Monitoring Report: Respiratory Viruses

Truveta Research

April 17, 2023

Intended Audience: This technical report is intended for scientific audiences.

About this report

This report contains current hospitalization trends associated with six common respiratory viruses: COVID-19, human metapneumovirus (HMPV), influenza virus, parainfluenza virus, respiratory syncytial virus (RSV), and rhinovirus. We used a subset of Truveta Data to identify laboratory-confirmed infections associated with these respiratory viruses in children and adults. Truveta was formed and governed by US health systems with a shared vision of saving lives with data. Truveta's 28 members provide 16% of patient care in the United States in more than 20,000 clinics and 700 hospitals. Updated data are provided daily to Truveta. The subset of Truveta Data used in this study was provided on April 10, 2023 and included de-identified patient care data primarily located across ten states: New York, California, Washington, Illinois, North Carolina, Wisconsin, Oregon, Alaska, Texas, and Montana.

The figures below are intended to describe trends and comparisons of respiratory virus-associated hospitalizations in different demographic groups and across seasons. For the purposes of this report, seasons are defined as the period from October through September of the following year. Given the unadjusted nature of the data, the rates do not account for undertesting and other variability that exist across patient groups, providers, and systems. For further limitations, see the section below.

Importance of this report

This report is intended to monitor the temporal patterns of key respiratory viruses in the United States. COVID, influenza, and RSV account for a large proportion of hospitalizations related to respiratory illnesses. To provide a more complete understanding of hospitalizations related to respiratory viruses, we have also included other viruses known to cause respiratory illness such as human metapneumovirus (HMPV), parainfluenza, and rhinovirus. Each of these viruses can lead to hospitalization and death especially in certain vulnerable populations. Together these viruses are a

significant cause of lower respiratory disease in infants, children, and older adults (Pastula et al., 2017; Shi et al., 2017, Centers for Disease Control and Prevention 2023a, Smits et al., 2023). Representative and timely data to proactively monitor infections are scarce.

It is important for public health experts and clinical providers to understand the trends in these infections to inform decisions about public health, clinical care, and public policy. Connecting population-level trends with granular clinical information available in Truveta Studio can be very useful to more deeply understand which cohorts are most impacted.

This report is intended to supplement the surveillance data provided by the CDC (Centers for Disease Control and Prevention, 2023b). This report includes additional independent data and clinical detail that is not captured in other reports.

Data

Respiratory virus case definition

A case is defined by laboratory-confirmed respiratory virus infection (COVID, HMPV, influenza, parainfluenza virus, RSV, or rhinovirus) in a person who:

1. Was hospitalized in a Truveta-associated health system and
2. Tested positive for the respiratory virus 14 days before or after the start of the hospitalization

For the purposes of this report test positivity is defined as a positive value for any LOINC code listed in table S1 for COVID, table S2 for HMPV, table S3 for influenza, table S4 for parainfluenza virus, table S5 for RSV, or table S6 for rhinovirus.

Data acquisition

Our study included hospitalized patients who tested positive for one of the selected respiratory viruses within 14 days before or during the hospitalization from October 01, 2018 to March 31, 2023 in Truveta Data.

Every respiratory virus-associated hospitalization has been grouped such that every hospitalization within 90 days of such an associated hospitalization is considered to be the same infection and thus only counted once.

Analysis

Overall population

Our study population consists of 183,597 hospitalizations of 169,361 unique patients. To align with seasonality in respiratory transmission, time periods include October 1st through September 30th of the following year. The demographics of patients are as follows:

Table 1: Demographics

	2018/2019 (N=18,198)	2019/2020 (N=30,329)	2020/2021 (N=42,306)	2021/2022 (N=49,348)	2022/2023 (N=29,180)	Overall (N=169,361)
Respiratory Virus						
COVID	0 (0%)	17,645 (58.2%)	38,100 (90.1%)	40,597 (82.3%)	16,834 (57.7%)	113,176 (66.8%)
HMPV	1,764 (9.7%)	1,222 (4.0%)	58 (0.1%)	971 (2.0%)	1,094 (3.7%)	5,109 (3.0%)
Influenza	5,226 (28.7%)	5,396 (17.8%)	57 (0.1%)	1,137 (2.3%)	4,796 (16.4%)	16,612 (9.8%)
Parainfluenza virus	1,901 (10.4%)	580 (1.9%)	559 (1.3%)	946 (1.9%)	712 (2.4%)	4,698 (2.8%)
RSV	2,383 (13.1%)	1,982 (6.5%)	574 (1.4%)	1,729 (3.5%)	2,790 (9.6%)	9,458 (5.6%)
Rhinovirus	6,924 (38.0%)	3,504 (11.6%)	2,958 (7.0%)	3,968 (8.0%)	2,954 (10.1%)	20,308 (12.0%)
Age Group						
0 - <6 months	1,015 (5.6%)	752 (2.5%)	531 (1.3%)	1,027 (2.1%)	888 (3.0%)	4,213 (2.5%)
6 - <12 months	465 (2.6%)	337 (1.1%)	221 (0.5%)	485 (1.0%)	389 (1.3%)	1,897 (1.1%)
1 - <2 years	704 (3.9%)	437 (1.4%)	405 (1.0%)	776 (1.6%)	575 (2.0%)	2,897 (1.7%)
2 - 4 years	901 (5.0%)	572 (1.9%)	467 (1.1%)	1,145 (2.3%)	970 (3.3%)	4,055 (2.4%)
5 - 17 years	832 (4.6%)	608 (2.0%)	828 (2.0%)	1,393 (2.8%)	1,027 (3.5%)	4,688 (2.8%)
18 - 49 years	2,269 (12.5%)	6,147 (20.3%)	9,810 (23.2%)	10,108 (20.5%)	4,062 (13.9%)	32,396 (19.1%)
50 - 64 years	3,370	7,411	10,375	9,540	4,479	35,175

	2018/2019 (N=18,198)	2019/2020 (N=30,329)	2020/2021 (N=42,306)	2021/2022 (N=49,348)	2022/2023 (N=29,180)	Overall (N=169,361)
	(18.5%)	(24.4%)	(24.5%)	(19.3%)	(15.3%)	(20.8%)
65 - 74 years	3,194 (17.6%)	5,745 (18.9%)	8,335 (19.7%)	9,224 (18.7%)	5,467 (18.7%)	31,965 (18.9%)
75 - 85 years	3,172 (17.4%)	5,034 (16.6%)	7,017 (16.6%)	9,342 (18.9%)	6,427 (22.0%)	30,992 (18.3%)
85+ years	2,276 (12.5%)	3,286 (10.8%)	4,317 (10.2%)	6,308 (12.8%)	4,896 (16.8%)	21,083 (12.4%)
Sex						
Female	9,566 (52.6%)	15,088 (49.7%)	20,624 (48.7%)	25,283 (51.2%)	15,313 (52.5%)	85,874 (50.7%)
Male	8,623 (47.4%)	15,221 (50.2%)	21,654 (51.2%)	24,032 (48.7%)	13,848 (47.5%)	83,378 (49.2%)
Unknown	9 (0.0%)	20 (0.1%)	28 (0.1%)	33 (0.1%)	19 (0.1%)	109 (0.1%)
Race						
White	12,467 (68.5%)	17,613 (58.1%)	26,896 (63.6%)	32,531 (65.9%)	19,404 (66.5%)	108,911 (64.3%)
Black or African American	2,140 (11.8%)	4,918 (16.2%)	4,810 (11.4%)	5,770 (11.7%)	3,097 (10.6%)	20,735 (12.2%)
Asian	888 (4.9%)	1,678 (5.5%)	2,012 (4.8%)	2,032 (4.1%)	1,328 (4.6%)	7,938 (4.7%)
American Indian or Alaska Native	160 (0.9%)	218 (0.7%)	339 (0.8%)	454 (0.9%)	265 (0.9%)	1,436 (0.8%)
Native Hawaiian or Other Pacific Islander	78 (0.4%)	168 (0.6%)	241 (0.6%)	207 (0.4%)	119 (0.4%)	813 (0.5%)
Other Race	1,727 (9.5%)	4,316 (14.2%)	5,932 (14.0%)	5,047 (10.2%)	2,549 (8.7%)	19,571 (11.6%)
Declined to answer	86 (0.5%)	265 (0.9%)	274 (0.6%)	308 (0.6%)	164 (0.6%)	1,097 (0.6%)
Unknown	652 (3.6%)	1,153 (3.8%)	1,802 (4.3%)	2,999 (6.1%)	2,254 (7.7%)	8,860 (5.2%)
Ethnicity						
Hispanic or Latino	1,873 (10.3%)	5,836 (19.2%)	7,649 (18.1%)	6,495 (13.2%)	3,594 (12.3%)	25,447 (15.0%)
Not Hispanic or Latino	14,491 (79.6%)	21,260 (70.1%)	31,009 (73.3%)	39,292 (79.6%)	23,282 (79.8%)	129,334 (76.4%)

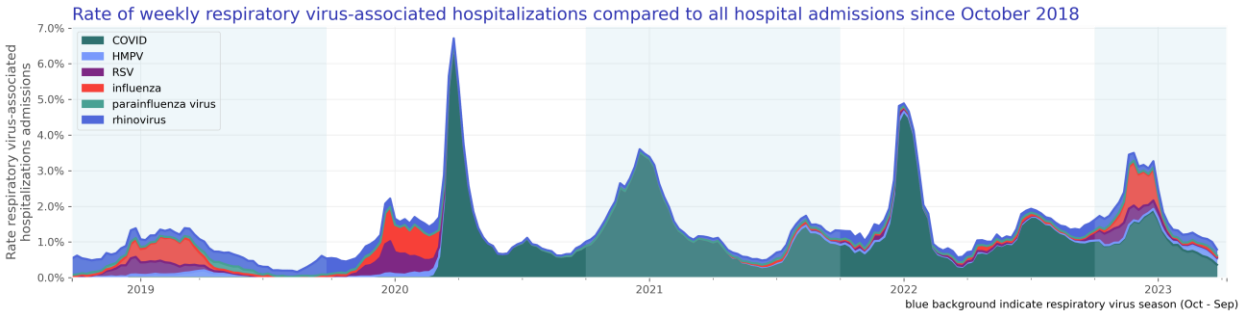
	2018/2019 (N=18,198)	2019/2020 (N=30,329)	2020/2021 (N=42,306)	2021/2022 (N=49,348)	2022/2023 (N=29,180)	Overall (N=169,361)
Declined to answer	110 (0.6%)	159 (0.5%)	200 (0.5%)	224 (0.5%)	155 (0.5%)	848 (0.5%)
Unknown	1,724 (9.5%)	3,074 (10.1%)	3,448 (8.2%)	3,337 (6.8%)	2,149 (7.4%)	13,732 (8.1%)
Asthma	3,010 (16.5%)	2,889 (9.5%)	3,382 (8.0%)	5,458 (11.1%)	3,930 (13.5%)	18,669 (11.0%)
Chronic Lung Disease	2,088 (11.5%)	1,928 (6.4%)	2,324 (5.5%)	3,400 (6.9%)	2,336 (8.0%)	12,076 (7.1%)

Time series analysis

The rate of respiratory virus-associated hospitalizations compared to all hospitalizations is shown in figure 1. Patients were included in this calculation on the first day of their hospitalization. If their stay was greater than one day, they were not counted in subsequent dates. Figure 2 shows a stacked variant of the same data.

Figure 1: Rate of weekly respiratory virus-associated hospitalizations compared to all hospital admissions since October 2018

Figure 2: Rate of weekly respiratory virus-associated hospitalizations compared to all hospital admissions since October 2018



COVID-19

Our COVID study population consists of 116,982 hospitalizations of 115,461 unique patients. To align with seasonality in respiratory transmission, time periods include October 1st through September 30th of the following year. The demographics of patients are as follows:

Table 2: COVID Demographics

	2019/2020 (N=17,645)	2020/2021 (N=38,100)	2021/2022 (N=40,597)	2022/2023 (N=16,834)	Overall (N=113,176)
Age Group					
0 - <6 months	33 (0.2%)	139 (0.4%)	296 (0.7%)	102 (0.6%)	570 (0.5%)
6 - <12 months	3 (0.0%)	31 (0.1%)	89 (0.2%)	32 (0.2%)	155 (0.1%)
1 - <2 years	4 (0.0%)	42 (0.1%)	98 (0.2%)	30 (0.2%)	174 (0.2%)
2 - 4 years	9 (0.1%)	39 (0.1%)	155 (0.4%)	42 (0.2%)	245 (0.2%)
5 - 17 years	95 (0.5%)	370 (1.0%)	574 (1.4%)	141 (0.8%)	1,180 (1.0%)
18 - 49 years	4,319 (24.5%)	9,094 (23.9%)	8,972 (22.1%)	2,423 (14.4%)	24,808 (21.9%)
50 - 64 years	4,969 (28.2%)	9,853 (25.9%)	8,439 (20.8%)	2,622 (15.6%)	25,883 (22.9%)
65 - 74 years	3,543 (20.1%)	7,857 (20.6%)	8,079 (19.9%)	3,435 (20.4%)	22,914 (20.2%)
75 - 85 years	2,928 (16.6%)	6,620 (17.4%)	8,299 (20.4%)	4,456 (26.5%)	22,303 (19.7%)
85+ years	1,742 (9.9%)	4,055 (10.6%)	5,596 (13.8%)	3,551 (21.1%)	14,944 (13.2%)
Sex					
Female	8,376 (47.5%)	18,495 (48.5%)	20,760 (51.1%)	8,720 (51.8%)	56,351 (49.8%)
Male	9,253 (52.4%)	19,579 (51.4%)	19,809 (48.8%)	8,101 (48.1%)	56,742 (50.1%)
Unknown	16 (0.1%)	26 (0.1%)	28 (0.1%)	13 (0.1%)	83 (0.1%)

	2019/2020 (N=17,645)	2020/2021 (N=38,100)	2021/2022 (N=40,597)	2022/2023 (N=16,834)	Overall (N=113,176)
Race					
White	9,148 (51.8%)	24,481 (64.3%)	27,337 (67.3%)	11,674 (69.3%)	72,640 (64.2%)
Black or African American	3,252 (18.4%)	4,134 (10.9%)	4,656 (11.5%)	1,663 (9.9%)	13,705 (12.1%)
Asian	1,044 (5.9%)	1,811 (4.8%)	1,527 (3.8%)	686 (4.1%)	5,068 (4.5%)
American Indian or Alaska Native	114 (0.6%)	302 (0.8%)	348 (0.9%)	129 (0.8%)	893 (0.8%)
Native Hawaiian or Other Pacific Islander	88 (0.5%)	212 (0.6%)	150 (0.4%)	42 (0.2%)	492 (0.4%)
Other Race	3,022 (17.1%)	5,297 (13.9%)	4,035 (9.9%)	1,381 (8.2%)	13,735 (12.1%)
Declined to answer	178 (1.0%)	250 (0.7%)	265 (0.7%)	89 (0.5%)	782 (0.7%)
Unknown	799 (4.5%)	1,613 (4.2%)	2,279 (5.6%)	1,170 (7.0%)	5,861 (5.2%)
Ethnicity					
Hispanic or Latino	4,273 (24.2%)	7,039 (18.5%)	5,155 (12.7%)	1,736 (10.3%)	18,203 (16.1%)
Not Hispanic or Latino	11,423 (64.7%)	27,740 (72.8%)	32,531 (80.1%)	13,757 (81.7%)	85,451 (75.5%)
Declined to answer	88 (0.5%)	174 (0.5%)	196 (0.5%)	77 (0.5%)	535 (0.5%)
Unknown	1,861 (10.5%)	3,147 (8.3%)	2,715 (6.7%)	1,264 (7.5%)	8,987 (7.9%)
Asthma	1,030 (5.8%)	2,777 (7.3%)	4,029 (9.9%)	1,875 (11.1%)	9,711 (8.6%)
Chronic Lung Disease	725 (4.1%)	2,053 (5.4%)	2,711 (6.7%)	1,280 (7.6%)	6,769 (6.0%)

Time series analysis

The rate of COVID-associated hospitalization is shown in figure 3. Figure 4 shows seasonality trends.

Figure 3: Rate of weekly COVID-associated hospitalizations compared to all hospital admissions since October 2018

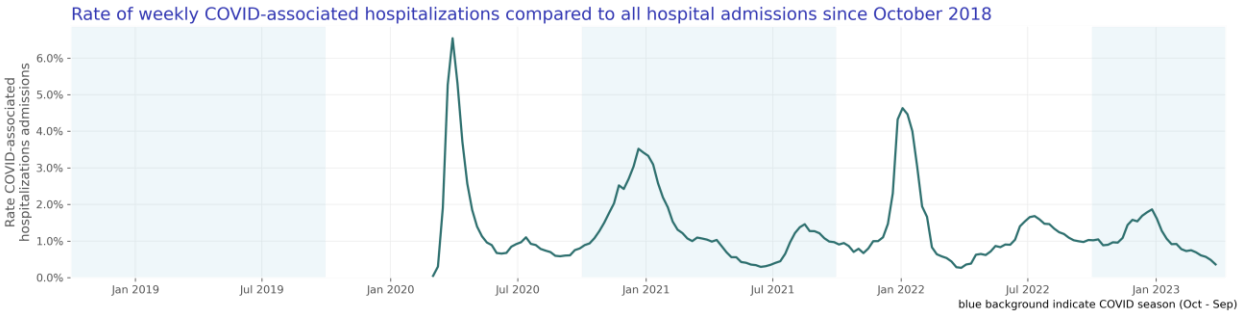
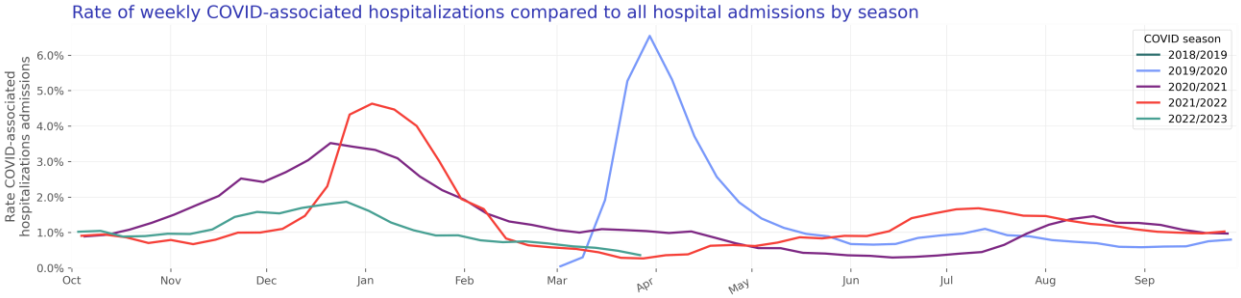


Figure 4: Rate of weekly COVID-associated hospitalizations compared to all hospital admissions by season



Human metapneumovirus (HMPV)

Our HMPV study population consists of 5,668 hospitalizations of 5,660 unique patients. To align with seasonality in respiratory transmission, time periods include October 1st through September 30th of the following year. The demographics of patients are as follows:

Table 3: HMPV Demographics

	2018/2019 (N=1,764)	2019/2020 (N=1,222)	2020/2021 (N=58)	2021/2022 (N=971)	2022/2023 (N=1,094)	Overall (N=5,109)
Age Group						
0 - <6 months	39 (2.2%)	24 (2.0%)	3 (5.2%)	25 (2.6%)	41 (3.7%)	132 (2.6%)
6 - <12 months	53 (3.0%)	34 (2.8%)	0 (0%)	53 (5.5%)	30 (2.7%)	170 (3.3%)
1 - <2 years	74 (4.2%)	45 (3.7%)	9 (15.5%)	63 (6.5%)	63 (5.8%)	254 (5.0%)
2 - 4 years	90 (5.1%)	42 (3.4%)	11 (19.0%)	109 (11.2%)	119 (10.9%)	371 (7.3%)

	2018/2019 (N=1,764)	2019/2020 (N=1,222)	2020/2021 (N=58)	2021/2022 (N=971)	2022/2023 (N=1,094)	Overall (N=5,109)
5 - 17 years	55 (3.1%)	26 (2.1%)	5 (8.6%)	57 (5.9%)	86 (7.9%)	229 (4.5%)
18 - 49 years	168 (9.5%)	135 (11.0%)	6 (10.3%)	103 (10.6%)	91 (8.3%)	503 (9.8%)
50 - 64 years	294 (16.7%)	220 (18.0%)	6 (10.3%)	151 (15.6%)	157 (14.4%)	828 (16.2%)
65 - 74 years	342 (19.4%)	248 (20.3%)	6 (10.3%)	161 (16.6%)	193 (17.6%)	950 (18.6%)
75 - 85 years	369 (20.9%)	256 (20.9%)	8 (13.8%)	151 (15.6%)	191 (17.5%)	975 (19.1%)
85+ years	280 (15.9%)	192 (15.7%)	4 (6.9%)	98 (10.1%)	123 (11.2%)	697 (13.6%)
Sex						
Female	1,020 (57.8%)	703 (57.5%)	30 (51.7%)	567 (58.4%)	626 (57.2%)	2,946 (57.7%)
Male	742 (42.1%)	518 (42.4%)	28 (48.3%)	404 (41.6%)	468 (42.8%)	2,160 (42.3%)
Unknown	2 (0.1%)	1 (0.1%)	0 (0%)	0 (0%)	0 (0%)	3 (0.1%)
Race						
White	1,245 (70.6%)	915 (74.9%)	29 (50.0%)	645 (66.4%)	667 (61.0%)	3,501 (68.5%)
Black or African American	185 (10.5%)	106 (8.7%)	7 (12.1%)	89 (9.2%)	88 (8.0%)	475 (9.3%)
Asian	92 (5.2%)	45 (3.7%)	2 (3.4%)	59 (6.1%)	61 (5.6%)	259 (5.1%)
American Indian or Alaska Native	12 (0.7%)	7 (0.6%)	0 (0%)	7 (0.7%)	13 (1.2%)	39 (0.8%)
Native Hawaiian or Other Pacific Islander	5 (0.3%)	9 (0.7%)	0 (0%)	6 (0.6%)	4 (0.4%)	24 (0.5%)
Other Race	160 (9.1%)	101 (8.3%)	18 (31.0%)	97 (10.0%)	134 (12.2%)	510 (10.0%)
Declined to answer	9 (0.5%)	10 (0.8%)	0 (0%)	5 (0.5%)	9 (0.8%)	33 (0.6%)
Unknown	56 (3.2%)	29 (2.4%)	2 (3.4%)	63 (6.5%)	118 (10.8%)	268 (5.2%)

	2018/2019 (N=1,764)	2019/2020 (N=1,222)	2020/2021 (N=58)	2021/2022 (N=971)	2022/2023 (N=1,094)	Overall (N=5,109)
Ethnicity						
Hispanic or Latino	174 (9.9%)	128 (10.5%)	14 (24.1%)	130 (13.4%)	201 (18.4%)	647 (12.7%)
Not Hispanic or Latino	1,404 (79.6%)	990 (81.0%)	42 (72.4%)	785 (80.8%)	797 (72.9%)	4,018 (78.6%)
Declined to answer	15 (0.9%)	13 (1.1%)	0 (0%)	3 (0.3%)	6 (0.5%)	37 (0.7%)
Unknown	171 (9.7%)	91 (7.4%)	2 (3.4%)	53 (5.5%)	90 (8.2%)	407 (8.0%)
Asthma	284 (16.1%)	191 (15.6%)	6 (10.3%)	169 (17.4%)	202 (18.5%)	852 (16.7%)
Chronic Lung Disease	209 (11.8%)	154 (12.6%)	3 (5.2%)	118 (12.2%)	80 (7.3%)	564 (11.0%)

Time series analysis

The rate of HMPV-associated hospitalization is shown in figure 5. Figure 6 shows seasonality trends.

Figure 5: Rate of weekly HMPV-associated hospitalizations compared to all hospital admissions since October 2018

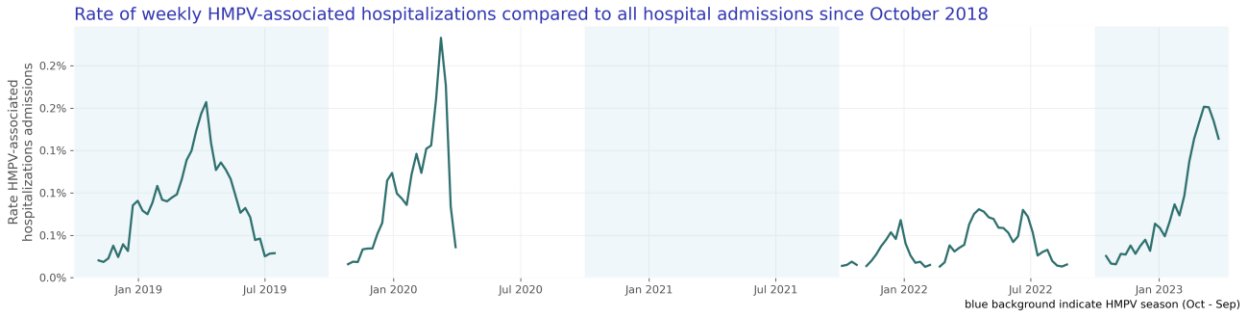
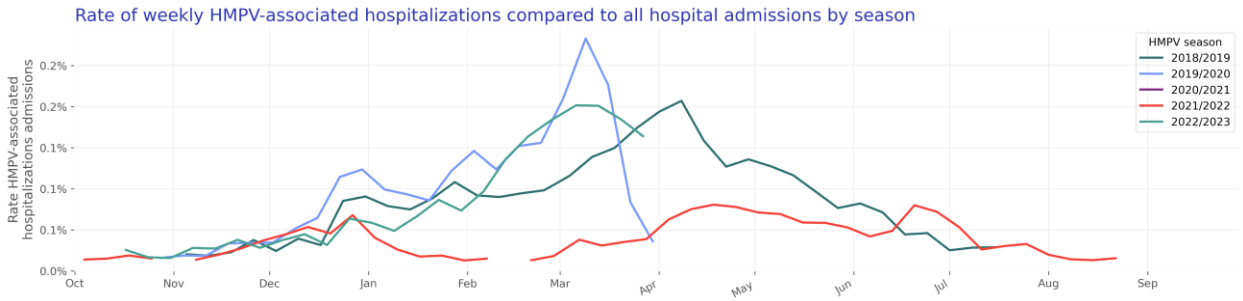


Figure 6: Rate of weekly HMPV-associated hospitalizations compared to all hospital admissions by season



Influenza virus

Our influenza study population consists of 17,832 hospitalizations of 17,750 unique patients. To align with seasonality in respiratory transmission, time periods include October 1st through September 30th of the following year. The demographics of patients are as follows:

Table 4: Influenza Demographics

	2018/2019 (N=5,226)	2019/2020 (N=5,396)	2020/2021 (N=57)	2021/2022 (N=1,137)	2022/2023 (N=4,796)	Overall (N=16,612)
Age Group						
0 - <6 months	65 (1.2%)	74 (1.4%)	0 (0%)	8 (0.7%)	24 (0.5%)	171 (1.0%)
6 - <12 months	32 (0.6%)	49 (0.9%)	0 (0%)	7 (0.6%)	29 (0.6%)	117 (0.7%)
1 - <2 years	49 (0.9%)	62 (1.1%)	0 (0%)	10 (0.9%)	26 (0.5%)	147 (0.9%)
2 - 4 years	74 (1.4%)	96 (1.8%)	2 (3.5%)	19 (1.7%)	96 (2.0%)	287 (1.7%)
5 - 17 years	155 (3.0%)	189 (3.5%)	1 (1.8%)	59 (5.2%)	210 (4.4%)	614 (3.7%)
18 - 49 years	784 (15.0%)	989 (18.3%)	9 (15.8%)	266 (23.4%)	879 (18.3%)	2,927 (17.6%)
50 - 64 years	1,179 (22.6%)	1,289 (23.9%)	15 (26.3%)	189 (16.6%)	940 (19.6%)	3,612 (21.7%)
65 - 74 years	1,068 (20.4%)	1,059 (19.6%)	7 (12.3%)	210 (18.5%)	1,018 (21.2%)	3,362 (20.2%)
75 - 85 years	1,081 (20.7%)	935 (17.3%)	18 (31.6%)	219 (19.3%)	954 (19.9%)	3,207 (19.3%)
85+ years	739 (14.1%)	654 (12.1%)	5 (8.8%)	150 (13.2%)	620 (12.9%)	2,168 (13.1%)
Sex						
Female	2,795 (53.5%)	2,888 (53.5%)	23 (40.4%)	661 (58.1%)	2,631 (54.9%)	8,998 (54.2%)
Male	2,429 (46.5%)	2,507 (46.5%)	34 (59.6%)	476 (41.9%)	2,161 (45.1%)	7,607 (45.8%)
Unknown	2 (0.0%)	1 (0.0%)	0 (0%)	0 (0%)	4 (0.1%)	7 (0.0%)

	2018/2019 (N=5,226)	2019/2020 (N=5,396)	2020/2021 (N=57)	2021/2022 (N=1,137)	2022/2023 (N=4,796)	Overall (N=16,612)
Race						
White	3,741 (71.6%)	3,510 (65.0%)	40 (70.2%)	735 (64.6%)	3,230 (67.3%)	11,256 (67.8%)
Black or African American	578 (11.1%)	817 (15.1%)	10 (17.5%)	171 (15.0%)	607 (12.7%)	2,183 (13.1%)
Asian	229 (4.4%)	279 (5.2%)	3 (5.3%)	49 (4.3%)	178 (3.7%)	738 (4.4%)
American Indian or Alaska Native	46 (0.9%)	41 (0.8%)	0 (0%)	23 (2.0%)	55 (1.1%)	165 (1.0%)
Native Hawaiian or Other Pacific Islander	18 (0.3%)	29 (0.5%)	1 (1.8%)	10 (0.9%)	23 (0.5%)	81 (0.5%)
Other Race	469 (9.0%)	538 (10.0%)	2 (3.5%)	76 (6.7%)	394 (8.2%)	1,479 (8.9%)
Declined to answer	12 (0.2%)	44 (0.8%)	0 (0%)	5 (0.4%)	25 (0.5%)	86 (0.5%)
Unknown	133 (2.5%)	138 (2.6%)	1 (1.8%)	68 (6.0%)	284 (5.9%)	624 (3.8%)
Ethnicity						
Hispanic or Latino	511 (9.8%)	723 (13.4%)	9 (15.8%)	152 (13.4%)	650 (13.6%)	2,045 (12.3%)
Not Hispanic or Latino	4,214 (80.6%)	4,148 (76.9%)	46 (80.7%)	906 (79.7%)	3,836 (80.0%)	13,150 (79.2%)
Declined to answer	18 (0.3%)	27 (0.5%)	0 (0%)	1 (0.1%)	23 (0.5%)	69 (0.4%)
Unknown	483 (9.2%)	498 (9.2%)	2 (3.5%)	78 (6.9%)	287 (6.0%)	1,348 (8.1%)
Asthma	813 (15.6%)	726 (13.5%)	3 (5.3%)	195 (17.2%)	800 (16.7%)	2,537 (15.3%)
Chronic Lung Disease	606 (11.6%)	401 (7.4%)	2 (3.5%)	104 (9.1%)	464 (9.7%)	1,577 (9.5%)

Time series analysis

The rate of influenza-associated hospitalization is shown in figure 7. Figure 8 shows seasonality trends.

Figure 7: Rate of weekly influenza-associated hospitalizations compared to all hospital admissions since October 2018

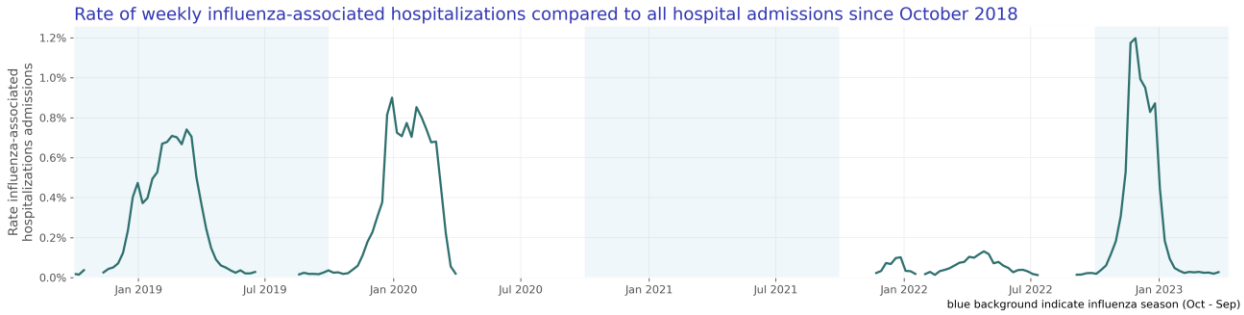
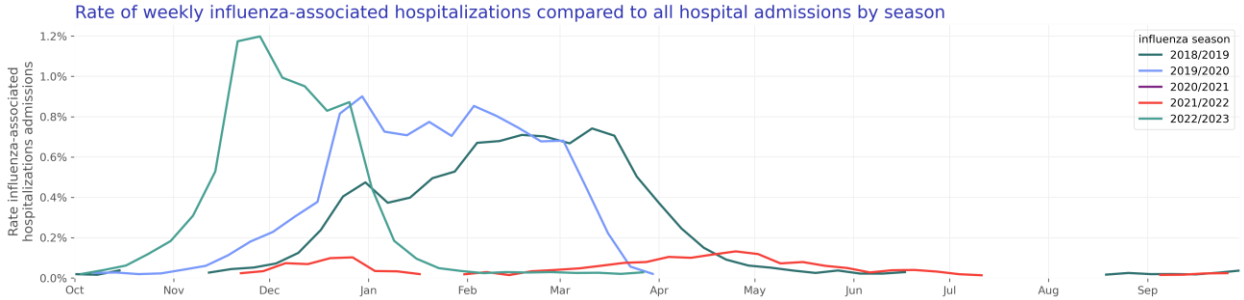


Figure 8: Rate of weekly influenza-associated hospitalizations compared to all hospital admissions by season



Parainfluenza virus

Our parainfluenza virus study population consists of 5,374 hospitalizations of 5,329 unique patients. To align with seasonality in respiratory transmission, time periods include October 1st through September 30th of the following year. The demographics of patients are as follows:

Table 5: Parainfluenza virus Demographics

	2018/2019 (N=1,901)	2019/2020 (N=580)	2020/2021 (N=559)	2021/2022 (N=946)	2022/2023 (N=712)	Overall (N=4,698)
Age Group						
0 - <6 months	94 (4.9%)	33 (5.7%)	31 (5.5%)	56 (5.9%)	47 (6.6%)	261 (5.6%)
6 - <12 months	49 (2.6%)	15 (2.6%)	25 (4.5%)	43 (4.5%)	30 (4.2%)	162 (3.4%)
1 - <2 years	95 (5.0%)	30 (5.2%)	49 (8.8%)	57 (6.0%)	33 (4.6%)	264 (5.6%)
2 - 4 years	91 (4.8%)	32 (5.5%)	47 (8.4%)	98 (10.4%)	70 (9.8%)	338 (7.2%)

	2018/2019 (N=1,901)	2019/2020 (N=580)	2020/2021 (N=559)	2021/2022 (N=946)	2022/2023 (N=712)	Overall (N=4,698)
5 - 17 years	78 (4.1%)	29 (5.0%)	43 (7.7%)	54 (5.7%)	46 (6.5%)	250 (5.3%)
18 - 49 years	166 (8.7%)	58 (10.0%)	71 (12.7%)	116 (12.3%)	72 (10.1%)	483 (10.3%)
50 - 64 years	347 (18.3%)	98 (16.9%)	88 (15.7%)	135 (14.3%)	107 (15.0%)	775 (16.5%)
65 - 74 years	340 (17.9%)	93 (16.0%)	91 (16.3%)	161 (17.0%)	98 (13.8%)	783 (16.7%)
75 - 85 years	382 (20.1%)	110 (19.0%)	69 (12.3%)	143 (15.1%)	131 (18.4%)	835 (17.8%)
85+ years	259 (13.6%)	82 (14.1%)	45 (8.1%)	83 (8.8%)	78 (11.0%)	547 (11.6%)
Sex						
Female	1,026 (54.0%)	316 (54.5%)	304 (54.4%)	512 (54.1%)	362 (50.8%)	2,520 (53.6%)
Male	874 (46.0%)	264 (45.5%)	255 (45.6%)	434 (45.9%)	349 (49.0%)	2,176 (46.3%)
Unknown	1 (0.1%)	0 (0%)	0 (0%)	0 (0%)	1 (0.1%)	2 (0.0%)
Race						
White	1,349 (71.0%)	400 (69.0%)	329 (58.9%)	557 (58.9%)	442 (62.1%)	3,077 (65.5%)
Black or African American	194 (10.2%)	59 (10.2%)	80 (14.3%)	113 (11.9%)	73 (10.3%)	519 (11.0%)
Asian	106 (5.6%)	44 (7.6%)	23 (4.1%)	60 (6.3%)	33 (4.6%)	266 (5.7%)
American Indian or Alaska Native	12 (0.6%)	4 (0.7%)	5 (0.9%)	9 (1.0%)	4 (0.6%)	34 (0.7%)
Native Hawaiian or Other Pacific Islander	11 (0.6%)	6 (1.0%)	5 (0.9%)	2 (0.2%)	2 (0.3%)	26 (0.6%)
Other Race	144 (7.6%)	59 (10.2%)	78 (14.0%)	120 (12.7%)	83 (11.7%)	484 (10.3%)
Declined to answer	8 (0.4%)	0 (0%)	2 (0.4%)	5 (0.5%)	2 (0.3%)	17 (0.4%)
Unknown	77 (4.1%)	8 (1.4%)	37 (6.6%)	80 (8.5%)	73 (10.3%)	275 (5.9%)

	2018/2019 (N=1,901)	2019/2020 (N=580)	2020/2021 (N=559)	2021/2022 (N=946)	2022/2023 (N=712)	Overall (N=4,698)
Ethnicity						
Hispanic or Latino	166 (8.7%)	55 (9.5%)	80 (14.3%)	146 (15.4%)	97 (13.6%)	544 (11.6%)
Not Hispanic or Latino	1,560 (82.1%)	466 (80.3%)	423 (75.7%)	734 (77.6%)	545 (76.5%)	3,728 (79.4%)
Declined to answer	10 (0.5%)	3 (0.5%)	2 (0.4%)	3 (0.3%)	2 (0.3%)	20 (0.4%)
Unknown	165 (8.7%)	56 (9.7%)	54 (9.7%)	63 (6.7%)	68 (9.6%)	406 (8.6%)
Asthma	323 (17.0%)	93 (16.0%)	83 (14.8%)	156 (16.5%)	99 (13.9%)	754 (16.0%)
Chronic Lung Disease	261 (13.7%)	86 (14.8%)	36 (6.4%)	98 (10.4%)	73 (10.3%)	554 (11.8%)

Time series analysis

The rate of parainfluenza virus-associated hospitalization is shown in figure 9. Figure 10 shows seasonality trends.

Figure 9: Rate of weekly parainfluenza virus-associated hospitalizations compared to all hospital admissions since October 2018

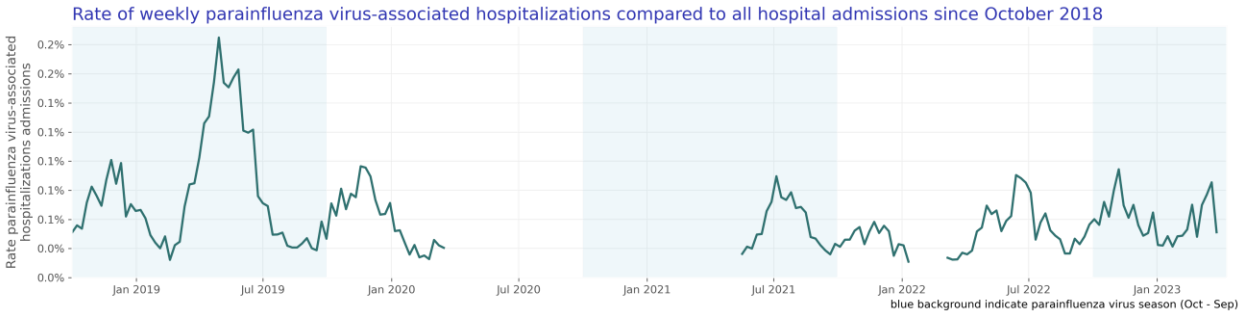
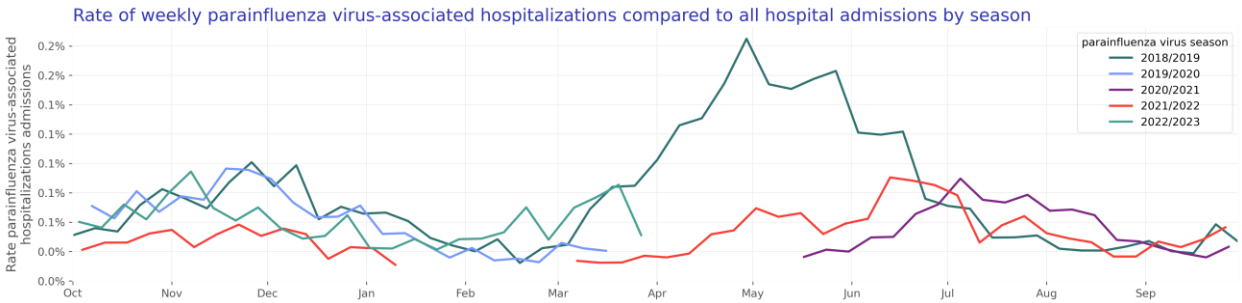


Figure 10: Rate of weekly parainfluenza virus-associated hospitalizations compared to all hospital admissions by season



Respiratory syncytial virus (RSV)

Our RSV study population consists of 14,453 hospitalizations of 14,352 unique patients. To align with seasonality in respiratory transmission, time periods include October 1st through September 30th of the following year. The demographics of patients are as follows:

Table 6: RSV Demographics

	2018/2019 (N=2,383)	2019/2020 (N=1,982)	2020/2021 (N=574)	2021/2022 (N=1,729)	2022/2023 (N=2,790)	Overall (N=9,458)
Age Group						
0 - <6 months	375 (15.7%)	370 (18.7%)	170 (29.6%)	321 (18.6%)	510 (18.3%)	1,746 (18.5%)
6 - <12 months	139 (5.8%)	122 (6.2%)	47 (8.2%)	109 (6.3%)	184 (6.6%)	601 (6.4%)
1 - <2 years	154 (6.5%)	139 (7.0%)	62 (10.8%)	149 (8.6%)	237 (8.5%)	741 (7.8%)
2 - 4 years	188 (7.9%)	145 (7.3%)	50 (8.7%)	163 (9.4%)	299 (10.7%)	845 (8.9%)
5 - 17 years	53 (2.2%)	39 (2.0%)	15 (2.6%)	62 (3.6%)	115 (4.1%)	284 (3.0%)
18 - 49 years	138 (5.8%)	95 (4.8%)	41 (7.1%)	159 (9.2%)	190 (6.8%)	623 (6.6%)
50 - 64 years	284 (11.9%)	222 (11.2%)	55 (9.6%)	195 (11.3%)	274 (9.8%)	1,030 (10.9%)
65 - 74 years	356 (14.9%)	291 (14.7%)	55 (9.6%)	204 (11.8%)	351 (12.6%)	1,257 (13.3%)
75 - 85 years	379 (15.9%)	321 (16.2%)	42 (7.3%)	217 (12.6%)	371 (13.3%)	1,330 (14.1%)
85+ years	317 (13.3%)	238 (12.0%)	37 (6.4%)	150 (8.7%)	259 (9.3%)	1,001 (10.6%)
Sex						
Female	1,259 (52.8%)	1,064 (53.7%)	315 (54.9%)	912 (52.7%)	1,487 (53.3%)	5,037 (53.3%)
Male	1,124 (47.2%)	917 (46.3%)	259 (45.1%)	816 (47.2%)	1,303 (46.7%)	4,419 (46.7%)
Unknown	0 (0%)	1 (0.1%)	0 (0%)	1 (0.1%)	0 (0%)	2 (0.0%)

	2018/2019 (N=2,383)	2019/2020 (N=1,982)	2020/2021 (N=574)	2021/2022 (N=1,729)	2022/2023 (N=2,790)	Overall (N=9,458)
Race						
White	1,599 (67.1%)	1,345 (67.9%)	322 (56.1%)	1,080 (62.5%)	1,766 (63.3%)	6,112 (64.6%)
Black or African American	250 (10.5%)	234 (11.8%)	121 (21.1%)	210 (12.1%)	322 (11.5%)	1,137 (12.0%)
Asian	121 (5.1%)	95 (4.8%)	27 (4.7%)	106 (6.1%)	172 (6.2%)	521 (5.5%)
American Indian or Alaska Native	23 (1.0%)	13 (0.7%)	2 (0.3%)	25 (1.4%)	30 (1.1%)	93 (1.0%)
Native Hawaiian or Other Pacific Islander	15 (0.6%)	13 (0.7%)	1 (0.2%)	17 (1.0%)	29 (1.0%)	75 (0.8%)
Other Race	239 (10.0%)	209 (10.5%)	63 (11.0%)	163 (9.4%)	205 (7.3%)	879 (9.3%)
Declined to answer	14 (0.6%)	10 (0.5%)	6 (1.0%)	10 (0.6%)	22 (0.8%)	62 (0.7%)
Unknown	122 (5.1%)	63 (3.2%)	32 (5.6%)	118 (6.8%)	244 (8.7%)	579 (6.1%)
Ethnicity						
Hispanic or Latino	283 (11.9%)	257 (13.0%)	78 (13.6%)	268 (15.5%)	440 (15.8%)	1,326 (14.0%)
Not Hispanic or Latino	1,813 (76.1%)	1,456 (73.5%)	440 (76.7%)	1,338 (77.4%)	2,139 (76.7%)	7,186 (76.0%)
Declined to answer	17 (0.7%)	6 (0.3%)	7 (1.2%)	8 (0.5%)	25 (0.9%)	63 (0.7%)
Unknown	270 (11.3%)	263 (13.3%)	49 (8.5%)	115 (6.7%)	186 (6.7%)	883 (9.3%)
Asthma	345 (14.5%)	240 (12.1%)	52 (9.1%)	232 (13.4%)	411 (14.7%)	1,280 (13.5%)
Chronic Lung Disease	228 (9.6%)	161 (8.1%)	32 (5.6%)	115 (6.7%)	210 (7.5%)	746 (7.9%)

Time series analysis

The rate of RSV-associated hospitalization is shown in figure 11. Figure 12 shows seasonality trends.

Figure 11: Rate of weekly RSV-associated hospitalizations compared to all hospital admissions since October 2018

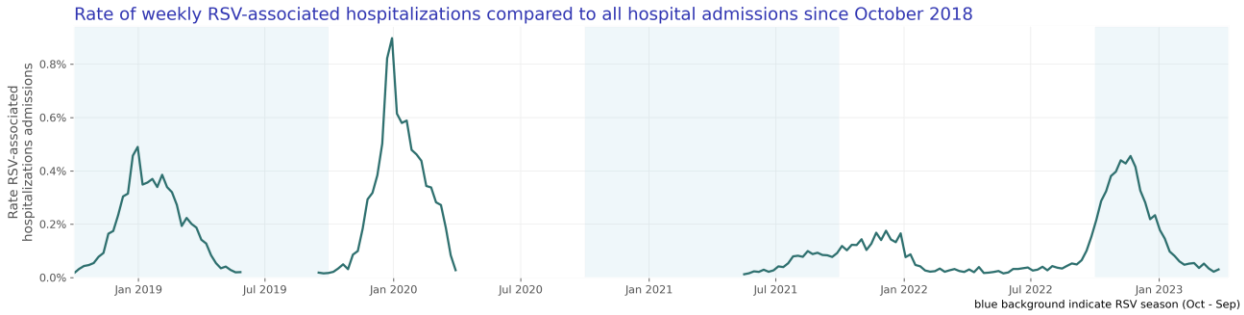
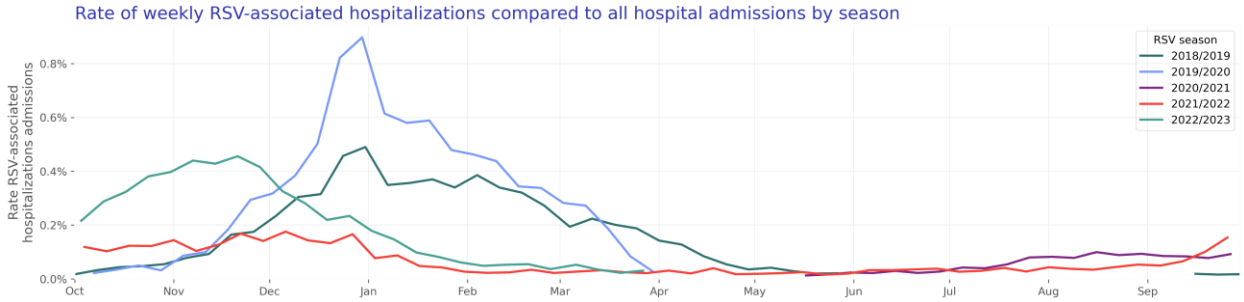


Figure 12: Rate of weekly RSV-associated hospitalizations compared to all hospital admissions by season



Rhinovirus

Our rhinovirus study population consists of 23,288 hospitalizations of 22,417 unique patients. To align with seasonality in respiratory transmission, time periods include October 1st through September 30th of the following year. The demographics of patients are as follows:

Table 7: Rhinovirus Demographics

	2018/2019 (N=6,924)	2019/2020 (N=3,504)	2020/2021 (N=2,958)	2021/2022 (N=3,968)	2022/2023 (N=2,954)	Overall (N=20,308)
Age Group						
0 - <6 months	442 (6.4%)	218 (6.2%)	188 (6.4%)	321 (8.1%)	164 (5.6%)	1,333 (6.6%)
6 - <12 months	192 (2.8%)	114 (3.3%)	118 (4.0%)	184 (4.6%)	84 (2.8%)	692 (3.4%)
1 - <2 years	332 (4.8%)	157 (4.5%)	243 (8.2%)	399 (10.1%)	186 (6.3%)	1,317 (6.5%)
2 - 4 years	458 (6.6%)	248 (7.1%)	318 (10.8%)	601 (15.1%)	344 (11.6%)	1,969 (9.7%)

	2018/2019 (N=6,924)	2019/2020 (N=3,504)	2020/2021 (N=2,958)	2021/2022 (N=3,968)	2022/2023 (N=2,954)	Overall (N=20,308)
5 - 17 years	491 (7.1%)	230 (6.6%)	394 (13.3%)	587 (14.8%)	429 (14.5%)	2,131 (10.5%)
18 - 49 years	1,013 (14.6%)	551 (15.7%)	589 (19.9%)	492 (12.4%)	407 (13.8%)	3,052 (15.0%)
50 - 64 years	1,266 (18.3%)	613 (17.5%)	358 (12.1%)	431 (10.9%)	379 (12.8%)	3,047 (15.0%)
65 - 74 years	1,088 (15.7%)	511 (14.6%)	319 (10.8%)	409 (10.3%)	372 (12.6%)	2,699 (13.3%)
75 - 85 years	961 (13.9%)	484 (13.8%)	260 (8.8%)	313 (7.9%)	324 (11.0%)	2,342 (11.5%)
85+ years	681 (9.8%)	378 (10.8%)	171 (5.8%)	231 (5.8%)	265 (9.0%)	1,726 (8.5%)
Sex						
Female	3,466 (50.1%)	1,741 (49.7%)	1,457 (49.3%)	1,871 (47.2%)	1,487 (50.3%)	10,022 (49.4%)
Male	3,454 (49.9%)	1,762 (50.3%)	1,499 (50.7%)	2,093 (52.7%)	1,466 (49.6%)	10,274 (50.6%)
Unknown	4 (0.1%)	1 (0.0%)	2 (0.1%)	4 (0.1%)	1 (0.0%)	12 (0.1%)
Race						
White	4,533 (65.5%)	2,295 (65.5%)	1,695 (57.3%)	2,177 (54.9%)	1,625 (55.0%)	12,325 (60.7%)
Black or African American	933 (13.5%)	450 (12.8%)	458 (15.5%)	531 (13.4%)	344 (11.6%)	2,716 (13.4%)
Asian	340 (4.9%)	171 (4.9%)	146 (4.9%)	231 (5.8%)	198 (6.7%)	1,086 (5.3%)
American Indian or Alaska Native	67 (1.0%)	39 (1.1%)	30 (1.0%)	42 (1.1%)	34 (1.2%)	212 (1.0%)
Native Hawaiian or Other Pacific Islander	29 (0.4%)	23 (0.7%)	22 (0.7%)	22 (0.6%)	19 (0.6%)	115 (0.6%)
Other Race	715 (10.3%)	387 (11.0%)	474 (16.0%)	556 (14.0%)	352 (11.9%)	2,484 (12.2%)
Declined to answer	43 (0.6%)	23 (0.7%)	16 (0.5%)	18 (0.5%)	17 (0.6%)	117 (0.6%)
Unknown	264 (3.8%)	116 (3.3%)	117 (4.0%)	391 (9.9%)	365 (12.4%)	1,253 (6.2%)

	2018/2019 (N=6,924)	2019/2020 (N=3,504)	2020/2021 (N=2,958)	2021/2022 (N=3,968)	2022/2023 (N=2,954)	Overall (N=20,308)
Ethnicity						
Hispanic or Latino	739 (10.7%)	400 (11.4%)	429 (14.5%)	644 (16.2%)	470 (15.9%)	2,682 (13.2%)
Not Hispanic or Latino	5,500 (79.4%)	2,777 (79.3%)	2,318 (78.4%)	2,998 (75.6%)	2,208 (74.7%)	15,801 (77.8%)
Declined to answer	50 (0.7%)	22 (0.6%)	17 (0.6%)	13 (0.3%)	22 (0.7%)	124 (0.6%)
Unknown	635 (9.2%)	305 (8.7%)	194 (6.6%)	313 (7.9%)	254 (8.6%)	1,701 (8.4%)
Asthma	1,245 (18.0%)	609 (17.4%)	461 (15.6%)	677 (17.1%)	543 (18.4%)	3,535 (17.4%)
Chronic Lung Disease	784 (11.3%)	401 (11.4%)	198 (6.7%)	254 (6.4%)	229 (7.8%)	1,866 (9.2%)

Time series analysis

The rate of rhinovirus-associated hospitalization is shown in figure 13. Figure 14 shows seasonality trends.

Figure 13: Rate of weekly rhinovirus-associated hospitalizations compared to all hospital admissions since October 2018

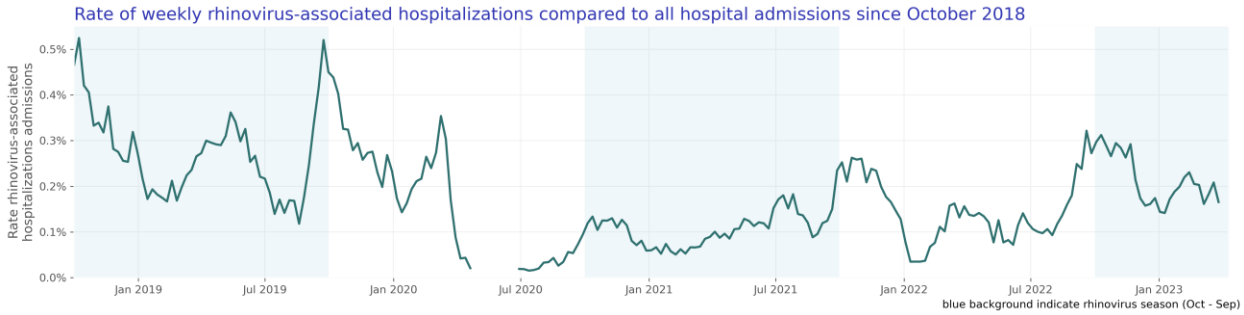
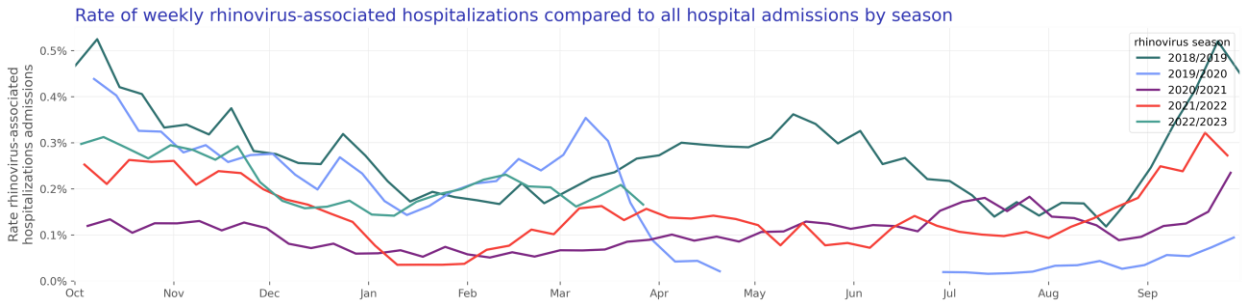


Figure 14: Rate of weekly rhinovirus-associated hospitalizations compared to all hospital admissions by season



Infants and children (age 0-4)

Estimates of the hospitalization rate of infants and children (defined as individuals less than five years of age) with respiratory virus infections are higher than other age groups except adults 65 and older (Centers for Disease Control and Prevention, 2023c; Centers for Disease Control and Prevention, 2023d). In table 8 we report counts for demographic factors of this high-risk population. In the future, we plan to include high-risk comorbid states, such as congenital heart disease, preterm birth, and cystic fibrosis (Committee on Infectious Diseases and Bronchiolitis Guidelines Committee et al., 2014).

Table 8: Table 1 for infants and children less than five

	2018/2019 (N=3,085)	2019/2020 (N=2,098)	2020/2021 (N=1,624)	2021/2022 (N=3,433)	2022/2023 (N=2,822)	Overall (N=13,062)
Respiratory Virus						
COVID	0 (0%)	49 (2.3%)	251 (15.5%)	638 (18.6%)	206 (7.3%)	1,144 (8.8%)
HMPV	256 (8.3%)	145 (6.9%)	23 (1.4%)	250 (7.3%)	253 (9.0%)	927 (7.1%)
Influenza	220 (7.1%)	281 (13.4%)	2 (0.1%)	44 (1.3%)	175 (6.2%)	722 (5.5%)
Parainfluenza virus	329 (10.7%)	110 (5.2%)	152 (9.4%)	254 (7.4%)	180 (6.4%)	1,025 (7.8%)
RSV	856 (27.7%)	776 (37.0%)	329 (20.3%)	742 (21.6%)	1,230 (43.6%)	3,933 (30.1%)
Rhinovirus	1,424 (46.2%)	737 (35.1%)	867 (53.4%)	1,505 (43.8%)	778 (27.6%)	5,311 (40.7%)
Age Group						
0 - <6 months	1,015 (32.9%)	752 (35.8%)	531 (32.7%)	1,027 (29.9%)	888 (31.5%)	4,213 (32.3%)
6 - <12 months	465 (15.1%)	337 (16.1%)	221 (13.6%)	485 (14.1%)	389 (13.8%)	1,897 (14.5%)
1 - <2 years	704 (22.8%)	437 (20.8%)	405 (24.9%)	776 (22.6%)	575 (20.4%)	2,897 (22.2%)
2 - 4 years	901 (29.2%)	572 (27.3%)	467 (28.8%)	1,145 (33.4%)	970 (34.4%)	4,055 (31.0%)
Sex						
Female	1,278	912	687	1,445	1,236	5,558

	2018/2019 (N=3,085)	2019/2020 (N=2,098)	2020/2021 (N=1,624)	2021/2022 (N=3,433)	2022/2023 (N=2,822)	Overall (N=13,062)
	(41.4%)	(43.5%)	(42.3%)	(42.1%)	(43.8%)	(42.6%)
Male	1,807 (58.6%)	1,186 (56.5%)	937 (57.7%)	1,985 (57.8%)	1,585 (56.2%)	7,500 (57.4%)
Unknown	0 (0%)	0 (0%)	0 (0%)	3 (0.1%)	1 (0.0%)	4 (0.0%)
Race						
White	1,463 (47.4%)	1,051 (50.1%)	757 (46.6%)	1,655 (48.2%)	1,363 (48.3%)	6,289 (48.1%)
Black or African American	470 (15.2%)	331 (15.8%)	289 (17.8%)	477 (13.9%)	337 (11.9%)	1,904 (14.6%)
Asian	236 (7.7%)	146 (7.0%)	100 (6.2%)	227 (6.6%)	201 (7.1%)	910 (7.0%)
American Indian or Alaska Native	42 (1.4%)	20 (1.0%)	14 (0.9%)	62 (1.8%)	49 (1.7%)	187 (1.4%)
Native Hawaiian or Other Pacific Islander	36 (1.2%)	32 (1.5%)	20 (1.2%)	32 (0.9%)	30 (1.1%)	150 (1.1%)
Other Race	566 (18.3%)	399 (19.0%)	320 (19.7%)	521 (15.2%)	342 (12.1%)	2,148 (16.4%)
Declined to answer	38 (1.2%)	20 (1.0%)	20 (1.2%)	22 (0.6%)	26 (0.9%)	126 (1.0%)
Unknown	234 (7.6%)	99 (4.7%)	104 (6.4%)	437 (12.7%)	474 (16.8%)	1,348 (10.3%)
Ethnicity						
Hispanic or Latino	644 (20.9%)	480 (22.9%)	317 (19.5%)	721 (21.0%)	699 (24.8%)	2,861 (21.9%)
Not Hispanic or Latino	1,990 (64.5%)	1,295 (61.7%)	1,152 (70.9%)	2,391 (69.6%)	1,835 (65.0%)	8,663 (66.3%)
Declined to answer	42 (1.4%)	14 (0.7%)	15 (0.9%)	19 (0.6%)	26 (0.9%)	116 (0.9%)
Unknown	409 (13.3%)	309 (14.7%)	140 (8.6%)	302 (8.8%)	262 (9.3%)	1,422 (10.9%)

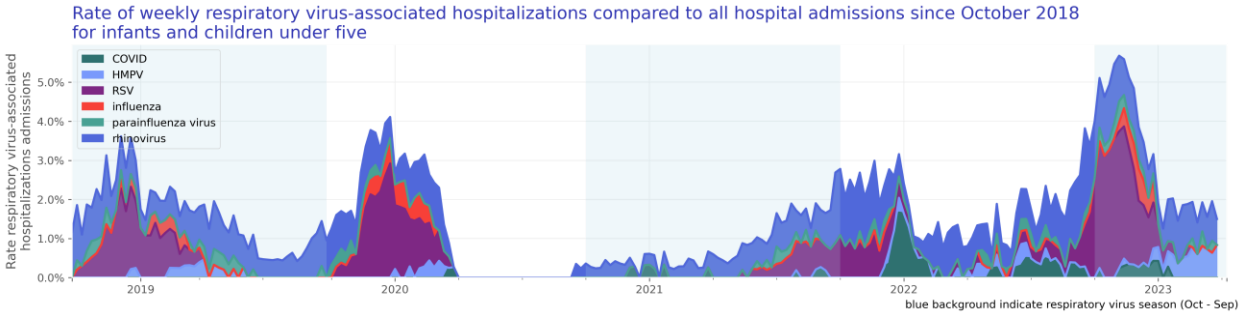
Time series analysis

The rate of respiratory virus-associated hospitalizations compared to all hospitalizations for infants and children under five is shown in figure 15. Patients were included in this calculation on the first day of their hospitalization. If their stay was

greater than one day, they were not counted in subsequent dates. Figure 16 shows a stacked variant of the same data.

Figure 15: Rate of weekly respiratory virus-associated hospitalizations compared to all hospital admissions since October 2018 for infants and children under five

Figure 16: Rate of weekly respiratory virus-associated hospitalizations compared to all hospital admissions since October 2018 for infants and children under five



Older adults (age 65 and over)

Respiratory viruses are also a major source of infection and hospitalizations in older adults (defined here as patients >=65 years of age). Incidence has been estimated between 3-10% annually for RSV in older adults (Boyce et al., 2000) and 8-10% for influenza in adults (Tokars et al., 2018).

Often, as is the case with influenza, older adults are at higher risk for hospitalization and death than other age groups (Czaja et al. 2019). There are comorbidities that are associated with increased hospitalization risk for older adults, such as congestive heart failure and chronic lung disease (Lee et al., 2013). Further, asthma, COPD, and congestive heart failure can exacerbate respiratory virus infections. Here we report counts for a selection of high-risk medical conditions such as chronic lung diseases, and asthma. In the future, we plan to include other high-risk groups.

Table 9: Table 1 for older adults (65 years of age and older)

	2018/2019 (N=8,642)	2019/2020 (N=14,065)	2020/2021 (N=19,669)	2021/2022 (N=24,874)	2022/2023 (N=16,790)	Overall (N=84,040)
Respiratory Virus						
COVID	0 (0%)	8,213 (58.4%)	18,532 (94.2%)	21,974 (88.3%)	11,442 (68.1%)	60,161 (71.6%)
HMPV	991 (11.5%)	696 (4.9%)	18 (0.1%)	410 (1.6%)	507 (3.0%)	2,622 (3.1%)
Influenza	2,888 (33.4%)	2,648 (18.8%)	30 (0.2%)	579 (2.3%)	2,592 (15.4%)	8,737 (10.4%)
Parainfluenza virus	981 (11.4%)	285 (2.0%)	205 (1.0%)	387 (1.6%)	307 (1.8%)	2,165 (2.6%)
RSV	1,052 (12.2%)	850 (6.0%)	134 (0.7%)	571 (2.3%)	981 (5.8%)	3,588 (4.3%)
Rhinovirus	2,730 (31.6%)	1,373 (9.8%)	750 (3.8%)	953 (3.8%)	961 (5.7%)	6,767 (8.1%)
Age Group						
65 - 74 years	3,194 (37.0%)	5,745 (40.8%)	8,335 (42.4%)	9,224 (37.1%)	5,467 (32.6%)	31,965 (38.0%)
75 - 85 years	3,172 (36.7%)	5,034 (35.8%)	7,017 (35.7%)	9,342 (37.6%)	6,427 (38.3%)	30,992 (36.9%)
85+ years	2,276 (26.3%)	3,286 (23.4%)	4,317 (21.9%)	6,308 (25.4%)	4,896 (29.2%)	21,083 (25.1%)
Sex						
Female	4,804 (55.6%)	7,156 (50.9%)	9,712 (49.4%)	12,624 (50.8%)	8,842 (52.7%)	43,138 (51.3%)
Male	3,834 (44.4%)	6,903 (49.1%)	9,947 (50.6%)	12,237 (49.2%)	7,941 (47.3%)	40,862 (48.6%)
Unknown	4 (0.0%)	6 (0.0%)	10 (0.1%)	13 (0.1%)	7 (0.0%)	40 (0.0%)
Race						
White	6,980 (80.8%)	9,642 (68.6%)	14,466 (73.5%)	18,666 (75.0%)	12,556 (74.8%)	62,310 (74.1%)
Black or African American	613 (7.1%)	1,909 (13.6%)	1,709 (8.7%)	2,267 (9.1%)	1,364 (8.1%)	7,862 (9.4%)
Asian	346 (4.0%)	746 (5.3%)	914 (4.6%)	939 (3.8%)	690 (4.1%)	3,635 (4.3%)

	2018/2019 (N=8,642)	2019/2020 (N=14,065)	2020/2021 (N=19,669)	2021/2022 (N=24,874)	2022/2023 (N=16,790)	Overall (N=84,040)
American Indian or Alaska Native	28 (0.3%)	57 (0.4%)	89 (0.5%)	119 (0.5%)	86 (0.5%)	379 (0.5%)
Native Hawaiian or Other Pacific Islander	15 (0.2%)	23 (0.2%)	52 (0.3%)	43 (0.2%)	27 (0.2%)	160 (0.2%)
Other Race	454 (5.3%)	1,248 (8.9%)	1,714 (8.7%)	1,642 (6.6%)	1,040 (6.2%)	6,098 (7.3%)
Declined to answer	18 (0.2%)	70 (0.5%)	68 (0.3%)	108 (0.4%)	80 (0.5%)	344 (0.4%)
Unknown	188 (2.2%)	370 (2.6%)	657 (3.3%)	1,090 (4.4%)	947 (5.6%)	3,252 (3.9%)
Ethnicity						
Hispanic or Latino	422 (4.9%)	1,441 (10.2%)	1,954 (9.9%)	1,811 (7.3%)	1,168 (7.0%)	6,796 (8.1%)
Not Hispanic or Latino	7,405 (85.7%)	11,165 (79.4%)	15,919 (80.9%)	21,316 (85.7%)	14,277 (85.0%)	70,082 (83.4%)
Declined to answer	29 (0.3%)	54 (0.4%)	68 (0.3%)	89 (0.4%)	81 (0.5%)	321 (0.4%)
Unknown	786 (9.1%)	1,405 (10.0%)	1,728 (8.8%)	1,658 (6.7%)	1,264 (7.5%)	6,841 (8.1%)
Asthma	1,304 (15.1%)	1,367 (9.7%)	1,558 (7.9%)	2,561 (10.3%)	2,038 (12.1%)	8,828 (10.5%)
Chronic Lung Disease	1,267 (14.7%)	1,131 (8.0%)	1,364 (6.9%)	2,172 (8.7%)	1,617 (9.6%)	7,551 (9.0%)

Time series analysis

The rate of respiratory virus-associated hospitalizations compared to all hospitalizations for adults 65 and over is shown in figure 17. Patients were included in this calculation on the first day of their hospitalization. If their stay was greater than one day, they were not counted in subsequent dates. Figure 18 shows a stacked variant of the same data.

Figure 17: Rate of weekly respiratory virus-associated hospitalizations compared to all hospital admissions since October 2018 for adults 65 years or older

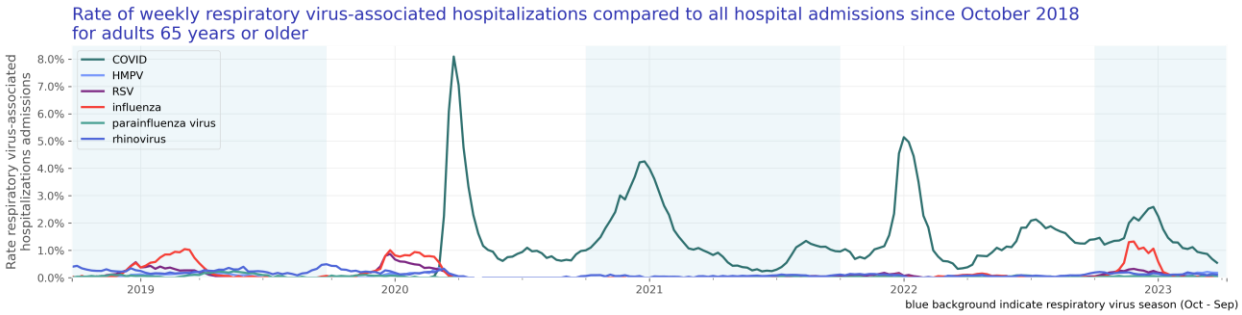
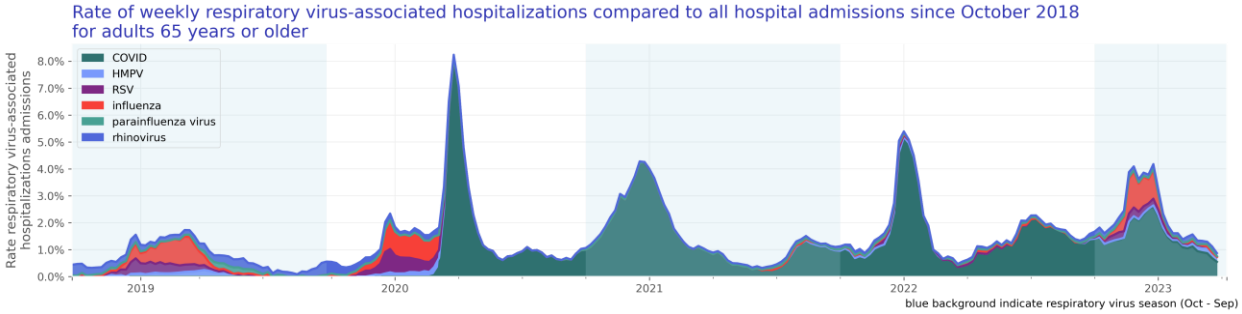


Figure 18: Rate of weekly respiratory virus-associated hospitalizations compared to all hospital admissions since October 2018 for adults 65 years or older



Trends in surveillance

Year-over-year trends indicate that overall counts of respiratory virus-associated hospitalizations collectively peaked slightly earlier (Nov-Dec), at a lower level, and sustained for a similar period (5 weeks) this season when compared to the 2021/2022 season. While the 2021/2022 season was driven predominantly by COVID, the 2022/2023 season was driven by both COVID and RSV. In contrast, hospitalizations in infants and children were increased this season (2022/2023) compared to last season (2021/2022). This was due to increases in RSV- and rhinovirus-related hospitalizations. This difference is most pronounced in the number of RSV infections in the 2–4-year-old age group. Infants, children and older adults constituted a larger proportion of the respiratory virus-associated hospitalized population this season when compared to prior seasons.

This report presents updated data through the end of March 2023. Based on this updated data, the percent of all admissions due to human metapneumovirus (HMPV) are near previous seasonal highs, however rates decreased during the last week of March. The percent of all admissions for parainfluenza and rhinovirus are moderate

for this time of year. The percent of all admissions due to COVID, RSV and influenza are stable and near previous lows for this time of year.

Limitations

- All data are preliminary and may change as additional data are obtained. These findings are consistent with data accessed April 10, 2023.
- These are raw counts and post-stratification methods have not been conducted.
- This analysis does not include patients hospitalized with a respiratory virus who were not tested for it or were tested later in their medical care (when laboratory tests results would have returned a negative result).
- Cohorts with small counts may be suppressed during the de-identification process leading to the appearance of zero patients for a given time period.
- The unknowns in this report either indicate the value was not included in the individual's electronic health record or that it was excluded from the data to protect an individual's identity as a part of Truveta's commitment to privacy (Truveta, 2022).

Suggested citation

Suggested citation: "Truveta Monitoring Report: Respiratory Viruses, Truveta Inc. Truveta.com/research. Accessed on DATE".

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Supplementary material

Table S1: LOINC codes for COVID-19 lab test

Code System	Concept Code	Concept Name
LOINC	94307-6	SARS-CoV-2 (COVID-19) N gene [Presence] in Specimen by Nucleic acid amplification using CDC primer-probe set N1
LOINC	94308-4	SARS-CoV-2 (COVID-19) N gene [Presence] in Specimen by Nucleic acid amplification using CDC primer-probe set N2
LOINC	94309-2	SARS-CoV-2 (COVID-19) RNA [Presence] in Specimen by NAA with probe detection
LOINC	94310-0	SARS-like coronavirus N gene [Presence] in Specimen by NAA with probe detection
LOINC	94314-2	SARS-CoV-2 (COVID-19) RdRp gene [Presence] in Specimen by NAA with probe detection
LOINC	94315-9	SARS-related coronavirus E gene [Presence] in Specimen by NAA with probe detection
LOINC	94316-7	SARS-CoV-2 (COVID-19) N gene [Presence] in Specimen by NAA with probe detection
LOINC	94500-6	SARS-CoV-2 (COVID-19) RNA [Presence] in Respiratory specimen by NAA with probe detection
LOINC	94533-7	SARS-CoV-2 (COVID-19) N gene [Presence] in Respiratory specimen by NAA with probe detection
LOINC	94534-5	SARS-CoV-2 (COVID-19) RdRp gene [Presence] in Respiratory specimen by NAA with probe detection
LOINC	94558-4	SARS-CoV-2 (COVID-19) Ag [Presence] in Respiratory specimen by Rapid immunoassay
LOINC	94559-2	SARS-CoV-2 (COVID-19) ORF1ab region [Presence] in Respiratory specimen by NAA with probe detection
LOINC	94642-6	SARS-CoV-2 (COVID-19) S gene [Cycle Threshold #] in Respiratory specimen by NAA with probe detection
LOINC	94643-4	SARS-CoV-2 (COVID-19) S gene [Cycle Threshold #] in Specimen by NAA with probe detection

Code System	Concept Code	Concept Name
LOINC	94644-2	SARS-CoV-2 (COVID-19) ORF1ab region [Cycle Threshold #] in Respiratory specimen by NAA with probe detection
LOINC	94645-9	SARS-CoV-2 (COVID-19) RdRp gene [Cycle Threshold #] in Specimen by NAA with probe detection
LOINC	94646-7	SARS-CoV-2 (COVID-19) RdRp gene [Cycle Threshold #] in Respiratory specimen by NAA with probe detection
LOINC	95522-9	SARS-CoV-2 (COVID-19) N gene [Log #/volume] (viral load) in Respiratory specimen by NAA with probe detection

Table S1: LOINC Codes for COVID lab test

Table S2: LOINC codes for human metapneumovirus lab test

Code System	Concept Code	Concept Name
LOINC	40979-7	Human metapneumovirus Ag [Presence] in Specimen by Immunofluorescence
LOINC	60425-6	Human metapneumovirus Ag [Presence] in Specimen
LOINC	88222-5	Human metapneumovirus Ag [Presence] in Nasopharynx by Immunofluorescence
LOINC	91810-2	Human metapneumovirus Ag [Presence] in Upper respiratory specimen by Immunofluorescence
LOINC	91831-8	Human metapneumovirus Ag [Presence] in Lower respiratory specimen by Immunofluorescence
LOINC	38917-1	Human metapneumovirus RNA [Presence] in Specimen by NAA with probe detection
LOINC	60266-4	Human metapneumovirus RNA [Presence] in Isolate by NAA with probe detection
LOINC	67820-1	Human metapneumovirus A RNA [Presence] in Specimen by NAA with probe detection
LOINC	67821-9	Human metapneumovirus B RNA [Presence] in Specimen by NAA with probe detection
LOINC	77024-8	Human metapneumovirus RNA [Presence] in Nasopharynx by NAA with probe detection
LOINC	82165-2	Human metapneumovirus RNA [Presence] in Nasopharynx by NAA with non-probe detection
LOINC	88534-3	Human metapneumovirus RNA [Presence] in Cornea or Conjunctiva by NAA with probe detection
LOINC	89651-4	Human metapneumovirus RNA [Presence] in Lower respiratory specimen by NAA with probe detection
LOINC	91809-4	Human metapneumovirus RNA [Presence] in Upper respiratory specimen by NAA with probe detection
LOINC	92134-6	Human metapneumovirus RNA [Presence] in Respiratory specimen by NAA with probe detection
LOINC	92978-6	Human metapneumovirus RNA [Presence] in Lower respiratory specimen by NAA with non-probe detection

Table S2: LOINC Codes for human metapneumovirus lab test

Table S3: LOINC codes for influenza lab test

Code System	Concept Code	Concept Name
LOINC	5860-2	Influenza virus A Ag [Presence] in Throat by Immunoassay
LOINC	5861-0	Influenza virus A Ag [Presence] in Throat by Immunofluorescence
LOINC	5862-8	Influenza virus A Ag [Presence] in Specimen by Immunoassay
LOINC	5863-6	Influenza virus A Ag [Presence] in Specimen by Immunofluorescence
LOINC	5864-4	Influenza virus B Ag [Presence] in Throat by Immunoassay
LOINC	5865-1	Influenza virus B Ag [Presence] in Throat by Immunofluorescence
LOINC	5866-9	Influenza virus B Ag [Presence] in Specimen by Immunoassay
LOINC	5867-7	Influenza virus B Ag [Presence] in Specimen by Immunofluorescence
LOINC	6435-2	Influenza virus A+B Ag [Presence] in Throat by Immunoassay
LOINC	6436-0	Influenza virus A+B Ag [Presence] in Throat by Immunofluorescence
LOINC	6437-8	Influenza virus A+B Ag [Presence] in Specimen by Immunoassay
LOINC	6438-6	Influenza virus A+B Ag [Presence] in Specimen by Immunofluorescence
LOINC	6439-4	Influenza virus A+B+C Ag [Presence] in Throat by Immunoassay
LOINC	6440-2	Influenza virus A+B+C Ag [Presence] in Throat by Immunofluorescence
LOINC	6441-0	Influenza virus A+B+C Ag [Presence] in Specimen by Immunoassay
LOINC	6442-8	Influenza virus A+B+C Ag [Presence] in Specimen by Immunofluorescence
LOINC	22825-4	Influenza virus A Ag [Presence] in Specimen by Immune diffusion (ID)
LOINC	24015-0	Influenza virus A+B Ag [Presence] in Specimen
LOINC	29721-8	Influenza virus C Ag [Presence] in Specimen by Immunofluorescence
LOINC	31858-4	Influenza virus A Ag [Presence] in Throat
LOINC	31859-2	Influenza virus A Ag [Presence] in Specimen
LOINC	31860-0	Influenza virus A+B Ag [Presence] in Throat
LOINC	31861-8	Influenza virus A+B+C Ag [Presence] in Throat
LOINC	31862-6	Influenza virus A+B+C Ag [Presence] in Specimen
LOINC	31863-4	Influenza virus B Ag [Presence] in Throat
LOINC	31864-2	Influenza virus B Ag [Presence] in Specimen
LOINC	31865-9	Influenza virus C Ag [Presence] in Specimen

Code System	Concept Code	Concept Name
LOINC	33535-6	Influenza virus A+B Ag [Presence] in Nasopharynx
LOINC	43874-7	Influenza virus A Ag [Presence] in Nasopharynx
LOINC	43895-2	Influenza virus B Ag [Presence] in Nasopharynx
LOINC	44558-5	Influenza virus A Ag [Presence] in Nasopharynx by Immunofluorescence
LOINC	44559-3	Influenza virus A Ag [Presence] in Bronchial specimen by Immunofluorescence
LOINC	44560-1	Influenza virus A Ag [Presence] in Nose by Immunofluorescence
LOINC	44561-9	Influenza virus A Ag [Presence] in Trachea by Immunofluorescence
LOINC	44562-7	Influenza virus A Ag [Presence] in Bronchial specimen
LOINC	44563-5	Influenza virus A Ag [Presence] in Nose
LOINC	44564-3	Influenza virus A Ag [Presence] in Nose by Immunoassay
LOINC	44566-8	Influenza virus A+B Ag [Presence] in Bronchial specimen
LOINC	44567-6	Influenza virus A+B Ag [Presence] in Nose
LOINC	44571-8	Influenza virus B Ag [Presence] in Nasopharynx by Immunofluorescence
LOINC	44572-6	Influenza virus B Ag [Presence] in Bronchial specimen by Immunofluorescence
LOINC	44573-4	Influenza virus B Ag [Presence] in Nose by Immunofluorescence
LOINC	44574-2	Influenza virus B Ag [Presence] in Trachea by Immunofluorescence
LOINC	44575-9	Influenza virus B Ag [Presence] in Nose by Immunoassay
LOINC	44576-7	Influenza virus B Ag [Presence] in Bronchial specimen
LOINC	44577-5	Influenza virus B Ag [Presence] in Nose
LOINC	46082-4	Influenza virus A Ag [Presence] in Nasopharynx by Immunoassay
LOINC	46083-2	Influenza virus B Ag [Presence] in Nasopharynx by Immunoassay
LOINC	49522-6	Influenza virus A H3 Ag [Presence] in Isolate by Immunofluorescence
LOINC	49529-1	Influenza virus A Ag [Presence] in Isolate by Immunofluorescence
LOINC	49534-1	Influenza virus B Ag [Presence] in Isolate by Immunofluorescence
LOINC	50701-2	Influenza virus A H1 Ag [Presence] in Isolate by Immunofluorescence
LOINC	54240-7	Influenza virus Ag [Presence] in Specimen
LOINC	54241-5	Influenza virus B Ag [Presence] in Isolate
LOINC	72367-6	Influenza virus A+B Ag [Presence] in Nose by Rapid immunoassay
LOINC	77383-8	Influenza virus A Ag [Presence] in Bronchoalveolar lavage by Immunofluorescence

Code System	Concept Code	Concept Name
LOINC	77384-6	Influenza virus B Ag [Presence] in Bronchoalveolar lavage by Immunofluorescence
LOINC	80382-5	Influenza virus A Ag [Presence] in Nasopharynx by Rapid immunoassay
LOINC	80383-3	Influenza virus B Ag [Presence] in Nasopharynx by Rapid immunoassay
LOINC	85821-7	Influenza virus B Victoria lineage Ag [Presence] in Isolate by Hemagglutination inhibition
LOINC	86318-3	Influenza virus B Yamagata lineage Ag [Presence] in Isolate by Hemagglutination inhibition
LOINC	86565-9	Influenza virus A Ag [Presence] in Tissue by Immunofluorescence
LOINC	88194-6	Influenza virus B Ag [Presence] in Tissue by Immunofluorescence
LOINC	88904-8	Influenza virus A Ag [Presence] in Lower respiratory specimen by Immunofluorescence
LOINC	88905-5	Influenza virus B Ag [Presence] in Lower respiratory specimen by Immunofluorescence
LOINC	34487-9	Influenza virus A RNA [Presence] in Specimen by NAA with probe detection
LOINC	38270-5	Influenza virus A H7 RNA [Presence] in Specimen by NAA with probe detection
LOINC	38271-3	Influenza virus A H6 RNA [Presence] in Specimen by NAA with probe detection
LOINC	38272-1	Influenza virus A H5 RNA [Presence] in Specimen by NAA with probe detection
LOINC	40981-3	Deprecated Influenza virus A RNA [Presence] in Unspecified specimen by Probe & target amplification method
LOINC	40982-1	Influenza virus B RNA [Presence] in Specimen by NAA with probe detection
LOINC	44091-7	Deprecated Influenza virus A hemagglutinin H5 RNA [Presence] in Unspecified specimen by Probe & target amplification method
LOINC	44795-3	Influenza virus A H5 Asian RNA [Presence] in Specimen by NAA with probe detection
LOINC	49520-0	Influenza virus A H1 RNA [Presence] in Isolate by NAA with probe detection
LOINC	49521-8	Influenza virus A H1 RNA [Presence] in Specimen by NAA with probe detection
LOINC	49523-4	Influenza virus A H3 RNA [Presence] in Isolate by NAA with probe detection
LOINC	49524-2	Influenza virus A H3 RNA [Presence] in Specimen by NAA with probe detection
LOINC	49526-7	Influenza virus A H5 RNA [Presence] in Isolate by NAA with probe detection
LOINC	49527-5	Influenza virus A H7 RNA [Presence] in Isolate by NAA with probe detection
LOINC	49528-3	Influenza virus A H9 RNA [Presence] in Specimen by NAA with probe detection
LOINC	49531-7	Influenza virus A RNA [Presence] in Isolate by NAA with probe detection
LOINC	49535-8	Influenza virus B RNA [Presence] in Isolate by NAA with probe detection
LOINC	50700-4	Influenza virus A.adamantane resistant RNA [Presence] by NAA with probe detection
LOINC	50702-0	Influenza virus A matrix protein RNA [Presence] in Isolate by Sequencing

Code System	Concept Code	Concept Name
LOINC	50704-6	Influenza virus A nucleoprotein RNA [Presence] in Isolate by Sequencing
LOINC	50705-3	Influenza virus A non-structural protein RNA [Presence] in Isolate by Sequencing
LOINC	50706-1	Influenza virus A polymerase A RNA [Presence] in Isolate by Sequencing
LOINC	50708-7	Influenza virus A polymerase B2 RNA [Presence] in Isolate by Sequencing
LOINC	57985-4	Influenza virus A H2 RNA [Presence] in Specimen by NAA with probe detection
LOINC	60267-2	Influenza virus C RNA [Presence] in Isolate by NAA with probe detection
LOINC	60530-3	Influenza virus A H9 RNA [Presence] in Isolate by NAA with probe detection
LOINC	60538-6	Influenza virus A H1+H3+B RNA [Presence] in Specimen by NAA with probe detection
LOINC	62462-7	Influenza virus A+B RNA [Presence] in Specimen by NAA with probe detection
LOINC	62860-2	Influenza virus C RNA [Presence] in Specimen by NAA with probe detection
LOINC	68986-9	Influenza virus A H5a RNA [Presence] in Specimen by NAA with probe detection
LOINC	68987-7	Influenza virus A H5b RNA [Presence] in Specimen by NAA with probe detection
LOINC	74785-7	Influenza virus B Victoria lineage RNA [Presence] in Specimen by NAA with probe detection
LOINC	74786-5	Influenza virus B Yamagata lineage RNA [Presence] in Specimen by NAA with probe detection
LOINC	76077-7	Influenza virus A RNA [Presence] in Bronchoalveolar lavage by NAA with probe detection
LOINC	76078-5	Influenza virus A RNA [Presence] in Nasopharynx by NAA with probe detection
LOINC	76079-3	Influenza virus B RNA [Presence] in Bronchoalveolar lavage by NAA with probe detection
LOINC	76080-1	Influenza virus B RNA [Presence] in Nasopharynx by NAA with probe detection
LOINC	99623-1	Influenza virus A N1 RNA [Presence] in Specimen by NAA with probe detection
LOINC	100343-3	Influenza virus B RNA [Presence] in Saliva (oral fluid) by NAA with probe detection
LOINC	100344-1	Influenza virus A RNA [Presence] in Saliva (oral fluid) by NAA with probe detection
LOINC	77026-3	Influenza virus A H1 RNA [Presence] in Nasopharynx by NAA with probe detection
LOINC	77027-1	Influenza virus A H3 RNA [Presence] in Nasopharynx by NAA with probe detection
LOINC	81428-5	Influenza virus A H7 Eurasia RNA [Presence] in Respiratory specimen by NAA with probe detection
LOINC	82166-0	Influenza virus A RNA [Presence] in Nasopharynx by NAA with non-probe detection
LOINC	82167-8	Influenza virus A H1 RNA [Presence] in Nasopharynx by NAA with non-probe detection
LOINC	82169-4	Influenza virus A H3 RNA [Presence] in Nasopharynx by NAA with non-probe detection
LOINC	82170-2	Influenza virus B RNA [Presence] in Nasopharynx by NAA with non-probe detection
LOINC	85477-8	Influenza virus A RNA [Presence] in Upper respiratory specimen by NAA with probe detection

Code System	Concept Code	Concept Name
LOINC	85478-6	Influenza virus B RNA [Presence] in Upper respiratory specimen by NAA with probe detection
LOINC	86568-3	Influenza virus A RNA [Presence] in Cerebral spinal fluid by NAA with probe detection
LOINC	86569-1	Influenza virus A RNA [Presence] in Tissue by NAA with probe detection
LOINC	86571-7	Influenza virus B RNA [Presence] in Cerebral spinal fluid by NAA with probe detection
LOINC	86572-5	Influenza virus B RNA [Presence] in Tissue by NAA with probe detection
LOINC	88193-8	Influenza virus A RNA [Presence] in Cornea or Conjunctiva by NAA with probe detection
LOINC	88195-3	Influenza virus B RNA [Presence] in Cornea or Conjunctiva by NAA with probe detection
LOINC	88592-1	Influenza virus B RNA [Presence] in Lower respiratory specimen by NAA with probe detection
LOINC	88596-2	Influenza virus B RNA [Presence] in Pericardial fluid by NAA with probe detection
LOINC	88599-6	Influenza virus A RNA [Presence] in Lower respiratory specimen by NAA with probe detection
LOINC	88600-2	Influenza virus A RNA [Presence] in Pericardial fluid by NAA with probe detection
LOINC	92141-1	Influenza virus B RNA [Presence] in Respiratory specimen by NAA with probe detection
LOINC	92142-9	Influenza virus A RNA [Presence] in Respiratory specimen by NAA with probe detection
LOINC	92808-5	Influenza virus A H3 RNA [Presence] in Upper respiratory specimen by NAA with probe detection
LOINC	92809-3	Influenza virus A H1 RNA [Presence] in Upper respiratory specimen by NAA with probe detection
LOINC	92976-0	Influenza virus B RNA [Presence] in Lower respiratory specimen by NAA with non-probe detection
LOINC	92977-8	Influenza virus A RNA [Presence] in Lower respiratory specimen by NAA with non-probe detection
LOINC	94394-4	Influenza virus A H3 RNA [Presence] in Lower respiratory specimen by NAA with probe detection
LOINC	94396-9	Influenza virus A H1 RNA [Presence] in Lower respiratory specimen by NAA with probe detection
LOINC	95658-1	Influenza virus A H7 Eurasia RNA [Presence] in Specimen by NAA with probe detection
LOINC	5229-0	Influenza virus A Ab [Titer] in Serum by Complement fixation
LOINC	5230-8	Influenza virus B Ab [Titer] in Serum by Complement fixation
LOINC	5862-8	Influenza virus A Ag [Presence] in Specimen by Immunoassay
LOINC	43895-2	Influenza virus B Ag [Presence] in Nasopharynx
LOINC	48310-7	Influenza virus A [Presence] in Specimen by Organism specific culture
LOINC	48509-4	Influenza virus A and B RNA [Identifier] in Specimen by NAA with probe detection
LOINC	72366-8	Influenza virus A and B Ag [Identifier] in Nose by Rapid immunoassay
LOINC	76078-5	Influenza virus A RNA [Presence] in Nasopharynx by NAA with probe detection
LOINC	92142-9	Influenza virus A RNA [Presence] in Respiratory specimen by NAA with probe detection

Table S3: LOINC Codes for influenza lab test

Table S4: LOINC codes for parainfluenza virus lab test

Code System	Concept Code	Concept Name
LOINC	5868-5	Parainfluenza virus 1 Ag [Presence] in Throat by Immunofluorescence
LOINC	5869-3	Parainfluenza virus 1 Ag [Presence] in Specimen by Immunofluorescence
LOINC	5870-1	Parainfluenza virus 2 Ag [Presence] in Throat by Immunofluorescence
LOINC	5871-9	Parainfluenza virus 2 Ag [Presence] in Specimen by Immunofluorescence
LOINC	5872-7	Parainfluenza virus 3 Ag [Presence] in Throat by Immunofluorescence
LOINC	5873-5	Parainfluenza virus 3 Ag [Presence] in Specimen by Immunofluorescence
LOINC	13327-2	Parainfluenza virus Ag [Presence] in Specimen by Immunofluorescence
LOINC	17414-4	Parainfluenza virus 1+2+3 Ag [Presence] in Specimen
LOINC	23678-6	Bovine parainfluenza virus 3 Ag [Presence] in Tissue by Immunofluorescence
LOINC	23699-2	Canine parainfluenza virus 2 Ag [Presence] in Tissue by Immunofluorescence
LOINC	31923-6	Parainfluenza virus 1 Ag [Presence] in Throat
LOINC	31924-4	Parainfluenza virus 1 Ag [Presence] in Specimen
LOINC	31925-1	Parainfluenza virus 2 Ag [Presence] in Throat
LOINC	31926-9	Parainfluenza virus 2 Ag [Presence] in Specimen
LOINC	31927-7	Parainfluenza virus 3 Ag [Presence] in Throat
LOINC	31928-5	Parainfluenza virus 3 Ag [Presence] in Specimen
LOINC	31929-3	Parainfluenza virus Ag [Presence] in Specimen
LOINC	38395-0	Parainfluenza virus 1 Ag [Presence] in Nasopharynx by Immunofluorescence
LOINC	38396-8	Parainfluenza virus 1 Ag [Presence] in Nose by Immunofluorescence
LOINC	40986-2	Parainfluenza virus 4 Ag [Presence] in Specimen by Immunofluorescence
LOINC	60424-9	Parainfluenza virus 4 Ag [Presence] in Specimen
LOINC	67808-6	Parainfluenza virus 1 Ag [Presence] in Isolate by Immunofluorescence
LOINC	67809-4	Parainfluenza virus 2 Ag [Presence] in Isolate by Immunofluorescence
LOINC	67810-2	Parainfluenza virus 3 Ag [Presence] in Isolate by Immunofluorescence
LOINC	67811-0	Parainfluenza virus 4 Ag [Presence] in Isolate by Immunofluorescence
LOINC	77385-3	Parainfluenza virus 1 Ag [Presence] in Bronchoalveolar lavage by Immunofluorescence
LOINC	77386-1	Parainfluenza virus 2 Ag [Presence] in Bronchoalveolar lavage by Immunofluorescence

Code System	Concept Code	Concept Name
LOINC	77387-9	Parainfluenza virus 3 Ag [Presence] in Bronchoalveolar lavage by Immunofluorescence
LOINC	77391-1	Parainfluenza virus 2 Ag [Presence] in Nasopharynx by Immunofluorescence
LOINC	77392-9	Parainfluenza virus 3 Ag [Presence] in Nasopharynx by Immunofluorescence
LOINC	88906-3	Parainfluenza virus 1 Ag [Presence] in Lower respiratory specimen by Immunofluorescence
LOINC	88907-1	Parainfluenza virus 2 Ag [Presence] in Lower respiratory specimen by Immunofluorescence
LOINC	88908-9	Parainfluenza virus 3 Ag [Presence] in Lower respiratory specimen by Immunofluorescence
LOINC	29908-1	Parainfluenza virus 1 RNA [Presence] in Specimen by NAA with probe detection
LOINC	29909-9	Parainfluenza virus 2 RNA [Presence] in Specimen by NAA with probe detection
LOINC	29910-7	Parainfluenza virus 3 RNA [Presence] in Specimen by NAA with probe detection
LOINC	41010-0	Parainfluenza virus 4 RNA [Presence] in Specimen by NAA with probe detection
LOINC	60254-0	Parainfluenza virus 1+2+3 RNA [Presence] in Specimen by NAA with probe detection
LOINC	60269-8	Parainfluenza virus 1 RNA [Presence] in Isolate by NAA with probe detection
LOINC	60415-7	Parainfluenza virus 4 RNA [Presence] in Isolate by NAA with probe detection
LOINC	60416-5	Parainfluenza virus 3 RNA [Presence] in Isolate by NAA with probe detection
LOINC	60417-3	Parainfluenza virus 2 RNA [Presence] in Isolate by NAA with probe detection
LOINC	61365-3	Parainfluenza virus RNA [Presence] in Specimen by NAA with probe detection
LOINC	67818-5	Parainfluenza virus 4a RNA [Presence] in Specimen by NAA with probe detection
LOINC	67819-3	Parainfluenza virus 4b RNA [Presence] in Specimen by NAA with probe detection
LOINC	76084-3	Parainfluenza virus 1 RNA [Presence] in Nasopharynx by NAA with probe detection
LOINC	76085-0	Parainfluenza virus 2 RNA [Presence] in Nasopharynx by NAA with probe detection
LOINC	76086-8	Parainfluenza virus 3 RNA [Presence] in Nasopharynx by NAA with probe detection
LOINC	76087-6	Parainfluenza virus 4 RNA [Presence] in Nasopharynx by NAA with probe detection
LOINC	97645-6	Parainfluenza virus 1+2+3+4 RNA [Presence] in Specimen by NAA with probe detection
LOINC	82171-0	Parainfluenza virus 1 RNA [Presence] in Nasopharynx by NAA with non-probe detection
LOINC	82172-8	Parainfluenza virus 2 RNA [Presence] in Nasopharynx by NAA with non-probe detection
LOINC	82173-6	Parainfluenza virus 3 RNA [Presence] in Nasopharynx by NAA with non-probe detection
LOINC	82174-4	Parainfluenza virus 4 RNA [Presence] in Nasopharynx by NAA with non-probe detection
LOINC	87387-7	Porcine parainfluenza virus 1 RNA [Presence] in Specimen by NAA with probe detection
LOINC	88208-4	Parainfluenza virus 1 RNA [Presence] in Cornea or Conjunctiva by NAA with probe detection

Code System	Concept Code	Concept Name
LOINC	88209-2	Parainfluenza virus 2 RNA [Presence] in Cornea or Conjunctiva by NAA with probe detection
LOINC	88210-0	Parainfluenza virus 3 RNA [Presence] in Cornea or Conjunctiva by NAA with probe detection
LOINC	88529-3	Parainfluenza virus RNA [Presence] in Cornea or Conjunctiva by NAA with probe detection
LOINC	88530-1	Parainfluenza virus 4 RNA [Presence] in Cornea or Conjunctiva by NAA with probe detection
LOINC	88559-0	Parainfluenza virus 2 RNA [Presence] in Lower respiratory specimen by NAA with probe detection
LOINC	88560-8	Parainfluenza virus 3 RNA [Presence] in Lower respiratory specimen by NAA with probe detection
LOINC	88561-6	Parainfluenza virus 4 RNA [Presence] in Lower respiratory specimen by NAA with probe detection
LOINC	88562-4	Parainfluenza virus RNA [Presence] in Lower respiratory specimen by NAA with probe detection
LOINC	88563-2	Parainfluenza virus 1 RNA [Presence] in Lower respiratory specimen by NAA with probe detection
LOINC	88890-9	Parainfluenza virus 1+2+3+4 RNA [Presence] in Nasopharynx by NAA with non-probe detection
LOINC	91798-9	Parainfluenza virus RNA [Presence] in Upper respiratory specimen by NAA with probe detection
LOINC	91799-7	Parainfluenza virus 4 RNA [Presence] in Upper respiratory specimen by NAA with probe detection
LOINC	91800-3	Parainfluenza virus 3 RNA [Presence] in Upper respiratory specimen by NAA with probe detection
LOINC	91801-1	Parainfluenza virus 2 RNA [Presence] in Upper respiratory specimen by NAA with probe detection
LOINC	91802-9	Parainfluenza virus 1 RNA [Presence] in Upper respiratory specimen by NAA with probe detection
LOINC	92137-9	Parainfluenza virus 4 RNA [Presence] in Respiratory specimen by NAA with probe detection
LOINC	92138-7	Parainfluenza virus 3 RNA [Presence] in Respiratory specimen by NAA with probe detection
LOINC	92139-5	Parainfluenza virus 2 RNA [Presence] in Respiratory specimen by NAA with probe detection
LOINC	92140-3	Parainfluenza virus 1 RNA [Presence] in Respiratory specimen by NAA with probe detection
LOINC	92883-8	Parainfluenza virus 1+2+3+4 RNA [Presence] in Lower respiratory specimen by NAA with probe detection
LOINC	92884-6	Parainfluenza virus 1+2+3+4 RNA [Presence] in Upper respiratory specimen by NAA with probe detection
LOINC	92963-8	Parainfluenza virus RNA [Presence] in Lower respiratory specimen by NAA with non-probe detection
LOINC	94483-5	Parainfluenza virus 1 RNA [Presence] in Lower respiratory specimen by NAA with non-probe detection

Code System	Concept Code	Concept Name
LOINC	94484-3	Parainfluenza virus 2 RNA [Presence] in Lower respiratory specimen by NAA with non-probe detection
LOINC	94485-0	Parainfluenza virus 3 RNA [Presence] in Lower respiratory specimen by NAA with non-probe detection
LOINC	94486-8	Parainfluenza virus 4 RNA [Presence] in Lower respiratory specimen by NAA with non-probe detection
LOINC	55097-0	Parainfluenza virus 1 [Presence] in Specimen by Organism specific culture
LOINC	55098-8	Parainfluenza virus 2 [Presence] in Specimen by Organism specific culture
LOINC	55099-6	Parainfluenza virus 3 [Presence] in Specimen by Organism specific culture

Table S4: LOINC Codes for parainfluenza virus lab test

Table S7: LOINC codes for rhinovirus lab test

Code System	Concept Code	Concept Name
LOINC	40992-0	Rhinovirus+Enterovirus Ag [Presence] in Specimen by Immunofluorescence
LOINC	7993-9	Rhinovirus RNA [Presence] in Specimen by NAA with probe detection
LOINC	40991-2	Rhinovirus+Enterovirus RNA [Presence] in Specimen by NAA with probe detection
LOINC	97954-2	Rhinovirus+Enterovirus A+B+C RNA [Presence] in Respiratory specimen by NAA with probe detection
LOINC	77025-5	Rhinovirus RNA [Presence] in Nasopharynx by NAA with probe detection
LOINC	80596-0	Rhinovirus 5' UTR RNA [Presence] in Nasopharynx by NAA with probe detection
LOINC	82175-1	Rhinovirus+Enterovirus RNA [Presence] in Nasopharynx by NAA with non-probe detection
LOINC	88213-4	Rhinovirus RNA [Presence] in Cornea or Conjunctiva by NAA with probe detection
LOINC	88721-6	Rhinovirus+Enterovirus RNA [Presence] in Nasopharynx by NAA with probe detection
LOINC	91131-3	Rhinovirus RNA [Presence] in Lower respiratory specimen by NAA with probe detection
LOINC	91793-0	Rhinovirus RNA [Presence] in Upper respiratory specimen by NAA with probe detection
LOINC	92130-4	Rhinovirus RNA [Presence] in Respiratory specimen by NAA with probe detection
LOINC	92807-7	Rhinovirus+Enterovirus RNA [Presence] in Upper respiratory specimen by NAA with probe detection
LOINC	92885-3	Rhinovirus+Enterovirus RNA [Presence] in Lower respiratory specimen by NAA with probe detection
LOINC	92956-2	Rhinovirus+Enterovirus RNA [Presence] in Lower respiratory specimen by NAA with non-probe detection

Table S7: LOINC Codes for rhinovirus lab test

Table S5: LOINC codes for RSV lab test

Code System	Concept Code	Concept Name
LOINC	5874-3	Respiratory syncytial virus Ag [Presence] in Throat by Immunoassay
LOINC	5875-0	Respiratory syncytial virus Ag [Presence] in Throat by Immunofluorescence
LOINC	5876-8	Respiratory syncytial virus Ag [Presence] in Specimen by Immunoassay
LOINC	5877-6	Respiratory syncytial virus Ag [Presence] in Specimen by Immunofluorescence
LOINC	20943-7	Bovine respiratory syncytial virus Ag [Presence] in Lung by Immune stain
LOINC	20944-5	Bovine respiratory syncytial virus Ag [Presence] in Lung by Immunoassay
LOINC	20945-2	Bovine respiratory syncytial virus Ag [Presence] in Lung by Immunofluorescence
LOINC	23679-4	Bovine respiratory syncytial virus Ag [Presence] in Specimen
LOINC	31751-1	Bovine respiratory syncytial virus Ag [Presence] in Lung
LOINC	31949-1	Respiratory syncytial virus Ag [Presence] in Throat
LOINC	31950-9	Respiratory syncytial virus Ag [Presence] in Specimen
LOINC	32040-8	Respiratory syncytial virus Ag [Presence] in Nose by Immunofluorescence
LOINC	33045-6	Respiratory syncytial virus Ag [Presence] in Nose
LOINC	50329-2	Respiratory syncytial virus Ag [Presence] in Tissue by Immune stain
LOINC	68966-1	Respiratory syncytial virus Ag [Presence] in Nasopharynx by Immunoassay
LOINC	72885-7	Respiratory syncytial virus Ag [Presence] in Nasopharynx by Rapid immunoassay
LOINC	77389-5	Respiratory syncytial virus Ag [Presence] in Bronchoalveolar lavage by Immunofluorescence
LOINC	77390-3	Respiratory syncytial virus Ag [Presence] in Nasopharynx by Immunofluorescence
LOINC	88909-7	Respiratory syncytial virus Ag [Presence] in Lower respiratory specimen by Immunofluorescence
LOINC	94613-7	Bovine respiratory syncytial virus Ag [Presence] in Tissue by Immune stain
LOINC	30075-6	Respiratory syncytial virus A RNA [Presence] in Specimen by NAA with probe detection
LOINC	30076-4	Respiratory syncytial virus B RNA [Presence] in Specimen by NAA with probe detection
LOINC	40988-8	Respiratory syncytial virus RNA [Presence] in Specimen by NAA with probe detection
LOINC	60271-4	Respiratory syncytial virus RNA [Presence] in Isolate by NAA with probe detection
LOINC	76088-4	Respiratory syncytial virus RNA [Presence] in Bronchoalveolar lavage by NAA with probe detection
LOINC	76089-2	Respiratory syncytial virus RNA [Presence] in Nasopharynx by NAA with probe detection

Code System	Concept Code	Concept Name
LOINC	77022-2	Respiratory syncytial virus A RNA [Presence] in Nasopharynx by NAA with probe detection
LOINC	77023-0	Respiratory syncytial virus B RNA [Presence] in Nasopharynx by NAA with probe detection
LOINC	80597-8	Respiratory syncytial virus A 5' UTR RNA [Presence] in Nasopharynx by NAA with probe detection
LOINC	82176-9	Respiratory syncytial virus RNA [Presence] in Nasopharynx by NAA with non-probe detection
LOINC	85479-4	Respiratory syncytial virus RNA [Presence] in Upper respiratory specimen by NAA with probe detection
LOINC	88202-7	Respiratory syncytial virus B RNA [Presence] in Cornea or Conjunctiva by NAA with probe detection
LOINC	88204-3	Respiratory syncytial virus A RNA [Presence] in Cornea or Conjunctiva by NAA with probe detection
LOINC	88528-5	Respiratory syncytial virus RNA [Presence] in Cornea or Conjunctiva by NAA with probe detection
LOINC	88595-4	Respiratory syncytial virus A RNA [Presence] in Lower respiratory specimen by NAA with probe detection
LOINC	88597-0	Respiratory syncytial virus B RNA [Presence] in Lower respiratory specimen by NAA with probe detection
LOINC	91133-9	Respiratory syncytial virus RNA [Presence] in Lower respiratory specimen by NAA with probe detection
LOINC	91794-8	Respiratory syncytial virus B RNA [Presence] in Upper respiratory specimen by NAA with probe detection
LOINC	91795-5	Respiratory syncytial virus A RNA [Presence] in Upper respiratory specimen by NAA with probe detection
LOINC	92131-2	Respiratory syncytial virus RNA [Presence] in Respiratory specimen by NAA with probe detection
LOINC	92957-0	Respiratory syncytial virus RNA [Presence] in Lower respiratory specimen by NAA with non-probe detection
LOINC	40982-1	Influenza virus B RNA [Presence] in Specimen by NAA with probe detection
LOINC	40988-8	Respiratory syncytial virus RNA [Presence] in Specimen by NAA with probe detection

Table S5: LOINC Codes for RSV lab test