Changes in Seasonal Respiratory Illnesses in the United States During the COVID-19 Pandemic

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Summary: Seasonal respiratory illnesses were reduced during the COVID-19 pandemic, as indicated by respiratory-related emergency department visits (excluding diagnosed COVID-19), and independent clinical laboratory positivity for influenza viruses, respiratory syncytial virus, human parainfluenza virus, adenoviruses, and human metapneumovirus.

Abstract

Background. Respiratory tract infections are common, often seasonal, and caused by multiple pathogens. We assessed whether seasonal respiratory illness patterns changed during the COVID-19 pandemic.

Methods. We categorized emergency department (ED) visits reported to the National Syndromic Surveillance Program according to chief complaints and diagnosis codes, excluding visits with diagnosed SARS-CoV-2 infections. For each week during March 1, 2020 through December 26, 2020 ("pandemic period"), we compared the proportion of ED visits in each respiratory category with the proportion of visits in that category during the corresponding weeks of 2017–2019 ("pre-pandemic period"). We analyzed positivity of respiratory viral tests from two independent clinical laboratories.

Results. During March 2020, cough, shortness of breath, and influenza-like illness accounted for twice as many ED visits compared with the pre-pandemic period. During the last four months of 2020, all respiratory conditions, except shortness of breath, accounted for a smaller proportion of ED visits than during the pre-pandemic period. Percent positivity for influenza virus, respiratory syncytial virus, human parainfluenza virus, adenoviruses, and human metapneumovirus were lower in 2020 than 2019. Although test volume decreased, percent positivity was higher for rhinovirus/enterovirus during the final weeks of 2020 compared with 2019; with ED visits similar to the pre-pandemic period.

Discussion. Broad reductions in respiratory test positivity and respiratory emergency department visits (excluding COVID-19) occurred during 2020. Interventions for mitigating spread of SARS-CoV-2 likely also reduced transmission of other pathogens. Timely surveillance is needed to understand community health threats, particularly when current trends deviate from seasonal norms.

Keywords: COVID-19; Syndromic; Respiratory; Emergency Department Visits; Laboratory

Abbreviations

SARS-CoV-2, severe acute respiratory syndrome coronavirus 2; ED, emergency department; URI, upper respiratory tract infection; LRTI, lower respiratory tract infection; US, United States; RSV, respiratory syncytial viruses; HPIV, human parainfluenza viruses; HMPV, human metapneumovirus; NSSP, National Syndromic Surveillance Program; ICD-10-CM, International Classification of Diseases, Tenth Revision, Clinical Modification; COVID-19, coronavirus disease 2019; PR, prevalence ratio; LOINC, Logical Observation Identifiers Names and Codes

Background

Respiratory illnesses occur frequently, and most persons in the United States (US) experience at least one acute upper respiratory tract infection (URI) annually [1]. URI symptoms include sore throat, sneezing, rhinorrhea, nasal congestion, sinus pain, cough, headache, myalgia, loss of appetite, chills, and fever [2]. Whereas URIs occur from the nasal cavity through the larynx, lower respiratory tract infections (LRTIs) occur below the larynx and include pneumonia, bronchitis, and bronchiolitis. LRTIs are responsible for a sizable proportion of emergency department (ED) visits and hospitalizations [3]. During 2001–2004, the average annual age-adjusted pneumonia-associated hospitalization rate in the US was 465 per 100,000 population, with 7.4% of these patients dying in the hospital [4]. Globally, community-acquired pneumonia is estimated to account for 15% of deaths in children < 5 years of age in 2007 [5], and in the US, bronchiolitis is the most common cause of hospitalizations among infants < 1 year old [6].

More than 200 viruses can cause respiratory infections [1, 2, 7]. Rhinoviruses are the most frequent cause of the common cold, responsible for 30% to 70% of all respiratory infections [2, 7]. Endemic human coronaviruses are common causes of respiratory illnesses in adults and are reported to have caused 7% to 18% of common colds prior to the novel coronavirus disease 2019 (COVID-19) pandemic [8, 9]. Other common causes of respiratory illness include respiratory syncytial virus (RSV) types A and B, human parainfluenza virus (HPIV) types 1–4, adenoviruses, human metapneumovirus (HMPV) and influenza viruses A-B.

Most but not all viral respiratory pathogens exhibit seasonal prevalence patterns [8-10]. Influenza, RSV, and human coronaviruses typically have peak incidence in the winter, rhinoviruses usually have peak incidence in spring and fall, and enteroviruses generally have peak incidence in the summer. Seasonality of respiratory viral infections is likely affected by multiple factors, including age-dependent human behavioral changes (e.g., school calendars and to a limited degree, spending time indoors during colder months) [8, 9, 11-13], meteorologic factors (e.g., humidity and temperature) [10], and climactic influences on host resistance (e.g., sun exposure and related vitamin D levels) [9, 14]. The COVID-19 pandemic globally changed typical patterns of influenza illness. While SARS-CoV-2 infections exhibited explosive growth in 2020, influenza activity in 2020 fell below historical seasonal norms [15], and ED visits were

less frequent than in prior years, with fewer patients presenting with influenza or acute bronchitis [16]. We examined symptoms and diagnoses among ED patients as well as changes in independent clinical laboratory respiratory viral test results in order to evaluate whether typical seasonal respiratory pathogen activity (excluding SARS-CoV-2) changed during the pandemic.

Methods

Data Sources

De-identified ED records were obtained from the National Syndromic Surveillance Program (NSSP), a collaboration among the Centers for Disease Control and Prevention (CDC), state and local health departments, and private sector health partners. Nonfederal EDs in 49 states (excluding Hawaii) participate in NSSP, constituting 70% of ED facilities in the US as of December, 2020 [17]. This study included 332,042,585 ED visits occurring during the study period of weeks 10 through 52 of each year from 2017 through 2020. This corresponds to March 5 through December 30 of 2017, March 4 through December 29 of 2018, March 3 through December 28 of 2019, and March 10 through December 26 of 2020.

Laboratory tests results were obtained from Laboratory A and Laboratory B, which are two large independent clinical laboratories with testing locations throughout the US. These laboratory companies require testing locations under their contract to have and maintain a certificate under the Clinical Laboratory Improvement Amendments of 1988. Laboratories A and B receive clinical specimens for diagnostic testing from patients in every US state. CDC receives all diagnostic test results conducted by Laboratories A and B for the respiratory pathogens included in this study (Supplemental Table 3). Laboratory A submits order and result records to NSSP every 10 minutes, including results from all states for any condition that is reportable in any state. Laboratory B reports weekly findings for selected tests to CDC's Data Hub, including nucleic acid amplification tests and antigen tests for respiratory pathogens [18]. Collectively, Laboratories A and B reported results for 2,530,315 viral respiratory specimen test

results during March 24, 2019 through December 31, 2020. Data from tests conducted by Laboratories A and B prior to March 24, 2019 were not available for this study.

Counts of COVID-19 cases were obtained from the CDC's COVID-19 Case Surveillance Public Use Dataset [19].

Classifying emergency department visits

ED visit records were classified into one or multiple categories based on text in chief complaints and International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) codes reported in discharge diagnosis fields. To categorize respiratory infections based on chief complaints, we included the categories "upper respiratory tract infection" and "lower respiratory tract infection." Additionally, the following chief complaint categories were the most frequent among respiratory-related ED visits in 2019, and were thus also included in this analysis: "cough," "influenza-like illness," "shortness of breath," "sore throat," and "fever or chills." We utilized a keyword weighting approach to categorize respiratory-related ED visits by defining terms and ICD-10-CM codes that resulted in records being included or excluded in each clinical categorization (Supplemental Tables 1, 2) [20, 21]. Chief complaint narratives for each visit record were scored based on a weighted keyword algorithm, with positive or negative values assigned for the presence of each keyword. Chief complaints with a score of six or greater were classified into the indicated category, and visits could be classified into more than one category. Abbreviations frequently used in medical records were included in the keyword matching algorithm [20, 21]. Pathogen-specific discharge diagnosis-based categories were defined based on reported ICD-10-CM codes for "influenza," "adenovirus," "human parainfluenza virus," "rhinovirus," "human metapneumovirus" and "respiratory syncytial virus." In order to focus analyses on illnesses due to pathogens other than severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), ED records that included a diagnosis of COVID-19 were excluded from chief -complaint and discharge diagnosis-based categories. These were defined as any ED visits with discharge diagnoses that include ICD-10-CM codes U07.1 or J12.82 or Systematized Nomenclature of Medicine clinical terms 840539006, 840544004, or 840533007.

We analyzed data for weeks 10 through 52 of each year from 2017 through 2020. For each week during March 5, 2017–December 26, 2020, we calculated the proportion of ED visits in each respiratory category as the number of visits in the respiratory category (V_{rc}) divided by the total number of ED visits occurring that week (V_{all}). For each week during March 1, 2020 through December 26, 2020, we calculated a prevalence ratio (PR) for each respiratory category as the proportion of ED visits in each respiratory category divided by the proportion of visits in that category during the corresponding weeks of 2017–2019:

$$\mathrm{PR} = \frac{\left(\frac{V_{rc}\ \text{during week N, 2020}}{V_{all}\ \text{during week N, 2020}}\right)}{\left(\frac{V_{rc}\ \text{during week N, 2017} + V_{rc}\ \text{during week N, 2018} + V_{rc}\ \text{during week N, 2019}}{V_{all}\ \text{during week N, 2017} + V_{all}\ \text{during week N, 2018} + V_{all}\ \text{during week N, 2019}}\right)}$$

As such, PR values >1 for a given respiratory category indicate that the proportion of visits during 2020 for that category was greater during 2020 than the proportion for the same week during the three prior years. We directly calculated 95% confidence intervals for PRs by exponentiating interval endpoints formed from standard error approximations of the logarithm of prevalence ratios. All analyses were conducted using R software, version 4.0.3.

Classifying laboratory findings

Laboratory results for each clinical specimen were classified into pathogen-specific groups based on Logical Observation Identifiers Names and Codes (LOINC) clinical terminology and test result description strings (Supplemental Table 3) [22]. All influenza A and B viruses were included in the influenza test category. Respiratory panel polymerase chain reaction (PCR) tests do not differentiate between human enterovirus and rhinovirus, and these were included in rhinovirus results. Counts of tests and denominator for positivity assessments included all tests with positive or negative results for each pathogen. This analysis included nucleic acid amplification tests and antigen tests, and excluded all inconclusive results, antibody tests, and tests with non-respiratory specimen sources. We used Pearson chi-squared tests of independence to compare count differences across time.

Human Subjects Review

This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.§§See e.g., 45 C.F.R. part 46; 21 C.F.R. part 56; 42 U.S.C. §241(d), 5 U.S.C. §552a, 44 U.S.C. §3501 et seq.

Results

Respiratory-related emergency department visits

We identified 77,317,484 ED visits occurring during March 1, 2020 through December 26 of 2020 , (weeks 10 through 52 of 2020, the "pandemic period"), and 252,826,677 ED visits occurring during weeks 10 through 52 of 2017, 2018, and 2019 (the "pre-pandemic period"). Among the ED visits occurring during weeks 10 through 52 of 2020, 1,782,463 (2.3%) included a diagnosis of COVID-19, and were excluded from respiratory classifications (i.e., URI, LRTI, sore throat, fever or chills, influenza-like illness cough, and shortness of breath).

During the pandemic period, 0.40% of visits were classified as URI, compared with 0.71% during the corresponding weeks of the pre-pandemic period (PR=0.56, 95% CI=0.56–0.57) (Table 1). Relative decreases were also observed for visits classified as LRTI (PR=0.51, 95% CI=0.51–0.52), and sore throat (PR=0.91, 95% CI=0.91–0.91). In contrast, the percent of visits with influenza-like illness (PR=1.06, 95% CI=1.06–1.07), cough (PR=1.08, 95% CI=1.07–1.08), and shortness of breath (PR=1.52, 95% CI=1.51–1.52) was higher during the pandemic period than pre-pandemic period. Visits with fever or chills were similarly prevalent when comparing the two time periods (PR = 1.00, 95% CI=1.00–1.00).

PR of respiratory-related visits varied throughout the pandemic period. During early March through mid-April of 2020, more than twice as many ED visits (PR>2.00) included chief complaints for cough, influenza-like illness, or shortness of breath, compared with the corresponding weeks during the pre-pandemic period. ED visits with ILI peaked during the March 8 through April 4, 2020 (PR=2.35, 95% CI=2.34–2.36), cough peaked during March 15 through April 4, 2020 (PR=2.71, 95% CI=2.71–2.72), and shortness of breath peaked during March 22 through April 18, 2020 (PR=2.37, 95% CI=2.36–2.38) (Figure 1A). By the week beginning May 10, 2020, the percent of ED visits for non-COVID-19

respiratory-related ED visits was below levels observed during the pre-pandemic period (PR <1.00 for each), with the exception of shortness of breath. By the week of June 14, 2020 ED visits with shortness of breath had declined to PR=1.36 (95% CI=1.35–1.37), at which time they began to rise in a second peak. PRs for all respiratory-related chief complaints increased until early July 2020, and by the end of 2020, prevalence of all non-COVID-19 respiratory conditions was lower than the prevalence during the corresponding weeks of the pre-pandemic period, with the exception of shortness of breath (Figure 1A). During the last four complete weeks of the 2020, 0.41% of ED visits were classified as URI, and 0.15% were classified as LRTI, a three-fold reduction compared with the pre-pandemic period: 1.24% had URI and 0.51% had LRTI during the same weeks of the pre-pandemic period (PR=0.33 and 0.29, respectively).

During March of 2020, the percent of ED visits with diagnoses for adenovirus, HMPV and rhinovirus was markedly elevated, compared with the pre-pandemic period (PR>5.00) (Figure 1B), although the number of viral tests performed for ED patients was not available. Relative to the pre-pandemic period, identification of Adenovirus among ED patients peaked during March 8 through March 28, 2020. Identification of HMPV and rhinovirus peaked during March 15 through March 21, 2020, PR=5.73 (95% CI=5.11–6.41) and PR=5.37 (95% CI=4.37–5.37), respectively. From August 23, 2020 through the end of 2020, the percent of ED visits with HMPV, HPIV, influenza, and RSV was consistently lower than during the latter half of the pre-pandemic years (PR<1 for each virus for every week during August 23, 2020 through the end of 2020). During this period of time, identification of adenovirus and rhinovirus varied from week to week; identification of adenovirus in ED patients was slightly less frequent than in the pre-pandemic period (PR=0.769, 95% CI=0.60–0.98), and identification of rhinovirus was slightly more frequent than in the pre-pandemic period (PR=1.18, 95% CI=1.11–1.25).

Increases in respiratory illnesses (Figure 1A) and viral pathogen identification (Figure 1B) among ED patients in March and early April of 2020 coincided with an initial peak in confirmed COVID-19 cases (Figure 1C). A second peak in confirmed COVID-19 cases occurred in July, 2020, and this coincided with a second rise in PR of ED visits for respiratory conditions.

Reductions in prevalence of ED visits for URIs and LRTIs in 2020 were observed for all age groups. For URIs and LRTIs, the greatest reductions in ED visits were among patients age 0–17 years (Figure 2).

Independent clinical laboratory testing

During the first five weeks of 2020, 290,134 tests for respiratory viral pathogens were administered, and during the five weeks March 8–April 11, 2020 464,267 were administered, an increase of 60.0% (Figure 3). During the first five weeks of 2020 74.4% percent of respiratory testes were multi-pathogen panels, and during the five weeks March 8–April 11, 2020 91.1% were multi-pathogen panel tests ($X^2 = 3{,}275.27$, $p < 0.01$). Testing for seasonal respiratory pathogens was generally less frequent in late 2020 compared with 2019, with the exception of two weeks in late 2020 where influenza testing volume slightly exceeded the volume of influenza testing recorded for the corresponding weeks of 2019 (Figure 3). During the final four weeks of 2020, 31,144 tests for rhinovirus, adenovirus, RSV, HMPV, and HPIV were performed, 65.8% less than the 91,070 tests performed during the corresponding weeks of 2019.

Among specimens tested for influenza, RSV, HMPV, or HPIV, the percent with a positive result declined in early 2020, and remained suppressed throughout the remainder of the year, without seasonal increases that occurred in 2019. In contrast, beginning the week of September 27, 2020, rhinovirus percent positivity exceeded positivity recorded from the corresponding weeks of 2019. During September 27, 2020 through December 26, 2020 (the last full week of 2020) 33.9% of rhinovirus tests (n = 6,891) were positive, compared with 26.3% (n = 21,306) corresponding weeks of 2019 ($\chi^2 = 79.2$, $p < 0.01$).

Discussion

ED and laboratory data suggest that seasonal patterns of respiratory illness activity were profoundly disrupted throughout 2020 compared with earlier years. The incidence of SARS-CoV-2 has been well-documented elsewhere [19], and this study examined the impact of the pandemic on other respiratory pathogens. Beginning in mid- to late-March 2020, the proportion of respiratory-related ED visits for illnesses that lacked a COVID-19 diagnosis declined sharply, and generally remained below

seasonal norms throughout 2020. During the final four weeks of 2020, URIs and LRTIs without COVID-19 diagnoses accounted for a third as many ED visits as they did during the corresponding weeks of the pre-pandemic period. Likewise, ED visits and laboratory testing positivity indicated that influenza virus, RSV, HMPV, and HPIV circulated at levels far below seasonal norms. This is consistent with reports of decreased influenza activity during the COVID-19 pandemic [15]. In contrast, we noted increases in ED visits for rhinovirus during late 2020, with prevalence of visits for rhinovirus similar to the pre-pandemic baseline, and a similar pattern was observed in independent clinical laboratory results for rhinovirus. Through the final three months of 2020, rhinovirus test positivity was slightly higher than levels observed in 2019.

Widespread interventions intended to reduce COVID-19 likely contributed to the reduced spread of a broad array of respiratory pathogens with the possible exception of rhinovirus transmissions in late 2020. Social distancing reduces opportunities for person-to-person transmission, and face coverings that inhibit exhaled secretions create a barrier suppressing diverse respiratory pathogens. However, not all respiratory viruses are equally controlled by these measures, and some, such as Adenovirus can remain infectious on surfaces longer than other viruses. Rhinovirus can be transmitted by aerosol, direct contact, or by touching contaminated environmental objects [23, 24]. In the UK, rhinovirus positivity declined following a national lockdown in late March of 2020, but rose sharply following re-opening of state primary and secondary schools in early September 2020, suggesting that the social distancing measures that were implemented did not prevent rhinovirus transmission in schools [25]. In addition, rhinovirus might be less susceptible to source-control methods, such as face coverings. One study found that surgical masks that reduced emission of influenza virus and coronavirus in respiratory droplets did not reduce detection of rhinoviruses in droplets or aerosols [26].

Cocirculation of respiratory pathogens can be affected by population dynamics at the host and population level as viruses and other pathogens compete for shared niches. It is possible that some of the changes in respiratory illness activity documented in our findings are affected by disruptions to typical virus-virus seasonal circulation patterns, and the reduction in influenza circulation could itself affect prevalence of other viruses. Nickbakhsh et al. demonstrated negative interactions between influenza A viruses and rhinovirus at the population and host level [27]. Rhinovirus circulation is proposed to have

delayed introduction of influenza A (H1N1) 2009 virus in France during 2009 [28, 29]. These reports are consistent with our observation of decreased influenza detection through 2020, but the impacts of viral interference and COVID-19 mitigation measures on the findings presented in this report are uncertain.

Our findings should be interpreted in the context of several limitations. Prevalence ratios of respiratory-related ED visits facilitate comparison between time periods. However, this has the potential to introduce bias from differences in comparison groups. We attempted to exclude patients with SARS-CoV-2 infection from ED visit analyses in order to highlight changes in respiratory activity from pathogens prevalent in the pre-pandemic period. We excluded visits with diagnostic codes specific to COVID-19, which were introduced on April 1, 2020 [30]; however, it is likely many ED patients with COVID-19 did not receive these diagnosis codes, particularly early in the pandemic when SARS-CoV-2 testing capacity was reduced. PRs in ED visits for respiratory conditions exhibit peaks in March–April of 2020 and June–July of 2020, which is similar to the timing of peaks in reported COVID-19 cases (Figure 1A, C) which would be expected if some patients with SARS-CoV-2 infections did not receive COVID-19 diagnostic codes, particularly early in the pandemic. This could contribute to elevated prevalence ratios for ED visits with shortness of breath in 2020, and our findings likely underestimate actual decreases in ED visits for non-COVID-19 respiratory visits.

Ascertainment bias might influence these results, particularly regarding viral testing in EDs (Figure 1 B). Diagnoses of specific respiratory pathogens among ED patients is incomplete, since viral tests are not performed for every patient with respiratory illness, and negative results are not documented in diagnosis codes. Testing protocols vary between facilities and likely change over time. We note a substantial peak in identification of vital respiratory pathogens in EDs in March of 2020 (Figure 1B), and while the number of viral tests performed in EDs is not available, the number of tests performed in independent clinical laboratories displays a substantial increase in testing, but not positivity, during this time period (Figure 3), which suggests that increased awareness of COVID-19, simultaneous with limited availability of tests for SARS-CoV2 led to increased testing for multiple respiratory pathogens in this time period. Increased identification of viral pathogens among ED patients during March of 2020 is therefore likely to be a consequence of increased testing rather than increased viral prevalence.

Clinical laboratory testing was limited to common respiratory viral pathogens. Bacterial infections causing both URI and LRTI were not considered in these analyses. Test volume for common respiratory viral pathogens was lower in late 2020 than in 2019 (with the exception of tests for influenza virus for two weeks), and changes in testing patterns could have influenced test positivity. A notable exception to this occurred during late March of 2020, when respiratory testing was five times more frequent than in 2019 (Figure 3). During this time period, the importance of identifying COVID-19 cases was increasing, and SARS-CoV-2 assays were not universally available; increased volume of tests for other respiratory pathogens could reflect attempts to rule out other respiratory pathogens. Although the volume of testing performed in EDs was not known, if heightened vigilance led to increased ED testing for respiratory pathogens in March 2020, this could have driven increases in the number of ED patients diagnosed with seasonal respiratory pathogens in this time period (Figure 1B). Because positivity rates in independent clinical tests did not likewise increase during this period, increases in identification of ED patients with "seasonal" respiratory pathogens is likely an artifact of changes in testing practices rather the result of increases in viral circulation.

Collectively, these findings document substantial changes in circulation of respiratory pathogens other than SARS-CoV-2 and in related health-seeking behavior. The long-term implications of these changes are uncertain, but it is expected that interventions designed to mitigate the spread of COVID-19 will continue to impact multiple respiratory pathogens. Understanding current viral circulation aids clinicians in understanding the most probable pathogens affecting patients, and continued surveillance is essential for guiding mitigation strategies.

Notes

Disclaimer

The contents of this paper are solely the responsibility of the authors and do not necessarily represent the official views of the Centers for Disease Control and Prevention.

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Conflict of Interest

The authors report no conflicts of interest. All authors have submitted ICME Forms for Disclosure of Potential Conflicts of Interest.

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Table 1. Respiratory-related chief complaints among emergency department (ED) visits as a percentage of all ED visits in the United States.

Chief Complaint	Number of ED Visits 2017–2019[a]	Percent of ED Visits 2017–2019[b]	Number of ED Visits 2020[c]	Percent of ED Visits 2020[d]	Prevalence Ratio (lower bound–upper bound)
Upper Respiratory Tract Infection	1,784,957	0.71	308,306	0.40	0.56 (0.56–0.57)
Lower Respiratory Tract Infection	693,970	0.27	109,220	0.14	0.51 (0.51–0.52)
Sore Throat	5,007,299	1.98	1,395,015	1.80	0.91 (0.91–0.91)
Fever or Chills	11,945,572	4.72	3,663,636	4.74	1.00 (1.00–1.00)
Influenza-like illness	3,913,802	1.55	1,274,296	1.65	1.06 (1.06–1.07)
Cough	9,101,699	3.60	2,992,737	3.87	1.08 (1.07–1.08)
Shortness of Breath	9,919,140	3.92	4,593,376	5.94	1.51 (1.51–1.52)

Abbreviation: ED, emergency department.

[a]Includes ED visits occurring during March 5 through December 30 of 2017, March 4 through December 29 of 2018, and March 3 through December 28 of 2019, which corresponds to weeks 10 through 52 of each year.

[b]Denominator for each percentage is 252,826,677 ED visits occurring during March 5 through December 30 of 2017, March 4 through December 29 of 2018, and March 3 through December 28 of 2019, which corresponds to weeks 10 through 52 of 2017, 2018, and 2019.

[c]Includes ED visits occurring during March 1, 2020 through December 26 of 2020, which corresponds to weeks 10 through 52 of 2020.

[d]Denominator for each percentage is 77,317,484 ED visits occurring during March 1, 2020 through December 26 of 2020, which corresponds to weeks 10 through 52 of 2020.

FIGURE LEGENDS

Figure 1. Relative prevalence[a] of respiratory-related chief complaints (A) and discharge diagnoses (B) among emergency department visits in the US, excluding patients with diagnosed COVID-19 by week[b]. Reported active cases of COVID-19[c] are displayed for comparison (C).

[a]For each week during March 5, 2017 through December 26, 2020 we calculated the proportion of emergency department (ED) visits in each respiratory category as the number of visits in the respiratory category divided by the total number of ED visits occurring that week. For each of these weeks, we calculated a prevalence ratio for each respiratory category as the proportion of ED visits in each respiratory category divided by the proportion of visits in that category during the corresponding weeks of 2017 through 2019. As such, prevalence ratio values >1 indicate that the proportion of visits during 2020 for that category was greater during 2020 than the proportion for the same week during the three prior years.

[b]Indicates the date the patient initiated an ED visit, by week, with the week start date for 2020 shown.

[c]Source: COVID Data Tracker. Available at: https://covid.cdc.gov/covid-data-tracker/.

Figure 2. Prevalence[a] of upper respiratory tract infections (A) and lower respiratory tract infections (B) among emergency department visits; 2020 compared with 2017–2019 by week of visit[b].

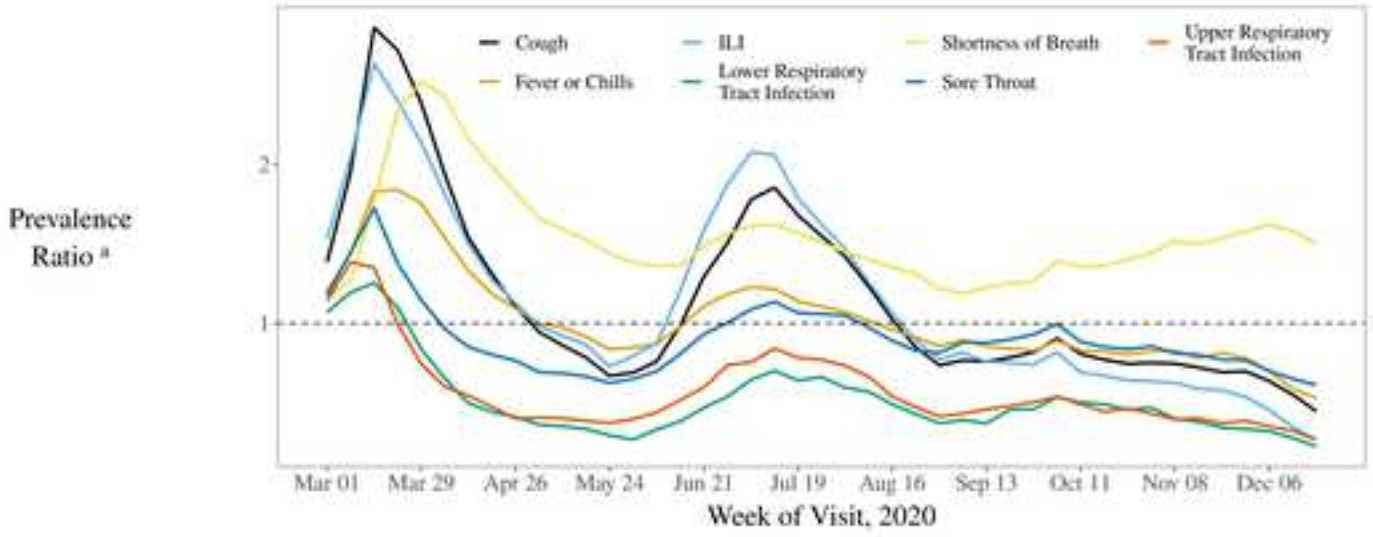
[a]For each week during March 5, 2017–December 26, 2020 we calculated the proportion of emergency department (ED) visits in each respiratory category as the number of visits in the respiratory category divided by the total number of ED visits occurring that week. For each week during March 1, 2020 through December 26, 2020, we calculated a prevalence ratio for each respiratory category as the proportion of ED visits in each respiratory category divided by the proportion of visits in that category during the corresponding weeks of 2017–2019. As such, prevalence ratio values >1 indicate that the

proportion of visits during 2020 for that category was greater during 2020 than the proportion for the same week during the three prior years.

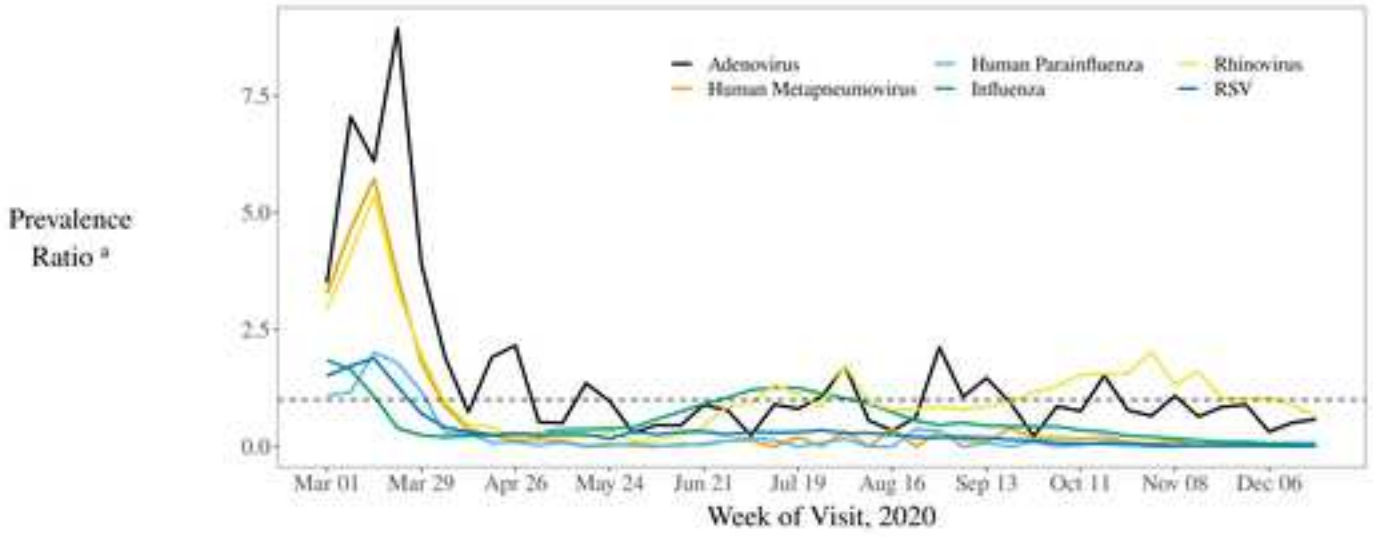
[b]Indicates the date the patient the emergency initiated an ED visit, by week, with the week start date for 2020 shown.

Figure 3. Respiratory specimen positivity from two independent clinical laboratories in the United States — March 24, 2019 through December 26, 2020.

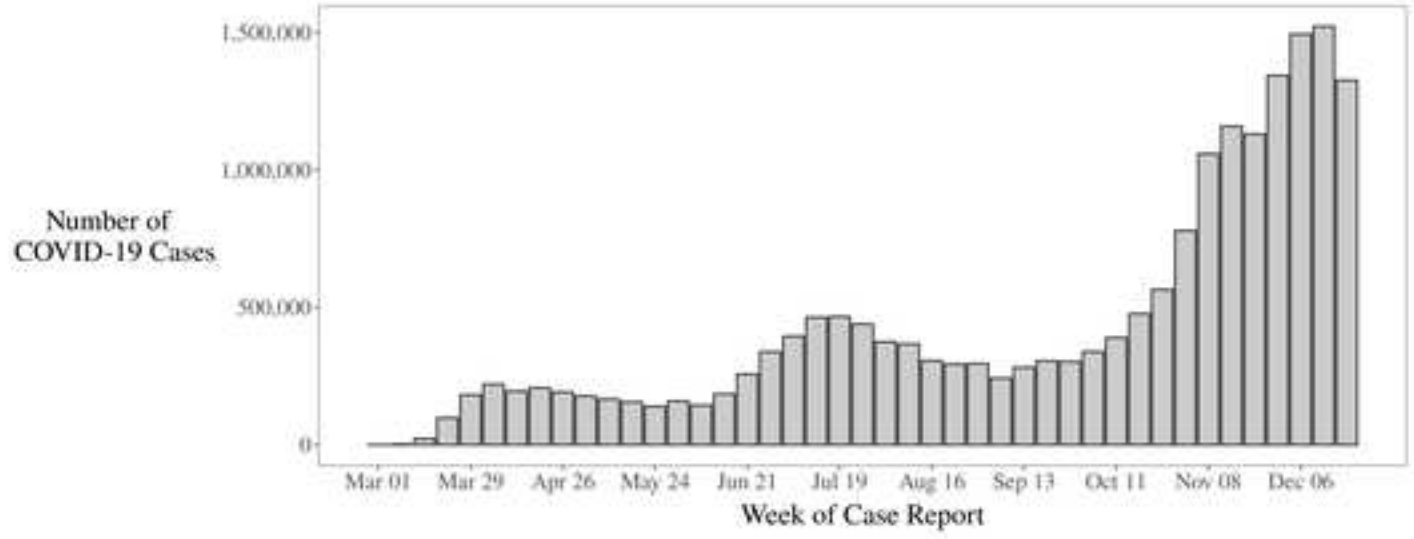
A.


Cough
Fever or Chills
ILI
Lower Respiratory Tract Infection
Shortness of Breath
Sore Throat
Upper Respiratory Tract Infection
Prevalence Ratio [a]
2
1
Mar 01
Mar 29
Apr 26
May 24
Jun 21
Jul 19
Aug 16
Sep 13
Oct 11
Nov 08
Dec 06
Week of Visit, 2020

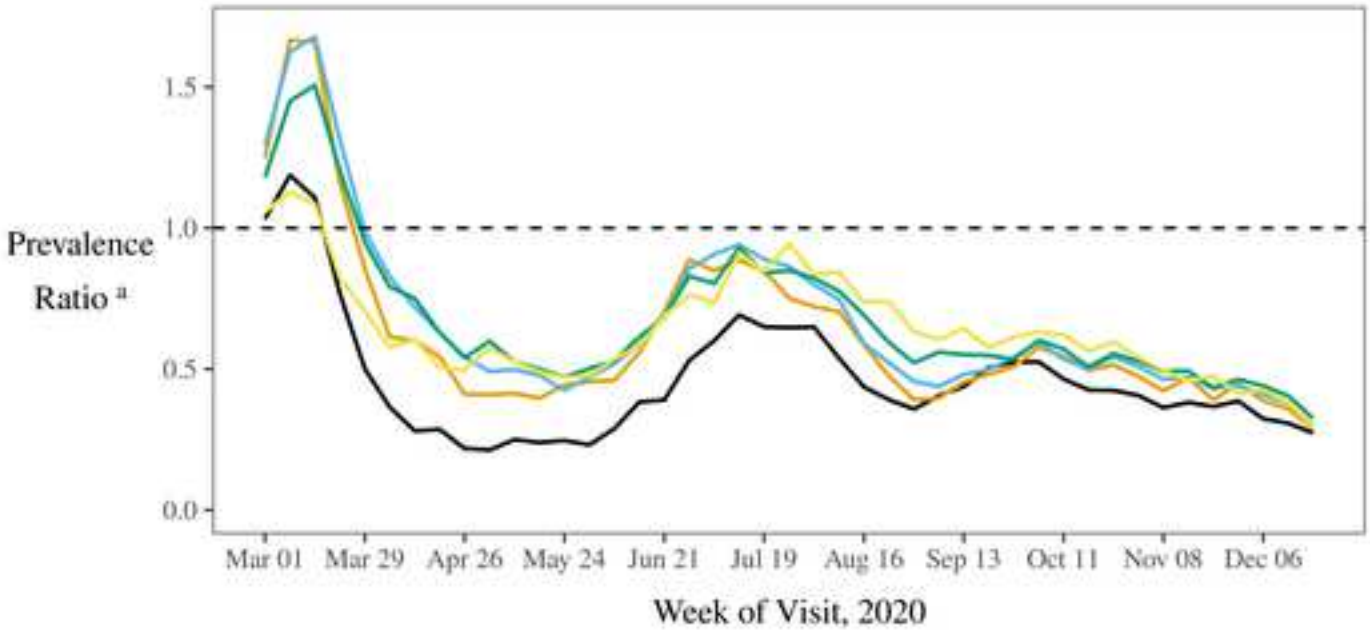
B.


Adenovirus
Human Metapneumovirus
Human Parainfluenza
Influenza
Rhinovirus
RSV
Prevalence Ratio [a]
7.5
5.0
2.5
0.0
Mar 01
Mar 29
Apr 26
May 24
Jun 21
Jul 19
Aug 16
Sep 13
Oct 11
Nov 08
Dec 06
Week of Visit, 2020

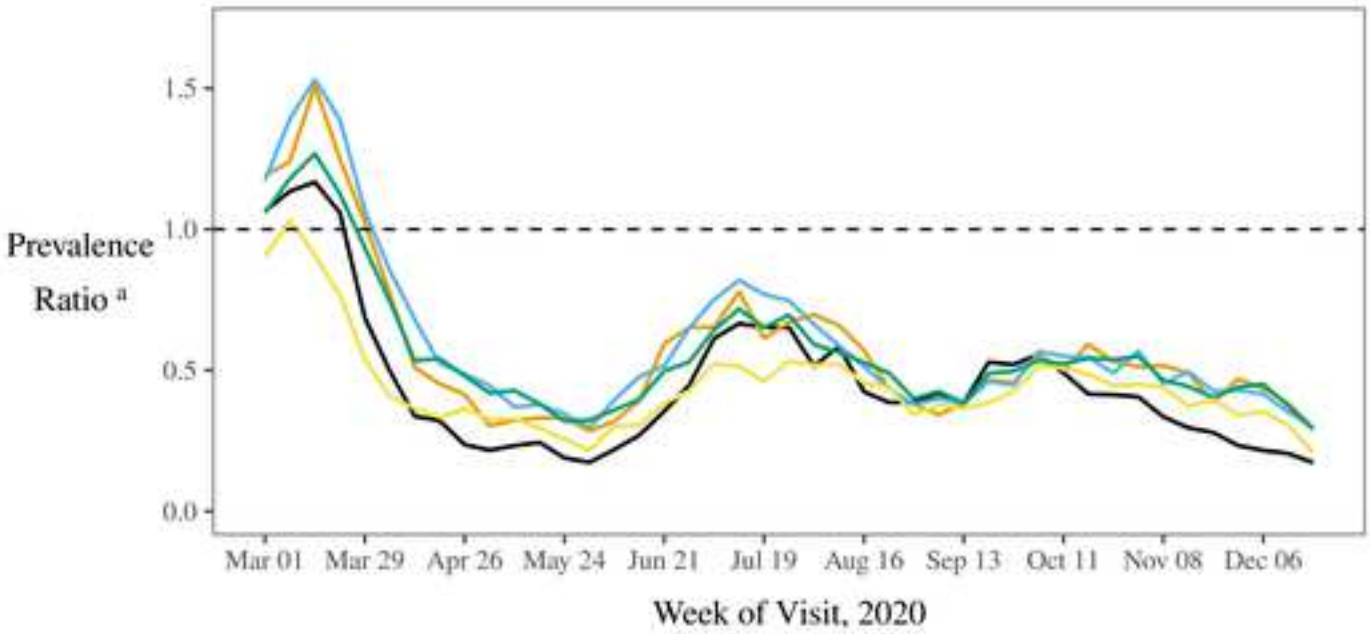
C.

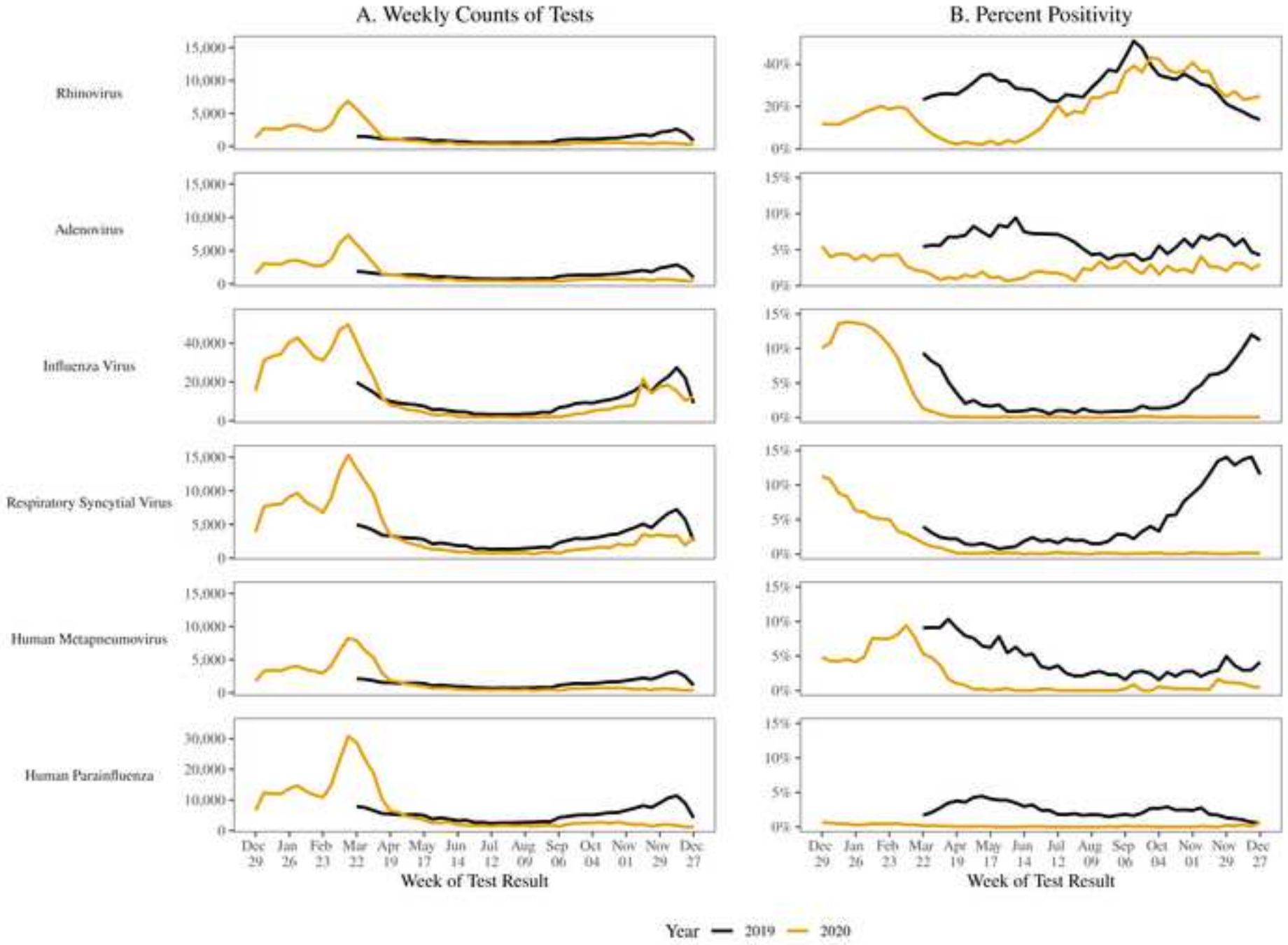

1,500,000
1,000,000
500,000
0
Number of COVID-19 Cases
Mar 01
Mar 29
Apr 26
May 24
Jun 21
Jul 19
Aug 16
Sep 13
Oct 11
Nov 08
Dec 06
Week of Case Report

A.


Prevalence Ratio [a]
1.5
1.0
0.5
0.0
Mar 01
Mar 29
Apr 26
May 24
Jun 21
Jul 19
Aug 16
Sep 13
Oct 11
Nov 08
Dec 06
Week of Visit, 2020

B.


Prevalence Ratio [a]
1.5
1.0
0.5
0.0
Mar 01
Mar 29
Apr 26
May 24
Jun 21
Jul 19
Aug 16
Sep 13
Oct 11
Nov 08
Dec 06
Week of Visit, 2020
Age Group
0-17
18-25
26-44
45-64
65+


A. Weekly Counts of Tests
B. Percent Positivity
Rhinovirus
Adenovirus
Influenza Virus
Respiratory Syncytial Virus
Human Metapneumovirus
Human Parainfluenza
15,000
10,000
5,000
0
40,000
20,000
30,000
40%
20%
15%
10%
5%
0%
Dec 29
Jan 26
Feb 23
Mar 22
Apr 19
May 17
Jun 14
Jul 12
Aug 09
Sep 06
Oct 04
Nov 01
Nov 29
Dec 27
Week of Test Result
Year
2019
2020