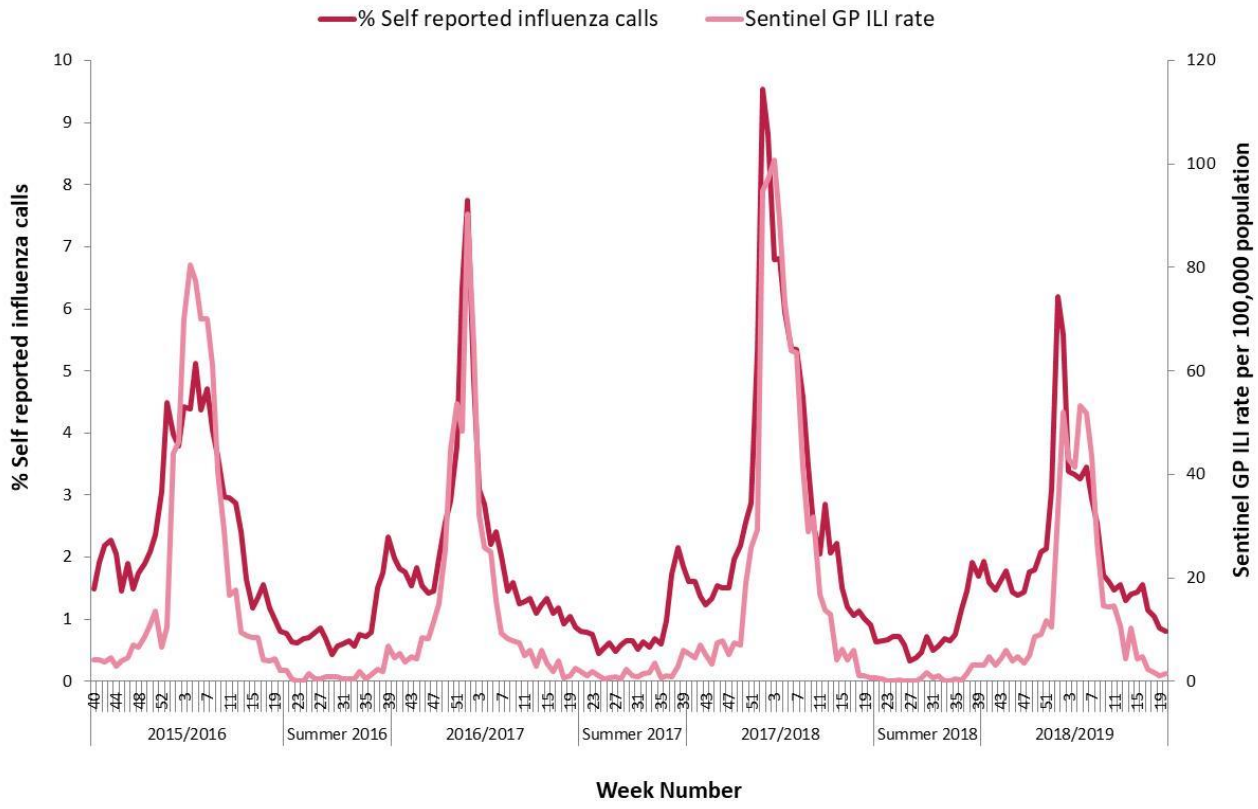
Figure 4. **Number of notified influenza outbreaks and predominant influenza type/subtype by season, 2009/2010 to 2018/2019, in Ireland**



GP Out-Of-Hours (OOHs)

The peak in influenza-related calls in the 2018/2019 influenza season was lower than in the previous two seasons. The percentage of influenza-related calls to GP out-of-hours services in Ireland, peaked during week 1 2019 at 6.2%, compared to the peak rate of 9.5% during week 1 2018 (figure 5).

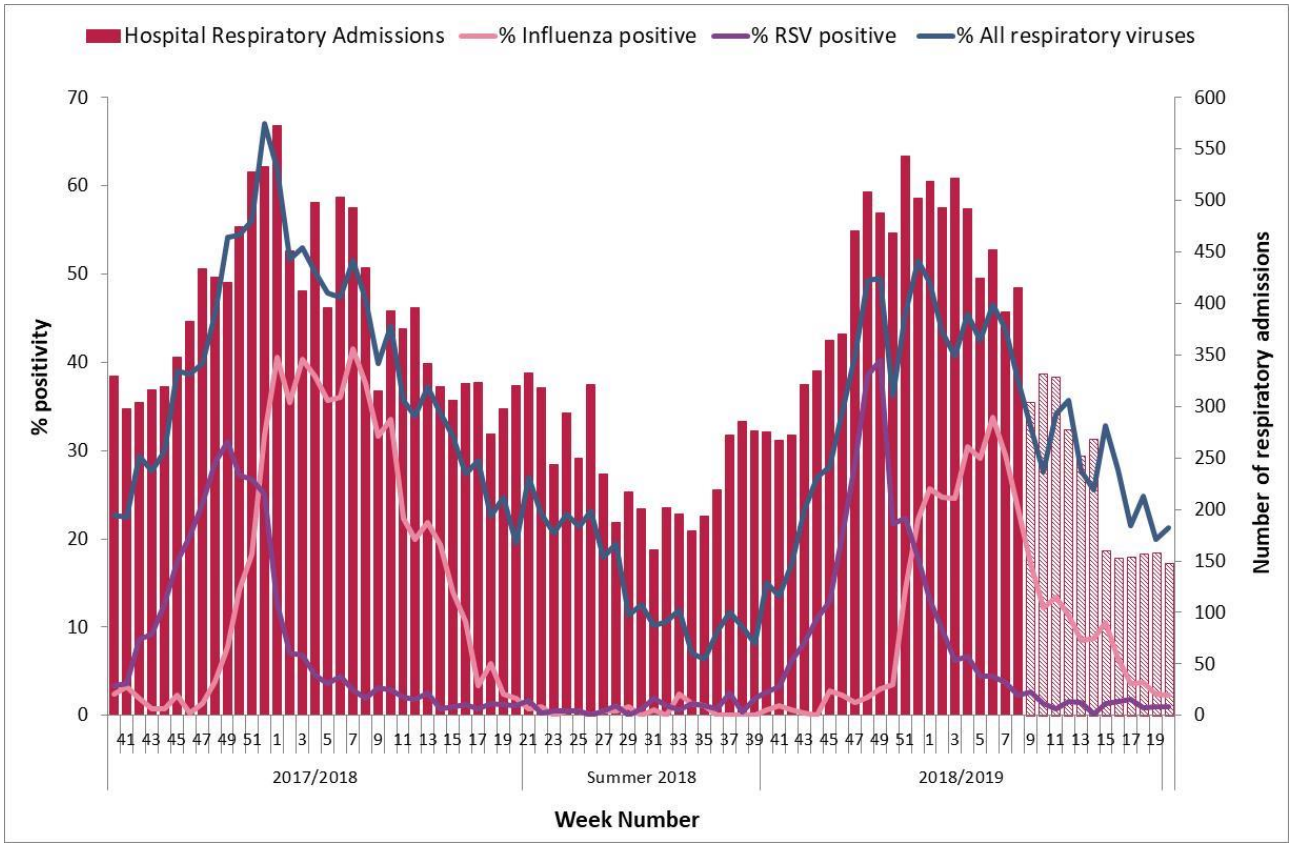
Figure 5. Self-reported influenza-related calls as a proportion of total calls to Out-of-Hours GP Co-ops and sentinel GP ILI consultation rate per 100,000 population by week and season, in Ireland



Sentinel hospital admissions

Hospital respiratory admissions reported from a network of sentinel hospitals during the 2018/2019 influenza season, peaked at 543 during week 51 2018. This was slightly lower than the peak in the 2017/2018 influenza season (n=573 in week 1) (figure 6). The peak in respiratory admissions coincided with the peak in respiratory virus positivity reported from non-sentinel sources; 52% of all non-sentinel specimens tested positive for a respiratory virus in week 52. It should be noted that one sentinel hospital in HSE Midwest was unable to report data from week 9 to week 20 and one hospital in HSE East was unable to report data from week 15 to week 20.

Figure 6. Number of respiratory admissions reported from the Irish sentinel hospital network and % positivity for influenza, RSV and all seasonal respiratory viruses tested* by the NVRL by week and season



***All seasonal respiratory viruses tested refer to non-sentinel respiratory specimens tested by the NVRL, which are routinely tested for influenza, RSV, adenovirus, parainfluenza viruses and human metapneumovirus (hMPV)**

Influenza and RSV notifications

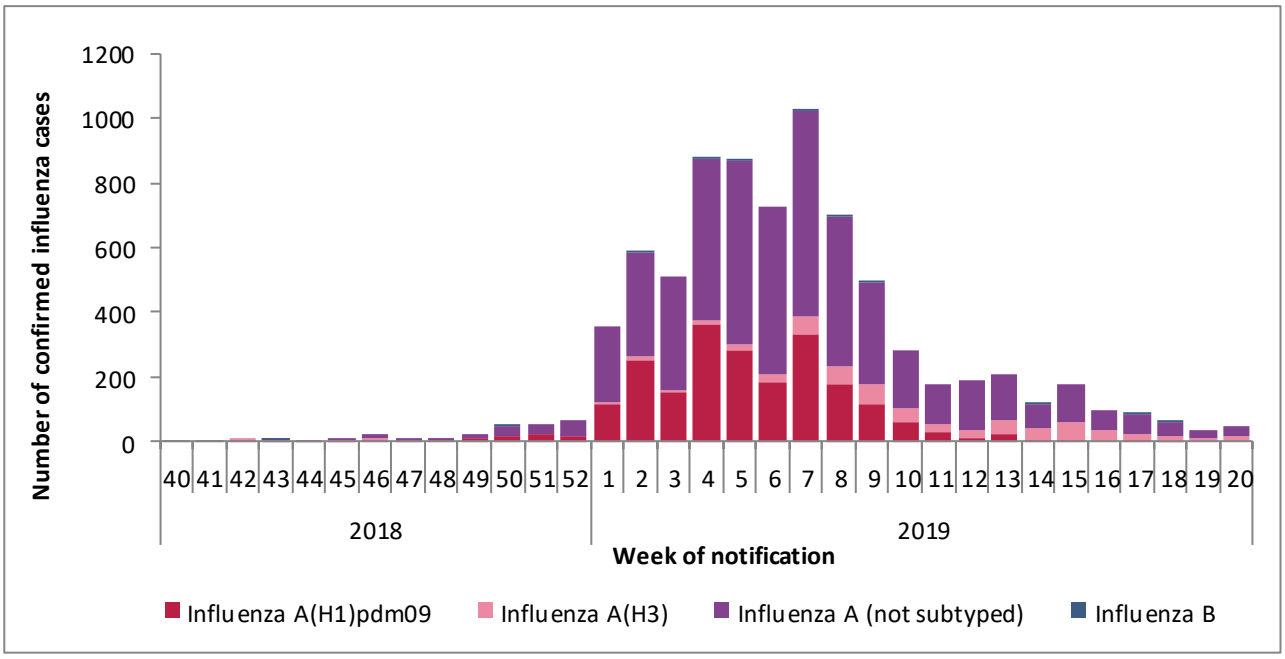
A total of 7,943 influenza cases were notified to HPSC on Ireland's Computerised Infectious Disease Reporting System (CIDR) during the 2018/2019 influenza season. Although this was the second highest number of influenza cases notified in a season, testing has increased in recent years and this is likely to have contributed to the relatively high number of notifications. Over one-third (35%) of cases nationally, were notified by HSE East, but notification rates were highest in HSE Midlands and Southeast. Of the

7,943 notifications, 7,939 were reported as confirmed cases, 1 as a probable case and 3 as possible cases.

Of the 7,939 confirmed influenza cases, 7,875 (99%) were positive for influenza A and 57 (<1%) were positive for influenza B (figure 7). The influenza type and subtype was not reported for the remaining seven cases. Of the 2,792 confirmed influenza A cases which were subtyped, 79% (n=2192) were influenza A(H1N1)pdm09 and 21% (n=600) were influenza A(H3N2).

A total of 3,627 RSV notifications were reported to HPSC during the 2018/2019 season; the highest number of RSV notifications reported since RSV was made notifiable in 2012.

Figure 7: Number of confirmed influenza cases notified on Ireland's Computerised Infectious Disease Reporting System by influenza type/subtype and by week of notification, 2018/2019 season, in Ireland



***Cases where influenza type was not reported are excluded (n=7)**

Confirmed influenza cases – Pregnancy status

Enhanced surveillance data on pregnant women with confirmed influenza is not routinely collected. Therefore these data likely underestimate the actual number of pregnant women with laboratory confirmed influenza during the 2018/2019 season.

A total of 52 confirmed influenza cases notified during the 2018/2019 season were reported as pregnant. Half of these cases, 50% (n=26) were positive for influenza A(H1N1)pdm09, 17% (n=9) were positive for A(H3N2), 31% (n=16) were A (not subtyped) and one case was positive for influenza B. The median age of the pregnant cases was 31

years (IQR 28-35). Week of gestation was reported for 28 (54%), with a median week of gestation of 29 weeks (IQR 16-35). Of the 28 cases with reported week of gestation, 54% (n=15) were in the third trimester, 28% (n=8) were in the second trimester and 18% (n=5) were in the first trimester. Forty four cases (85%) were reported as hospital inpatients. Influenza vaccination status was only reported for 12 cases, of whom 4 had been vaccinated. No pregnant cases were either admitted to ICU or died during the 2018/2019 influenza season.

A further 84 influenza cases, for whom pregnancy status was not reported, were reported as having attended maternity hospitals as ED patients (n=53), inpatients (n=28) or outpatients/day patients (n=3). None of these patients were admitted to ICU or died.

Confirmed influenza cases hospitalised

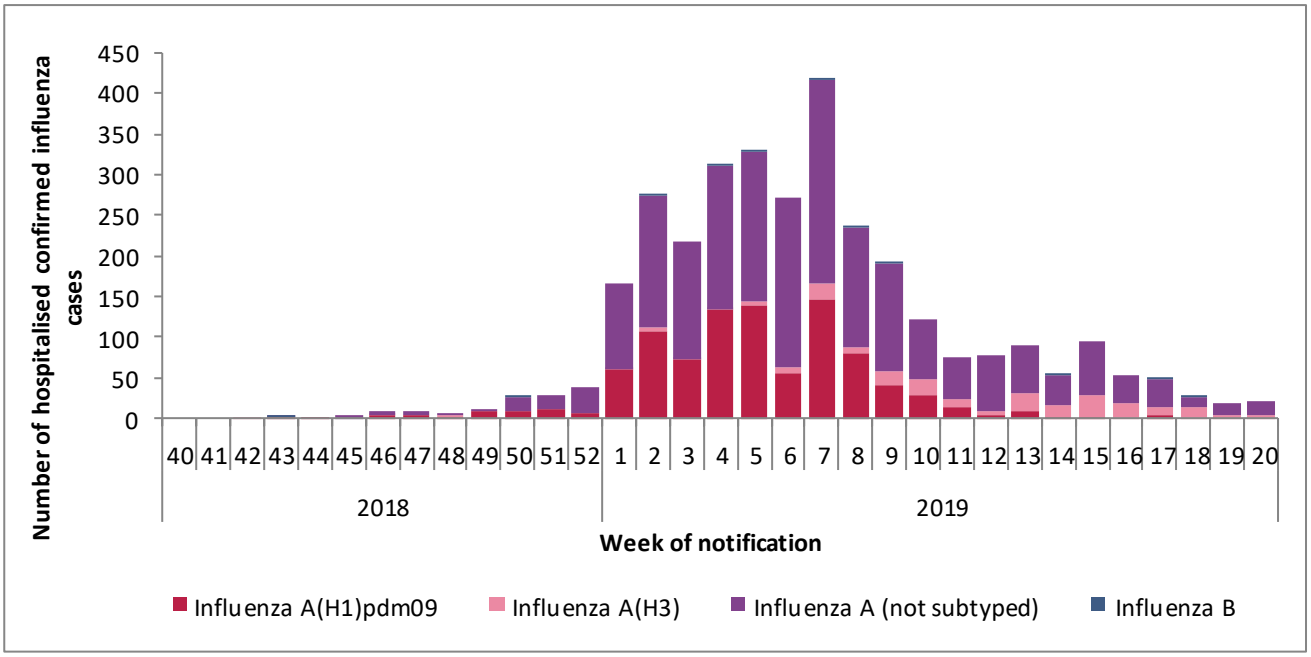
During the 2018/2019 season, 3,244 (68/100,000 population) laboratory confirmed influenza hospitalised cases were notified to HPSC (41% of all confirmed influenza cases notified). This was a decrease compared to the 2017/2018 season, which was a particularly severe influenza season, but was high compared to other recent seasons (figure 8, table 3).[d]

The median age of hospitalised influenza cases during the season was 38 years old. The highest age specific rate for hospitalised influenza cases was in those aged <5 years (n=803, 242/100,000 population) and those aged 65 years and older (n=949, 149/100,000 population) (table 4, figure 9).

Of the 3,244 confirmed influenza hospitalised cases, 99% (n=3,222) were positive for influenza A and less than 1% (n=18) were positive for influenza B (figure 7). The influenza type was not reported for the remaining four cases. Of the 1,157 confirmed influenza A cases which were subtyped, 81% (n=938) were influenza A(H1N1)pdm09 and 19% (n=219) were influenza A(H3N2).

[d] Surveillance of confirmed influenza hospitalised cases in all age groups began in 2009.

Figure 8: Number of confirmed influenza cases hospitalised, by influenza type/subtype, notified on Ireland's Computerised Infectious Disease Reporting System, 2018/2019 season, in Ireland



***Cases where influenza type was not reported are excluded (n=4)**

Table 3. Summary of confirmed influenza hospitalised cases for all ages by season, 2009/2010 - 2018/2019, in Ireland

	2009 pdm	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
Predominant flu type	AH1pdm09	AH1pdm09, B	AH3	B, AH3, AH1pdm09	AH3, AH1pdm09	AH3, B	AH1pdm09, B	AH3	B, AH3, AH1pdm09	AH1pdm09, AH3
Number of hospitalised cases	1059	968	147	469	693	1,008	1,859	1,423	4,723	3,244
Hospitalisation rate/100,000	23	21	3	10	15	21	39	30	99	68
Proportion A:B	100:0	75:25	94:6	52:48	98:2	77:23	66:34	96:4	46:54	99:1
Median age	17	29	27	32	51	59	30	67	63	38
Hospital deaths	25	42	6	22	34	47	77	67	200	84
Hospital case fatality rate	2%	4%	4%	5%	5%	5%	4%	5%	4%	3%

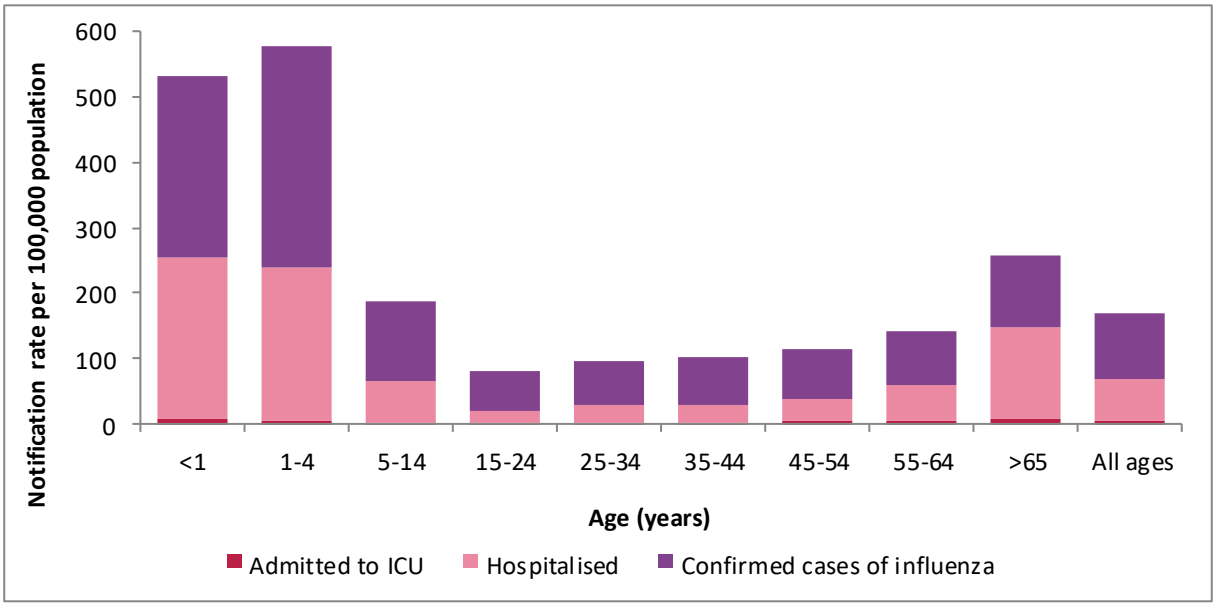
***Rates for 2009/2010 - 2013/2014 are based on the 2011 CSO census and rates for 2014/2015 - 2018/2019 are based on the 2016 CSO census**

Table 4. Age specific rates for confirmed influenza cases hospitalised and admitted to critical care during the 2018/2019 influenza season, in Ireland

Age (years)	Hospitalised		Admitted to ICU	
	Number	Age specific rate per 100,000 population	Number	Age specific rate per 100,000 population
<1	159	255.4	4	6.4
1-4	644	239.2	12	4.5
5-14	442	65.5	9	1.3
15-24	106	18.4	2	0.3
25-34	192	29.1	7	1.1
35-44	215	28.8	18	2.4
45-54	240	38.3	28	4.5
55-64	297	58.4	26	5.1
≥65	949	148.8	53	8.3
Total	**3244**	**68.1**	**159**	**3.3**

***Age specific rates are based on the 2016 CSO census**

Figure 9. Age specific notification rates per 100,000 population for confirmed influenza cases, by hospitalisation status, during the 2018/2019 influenza season, in Ireland



Enhanced surveillance hospital data on 0-14 year age group

A total of 3,117 confirmed influenza cases aged between 0 and 14 years were notified on Ireland's Computerised Infectious Disease Reporting System (CIDR) for the 2018/2019 influenza season, 1,245 (40%) of these cases were reported as hospital inpatients. Over 99% of the hospitalised cases in this age group were positive for influenza A (99.6%, n=1240) and less than 1% were positive for influenza B (n=5). The subtype was available for 42% of the influenza A cases: 89% (n=462) were influenza A(H1N1)pdm09 and 11% (n=55) were influenza A(H3N2). The median age of hospitalised paediatric cases was 3 years (IQR 1-6). Sixty five percent (n=803) were aged between 0 and 4 years, with 13% (n=159) aged less than one year.

Enhanced surveillance forms were completed for approximately one quarter of hospitalised paediatric cases of influenza. For analysis of enhanced variables, cases with missing data were excluded from calculations of proportions. The most frequently reported symptoms included: fever (98%), cough (89%) and fatigue (87%). The most frequently reported complications included secondary bacterial pneumonia (15%), primary influenza viral pneumonia (10%), acute otitis media (8%) and other respiratory complications (7%). Other unspecified complications were reported for 13% of cases. The length of stay in hospital was reported for just over half of hospitalised cases and the median length of stay was 2 days (IQR 1 - 3 days).

Risk group status was reported for one third (n=409) of hospitalised influenza cases in the 0-14 year age group, with 30% (n=124) of cases reported as belonging to one or more risk groups for influenza. Where patients belonged to risk groups, the most

frequently reported risk groups included chronic respiratory disease (including asthma) (44%), any condition that can compromise respiratory function (22%), chronic neurological disease (12%) and immunosuppression (9%).

Of the 1,245 confirmed influenza paediatric cases reported as hospitalised during the 2018/2019 influenza season, influenza vaccination status was reported for 412 (33%) cases. Of these 412 cases, 12 (3%) were reported as having received the influenza vaccine for the 2018/2019 influenza season. Of the 101 cases in reported risk groups for influenza and with known vaccination status, 8% were vaccinated. Additional surveillance data on paediatric cases admitted to critical care units are detailed in the next section.

Confirmed influenza cases admitted to ICU

During the 2018/2019 season, 159 (3.3/100,000 population) laboratory confirmed influenza cases in all age groups were admitted to critical care units and reported to HPSC. Of the 159 cases admitted to critical care units, 133 were adults and 26 were paediatric cases[e].

Of the 159 critical care cases, 158 were infected with influenza A (>99%) and one was infected with influenza B. Where influenza A subtype was reported (n=92); 80 (87%) were infected with influenza A(H1N1)pdm09 and 12 (13%) were infected with influenza A(H3N2).

Age specific rates for confirmed influenza cases admitted to critical care units during the 2018/2019 season were highest in those aged 65 years and older (8.3 per 100,000 population) and those aged less than one year old (6.4 per 100,000 population) (table 4, figure 9). The overall median age of all cases was 54 years.

Of the 26 paediatric cases aged between 0 and 14 years, data on underlying medical conditions were reported for 24 (92%) cases; 50% were reported to have one or more underlying medical conditions. The most frequently reported underlying medical conditions for children in ICU were Down syndrome (n=4), neurological conditions (n=4), immunosuppression (n=2) and heart conditions (n=2).

Of the 108 (81%) adults with data reported for underlying medical conditions, 85% of cases were reported to have underlying medical conditions. The most frequently reported underlying medical conditions for adults were chronic heart conditions and

[e] For the purposes of this surveillance system, paediatric cases refer to all cases aged 0-14 years.

chronic respiratory disease. No ICU cases were reported as pregnant during the 2018/2019 season. Smoking status was known for 71 adults and 49 were reported as current/former smokers. Seven adults in ICU were reported to have alcohol related disease.

During the 2018/2019 season, 98 adult (88%, 98/111) and 14 (64%, 14/22) paediatric influenza cases admitted to critical care units were reported as requiring ventilation during their stay in critical care. The median length of stay in critical care was 7 days for adults and 4 days for children.

Of the 78 (59%) adults with known vaccination status, 18% (n=14) were vaccinated. Three were aged 15-64 years and eleven were aged 65 years or older. Four of the fourteen were immunosuppressed. Of the 10 (39%) children with known vaccination status, none were vaccinated. Vaccination status was known for 66 adults and 5 children with underlying medical conditions. 17% of the adults and none of the children, with medical conditions, were vaccinated. Of 131 cases with known antiviral status, 95% of adults and 75% of paediatric cases were reported to have received antiviral therapy. Forty three adults (32%) and two paediatric influenza cases (8%) admitted to critical care units during the 2018/2019 season died.

A summary of all confirmed influenza cases admitted to critical care units and reported to HPSC between 2009 and the 2018/2019 season is shown in table 5 for all ages.

Table 5. Summary of confirmed influenza cases admitted to critical care units and reported to HPSC, 2009 pandemic period to 2018/2019, in Ireland

	Confirmed Influenza Cases Admitted to Critical Care Units									
	2009 pdm period	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
Predominant flu type/subtype	AH1pdm09	AH1pdm09; B	AH3	B; AH3 & AH1pdm09	AH3; AH1pdm09	AH3; B	AH1pdm09; B	AH3	B; AH3 & AH1pdm09	AH1pdm09, AH3
Total cases	100	121	15	39	83	69	161	51	191	159
Crude rate /100,000	2.2	2.6	0.3	0.8	1.8	1.4	3.4	1.1	4.0	3.3
% Influenza A:B	100:0	95:5	100:0	59:41	98:2	80:20	82:18	88:12	52:48	99:1
Median age (years)	34	49	60	39	50	63	51	67	62	54
Females	50%	53%	80%	49%	41%	41%	42%	33%	54%	47%
Pregnant/postpartum	8	8	0	4	4	1	5	0	2	0
% Co-morbidities	82%	74%	93%	90%	85%	86%	83%	93%	85%	78%
% Vaccinated	NA	17%	-	-	32%	47%	18%	31%	35%	16%
Antiviral treatment	NA	NA	86%	88%	90%	83%	94%	84%	96%	92%
ICU: Hospital ratio	9%	13%	10%	8%	12%	7%	9%	4%	4%	5%
ICU Median LOS - Adult	12	14	5	9	9	9	9	5	7	7
ICU Median LOS - Paed.	8	7	3	5	8	3	5	3	2	4
Mechanical ventilation	86%	90%	77%	91%	94%	93%	92%	98%	85%	84%
ECMO	5	10	0	0	2	1	11	0	1	2
Total deaths - all causes	18	35	5	11	27	23	47	20	50	45
Case fatality rate	18%	29%	33%	28%	33%	33%	29%	39%	26%	28%

Rates for 2009/2010 – 2013/2014 are based on the 2011 CSO census, rates for 2014/2015 - 2018/2019 are based on the 2016 CSO census

Mortality data

During the 2018/2019 influenza season 97 influenza cases notified on CIDR were reported to have died (2 per 100,000 population, 1.2% of notified influenza cases) (table 6). This was a lower mortality rate than in 2017/2018 (5.5 per 100,000 population, 261 deaths), but was relatively high when compared to the past five seasons. Age is likely to have had an impact on mortality. The median age for all cases of influenza notified in 2018/2019 was 31 years compared to 53 years in 2017/2018. The age profile of influenza cases tends to be younger in seasons where influenza A(H1N1)pdm09 is the dominant circulating strain. As is typical, the mortality rate was highest in those aged 65 years and older (10 per 100,000 population). The median age of patients who died during the 2018/2019 influenza season was 74 years (interquartile range: 60-80). Sixty eight percent of those who died were aged 65 years or older, 20% were aged 45-64 years, 10% were aged 25-44 years and there were two deaths in children aged 5-14 years.

The influenza case classification was reported as confirmed for 96 of the cases who died and probable for the remaining case. Influenza virus type/subtype was reported for 94 of the cases who died and all deaths were associated with influenza A; 34 with influenza A(H1N1)pdm09, 11 with A(H3N2) and 49 with influenza A (not subtyped).

HPSC monitors excess all-cause deaths in Ireland. An increase in all-cause excess mortality was observed in weeks 2, 4, 5, 6 and 7 (early January to mid-February) of the 2018/2019 influenza season

Table 6. Number (and crude rate* per 100,000 population) of notified influenza cases that died from all causes and were reported on Ireland's Computerised Infectious Disease Reporting System (CIDR) by influenza season, 2009/2010-2018/2019

	2009 pdm	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
Number of deaths	32	43	12	38	58	66	86	94	261	97
Crude rate/100,000	0.7	0.9	0.3	0.8	1.2	1.4	1.8	2.0	5.5	2.0

***Rates for 2009/2010 – 2013/2014 are based on the 2011 CSO census, rates for 2014/2015 - 2018/2019 are based on the 2016 CSO census**

Discussion

The 2018/2019 influenza season was a moderate season, but still had a significant impact on the Irish health system, with high numbers of influenza detections and high hospitalisation and ICU admission rates. The community influenza-like illness (ILI) rate went above the baseline threshold level in the first week in January 2019 and stayed above baseline for eight consecutive weeks (up to week ending February 24th). The ILI rate peaked during week 5 (week ending February 3rd) at 53 per 100,000 population, which was significantly lower than the peak in 2017/2018 (101 per 100,000) and the overall ILI rate did not exceed the medium threshold level (62.3 per 100,000). However, the ILI rate for children (<15 years old) exceeded the medium threshold level in weeks 4 and 5 (21st January to 3rd February) and the ILI rate for adults aged 65 years and older exceeded the medium threshold level in week 2 (7th-13th January).

Influenza virus detections by the National Virus Reference Laboratory (NVRL) (n=2,608) and confirmed influenza notifications (detections by all laboratories in Ireland) (n=7,939) reported on the CIDR system were at high levels during the 2018/2019 season (third and second highest levels ever reported). However, testing for influenza has increased in recent years and this should be taken into consideration when comparing data on influenza detections and hospitalisations from different seasons.

During the 2018/2019 influenza season, influenza A(H1N1)pdm09 was the dominant virus circulating, with smaller numbers of influenza A(H3N2) co-circulating and very few influenza B viruses detected. From mid-March 2019, there was a higher proportion of influenza A(H3N2) viruses circulating with very few A(H1N1)pdm09 viruses detected.

Sequencing of a subset of the influenza A(H1N1) pdm09 viruses detected during the 2018/2019 season found increased genetic divergence and the emergence of a number of genetic subgroups with key amino acid substitutions. However there was no evidence that these substitutions were associated with antigenic changes and antigenic characterisation showed that the circulating influenza A(H1N1)pdm09 viruses were well recognised by the antiserum raised against the strain used in the vaccine. Sequencing of influenza A(H3N2) viruses indicated that most (three quarters of sequenced viruses) belonged to the same clade as the vaccine strain (3c.2a1). The remaining A(H3N2) viruses sequenced were 3c.3a viruses – an increase in this clade was noted globally and in Ireland midway through the 2018/2019 season and the A(H3N2) component of the vaccine for the 2019/2020 season is a 3C.3a virus.

During each season, influenza places a considerable burden on the Irish health system. Relatively high numbers of confirmed influenza hospitalised cases (n=7,939,

the second highest number of hospitalised influenza cases ever reported) and ICU cases (n=159) were reported during the 2018/2019 season. More than 99% of hospitalisations and ICU admissions were due to influenza A. Where influenza A subtyping was carried out, 79% of hospitalised cases and 87% of ICU cases were due to influenza A(H1N1)pdm09.

As is typical, the highest disease burden was in young children and the elderly, with particularly high hospitalisation and ICU admission rates in children aged less than 5 years old and in adults aged 65 years and older. Despite this, vaccination of children in high risk groups for influenza remains low. Half of the children admitted to ICU in 2018/2019 had underlying medical conditions and none had been vaccinated. Of hospitalised children with information on risk groups, 30% had underlying medical conditions and only 8% of these patients had been vaccinated.

Influenza outbreaks were reported throughout the 2018/2019 season but at lower levels than during the 2017/2018 season. Of the 66 notified influenza outbreaks, 49% were in acute hospitals and 47% were in residential care facilities, with smaller numbers of outbreaks reported in other settings. Outbreaks occurred in all HSE areas but 44% of the influenza outbreaks in 2018/2019 were reported by HSE E. Where influenza type was reported, all outbreaks were due to influenza A and where influenza A subtype was available, 59% were due to influenza A(H1N1)pdm09.

The mortality rate was lower in the 2018/2019 season (2 per 100,000, 97 deaths) than in 2017/2018 season (5.5 per 100,000, 261 deaths), but was relatively high when compared to other recent seasons. The age profile of influenza cases tends to be younger in seasons where influenza A(H1N1)pdm09 is the dominant circulating strain and this affects the mortality rate. Where influenza virus type/subtype was reported, all deaths were associated with influenza A. Influenza A subtype was available for just under half of cases who died and 76% of these were infected with influenza A(H1N1)pdm09.

Additional strategies are needed to reduce the morbidity and mortality associated with influenza in high-risk groups and elderly populations. The high burden of influenza in children and the elderly in Ireland calls for sustained efforts to improve protective measures. Surveillance programmes should continue to monitor the transmission of influenza, influenza severity, changes in circulating viruses, vaccination status and vaccine effectiveness. Increasing vaccine uptake levels, introducing alternative vaccination strategies, such as universal influenza vaccination of children and/ use of improved (adjuvanted/high dose) vaccines for the elderly, should be considered.

Further information available on HPSC website

- Further information about influenza is available at https://www.hpsc.ie/a-z/respiratory/influenza/
- Influenza surveillance reports are available at https://www.hpsc.ie/a-z/respiratory/influenza/seasonalinfluenza/surveillance/influenzasurveillancereports/
- Previous annual reports are available at https://www.hpsc.ie/abouthpsc/annualreports/

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