NIPH
Norwegian Institute of Public Health

2022

REPORT

NORWAY:

Influenza Virological and

Epidemiological season report

October 2022

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The 2021-2022 influenza season, Norway

Summary

- There was no influenza outbreak in Norway during the preceding 2020-2021 season.

- Consistent with the very low influenza activity during the preceding two seasons, seroprevalence against contemporary influenza viruses in August 2021 had declined and the susceptibility of the unvaccinated part of the population had increased.

- The vaccine coverage in the national immunisation programme reached the highest level ever recorded. Approximately 1.4 million doses were distributed to risk groups and health care personnel, and the number of discarded doses was estimated to 150.000. According to the national immunisation registry SYSVAK, the vaccine coverage among persons 65 years or older was at least 63 percent. The estimated number of doses used (private market included) has increased by 27 % compared to the preceding 2020/21 season.

- A slight increase in influenza virus detections, predominantly A(H3N2), was seen during the autumn and early winter of 2021, but only in early March 2022 did this start to develop into a medium-magnitude outbreak. The frequency of detections peaked just before Easter, in week 14 (21%), and subsequently by early June had returned to very low, where it remained through summer with around 1 % positivity rate.

- The proportion of influenza-like illness (ILI) increased from mid-March and crossed the epidemic threshold in week 13, 2022. The ILI rate then indicated low-level influenza intensity for five weeks before returning down to very low level. Due to effects of the COVID-19 pandemic there is uncertainty concerning how well the ILI indicator now performs.

- The trends of influenza hospitalisations and ICU admissions reflected the trends in influenza detections well, with a late peak around week 14-16 in 2022. Between week 2021-40 and 2022-39, a total of 2,663 patients were admitted to hospital with influenza, and 63 patients were admitted to ICU. Seven influenza outbreaks in long-term care facilities were notified.

- A total of 14,846 cases of influenza have been laboratory confirmed, out of 600,309 patients tested during this season. During December-February the weekly number of persons tested for influenza was unprecedented, more than three times higher than normal, to a large extent due to testing for both SARS-CoV-2 and influenza on specimens taken for COVID-19 screening or verification, thus often without any clinical indication for influenza. After relaxation of SARS-CoV-2 measures and allowing for test on clinical indication the weekly number of influenza test have returned to normal.

- Among the 14,706 detected influenza A viruses, 2,769 have been subtyped as H3 and 217 as H1. Among the 140 recorded detections of influenza B, 29 have been identified in the National Influenza Centre as B/Victoria lineage and none as B/Yamagata.

- The H3N2 viruses driving the influenza this season were belonging to the genetic group 3C.2a1b.2a.2. The majority of the viruses possessed the antigen drift substitution H156S in the HA protein. These viruses correspond well to the H3 vaccine component for the Northern hemisphere 2022/23 season, A/Darwin/6/2021.

- A change in the H1N1 viruses has been observed over summer and early autumn. The virus has acquired several mutations and the drift variant is antigenic different. Less immunity against this variant is expected.
- No resistance to neuraminidase inhibitors or adamantanes has been detected, but one single case with a baloxavir resistance mutation in the PA gene was found, not treatment related. This is the first balaxovir resistance ever detected in Norway.

Influensasesongen 2021-2022 i Norge (summary in Norwegian)

Hovedbudskap

- Influensautbruddet i Norge uteble i den foregående 2020-2021 sesongen.
- I samsvar med at det hadde vært svært lite influensa de siste sesongene, var også forekomsten av beskyttende antistoff mot aktuelle influensavirus lavere i august 2021 enn i tidligere år. Dette tydet på at den uvaksinerte del av befolkningen var mer mottakelig for fremtidige influensautbrudd.
- Det var rekordhøy oppslutning om vaksinasjonsprogrammet. Det ble sendt ut omtrent 1,4 millioner doser til bruk for målgruppene, men med en meldt kassasjon på omtrent 150.000 doser. Vaksinasjonsdekningen blant personer over 65 år var ifølge SYSVAK på 63 prosent på landsbasis. Estimert antall brukte doser totalt (både program og vanlig salg) var 27 % høyere enn i sesongen 2020/21.
- Høsten og forvinteren 2021/2022 ble det påvist en liten økning, primært influensa A(H3N2), uten at det utviklet seg til noe utbrudd av betydning. Først i begynnelsen av mars 2022 kom det en klar økning. Antall og andel influensapositive prøver kulminerte i en middelstor topp like før påske, i uke 14 (21 %). Deretter var det fallende forekomst inntil det var nede rundt 1% av de testede tidlig i juni, en andel som har holdt seg gjennom sommeren.
- Nivået av influensalignende sykdom økte medio mars 2022. Influensautbruddet krysset utbruddsterskelen i uke 13 og lå på lavt nivå i fem uker før nivået returnerte til svært lavt. Det er usikkerhet knyttet til hvor godt ILI-indikatoren måler influensaaktiviteten som følge av endringer i diagnosepraksis i primærhelsetjenesten i kjølvannet av covid-19-pandemien.
- Trendene i antall innleggelser i sykehus og intensivavdeling med influensa har gjenspeilet trenden i influensapåvisninger, med en topp rundt uke 14-16. Mellom uke 2021-40 og 2022-39 var det rapportert om totalt 2 663 innleggelser i sykehus og 63 innleggelser i intensivavdeling. FHI er varslet om syv utbrudd av influensa i helseinstitusjoner denne sesongen.
- I alt er det denne sesongen laboratoriepåvist 14 846 influensatilfeller, etter at 600 309 personer er testet (over tre ganger normalen). I perioden desember 2021-februar 2022 lå antallet testede rekordhøyt, i stor grad fordi influensatest også ble gjort på prøver for covid-19 screening eller bekreftelse, dvs. for det meste uten klinisk mistanke om influensa. Etter at testing for covid-19 ble trappet og testing på klinisk indikasjon ble startet igjen har det ukentlige antallet influensatester returnert til nivå som var vanlig før pandemien.

- Blant 14 706 influensa A-påvisninger er 2759 virus subtypet som A(H3) og 217 som A(H1). Av de 115 registrerte influensa B-påvisninger er 29 bekreftet ved det nasjonale influensasenteret som genotype B/Victoria mens ingen har vært B/Yamagata.

- Influensa A(H3N2)-virus, som dominerte hele denne sesongen, tilhørte den genetiske gruppen 3C.2a1b.2a.2. De fleste av disse hadde antigen drift-mutasjonen H156S i HA-proteinet. Disse virusene samsvarer godt med H3N2-komponenten i kommende sesongs influensavaksine, A/Darwin/6/2021.

- Gjennom sommeren og tidlig høst er det dukket opp H1N1 virus med en rekke mutasjoner som fører til antigen drift og det ventes lavere immunitet mot disse H1N1 virusene.

- Det er ikke funnet influensavirus med resistensmutasjoner mot neuraminidasehemmere eller adamantaner. Det ble imidlertid funnet ett enkelt virus med mutasjon i PA-proteinet som gir resistens mot baloxavir. Tilfellet er det førstepåviste tilfellet av baloxavir i Norge. Tilfellet var ikke behandlingsrelatert.

A look back at the preceding 2020/2021 season

The 2020/21 season in Norway was characterized by a virtual absence of influenza detections. The proportion of influenza-like illness (ILI) in primary health care never exceeded the epidemic threshold; no outbreaks of influenza in health care institutions were reported, and the numbers of influenza hospitalisations and ICU admissions were very low.

That season, only 20 sporadic cases of influenza were detected out of 155,198 tested. Of these, 7 were A(H3N2), 2 A(H1N1), 8 B (not genotyped) and 3 B/Victoria. No B/Yamagata lineage viruses were detected.

The influenza A(H3N2) viruses belonged to the antigenically distinct 3C.2a1b.2a.2 subgroup and most closely resembled viruses like A/Bangladesh/100009/2020.

The influenza B-viruses belonged to the B-Victoria lineage(del162-164) and the antigenic different group of viruses originating from West Africa.

The H1N1 viruses belonged to 6B.1A/183P-7.

The 2021/2022 season

The components of the surveillance system are briefly described in Appendices.

Influenza-like illness (ILI) in primary health care

The proportion consultations for ILI in primary health care started to increase in mid-March and crossed the epidemic threshold in week 13 2022 (Figure 1). Never before has an outbreak of seasonal influenza been registered this late in a season in Norway. The outbreak remained at low level for five weeks before crossing the threshold back to very low level, where it remains at present.

The coding practices for influenza in primary health care has been altered due to the COVID-19 pandemic. Therefore, there has been uncertainties as to how well the ILI indicator would perform to measure influenza activity in this new setting. This season, a rise in laboratory confirmed influenza preceded the increase in ILI by three weeks. How the ILI indicator will perform in future influenza outbreaks must be evaluated continuously in the coming years.
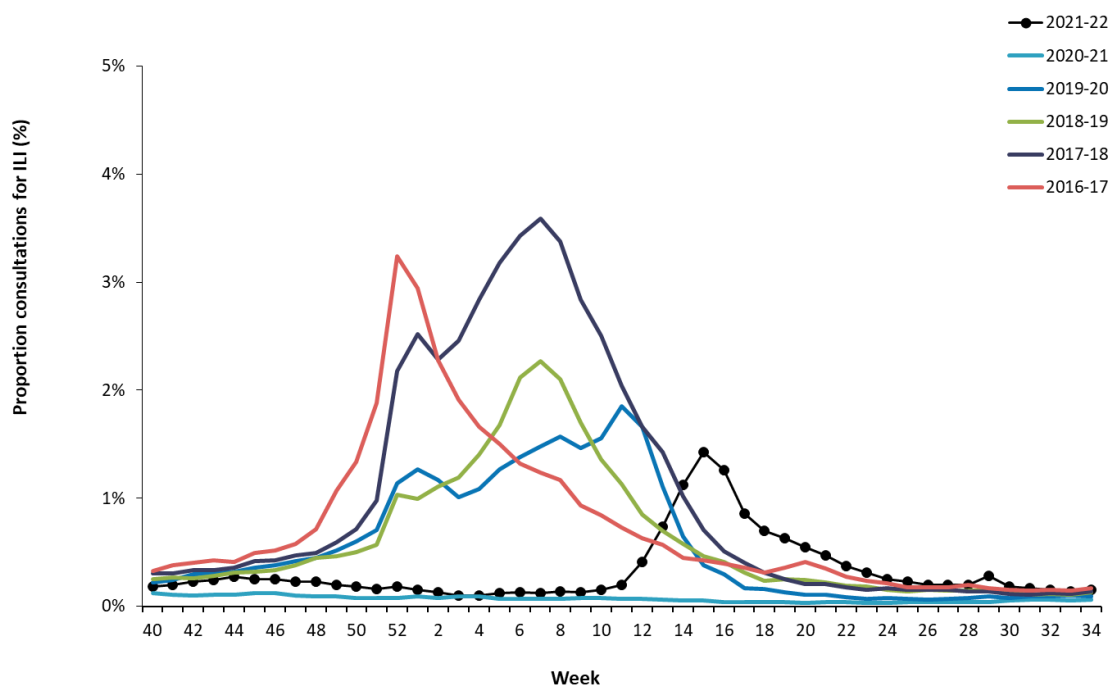

Figure 1. Weekly proportion of patients in general practice and emergency clinics diagnosed with ILI, Norway, 2021-2022 season (black dotted line) and previous five seasons. Source: Sykdomspulsen with data from KUHR, NIPH.

Outbreaks in health care institutions

Seven outbreaks of influenza were reported from health care institutions throughout week 13-22 this season through VESUV, the national web-based outbreak alert system.

Influenza hospitalisations based on registry data

In this surveillance system, a patient hospitalised with influenza is defined as a person who has an influenza-related ICD-10 code (J09-J10) registered upon discharge, who has been hospitalised overnight, and who has tested positive for influenza with a PCR test within 14 days before or up to 2 days after hospital admission. Between week 40-2021 and 39-2022, altogether 2,663 (49.1 per 100,000 population) patients were hospitalised with influenza. The weekly number of new patients admitted varied from 0 to 20 between week 2021-40 and week 2022-9, after which the weekly number of new patients admitted rapidly increased, reaching a peak of 417 in week 2022-15 (figure 2). Since week 2022-24, the weekly number of new patients admitted remained <20 again. The highest hospitalisation rates per 100,000 inhabitants were reported in the counties of Innlandet and Vestland (table 1). The median age of the 2,663 patients was 66 years (interquartile range 29-79 years), and 1,340 (50 %) of them were male. The highest hospitalisation rates per 100,000 inhabitants were reported among the >80-year-olds and 65-79-year-olds, followed by 0-4-year-olds (table 2). The median length of stay was 3 days (lower – upper quartile 1-5 days), with variation between age groups (table 2). A total of 94 patients hospitalised with influenza died in hospital or within 14 days after discharge, with the majority of the deaths registered among patients aged 65 or older (table 2).

In comparison, in season 2020-2021 there was no circulation of influenza in Norway, and this registry-based surveillance system identified <5 patients hospitalised with influenza during the entire season.
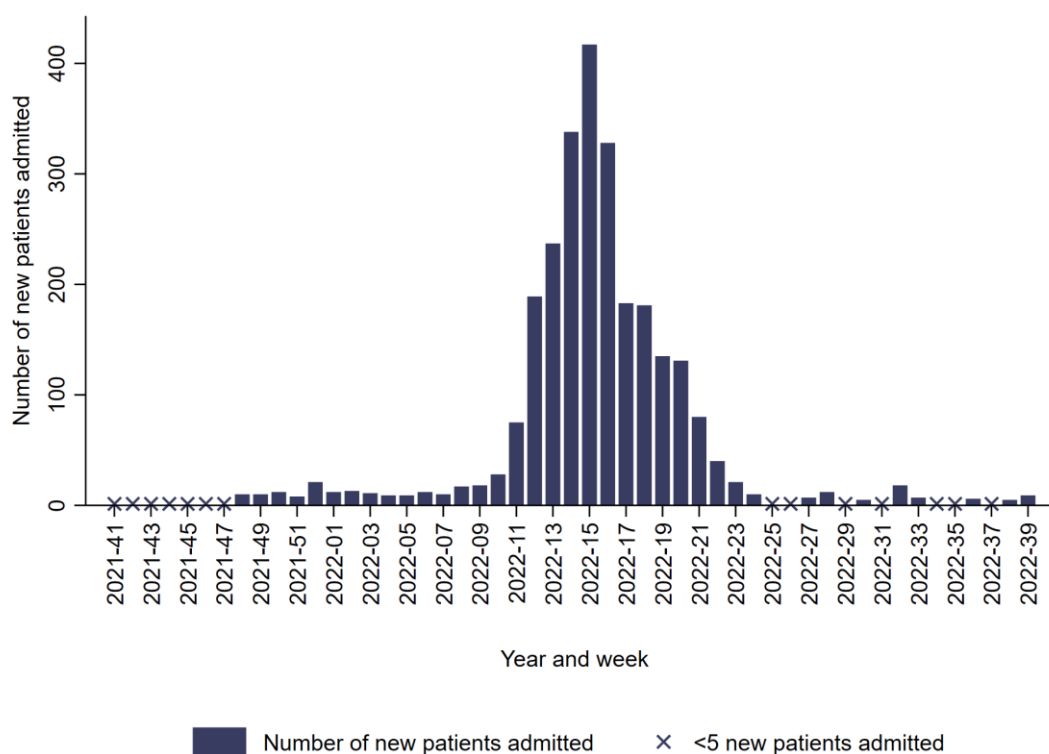

Figure 2. Weekly number of patients hospitalised with laboratory confirmed influenza and influenza diagnosis, Norway, 4 October 2021 – 2 October 2022. Source: The Norwegian Emergency Preparedness Register (Beredt C19) with data from the Norwegian Patient Registry and the Norwegian Surveillance System for Communicable Diseases (MSIS) laboratory database

Table 1. Number of patients hospitalised with laboratory confirmed influenza and influenza diagnosis by county of residence, Norway, 4 October 2021 – 2 October 2022. Source: The Norwegian Emergency Preparedness Register (Beredt C19) with data from the Norwegian Patient Registry and the Norwegian Surveillance System for Communicable Diseases (MSIS) laboratory database

| | Weeks 40/2021 - 39/2022 | |
County	Number	Incidence per 100000
Agder	159	51.1
Innlandet	227	61.1
Møre and Romsdal	131	49.3
Nordland	105	43.7
Oslo	387	55.3
Rogaland	236	48.6
Troms and Finnmark	79	32.7
Trøndelag	235	49.6
Vestfold and Telemark	179	42.1
Vestland	379	59.1
Viken	520	41.0
Totalt	2663	49.1

Table 2. Number of patients hospitalised with laboratory confirmed influenza and influenza diagnosis, length of stay and in-hospital deaths by age group, Norway, 4 October 2021 – 2 October 2022. Source: The Norwegian Emergency Preparedness Register (Beredt C19) with data from the Norwegian Patient Registry, the Norwegian Surveillance System for Communicable Diseases (MSIS) laboratory database and the National Population Registry

| | Weeks 40/2021 - 39/2022 | | | | | | | |
| | Patients hospitalised with influenza | | | Length of stay (days) | | | In-hospital deaths | |
Age group (years)	Number	Incidence per 100000	Proportion (%)	Median	Lower quartile	Upper quartile	Number	Proportion (%)
0-4	181	64.6	7	1	1	3	0	0
5-14	145	22.8	5	1	1	2	0	0
15-29	349	34.2	13	1	1	2	<5	-
30-64	614	24.6	23	2	1	4	8	1
65-79	766	102.2	29	3	2	6	35	5
80+	608	253.0	23	4	2	7	50	8
Total	2663	49.1	100	3	1	5	94	4

While registry data on influenza-positive PCR tests have been available only since the start of the COVID-19 pandemic, registry data based on hospital discharge codes alone show that the age groups 5-14 and 15-29 years had an exceptionally high incidence of hospital admissions in season 2021-2022 compared to previous seasons for which data is available (figure 3). Nevertheless, the incidence was highest among the elderly and youngest children, as usual.
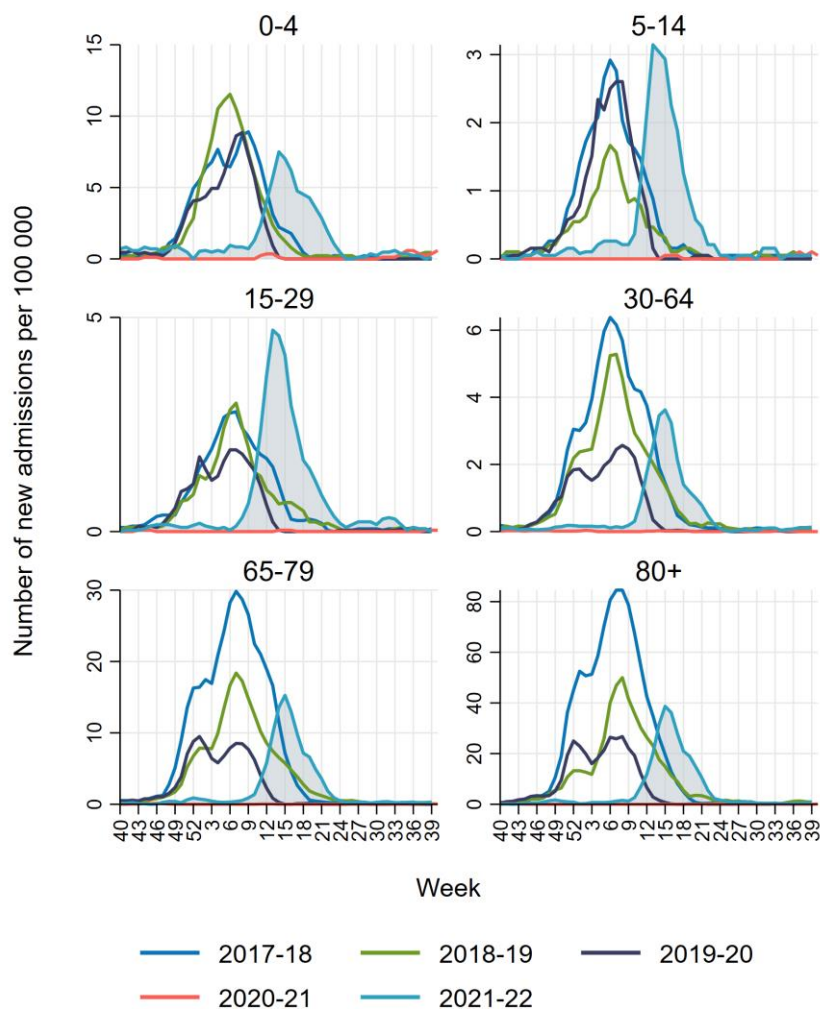
Figure 3. Three-week moving average of hospital admissions with influenza diagnosis per 100,000 by age group and season, Norway, 2 October 2017 – 2 October 2022. Source: The Norwegian Emergency Preparedness Register (Beredt C19) with data from the Norwegian Patient Register

Influenza patients in intensive care units

Between weeks 40-2021 and 24-2022, 63 patients were admitted to ICU with confirmed influenza. The highest numbers of weekly admissions were registered in weeks 13-17, with 6-9 admissions per week. During the remaining weeks, less than 5 new patients were admitted per week. The highest admission rates per 100,00 inhabitants were reported in the counties of Møre and Romsdal (3.4 per 100,000, N = 9), Oslo (2.1 per 100,000, N = 15) and Vestfold and Telemark (1.9 per 100,000, N = 8), while the remaining 8 counties reported an admission rate of 1.3 per 100,000 or lower. The median age of the 63 patients was 71 years (lower – upper quartile 57-78 years), and 30 (48 %) were male. Of the 63 patients, 52 (83%) received ventilatory support. Nine (14%) of the 63 patients died.

In comparison, less than five patients with influenza were admitted to ICU in Norway during the entire preceding 2020-2021 season, which is very low.

Laboratory confirmed influenza: Virological surveillance

Altogether, 600,309 patients in Norway were tested for influenza during weeks 40/2021-39/2022 (all time high), resulting in 14,706 recorded detections of influenza A virus and 140 influenza B virus (Figure 4, Table 5).
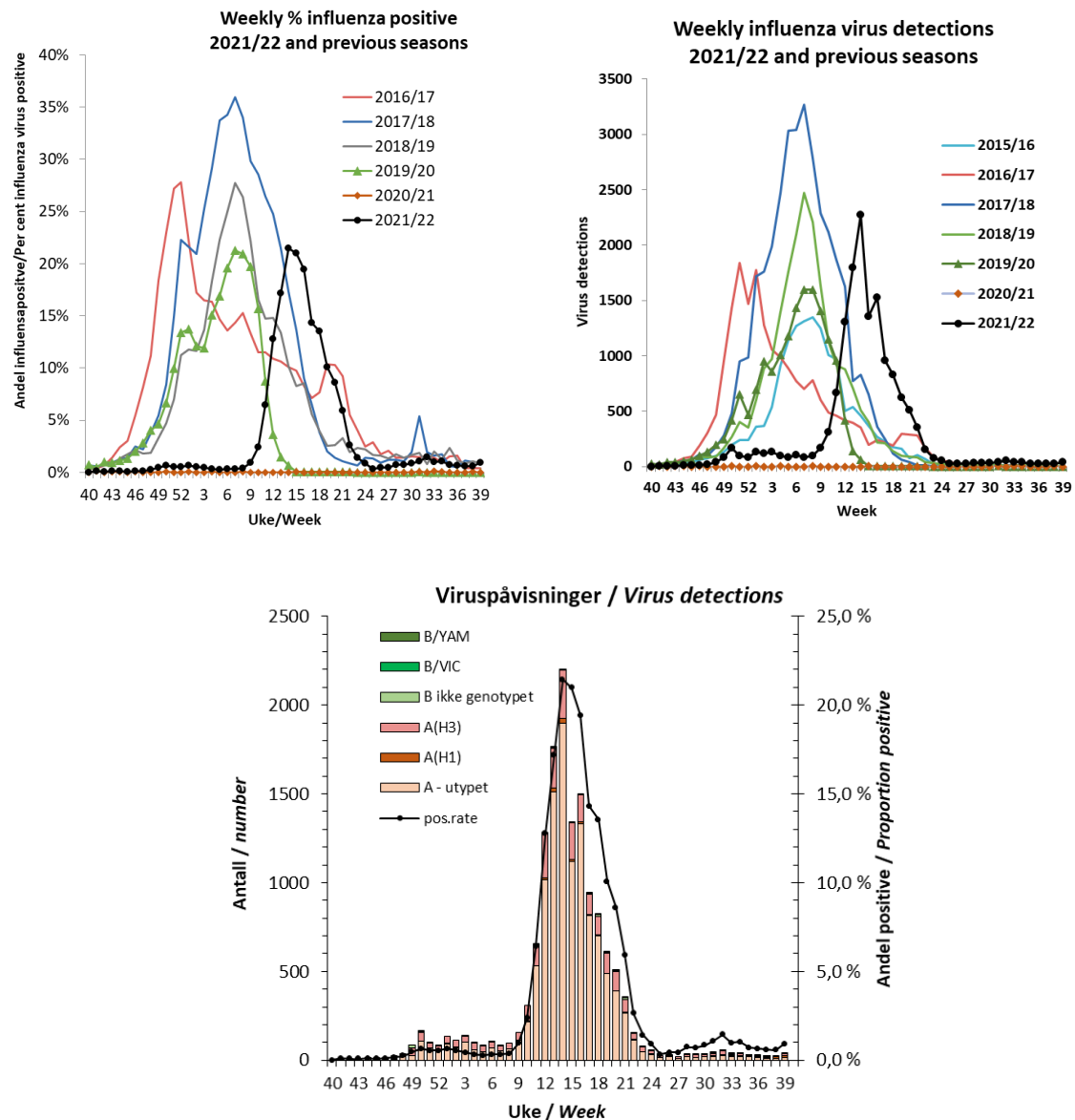

Figure 4. Laboratory detections, Norway 2021-2022. Upper left-hand panel: Weekly proportion of influenza virus positive specimens, with previous season proportions shown for comparison. Upper right-hand panel: Weekly number of influenza virus detections, with previous season numbers shown for comparison. Seasons impacted by Covid-19 are marked with symbols.
Lower panel: Weekly number of the different influenza viruses, displayed as stacked bars.

In a few instances in the autumn, trace amounts of virus RNA representing three or four different subtypes/lineages were detected in a sample, this has been interpreted as likely contamination with tetravalent influenza vaccine and has not been included in counts.

During the periods with extremely low prevalence of influenza in the population, the positive predictive value of the tests is expected to be poorer than usual, and in accordance with this, more positive results than usual could not be confirmed in the National Influenza Centre (NIC). This has particularly been the case for the type B virus detections, among which nearly 20% of 49 referred specimens could not be verified as influenza B positive in the NIC. It is thus possible that a considerable proportion of the 140 recorded influenza B virus infections are spurious. In contrast, less than 2% of the almost 1600 referred influenza A positive specimens could not be confirmed and/or subtyped in the NIC.

The number of detections started to rise in late November and levelled out after a small peak in week 50 when 157 out of 25,077 specimens (0.6%) tested positive for influenza. Only in week 9/2022 the numbers again started to rise, leading up to a medium-magnitude peak around Easter, weeks 14-16 (Figure 4). In several decades of virological influenza surveillance, this is the latest time of winter/spring we have had a sizeable first influenza peak.

Influenza A(H3N2) viruses were strongly predominant throughout the season (figure 4 and 5). Among the 14,706 detected influenza A viruses, 2759 have been subtyped as H3 and 217 as H1, either in the primary laboratory or in the NIC. However, in the most recent weeks the field may have started to open up, with H3 predominance declining and increasing for H1 viruses, also the proportion of type B detections are rising slightly.
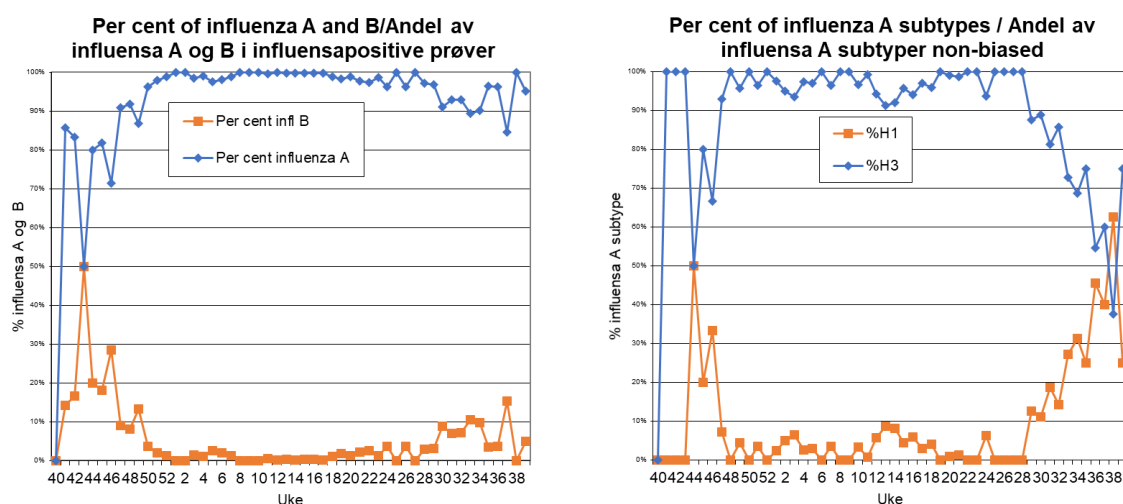

Figure 5. Weekly proportions of influenza virus type A and B (left) and subtype H1 and H3 among influenza A viruses that have been tested for both H1 and H3 (right).

Table 3. Detections and number of samples tested during the 2021-2022 season per age group

Aldersgruppe/ age group	Uke/week 2021 40 - 2022 39						
	Prøver/ Specimens	A(utypet)/ not subtyped	A(H1)	A(H3)	B ikke genotypet/ not lineage typed	% positive	Per 100 000
0-4	44 620	712	44	247	18	2,3 %	361,5
5-14	66 856	1 605	25	389	30	3,1 %	321,3
15-24	87 533	3 041	26	548	22	4,2 %	556,6
25-59	248 716	3 960	78	797	52	2,0 %	192,8
≥60	150 889	2 447	41	569	18	2,0 %	241,7

The most affected age group was the 15-24 years old in which 4,2 % of the samples tested positive for influenza overall, whereas people 25-59 years old were the least affected with an overall positivity rate of 2,0 % (Table 3).

Geographically, the counties Agder, Oslo and Viken reached the highest positivity rates, with Agder recording a positivity rate of 29,9 in week 16. The county Nordland experienced a rather late peak in the influenza activity compared to the rest of the country, reaching a positivity rate of 23,8 % in week 20 (Table 4).

Table 4. The percentage positive samples per county and per week from week 1. 2022.

Ukenummer	Agder	Innlandet	Møre og Romsdal	Nordland	Oslo	Rogaland	Troms og Finnmark	Trøndelag	Vestfold og Telemark	Vestland	Viken
202201	0,0 %	0,8 %	1,9 %	0,8 %	2,4 %	0,4 %	0,4 %	0,7 %	2,0 %	0,2 %	1,6 %
202202	0,5 %	0,6 %	1,4 %	0,7 %	1,7 %	0,0 %	0,0 %	0,2 %	0,9 %	0,3 %	2,0 %
202203	0,0 %	0,8 %	0,5 %	0,5 %	1,4 %	0,0 %	0,0 %	0,4 %	1,1 %	0,3 %	1,6 %
202204	0,0 %	0,0 %	0,8 %	0,2 %	1,9 %	0,0 %	0,0 %	0,0 %	1,3 %	0,2 %	1,9 %
202205	0,9 %	0,5 %	0,0 %	0,1 %	1,9 %	0,0 %	0,0 %	0,0 %	2,4 %	0,1 %	1,1 %
202206	0,6 %	0,5 %	0,5 %	0,0 %	3,6 %	0,1 %	0,5 %	1,1 %	3,1 %	0,1 %	1,4 %
202207	0,0 %	0,7 %	0,5 %	0,0 %	2,7 %	0,0 %	0,0 %	0,0 %	4,0 %	0,1 %	1,2 %
202208	0,5 %	0,4 %	4,0 %	0,0 %	2,1 %	0,6 %	0,0 %	0,3 %	2,3 %	0,1 %	2,0 %
202209	0,6 %	1,1 %	3,3 %	0,0 %	3,6 %	1,3 %	1,3 %	1,3 %	4,2 %	0,3 %	4,2 %
202210	1,9 %	1,8 %	6,6 %	0,3 %	8,6 %	1,8 %	0,0 %	2,6 %	5,0 %	0,9 %	8,0 %
202211	7,9 %	5,2 %	11,5 %	0,4 %	13,8 %	8,0 %	3,5 %	5,9 %	14,4 %	2,5 %	15,4 %
202212	15,4 %	11,7 %	9,9 %	1,2 %	23,8 %	13,8 %	12,2 %	8,6 %	19,0 %	8,0 %	23,1 %
202213	20,1 %	12,9 %	5,0 %	3,4 %	28,8 %	20,1 %	21,0 %	14,3 %	18,6 %	15,3 %	27,0 %
202214	29,0 %	17,7 %	10,0 %	4,9 %	27,7 %	19,0 %	19,9 %	20,3 %	19,0 %	22,1 %	27,9 %
202215	27,8 %	16,6 %	15,1 %	9,4 %	26,5 %	20,9 %	19,4 %	19,6 %	16,2 %	23,4 %	24,4 %
202216	29,9 %	17,4 %	14,0 %	10,6 %	17,6 %	24,2 %	14,7 %	15,8 %	17,9 %	22,3 %	21,4 %
202217	20,7 %	12,1 %	14,5 %	9,7 %	12,1 %	17,1 %	12,7 %	12,6 %	13,6 %	15,1 %	15,3 %
202218	21,3 %	15,8 %	15,8 %	10,9 %	13,9 %	14,4 %	16,3 %	12,7 %	12,5 %	12,1 %	11,7 %
202219	8,0 %	13,4 %	13,8 %	14,8 %	9,3 %	10,1 %	14,4 %	11,0 %	6,9 %	7,7 %	8,1 %
202220	6,9 %	10,7 %	11,7 %	23,8 %	4,7 %	5,0 %	12,8 %	9,9 %	5,5 %	6,5 %	6,4 %
202221	3,9 %	5,0 %	8,6 %	22,3 %	3,0 %	5,8 %	11,4 %	8,3 %	2,0 %	3,7 %	2,2 %
202222	2,7 %	3,8 %	4,0 %	12,4 %	1,6 %	0,6 %	5,3 %	2,0 %	1,4 %	1,1 %	1,2 %
202223	0,0 %	1,6 %	0,2 %	4,9 %	1,4 %	1,4 %	8,5 %	0,4 %	0,5 %	1,0 %	1,0 %
202224	0,5 %	1,4 %	0,4 %	3,1 %	0,5 %	1,8 %	2,2 %	0,5 %	0,4 %	0,9 %	0,3 %
202225	0,5 %	0,0 %	0,5 %	1,2 %	0,3 %	0,0 %	1,6 %	0,4 %	0,2 %	0,1 %	0,3 %
202226	0,7 %	0,2 %	0,5 %	1,5 %	0,3 %	0,0 %	0,4 %	0,4 %	0,4 %	0,6 %	0,1 %
202227	1,3 %	0,2 %	0,6 %	0,3 %	0,4 %	0,3 %	0,5 %	1,3 %	0,0 %	0,5 %	0,1 %
202228	0,0 %	0,3 %	1,0 %	0,0 %	1,4 %	0,6 %	0,6 %	1,3 %	0,3 %	0,9 %	0,4 %
202229	2,1 %	0,6 %	0,3 %	0,0 %	0,5 %	0,3 %	1,7 %	0,6 %	1,2 %	0,6 %	0,9 %
202230	0,0 %	0,0 %	0,7 %	0,4 %	1,9 %	0,7 %	0,0 %	0,7 %	1,0 %	1,0 %	0,7 %
202231	0,9 %	0,7 %	2,0 %	0,0 %	0,9 %	0,4 %	0,0 %	2,1 %	2,2 %	1,2 %	0,6 %
202232	3,6 %	0,4 %	0,7 %	1,2 %	2,1 %	2,0 %	1,7 %	1,2 %	0,5 %	1,6 %	1,3 %
202233	0,9 %	0,4 %	0,3 %	0,4 %	1,8 %	3,7 %	1,1 %	0,0 %	1,3 %	0,6 %	0,7 %
202234	0,9 %	0,4 %	1,8 %	0,0 %	2,3 %	2,1 %	0,0 %	0,4 %	0,3 %	0,8 %	1,3 %
202235	0,0 %	0,0 %	0,9 %	0,0 %	0,9 %	0,4 %	0,6 %	0,0 %	1,3 %	0,5 %	1,3 %
202236	1,7 %	0,4 %	1,0 %	0,4 %	1,1 %	0,0 %	0,0 %	0,4 %	0,5 %	0,9 %	0,4 %
202237	0,7 %	0,0 %	0,3 %	0,4 %	0,8 %	0,4 %	0,6 %	0,0 %	0,5 %	0,5 %	0,7 %
202238	0,9 %	0,0 %	0,6 %	0,0 %	0,6 %	0,0 %	0,5 %	0,4 %	0,4 %	1,0 %	0,8 %
202239	0,7 %	0,0 %	1,0 %	0,4 %	1,2 %	0,4 %	0,0 %	0,8 %	0,5 %	1,3 %	1,4 %

Virological sentinel surveillance

Due to the redirection since March 2020 of respiratory infection specimen collection away from general practices and emergency wards to Covid-19 testing stations, the virological sentinel system for influenza was not operable between mid-March 2020 and mid-February 2022. However, with the return of patients to general practices the sentinel system was reactivated and strengthened by including more GPs and engaging sentinel laboratories for testing. From week 7, 2022, physicians send specimens to their routine laboratory and the NIC receives the data as well as influenza and SARS_CoV-2 positive specimens for subtyping and characterisation.

From the reactivation in week 7 and through week 39/2022, 1186 sentinel specimens were tested, with 232 detections of influenza virus A (201 subtype H3, 5 subtype H1, and 26 not subtyped), and 9 influenza virus B (of which 4 were Victoria-lineage and 5 were not lineage identified). In addition, 85 SARS-CoV-2, 2 RSV, 201 rhinovirus, 57 hMpV, 44 parainfluenza virus and 24 other human coronaviruses were detected. Influenza detections increased and peaked simultaneously to the detections in the non-sentinel virological surveillance (Figure 7).
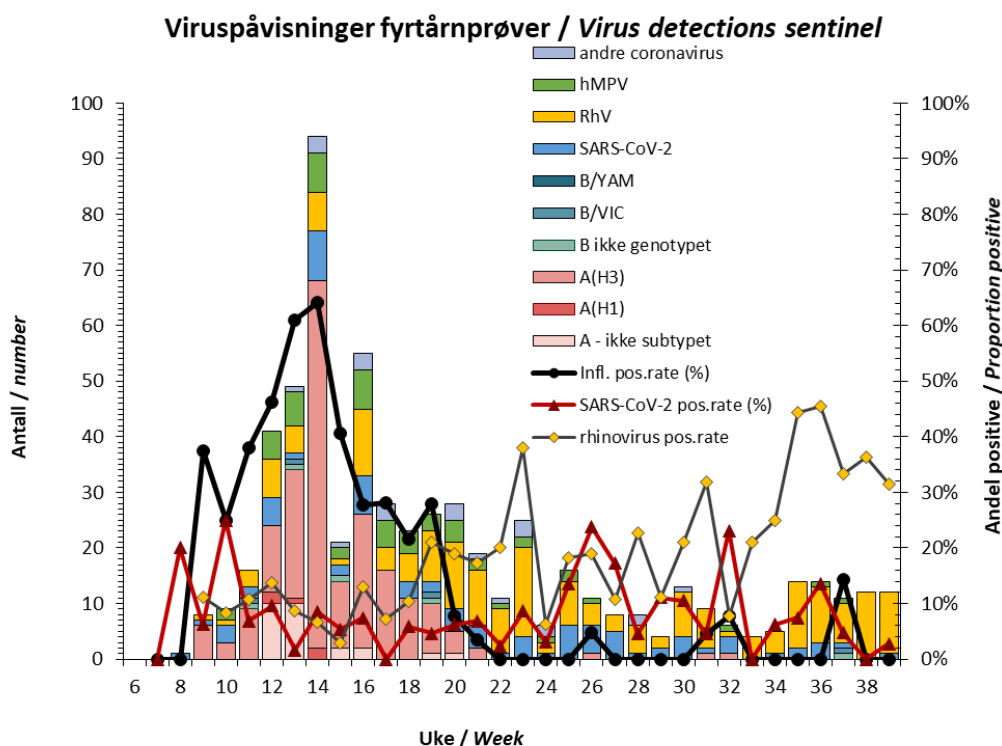

Figure 6. Weekly numbers of detections and per cent positives of respiratory viruses in the respiratory sentinel surveillance.

Table 5. Weekly incidence of influenza-like illness (ILI), total number of specimens tested for influenza, proportion of specimens positive for influenza virus, and influenza virus detections per type/subtype/lineage (non-sentinel and sentinel combined), in Norway from week 40/2021 through week 39/2022.

week	Clinical surveillance % ILI	Specimens	% positive	A not subtyped	A(H1) pdm09	A(H3)	B not lineage typed	B/Victoria lineage	B/Yamagata lineage
								Virus detections	
40	0,2 %	6286	0,00 %	0	0	0	0	0	0
41	0,2 %	6514	0,11 %	0	0	6	1	0	0
42	0,2 %	7921	0,08 %	3	0	2	1	0	0
43	0,2 %	9279	0,09 %	3	0	1	4	0	0
44	0,3 %	14588	0,10 %	10	1	1	3	0	0
45	0,3 %	15955	0,07 %	4	1	4	2	0	0
46	0,3 %	14619	0,10 %	4	2	4	4	0	0
47	0,2 %	14532	0,15 %	6	1	13	2	0	0
48	0,2 %	15696	0,24 %	18	0	16	3	0	0
49	0,2 %	17787	0,47 %	26	2	44	11	0	0
50	0,2 %	25457	0,65 %	110	0	49	5	1	0
51	0,2 %	18256	0,54 %	67	1	28	2	0	0
52	0,2 %	15098	0,55 %	54	0	28	1	0	0
1	0,2 %	20914	0,64 %	90	4	40	0	0	0
2	0,1 %	21602	0,53 %	69	8	38	0	0	0
3	0,1 %	30388	0,44 %	101	3	29	2	0	0
4	0,1 %	30343	0,33 %	60	1	38	1	0	0
5	0,1 %	29675	0,27 %	45	1	33	2	0	0
6	0,1 %	31604	0,33 %	70	0	33	1	1	0
7	0,1 %	24832	0,33 %	51	2	28	1	0	0
8	0,1 %	25741	0,37 %	63	0	32	0	0	0
9	0,1 %	17221	0,96 %	111	0	54	0	0	0
10	0,2 %	12898	2,40 %	219	4	87	0	0	0
11	0,2 %	10321	6,43 %	530	3	128	2	1	0
12	0,4 %	10204	12,77 %	1025	15	262	1	0	0
13	0,7 %	10480	17,16 %	1520	22	251	3	2	0
14	1,1 %	10585	21,45 %	1897	28	342	3	0	0
15	1,4 %	6459	20,98 %	1122	10	219	4	0	0
16	1,3 %	7840	19,44 %	1334	12	174	4	0	0
17	0,9 %	6676	14,30 %	815	4	134	1	1	0
18	0,7 %	6138	13,55 %	700	4	119	8	1	0
19	0,6 %	6185	10,1 %	489	2	120	9	2	0
20	0,6 %	5959	8,6 %	391	3	112	3	3	0
21	0,5 %	5963	5,9 %	268	3	75	6	2	0
22	0,4 %	5870	2,6 %	111	5	35	2	2	0
23	0,3 %	5347	1,4 %	46	1	28	1	0	0
24	0,3 %	6054	0,9 %	34	3	15	2	0	0
25	0,2 %	7098	0,3 %	16	1	7	0	0	0
26	0,2 %	6240	0,4 %	22	0	4	1	0	0
27	0,2 %	5347	0,4 %	12	0	11	0	0	0
28	0,2 %	4821	0,7 %	19	2	13	1	0	0
29	0,3 %	4493	0,71 %	14	3	14	1	0	0
30	0,2 %	4083	0,83 %	22	1	8	2	1	0
31	0,2 %	3985	1,08 %	23	4	13	1	2	0
32	0,2 %	3857	1,45 %	28	6	18	1	3	0
33	0,1 %	3833	0,99 %	20	6	8	1	3	0
34	0,2 %	3924	1,04 %	22	4	11	2	2	0
35	0,2 %	4024	0,72 %	19	6	3	1	0	0
36	0,2 %	4195	0,64 %	14	6	6	1	0	0
37	0,2 %	4294	0,61 %	9	7	6	2	2	0
38	0,2 %	4404	0,57 %	9	13	3	0	0	0
39	0,2 %	4424	0,93 %	15	12	12	2	0	0
Total		600309		11720	217	2759	111	29	0
week	% ILI	Specimens	% positive	A not subtyped	A(H1) pdm09	A(H3)	B not lineage typed	B/Victoria lineage	B/Yamagata lineage
			Type A: 14706				Type B: 140		

Genetic characterisation of the viruses in circulation

This season, the NIC at the Norwegian Institute of Public Health has received 2,327 influenza virus positive samples for further analysis in the national monitoring. Of these 836 (36 %) have been subjected to further in-depth analysis with whole genome sequencing (Figure 6).

Influenza A(H3N2)

At the start of the season in 2021 almost all cases were similar to the A (H3N2) virus that caused outbreaks in South Asia summer of 2021 and early autumn. Most viruses detected in Europe at that time appeared to be this genetic variant. This virus has somewhat altered antigenic properties in relation to the influenza A(H3N2) virus we have had in circulation in Norway before. The viruses were characterized as A/Bangladesh/4005/2020-like viruses belonging to the genetic group 3C.2a1b.2a.2 with the following defining mutations in HA1: Y159N, T160I, L164Q, D190N, F193S and Y195F. The majority of H3 viruses detected in Norway had the E50K substitution as well and some with and without the antigenic drift substitution H156S. This is a potential key mutation for antigenic drift and has been shown in functional studies to be somewhat antigenically different from the vaccine of the northern hemisphere. However, the main H3N2 virus causing the late influenza outbreak in Norway spring 2022 was a slightly different 3C.2a1b.2a.2 virus, A/Darwin/6/2021-like (Figure 7). Compared to the H3 vaccine strain for the Northern hemisphere 2021-22, most of these viruses possessed the HA1 amino acid mutations: D53G, D104G, **H156S**, Y159N, K160I, L164Q, N171K, R186D, D190N, P198S and K276R. During summer additional single substitutions have occurred in small groups of viruses; S124N has appeared in some of the viruses, L164Q in others, I140M, T164S, R299K and E50K in others. E50K was dominating in the early season version of the A/Bangladesh/4005/2020 viruses. Some new Bangladesh-like viruses have reappeared during summer, but with additional substitutions: F79V, I140K, S262N and loss of R269K. Only five cases have been identified as 3C.2a1b.1a (A/Denmark/3264/2019-similar).

The H3 component of the Northern Hemisphere vaccine was changed in February from 3C.2a1b.2a1 to the new Darwin-like H3 virus 3C.2a1b.2a.2. This is a good match compared to the circulating viruses in Norway this season. Viruses have been sent to the WHO Collaborating Centre for Influenza in London, UK for further analysis and genetic sequences deposited in the GISAID EpiFlu database.
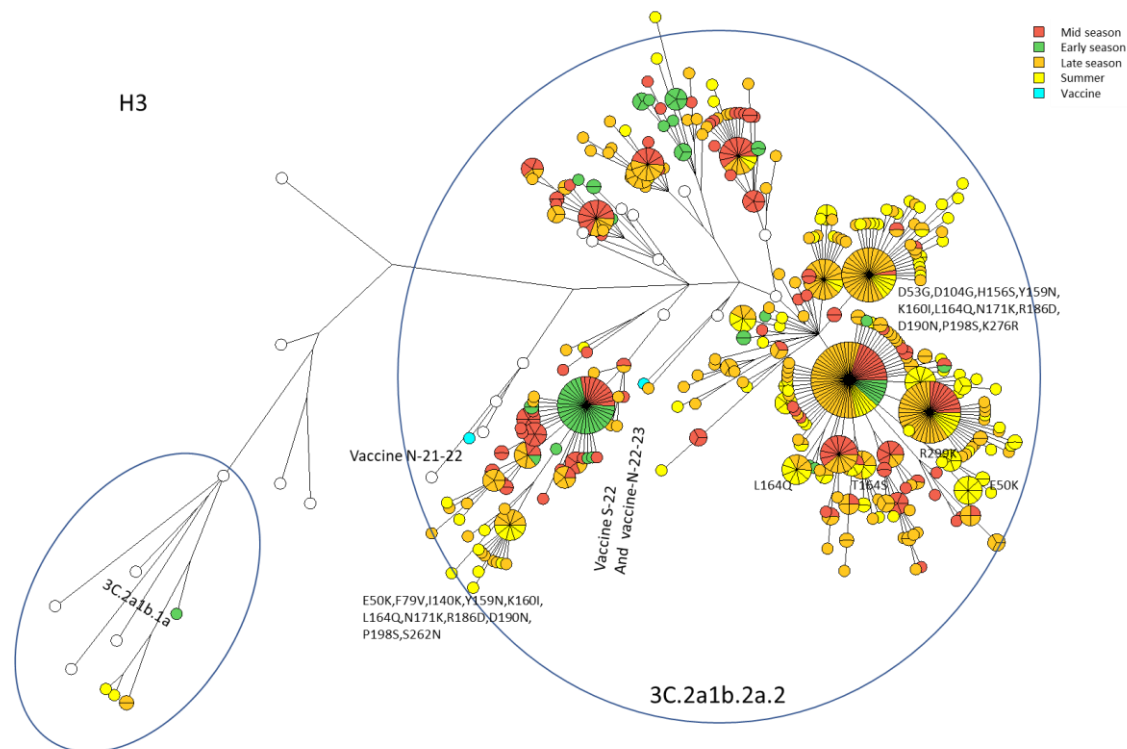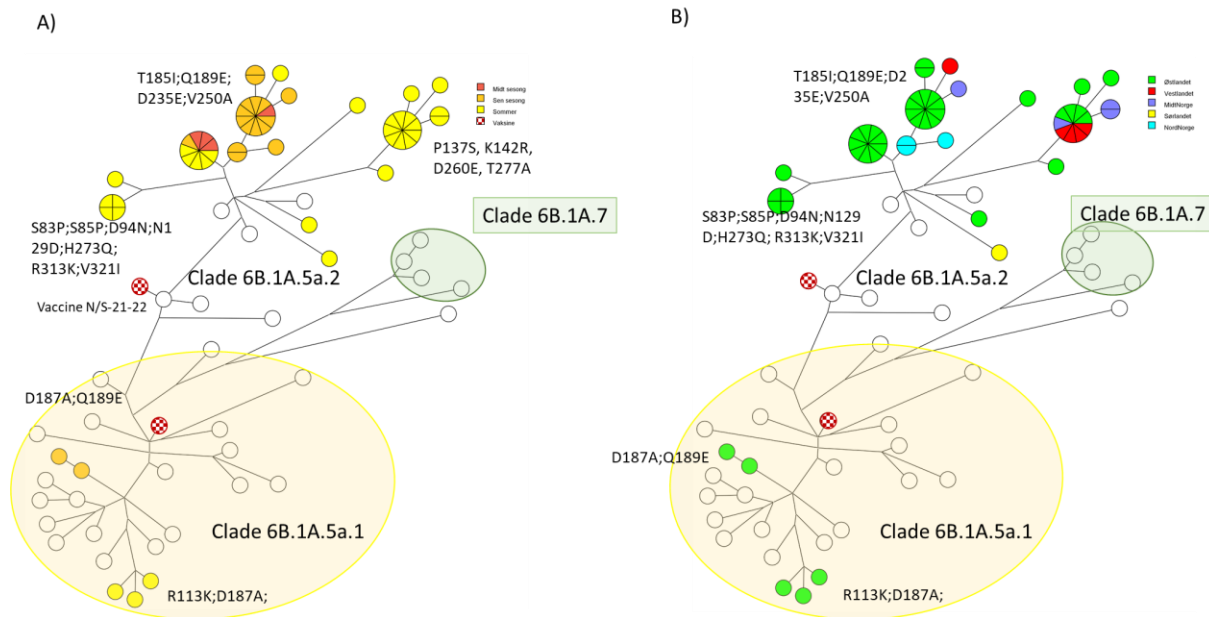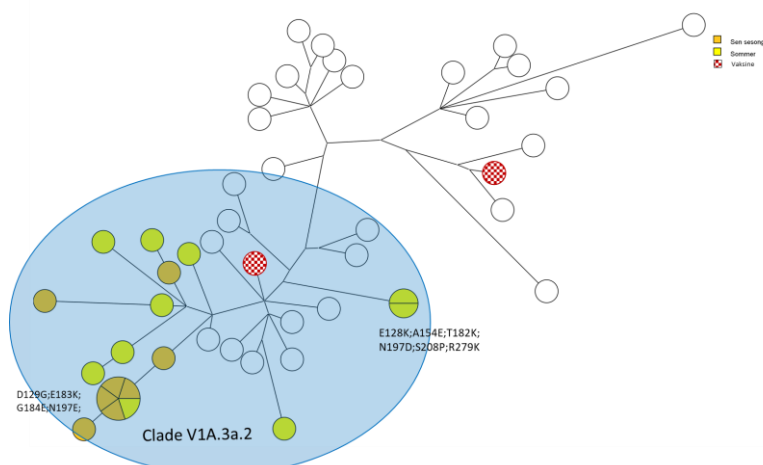
Figure 7: Genetic relationship of Norwegian A(H3N2) virus together with the H3N2 vaccine component for the Northern hemisphere 2021/22 and Southern hemisphere 2022, HA-gene. Each circle or sector represents one virus, and the clusters show genetic relationship. Left: Norwegian samples colour coded on time for sampling, early season before week 51, and mid-season from week 51 to 11. Late season from week 12 to 22, summer from week 23 to 39.

Influenza A(H1N1)

Influenza A(H1N1) viruses of both clade 6B.1A.5a.2 and 6B1A.5a.1 have been detected during the season although at fairly low numbers. However; during summer and autumn 2022 H1 viruses increased in proportion. 6B.1A.5a.2 viruses like A H1/India/Pun-NIV312851/2021 have been dominating the H1 viruses (figure 8) possessing the HA substitutions (compared to the vaccine strain): K54Q, N129D, K130N, N156K, L161I, T185I, A186T, Q189E, T216A, E224A, D235E, V250A, R259K, K308R. The H1 component has been changed in the seasonal influenza vaccine 2023 for the southern hemisphere in order to match the circulating H1 viruses better. During summer 2022 several cases of 6B.1A.5a.2 was detected that possessed some additional substitutions in HA1: P137S, K142R, D260E, and T277A. Some of these changes are important for antigen drift and the viruses are shown by the WHO collaborating laboratory to be antigenic different from the other H1 viruses from the season. Th viruses are also detected now late season in other countries and in Norway in several regions, indicating that there have already been several introductions to Norway. These viruses have special attention the following 2022-23 season. Few cases of 6B.1A.5a.1 was detected, but most at the end of the season.

Figure 8: Genetic relationship of Norwegian A(H1N1) virus together with the H1N1 vaccine component for the Northern hemisphere 2021/22 and Southern hemisphere 2022, HA-gene. Each circle or sector represents one virus, and the clusters show genetic relationship. Norwegian samples A) colour coded on time for sampling, early season before week 51, and mid-season from week 51 to 11, Late season from week 12 to 22, summer from week 23 to 39. B) colour coded by region of detection.

Influenza B/Victoria lineage

Only 14 cases of influenza B/Victoria could be genetically characterised (Figure 9), and they all belonged to the V1A.3a.2 clade B/Austria/1359417/2021 possessing D144G, E183K and G184E; however; two viruses possessed E128K, A154E, T182K, N197D, S208P and R279K. It is unknown which effect these mutations will have on the virus, but these will be followed closely the next season, 2022-23.

Figure 9: Genetic relationship of Norwegian B-Victoria virus together with the H1N1 vaccine component for the Northern hemisphere 2021/22 and Southern hemisphere 2022, HA-gene. Each circle or sector represents one virus, and the clusters show genetic relationship. Norwegian samples A) colour coded on time for sampling, early season before week 51, and mid-season from week 51 to 11, Late season from week 12 to 22, summer from week 23 to 39. B) colour coded by region of detection.

Table 6. Weekly genetic characterisations of Norwegian influenza viruses season 2021-22

Uker

Radetiketter	41	42	43	45	46	47	48	49	50	51	52	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	Totalsum
3C.2a1b.1a										1																				2						1	1													5
genAH3/Denmark/3264/2019										1																				2						1	1													5
3C.2a1b.2a.2	4	2	1	4	4	10	6	16	19	4	5	7	5	11	23	8	8	2	14	40	23	27	22	31	74	39	27	20	14	49	51	49	23	18	7	4	4	10	9	9	6	11	14	5	9	2	5	4	1	760
genAH3/Bangladesh/4005/2020	4	2	1	4	4	10	6	16	19	4	5	7	5	11	23	8	8	2	14	40	23	27	22	31	74	39	27	20	14	49	51	49	23	18	7	4	4	10	9	9	6	11	14	5	9	2	5	4	1	760
6B.1A.5a.1																									1	1						1												1			1			5
genAH1/Guangdong-Maonan/SWL1536/2019																									1	1						1												1			1			5
6B.1A.5a.2												1	1										2	3	3	6	2			1	2	1	3	1	2	1			1				1	3	2	1	4	3	6	50
genAH1/India/Pun-NIV312851/2021												1	1										2	3	3	6	2			1	2	1	3	1	2	1			1				1	3	2	1	4	3	6	50
V1A.3a.2																								1		2	3	2															2	3	1			2		16
genBVicB/Austria/1359417/2021																								1		2	3	2															2	3	1			2		16
Totalsum	4	2	1	4	4	10	7	16	19	4	5	8	6	11	23	8	8	2	14	40	23	29	25	36	82	42	27	20	16	53	55	50	27	20	9	6	4	10	10	9	6	12	19	11	11	6	5	10	7	836

Antiviral susceptibility

During the season 674 samples were genetically analysed for antiviral neuraminidase resistance at the reference laboratory. No neuraminidase resistance was detected. However, 3 H3N2 viruses had the I222V substitution in NA. This substitution is not associated with resistance in H3N2 viruses,but could infer resistance together with substitutions in position 119. Such substitutions were however not found in any of the Norwegian viruses.

As baloxavir got licensed in Norway in May 2021 also resistance towards baloxavir is investigated, although this antiviral is not in active use in Norway. This drug tends to have slightly higher degree of antiviral resistance developing. This has been the most widely used drug in Japan. In 2018 the resistance towards baloxavir in Japan was at 1,5 % and in 2019 at 9.5 %, mainly found in treated children. However, human to human transmission has also been detected (Takashita *et al.*, 2019; Imai *et al.*, 2020). Out of 442 influenza viruses in Norway investigated for baloxavir resistance one single case (0.23 %) from week 19 was detected.

This is the first potential baloxavir resistance case in Norway. The sample was from an elderly (>80 years old) hospitalized case, not undergone antiviral treatment, infected with influenza A(H3N2), possessing the I38T substitution in the PA protein.

No samples had neuraminidase susceptibility phenotypic testing performed as antiviral resistance testing of influenza virus has been deprioritized during the COVID-19 pandemic.

For many years all circulating influenza viruses have been resistant to adamantanes, thus the antiviral is not used for treatment in Norway and most other countries. However, in recent years there have been reports of single cases that areiusceptible again. Therefore, NIPH has again resumed testing for adamantane resistance. All cases investigated for adamantane resistance (476) possessed the S31N substitution in the M2 protein indicating high resistance towards adamantanes. .

Population immunity against recent influenza viruses, August 2021

In August each year, the National Influenza Seroepidemiology Programme solicits approximately 2000 anonymised residual sera from clinical/microbiological laboratories across Norway. The sera, aimed to be representative of the Norwegian population geographically and by age composition, are tested by the haemagglutination-inhibition (HI) test to determine the antibody immunity against relevant circulating influenza viruses.

Due to COVID-19 workload, the analysis of sera was not carried out in 2020, and from the August 2021 collection only a subset of ca. 660 sera was analysed. The main findings are shown in figure 10 and table 7, and summarised as follows:
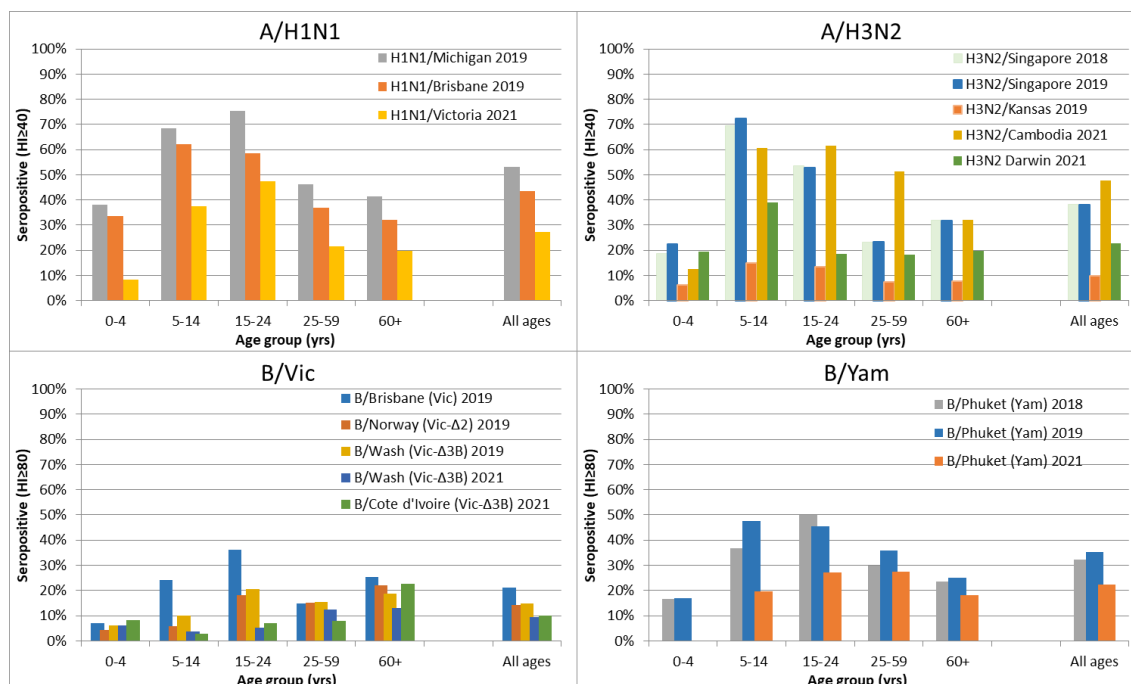

Figure 10. Seroprevalence in August 2021 to current influenza A and B reference and vaccine strains for 'All ages' and in various age groups. For comparison, seroprevalences to some virus strains in August 2019 are also shown.
H1N1/Michigan= A/Michigan/45/2015 (H1N1)pdm09 clade 6B.1; H1N1/Brisbane= A/Brisbane/02/2018 (H1N1)pdm09 clade 6B.1A1; H1N1/Victoria= A/Victoria/2570/2019(H1N1); H3N2/Singapore= A/Singapore/INFIMH-16-0019/2016 (H3N2) clade 3C.2a1 ; Kansas= A/Kansas/14/2017 (H3N2) clade 3C.3a.1; H3N2/Cambodia= A/Cambodia/e0826360/2020(H3N2), 3C.2a1b.2a.1; H3N2/Darwin= A/Darwin/9/2021(H3N2), 3C.2a1b.2a.2; B/Brisbane= B/Brisbane/60/2008 (Victoria lineage, V1.A); B/Norway= B/Norway/2409/2017 (Victoria lineage, V1A.1); B/Wash=B/Washington/02/2019 (Victoria lineage, V1A.3); B/Cote d'Ivoire= B/Cote d'Ivoire/948/2020 (Victoria lineage, V1A.3a.1); B/Phuket= B/Phuket/3073/2013 (Yamagata lineage).

For A(H1N1) viruses, there has been a drop in seroprevalence in all the age groups, leading to less than 30 % prevalence in all ages and, notably, less than 10% prevalence in children less than five years old.

For A(H3N2) viruses, the seroprevalence against the 3C.2a1b.2a.1 ("Cambodia-like") was substantial in 5-59 years age group and in all ages. The seroprevalence against the recently predominant 3C.2a1b.2a.2 ("Bangladesh-like") subgroup was much lower.

The seroprevalence against contemporary B/Victoria-lineage viruses was low in 2019 and had declined further in August 2021, with overall seroprevalence of only 10 % against recent B/Victoria variants represented by B/Washington/02/2019 (V1A.3) and B/Cote d'Ivoire/948/2020 (V1A.3a.1).

For the B/Yamagata-lineage viruses, represented by the vaccine virus for tetravalent vaccines, B/Phuket/3070/2013, the seroprevalence had declined since 2019, with overall seroprevalence at 22%, and similar proportions in all age groups except 0-4 year olds for whom the seroprevalence was zero.

Table 7. Influenza seroepidemiology results in August 2021 – Seroprevalence* in age groups.
For comparison data from studies performed for the preceding years 2016-2019 are also included.

Influenza strains (Year$^\$$)	Age groups						
	0-4	5-14	15-24	0-24	25-59	60+	All ages
H1 X-179A/A(H1N1)pdm09 (2016)	30	66	62	56	38	36	46
H1 Slovenia/2903/15 (2016)	34	66	68	60	38	33	47
H1 X-179A/A(H1N1)pdm09 (2017)	25	79	77	67	52	46	57
H1 Michigan/45/15 (2017)	26	79	79	68	50	42	56
H1 Michigan/45/15 (2018)	17	67	71	58	48	41	51
H1 Michigan/45/15 (2019)	38	68	75	64	46	41	53
H1 Brisbane/02/18 (2019)	34	62	58	54	37	32	44
H1 Victoria/2570/19 (2021)**	*8*	*37*	*47*	*36*	*22*	*20*	*27*
H3 Switzerland/9715293/13 (2016)	18	60	29	39	21	33	31
H3 Hong Kong/5738/14 (2016)	14	53	26	34	14	22	24
H3 Hong Kong/5738/14 (2017)	28	78	59	60	30	43	45
H3 Norway/3806/16 (2017)	28	77	68	63	36	45	49
H3 Hong Kong/5738/14 (2018)	25	78	72	63	36	43	50
H3 Sing/INFIMH-16-19/2016 (2018)	19	70	54	52	23	32	38
H3 Switzerland/8060/17(2018)	25	71	47	51	29	34	40
H3 Sing/INFIMH-16-19/2016 (2019)	22	72	53	53	27	34	40
H3 Kansas/14/17 (2019)	6	15	13	12	7	8	10
H3 Cambodia/e0826360/20 (2021)**	*13*	*61*	*61*	*52*	*51*	*32*	*48*
H3 Darwin/9/21 (2021)***	*20*	*39*	*18*	*28*	*18*	*20*	*23*
B/Vic Brisbane/60/08 (2016)	9	28	15	19	9	15	15
B/Vic Brisbane/60/08 (2017)	11	27	27	23	13	26	20
B/Vic Brisbane/60/08 (2018)	3	23	31	22	15	21	19
B/VicΔ2 Norway/2409/17 (2018)	1	4	15	7	18	23	14
B/Vic Brisbane/60/08 (2019)	7	24	36	24	15	25	21
B/VicΔ2 Norway/2409/17 (2019)	4	6	18	10	15	22	14
B/VicΔ3B Wash/02/19 (2019)**	6	10	20	13	15	19	15
B/Wash/02/19 (Vic-Δ3B) (2021)**	*6*	*4*	*5*	*5*	*12*	*13*	*10*
B/Cote d'Ivoire/948/20 (Vic-Δ3B) (2021)	*8*	*3*	*7*	*6*	*8*	*23*	*10*
B/Yam Phuket/3073/13 (2016)	5	23	39	25	26	20	24
B/Yam Phuket/3073/13 (2017)	4	28	33	25	23	19	23
B/Yam Phuket/3073/13 (2018)**	17	37	50	38	30	24	32
B/Yam Phuket/3073/13 (2019)**	17	48	46	39	36	25	35
B/Yam Phuket/3073/13 (2021)**	*0*	*20*	*27*	*19*	*28*	*18*	*22*
Sera analysed (n): 2016 Aug	188	351	333	874	745	411	2028
Sera analysed (n): 2017 Aug	189	318	353	860	797	436	2093
Sera analysed (n): 2018 Aug	155	251	236	642	501	275	1418
Sera analysed (n): 2019 Aug	113	187	171	471	375	208	1054
Sera analysed (n): 2019 Aug	***48***	***107***	***114***	***269***	***250***	***137***	***656***

$^\$$Year of serum collection and HI analysis.

*All entries are per cent of sera having HI titres >40 for the A strains and > 80 for the ether-treated B strains.

**(Corresponding to) components of the Northern hemisphere influenza vaccine (trivalent/quadrivalent) for the season 2021-2022.

***(Corresponding to) components of the Southern hemisphere influenza vaccine (trivalent/quadrivalent) for the season 2022.

B/Yam: B/Yamagata/16/1988 lineage; **B/Vic**: B/Victoria/2/1987 lineage

Vaccine distribution and coverage

Vaccine distribution

A total of 1.8 million influenza vaccine doses was distributed in the 2021/22 season. 1.4 million of these were distributed from NIPH specifically intended for persons in medical risk groups and health care personnel involved in direct patient care. Municipalities and hospitals reported that 150.000 of these doses were not used. The estimated number of doses administered per season increased by 27 % in 2021/22 compared to 2020/21 and has doubled in the last 4 years (Figure 11)
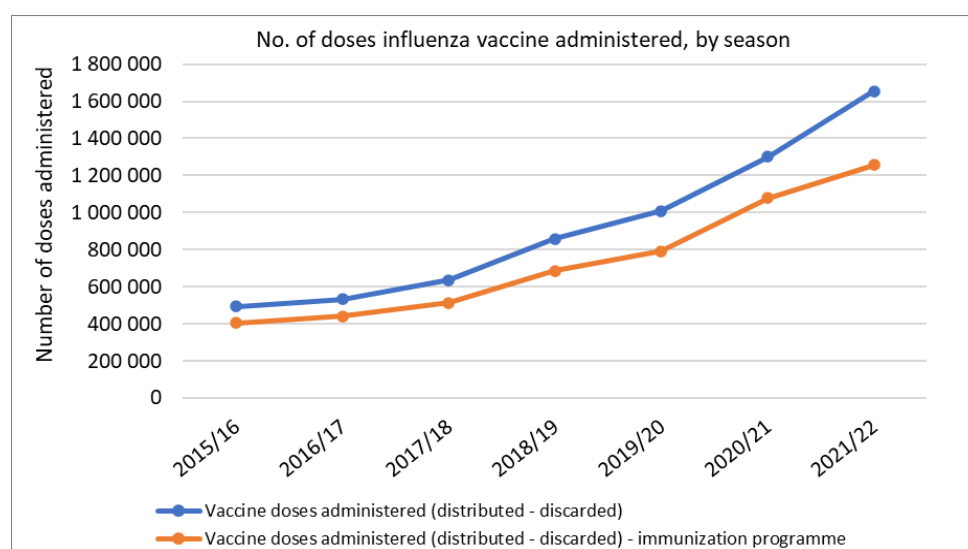
Figure 11: Estimated number of influenza vaccine doses administered in the Norwegian Influenza Immunisation Programme, by season, from September 2015 through May 2022.

Vaccine coverage

Vaccine coverage was estimated both by self-report and register data estimates in the 2021/22-influenza season. See Appendix for additional information on data collection methods.

Vaccine coverage estimates based on registry data

Coverage estimates from SYSVAK

Approximately 80% of all vaccinations are registered in the Norwegian Immunization Registry (SYSVAK). As such, coverage estimates from SYSVAK are considered mimimum estimates. According to SYSVAK, at least 31% of the general population received an influenza vaccine this season.

Coverage data from SYSVAK for the population 65 years or older are published yearly in Kommunehelsa statistikkbank (1). A total of 63% in this age group were registered as vaccinated during the 2021/22-season (figure 12).

Reported vaccination coverage was 56% among health care workers with patient contact. Among health care workers that also reported chronic conditions, vaccination coverage was 74%.

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1. Folkehelseinstituttet. Kommunehelsa statistikkbank - Influensavaksinerte over 65 år. https://khs.fhi.no/webview/
2. Emergency preparedness register for COVID-19 (Beredt C19). Last Updated: 12.09.2022. https://www.fhi.no/en/id/infectious-diseases/coronavirus/emergency-preparedness-register-for-covid-19/
3. Klüwer B, Rydland KM, Laake I, Todd M, Juvet LK, Mamelund S-E. Influenza risk groups in Norway by education and employment status. Scand J Public Health. 2021:14034948211060635.

Animal influenza

Highly pathogenic avian influenza (HPAI) was detected for the first time in wild birds in Norway in 2020 (4). In November 2021, there were outbreaks of HPAIV A(H5N1) in two holdings of laying hens in Southern-Norway. This was the first ever outbreak of highly pathogenic avian influenza in commercial poultry holdings in Norway. In the 2021-2022 season, HPAIVs were detected in wild birds all across Norway, including in high arctic areas such as Spitzbergen and Jan Mayen. Two different viruses predominated: H5N1 and H5N5. In June 2022, a large number of sick or dead seabirds (mainly Northern gannets) were found along the Norwegian coast, and in July and August three instances of HPAIV H5N1 infection were also detected wild red foxes that probably had fed on such birds. This was the first detection of avian influenza in mammals in Norway. All HPAIVs detected in Norway so far have belonged to clade 2.3.4.4b. No cases of avian influenza have been detected in humans in Norway. The Norwegian Institute of Public Health has assessed the risk for human infection as very low (5), but increased awareness and precautionary infection control measures are recommended to prevent zoonotic infection.

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4 Veterinærinstituttet: https://www.vetinst.no/fugleinfluensa-i-norge

5 Folkehelseinstituttet. Vurdering av risiko for smitte til mennesker med høypatogen fugleinfluensa A(H5N1) i Norge. Available from: https://www.fhi.no/publ/2021/vurdering-av-risiko-for-smitte-til-mennesker-med-hoypatogen-fugleinfluensa--/

Previous seasonal influensa reports:

https://www.fhi.no/sv/influensa/influensaovervaking/arsrapporter/

Previous Norwegian reports prepared for the WHO vaccine consultation meeting:

WHO-rapporter - FHI (https://www.fhi.no/sv/influensa/influensaovervaking/who-rapporter/)

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Appendices

Methods

Influenza-like illness

Norwegian ILI surveillance data is provided by Sykdomspulsen (sKUHR data). Sykdomspulsen receives data from the KUHR-system (hosted by the Norwegian Directorate of Health), which daily provides anonymised data on influenza diagnosed in primary health care consultations. The information is admitted to KUHR through doctors' reimbursement claims to the health authorities. Sykdomspulsen has been receiving KUHR data since 2014 and is supported by retrospective data from the 2006-07 season and onwards.

Virological surveillance

Virological sentinel surveillance: Usually, a network of volunteer sentinel physicians throughout the country collects specimens from patients with ILI for analysis at the National Influenza Centre. During the first two years of COVID-19 pandemic this sentinel network was unable to operate, because community respiratory illness testing was almost completely redirected to the SARS-CoV-2 testing infrastructures. From February 2022, an improvised virological sentinel surveillance has been reactivated, in which the participating practices send the specimens to a routine primary laboratory for rapid-turnaround testing for influenza, SARS-CoV-2 and some other respiratory viruses. The patient data and outcomes are provided to the NIC, and positive specimens forwarded for further work and biobanking.

Comprehensive virological surveillance: In addition, medical microbiology laboratories that perform influenza diagnostics report all testing outcomes in real-time to the newly established national MSIS laboratory database. Surveillance statistics for laboratory confirmed influenza has been harvested from this database. These laboratories also contribute influenza positive specimens to the NIC for further characterisation. Even though most of these laboratories are affiliated to hospitals, a large proportion of specimens tested for influenza virus are from outpatients visiting general practitioners, and, during the COVID-19 pandemic, SARS-CoV-2 testing stations.

Registry-based surveillance of influenza hospitalisations

In the 2021-2022 season, surveillance of influenza-related hospital admissions continued to be registry-based and nationwide. In the previous season, this system relied solely on data from the Norwegian Patient Registry, counting inpatient hospital admissions with ICD-10 codes for influenza (J09-J11). Since the beginning of the 2021-2022 season, the data on hospital discharge codes from NPR have been linked to data on PCR tests positive for influenza obtained from the Norwegian Surveillance System for Communicable Diseases (MSIS) laboratory database to enhance the specificity of the registry-based surveillance. Case-based data on PCR-positive influenza tests is available from season 2020-2021 onward, while historical data from the Norwegian Patient Registry is available from the beginning of year 2017. A patient hospitalised with influenza is defined as a person who has an influenza-related diagnosis code registered in NPR, who has been hospitalised overnight, and who has tested positive for influenza with a PCR test within 14 days before or up to 2 days after hospital admission. Only the first admission per season is included (readmissions excluded). The previously used, laboratory-based surveillance system for influenza-related hospitalisations was discontinued after the 2020-2021 season.

Influenza patients in intensive care units

Since the 2018-19 season, almost all intensive care units (ICUs) in Norway have reported data on patients receiving intensive care with suspected or confirmed influenza to the Norwegian Intensive Care Registry (NICR) using an electronic form. Usually, hospitals are advised to report patients between weeks 40 and 20 each monitoring season, however, during the 2021-2022 season the reporting was continued up to week 24. Up to the 2020-2021 season, only anonymised data were reported from NICR to the NIPH. In the season 2021-2022 the NIPH has begun to receive case-based data on a daily basis, with historical data since the 2018-2019 season.

Influenza seroepidemiology

The National Influenza Seroepidemiology Programme annually in August solicits about 2000 serum samples collected during the weeks 31-35 from clinical/microbiological laboratories covering the 19 counties of Norway. These anonymised convenience sera are aimed to be representative of the Norwegian population geographically and by age composition. In normal times these sera are tested by the haemagglutination-inhibition (HI) test to determine the antibody immunity to relevant circulating influenza viruses. However, due to capacity limitations imposed by the response to COVID-19, the sera collected in 2020 were only tested for antibody against SARS-CoV-2 and not against influenza, and only a subset of the 2021 sera were tested against influenza.

Vaccine distribution and coverage

Data on distribution and discarded doses

Distribution data is gathered from Department of Infection Control and Vaccine at NIPH and from IQVIA Solutions (distribution from other wholesalers). Information on discarded doses is collected from the municipalities through an annual survey.

Coverage estimates from SYSVAK

Vaccine coverage data is gathered from the Norwegian immunisation registry SYSVAK. SYSVAK is a national, electronic immunisation registry that records an individual's vaccination status and vaccination coverage in Norway.

It has been mandatory to register all administered influenza vaccines in the Norwegian Immunisation registry (SYSVAK) since 2009. Registration initially required a documented consent from the vaccinee, but this requirement was removed 01.01.2020, from when it also became mandatory to use electronic registration for all influenza vaccines. While these measures have reduced underreporting, SYSVAK still only registered 81% of the influenza vaccine doses that were distributed last season (not including doses reported as discarded). Coverage estimates based on recorded immunisations (SYSVAK) alone, such as estimates for the general population or residents >=65 years in Norway (figure 8), are therefore considered minimum estimates.

Coverage estimates from BeredtC19

The Emergency Preparedness register for Covid-19 (Beredt C19) extracts and compiles data from several data sources in order to establish a knowledge database that continually supplies the NIPH with a current overview of the pandemic situation. Beredt C19 includes information

that has already been collected in the healthcare service, national health registries and medical quality registers, as well as other administrative registers with information about the Norwegian population.

Beredt C19 supplied estimates of the influenza vaccination status in various target groups of the Influenza Immunisation Programme for the 2021/22-season through linkage of several central registries. Vaccination status was determined from the Norwegian Immunisation registry (SYSVAK). Health care workers with patient contact (HCWs) were identified through organisational databases (not corrected for active duty or patient contact), while individuals with high risk of severe influenza were identified by way of diagnostic data from reimbursement databases in the health services. Coverage estimates that rely on data from several registries are as such vulnerable to several possible sources of bias. Important examples comprise misclassification of group affiliation (belongs to target group or not) and vaccination status (primarily due to underreporting/ incomplete data capture). These and other issues may influence the data, resulting in coverage estimates that may be both over- and underestimations of the true vaccination coverage in the relevant groups.

Coverage estimates from Statistics Norway (SSB) – self-reported vaccination and risk conditions

Statistics Norway have included questions on influenza risk groups, patient-centred work in health care and vaccination on behalf of the NIPH in their Travel and Vacation survey (T&V-survey) in the 2nd and 3rd quarter since 2015 (1). The T&V-survey is a quarterly survey of repeated cross-sectional design with the objective to map the travel behaviour of the Norwegian population and collect data for other official statistics. The survey is an interviewer-administered, computer-assisted telephone interview. The sampling frame is the Norwegian National Registry, where every citizen has a unique identifier. The target population is the Norwegian population aged 16–79 years. Statistics Norway draws a new sample of 2000 individuals each quarter by way of stratified random sampling, based on place of residence, sex and 10-year age group - to ensure that the age and sex structure of the sample mirrors the distribution in the target population in each county.

Self-reported vaccination is admittedly susceptible to both recall bias and response bias (adherence to the vaccine recommendations), and might introduce misclassification, primarily through overreporting, compared to registry data (2, 3). Nonetheless, self-reported vaccination is widely used, both in coverage surveys and effectiveness studies, and is generally in good agreement with register-based estimates (4-6). Furthermore, as the success of the immunisation programme is contingent on the individual's recognition of themselves as belonging to the risk group or target group, self-reported risk group- and vaccination status offer an important perspective in the management of the programme, by virtue of being a measure of vaccine acceptance that offer an opportunity to gauge attitudes to influenza vaccines and -vaccination in different population groups.

References

1. Statistics Norway. Reise- og ferieundersøkelsen. Dokumentasjon [Travel & Vacation Survey, Documentation] Oslo: Statistics Norway; 2021 [Available from: https://www.ssb.no/transport-og-reiseliv/artikler-og-publikasjoner/reise-og-ferieundersokelsen.
2. Jimenez-Garcia R, Hernandez-Barrera V, Rodriguez-Rieiro C, Carrasco Garrido P, Lopez de Andres A, Jimenez-Trujillo I, et al. Comparison of self-report influenza vaccination coverage with data from a population based computerized vaccination registry and factors associated with discordance. Vaccine. 2014;32(35):4386-92.

3. Jackson ML. Use of self-reported vaccination status can bias vaccine effectiveness estimates from test-negative studies. Vaccine X. 2019;1:100003.
4. Regan AK, Wesley MG, Gaglani M, Kim SS, Edwards LJ, Murthy K, et al. Consistency of self-reported and documented historical influenza vaccination status of US healthcare workers. Influenza Other Respir Viruses. 2022.
5. Petrie JG, Fligiel H, Lamerato L, Martin ET, Monto AS. Agreement between state registry, health record, and self-report of influenza vaccination. Vaccine. 2021;39(38):5341-5.
6. Nowalk MP, D'Agostino HEA, Zimmerman RK, Saul SG, Susick M, Raviotta JM, et al. Agreement among sources of adult influenza vaccination in the age of immunization information systems. Vaccine. 2021;39(47):6829-36.

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