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Incidence and Clinical Characteristics of Severe Acute Respiratory Syndrome Coronavirus 2 Infection After Vaccination in Children

Megan E. Reyna, BA[1], Priya R. Edward, MD[1], Egon A. Ozer, MD, PhD[2,3], Lacy M. Simons, BS[2,3], Judd F. Hultquist, PhD[2,3], Ramon Lorenzo-Redondo, PhD[2,3], Ami B. Patel, MD, MPH[1,2], and Larry K. Kociolek, MD, MSCI[1,2]

The objective of this single-center cohort study was to characterize the frequency, clinical characteristics, and molecular epidemiology of pediatric severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection after vaccination. Between May 15, 2021, and January 1, 2022, 171 children experienced SARS-CoV-2 infection postvaccination, 146 (86%) following the Omicron variant predominance. Outcomes were generally mild and comparable before and after Omicron predominance. *(J Pediatr 2022; ■:1-6).*

The rollout of highly effective vaccines for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) reduced the incidence of coronavirus disease 2019 (COVID-19) and the burden of the illness on health care systems.[1-3] However, the emergence of variants of concern (VOCs), particularly those with vaccine-evading mutations, such as Omicron,[4] has led to a greater incidence of COVID-19, especially among individuals who have completed the primary vaccine series.[5] Although the durability of SARS-CoV-2 vaccines has not been characterized in all pediatric age groups, anti-spike antibodies in adolescents wane significantly by 6 months postvaccination,[6] and booster doses increase protection.[7] Although COVID-19 in vaccinated adults is relatively mild,[8] little is known about the frequency and clinical characteristics of COVID-19 in children who have completed the primary SARS-CoV-2 vaccine series. As of summer 2022, among Chicago residents, nearly 50% of children aged 5-11 years and 75% of those aged 12-17 years old had completed the primary series of SARS-CoV-2 vaccines.[9] Children are increasingly returning to congregate settings, such as schools and childcare facilities, with variable enforcement of COVID-19 mitigation measures. With the risk of COVID-19 potentially increasing, a better understanding of pediatric COVID-19 after vaccination is needed.

In the spring of 2021, the US experienced a surge of COVID-19 during which the alpha and gamma VOCs predominated. These were largely supplanted by the Delta VOC, which predominated through summer and fall 2021. In December 2021, the Omicron VOC rapidly became the predominant strain, leading to a steep increase in COVID-19 cases and hospitalizations nationwide.[10,11] In children, the effectiveness of messenger RNA (mRNA) vaccines in preventing COVID-19 was notably diminished for the Omicron VOC.[12,13] Consistent with these data, the incidence of pediatric COVID-19 surged substantially in both vaccinated and unvaccinated children during this period.

The objective of this single-center cohort study was to characterize the frequency and clinical characteristics of pediatric COVID-19 cases among those previously vaccinated against SARS-CoV-2. Additionally, we delineated pre-Omicron and Omicron periods using community molecular epidemiology and whole-genome sequencing (WGS) to examine the prevalence of VOCs in vaccinated children and the association between VOCs with clinical outcomes. These data are essential for informing ongoing public health strategy for vaccination and nonpharmacologic mitigation interventions for children.

Methods

This retrospective cohort study was conducted at the Ann & Robert H. Lurie Children's Hospital of Chicago. The hospital's Institutional Review Board approved this study (IRB 2020-3792). Vaccine records for the state of Illinois, including SARS-CoV-2 vaccines, were available through the Illinois Comprehensive Automated Immunization Registry Exchange (I-CARE) and autopopulated into the hospital's electronic medical record. We considered a person to be fully

COVID-19	Coronavirus disease 2019
Ct	Cycle threshold
GISAID	Global Initiative on Sharing Avian Influenza Data
I-CARE	Illinois Comprehensive Automated Immunization Registry Exchange
mRNA	Messenger RNA
RT-PCR	Reverse-transcription polymerase chain reaction
SARS-CoV-2	Severe acute respiratory syndrome coronavirus 2
VOC	Variant of concern
WGS	Whole-genome sequencing

From the [1]Ann & Robert H. Lurie Children's Hospital of Chicago, Chicago, IL; [2]Division of Infectious Diseases, Northwestern University Feinberg School of Medicine, Chicago, IL; and [3]Center for Pathogen Genomics and Microbial Evolution, Northwestern University Havey Institute for Global Health, Chicago, IL

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vaccinated as of 14 days after receipt of the second dose of Pfizer-BioNTech (Pfizer) or Moderna mRNA vaccine (Moderna), or 14 days after receipt of a single dose of the J&J/Janssen viral vector vaccine (Janssen Vaccines).

All patients aged 0-20 years with a positive reverse-transcription polymerase chain reaction (RT-PCR) test for SARS-CoV-2 after being fully vaccinated, irrespective of COVID-19 symptoms, were identified as having COVID-19 after vaccination via an electronic medical record query. In cases where multiple infections were suspected, only the first infection was included. Dates of Pfizer-BioNTech vaccine Emergency Use Authorization by the US Food and Drug Administration for individuals aged 0-20 years are listed in **Figure 1** (available at www.jpeds.com).

The first COVID-19 infection in a fully vaccinated child at our center was diagnosed on May 15, 2021, which we defined as the first day of the study period; our study period continued through January 1, 2022. The COVID-19 incidence at our center during this period was included as well. We stratified the study period into pre-Omicron and Omicron periods. We defined the beginning of the Omicron period as the date after which 50% of our medical center surveillance samples undergoing WGS were identified as the Omicron VOC, which occurred during the week of December 6-12, 2021.

SARS-CoV-2 WGS

After identifying our patient cohort, all residual diagnostic specimens with sufficient volume for RNA extraction and a sufficiently low quantitative RT-PCR cycle threshold (Ct) value (ie, sufficiently high viral load) were subject to SARS-CoV-2 WGS at the Center for Pathogen Genomics and Microbial Evolution at Northwestern University. A small subset of samples were also sequenced at the Regional Innovative Public Health Laboratory at the Chicago Department of Public Health and Rush University Medical Center through their COVID-19 surveillance program. Laboratory methods for viral RNA extraction, complementary DNA synthesis, viral genome amplification, sequencing library preparation, Illumina sequencing, genome assembly, and phylogenetic analysis are described in the **Appendix** (available at www.jpeds.com). Consensus genome sequences were deposited in the Global Initiative on Sharing Avian Influenza Data (GISAID) public database (**Table I**; available at www.jpeds.com).

Study Data and Definitions

Vaccination dates and type, as well as positive SARS-CoV-2 PCR test date, were extracted directly from the electronic medical record. Manual chart review was completed to extract demographic data (ie, age, sex, race, and ethnicity) and pertinent clinical characteristics for each patient infection. The clinical data included comorbid conditions (specifically diabetes, respiratory disease, cardiac disease, immunocompromising conditions, and obesity, defined as body mass index ≥95th percentile), presence of a viral coinfection by a multiplex PCR test (BioFire Respiratory 2.1 Panel; BioFire Diagnostics), symptom data (fever, rhinorrhea, congestion, loss of taste/smell, cough, shortness of breath, sore throat, gastrointestinal symptoms, headache), hospitalization for COVID-19, and receipt of therapies for COVID-19 (eg, monoclonal antibodies, remdesivir, corticosteroids, tocilizumab, baricitinib, supplemental oxygen). Of note, corticosteroids were recorded as COVID-19 treatment if given specifically as treatment for COVID-19 at the provider's discretion; for example, if corticosteroids were given solely for croup symptoms in a child who was SARS-CoV-2–positive, that was not considered COVID-19 treatment. Each patient was assigned a World Health Organization COVID-19 Severity Score.[14]

Statistical Analyses

Demographic, clinical, and outcome categorical variables for the entire cohort, as well as for patient subgroups infected during the pre-Omicron and Omicron periods, were summarized and reported as frequency and percentage or as median and IQR. The frequencies of these variables were compared between subgroups using the χ^2 test or Fisher exact test; continuous variables were compared using the Wilcoxon rank-sum test. A 2-sided P value $< .05$ was considered statistically significant. Statistical analyses were performed using Stata/IC 16.0 (StataCorp).

Results

Figure 1 illustrates changes in overall COVID-19 incidence at our center during the study period of May 15, 2021, to January 1, 2022. In late December 2021, there was a >4-fold increase in incidence, jumping from 221 total cases between December 5 and December 18 to 1032 cases between December 19 and January 1, corresponding to the emergence and predominance of Omicron. During the study period, 171 patients in our center experienced COVID-19 after SARS-CoV-2 vaccination (**Table II**). There were 25 (14.6%) such infections during the 30-week pre-Omicron period and 146 (85.4%) during the 3-week Omicron period. The proportion of COVID-19 cases in vaccinated children increased when Omicron became predominant, accounting for 12.3% of all infections during our Omicron period, compared with 3.3% of all cases in our pre-Omicron period, during which time the Delta VOC was largely predominant. Of the samples with measured SARS-CoV-2 RT-PCR Ct values, 10 of 21 samples (47.6%) in the pre-Omicron period and 95 of 123 (77.2%) samples in the Omicron period had a Ct <30 and were eligible for WGS. Residual samples from 98 patients (57%) were available and successfully sequenced, and all were identified as a VOC, including 93 (94.9%) Omicron, 4 (4.1%) Delta, and 1 (1%) was Gamma. The patient population was significantly younger during the Omicron period (median, 14 [IQR, 12-16] years vs 16 [IQR, 13-17] years; $P = .002$).

All demographic, clinical, and outcome data for the entire cohort, and during the pre-Omicron (May 15, 2021, to December 11, 2021) and Omicron (December 12, 2021, to

Table II. Demographics, clinical characteristics, and outcomes of 171 children with COVID-19 following vaccination

Variables	Total infections following vaccination, n (%) (N = 171)	Pre-Omicron, n (%) (N = 25)	Omicron, n (%) (N = 146)	*P* value
Age, y, median (IQR)	14 (12-16)	16 (13-17)	14 (12-16)	**.0022**
Days between vaccination* and infection, median (IQR)	160 (76-186)	116 (95-163)	167.5 (40-187)	**.0382**
Sex (male), n (%)	90 (52.6)	15 (60)	75 (51.4)	.517
Race (Black), n (%)	31 (18.1)	0 (0)	31 (21.2)	.071
Ethnicity (Hispanic), n (%)	56 (32.8)	10 (40)	46 (31.5)	.676
Comorbid condition for COVID-19 complications (any), n (%)	89 (52.1)	11 (44)	78 (53.4)	.397
Cardiac	10 (5.9)	0 (0)	10 (6.9)	.361
Respiratory	38 (22.2)	3 (12)	35 (24)	.296
Immunodeficiency	18 (10.5)	2 (8)	16 (10.9)	1.00
Diabetes	4 (2.3)	0 (0)	4 (2.7)	1.00
Obesity	35 (20.5)	6 (24)	29 (19.9)	.163
COVID vaccine type (Pfizer-BioNTech), n (%)	167 (97.7)	24 (96)	143 (98)	.472
Received booster dose, n (%)	5 (2.9)	0 (0)	5 (3.4)	1.00
Received third dose because of immunodeficiency, n (%)	1 (0.6)	1 (4)	0 (0)	.146
Viral coinfection†, n (%)	1 (0.6)	0 (0)	1 (0.7)	1.00
Symptoms of COVID-19 (any), n (%)	151 (88.3)	17 (68)	134 (91.8)	**.003**
Fever	50 (29.2)	7 (28)	43 (29.5)	1.00
Upper respiratory infection symptoms	60 (35.1)	9 (36)	51 (34.9)	1.00
Loss of taste and/or smell	3 (1.8)	0 (0)	3 (2.1)	1.00
Cough	54 (31.6)	5 (20)	49 (33.6)	.245
Shortness of breath	10 (5.9)	0 (0)	10 (6.9)	.361
Sore throat	56 (32.8)	5 (20)	51 (34.9)	.171
Gastrointestinal symptoms	20 (11.7)	0 (0)	20 (13.7)	**.047**
Headache	30 (17.5)	4 (16)	26 (17.8)	1.00
Other	45 (26.3)	3 (12)	42 (28.8)	.089
Hospitalized for COVID-19‡, n (%)	4 (2.3)	0 (0)	4 (2.7)	1.00
COVID-19 pharmacologic treatment, n (%)	2 (1.2)	1 (4)	1 (0.7)	.272
Monoclonal antibodies§, n (%)	1 (0.6)	1 (4)	0 (0)	.146
Remdesivir	1 (0.6)	0 (0)	1 (0.7)	1.00
Corticosteroids	1 (0.6)	0 (0)	1 (0.7)	1.00
COVID-19 severity score, n (%)				
Mild (1-2)	165 (96.5)	25 (100)	140 (95.9)	.594
Moderate (3-5)	6 (3.5)	0 (0)	6 (4.1)	

Bold *P* values denote statistical significance.
*Day 1 starts 14 days after completing primary vaccine series.
†The single viral coinfection was rhinovirus/enterovirus.
‡No patients required respiratory support or intensive care.
§Specific monoclonal antibody unavailable; patient received at outside location.

January 1, 2022) periods, are listed in **Table II**. Among the 171 patients with COVID-19 after vaccination, 167 (97.7%) had received the Pfizer-BioNTech mRNA vaccine. Six patients had received a third dose of vaccine. Five patients received a booster dose, a median 200 (IQR, 198-204) days after receipt of second dose, and 1 patient received a third dose because of underlying immunodeficiency at 106 days after the second dose. The median time elapsed between the date of full vaccination and date of a positive SARS-CoV-2 test was greater during the Omicron period (168 [IQR, 40-187] days vs 116 [IQR, 95-163] days; $P = .039$), and **Figure 2** illustrates these data for successfully sequenced samples. Among the entire cohort, 89 patients (52.1%) had a comorbid condition, most commonly a respiratory condition (n = 38; 22.2%) or obesity (n = 35; 20.5%). There were no significant differences in the frequency of comorbid conditions between the time periods. During the Omicron period, patients with COVID-19 after vaccination were significantly more likely to experience symptoms of COVID-19 (91.8% vs 68%; $P = .003$), particularly gastrointestinal symptoms (13.7% vs 0%; $P = .047$). No children with multisystem inflammatory syndrome in children after vaccination were identified in our cohort.

In total, 9 patients with COVID-19 after vaccination were hospitalized (all during the Omicron period), but only 4 (2.3%) were hospitalized because of their COVID-19 infection; the remainder were asymptomatic or mild infections in children who were hospitalized for a different reason (eg, psychiatric care, treatment for an alternative medical problem). Each of these cases was in children with a complex medical history (**Table III**; available at www.jpeds.com). None of these patients experienced a concomitant infection with a different respiratory virus. None of the hospitalized patients required supplemental oxygen. One of the hospitalized patients received corticosteroids and remdesivir as treatment. One other patient reportedly received monoclonal antibodies as early directed therapy for mild infection (specific monoclonal antibody received at outside infusion center by verbal self-report; unable to be confirmed); this patient did not require hospitalization. Two of the 4 samples were successfully sequenced from

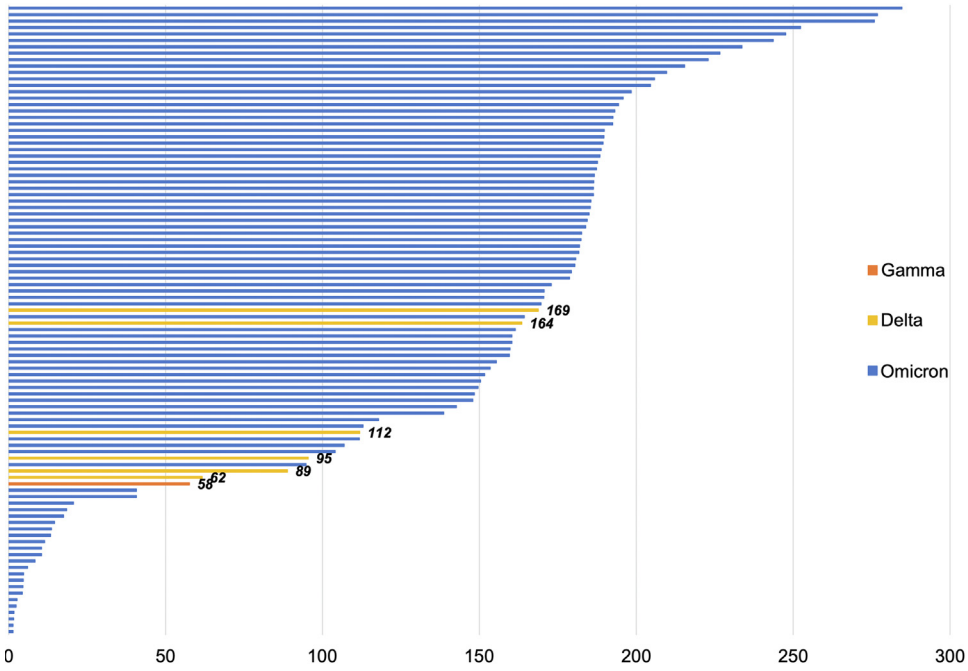

Figure 2. Days between full vaccination and positive SARS-CoV-2 test for 98 patients with a successfully sequenced SARS-CoV-2 nasopharyngeal sample. Samples are organized from longest to shortest period between being fully vaccinated (ie, day 0 is 14 days after receiving dose 2) and infection date. Among the 98 samples, 93 (94.9%) were Omicron (blue), 4 (4.1%) were Delta (yellow), and 1 (1%) was Gamma (red). For the 5 non-Omicron samples, the number of days between vaccination and a positive SARS-CoV-2 test is labeled beside the line.

the hospitalized participants and identified as the BA.1 lineage of the Omicron VOC.

Discussion

At the Ann & Robert H. Lurie Children's Hospital of Chicago, COVID-19 incidence increased sharply in mid to late December 2021. The incidence of COVID-19 in children who completed the primary vaccine series also increased during this time; 12.3% of all infections between December 12, 2021, and January 1, 2022, were in previously vaccinated children. Among all COVID-19 infections occurring after vaccination in this time period in this study, nearly 95% were caused by the Omicron VOC, which has been shown to have increased transmissibility and vaccine evasion.[4,15] COVID-19 after vaccination generally occurred at least 5 months after completion of the primary vaccination series, supporting the currently recommended booster schedule in children aged 12 years and older that recommends a single booster 5 months after the primary series in all children aged 12 and older; a third dose 1 month after the initial 2-dose series, a first booster 3 months later, and then a second booster 4 months later is currently recommended for immunocompromised children aged 12 years and older.[16] Although patients with COVID-19 after vaccination during the Omicron period were younger than those in the pre-Omicron period, this is biased by the fact that children younger than 12 years were not eligible for the vaccine until late in the pre-Omicron period. Along those lines, during the Omicron period, children aged 12 years and older might have concomitantly experienced waning immunity several months after becoming eligible for vaccine,[6] complicating the ability to discern waning immunity from Omicron vaccine escape, although both likely contributed to the rise in COVID-19 in this age group during the Omicron period.

We found that COVID-19 after vaccination was generally mild and only rarely required hospitalization or treatment. The severity of COVID-19 caused by the Omicron VOC in children after vaccination, characterized by proportion of infections requiring hospitalization, treatment, respiratory support, or intensive care, was low and did not differ between the pre-Omicron and Omicron periods. This supports recent data showing that although current vaccine regimens are less effective at preventing COVID-19 caused by Omicron, they were largely protective against hospitalization and severe disease in children.[10,11] Hospitalization events observed in vaccinated patients experiencing COVID-19 were driven by the medical complexity of patients who would benefit from close monitoring by their care teams, not by the severity of their infection. Of the 4 hospitalization events for COVID-19, 3 were only 1-day stays for observation and did not require any intervention. During the Omicron period, COVID-19 after vaccination was more frequently associated with symptoms, with a greater prevalence of gastrointestinal

symptoms during this period. Differences in symptomatology may represent strain-specific differences, but this requires further investigation.

This study has several limitations. As a single-center study, our data might not be externally generalizable. Based on the availability and Ct values of our samples, we were able to collect WGS data for only 57% of our samples. Furthermore, a greater proportion of samples during the Omicron period (77.2% vs 47.6% in the pre-Omicron period) had a Ct <30 and were eligible for sequencing. The reasons for this are unknown but could be explained by reported immune evasion by Omicron,[4] leading to higher nasopharyngeal viral loads. Furthermore, the proportion of infections with symptoms was higher during the Omicron period; a previous study in children reported higher nasopharyngeal viral loads in children with COVID-19 symptoms.[17] To account for this, we also used time as a proxy for variant trends, as was done in prior studies,[10,11] although we acknowledge that this is an imperfect delineator. Additionally, the pre-Omicron and Omicron periods were distinguishable not only by their most prevalent VOC, but also by the ages of those eligible for vaccination against SARS-CoV-2. This could have impacted our data by skewing the age group younger or potentially by misrepresenting outcomes as Omicron-related as opposed to age-related. As an additional confounder, there was an increase in the number of children vaccinated against SARS-CoV-2 over time, which might have played a role in the increasing frequency of COVID-19 among vaccinated children in the later time periods. Furthermore, although we used an electronic state registry to identify vaccine history in our patients, and we consider this more reliable than report of vaccine history by the historian and documentation in the medical record, it is possible that some vaccinated children were not captured by this registry. Finally, the patients presenting at our hospital may have changed over time given the general change in testing patterns between the pre-Omicron and Omicron periods; during the latter, there was greater access to at-home SARS-CoV-2 tests, which could have impacted the number and medical complexity of patients who would have been tested previously at our hospital.

In summary, cases of COVID-19 after completion of a primary vaccine series against SARS-CoV-2 are increasingly likely to occur because of waning immunity and emerging VOCs with vaccine escape. Nevertheless, our data strongly suggest that vaccines are an effective and vital tool for reducing severe outcomes as a vast majority of COVID-19 cases after vaccination in our study were mild. As new VOCs arise, investigations of their vaccine-evading characteristics will be needed to monitor and quickly identify when additional nonpharmacologic risk mitigation tools should be used. This information will be particularly helpful to inform public health strategy in pediatric populations, as the safety of schools and childcare centers remains a priority. Continued investigation of COVID-19 in the vaccinated population also will be important to help guide booster shot priorities for children. ■

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Reprint requests: Larry K. Kociolek, MD, 225 E Chicago Ave, Box 220, Chicago, IL 60611. E-mail: lkociolek@luriechildrens.org

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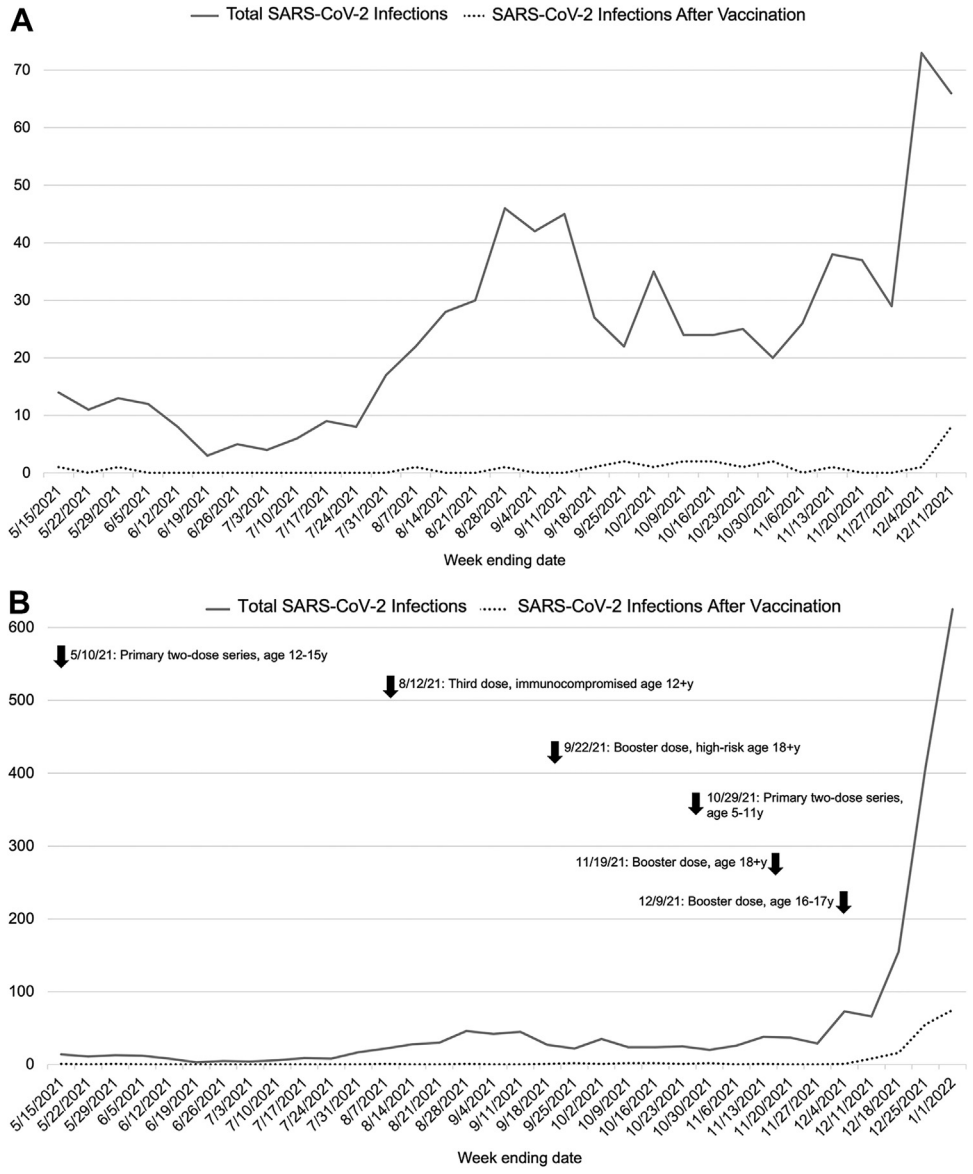

Figure 1. Incidence of total SARS-CoV-2 infection and SARS-CoV-2 infection after vaccination at Lurie Children's during the **A,** pre-Omicron study period (May 15, 2021, to December 11, 2021, prior to the substantial surge in SARS-CoV-2 infection activity) and **B,** the complete study period (May 15, 2021, to January 1, 2022). The solid line represents the total incidence of pediatric SARS-CoV-2 infection, and the dashed line represents the total incidence of SARS-CoV-2 infection after vaccination. In **B**, arrows indicate date of Food and Drug Administration Emergency Use Authorization of Pfizer-BioNTech SARS-CoV-2 mRNA vaccine in children and young adults aged 0-20 years. Not shown is the initial authorization of SARS-CoV-2 vaccine in adolescents aged 16+ years on December 11, 2020.

Table I. GISAID accession numbers, lineages, and VOC classification of 98 SARS-CoV-2 sequences included in the study

ID	GISAID accession	Pango lineage	NextClade clade	Variant classification
LCH-0984	EPI_ISL_9513520	BA.1.1	21K	Omicron
LCH-0985	EPI_ISL_9513521	BA.1	21K	Omicron
LCH-0986	EPI_ISL_9513522	BA.1	21K	Omicron
LCH-0987	EPI_ISL_9513523	BA.1	21K	Omicron
LCH-0988	EPI_ISL_9513524	BA.1	21K	Omicron
LCH-0990	EPI_ISL_9513525	BA.1	21K	Omicron
LCH-0991	EPI_ISL_9513526	BA.1.1	21K	Omicron
LCH-0992	EPI_ISL_9513527	BA.1	21K	Omicron
LCH-0993	EPI_ISL_9513528	BA.1	21K	Omicron
LCH-0994	EPI_ISL_9513529	BA.1	21K	Omicron
LCH-0995	EPI_ISL_9513530	BA.1	21K	Omicron
LCH-0997	EPI_ISL_9513531	BA.1	21K	Omicron
LCH-0998	EPI_ISL_9513532	BA.1	21K	Omicron
LCH-0999	EPI_ISL_9513533	BA.1	21K	Omicron
LCH-1000	EPI_ISL_9513534	BA.1	21K	Omicron
LCH-1001	EPI_ISL_9303283	BA.1	21K	Omicron
LCH-1003	EPI_ISL_9303285	BA.1.1	21K	Omicron
LCH-1004	EPI_ISL_9303286	BA.1	21K	Omicron
LCH-1005	EPI_ISL_9303287	BA.1.1	21K	Omicron
LCH-1006	EPI_ISL_9303288	BA.1	21K	Omicron
LCH-1007	EPI_ISL_9303289	BA.1	21K	Omicron
LCH-1008	EPI_ISL_9303290	BA.1	21K	Omicron
LCH-1009	EPI_ISL_9513535	BA.1	21K	Omicron
LCH-1012	EPI_ISL_9513536	BA.1	21K	Omicron
LCH-1013	EPI_ISL_9513537	BA.1.1	21K	Omicron
LCH-1014	EPI_ISL_9513538	BA.1	21K	Omicron
LCH-1015	EPI_ISL_9513539	BA.1.1	21K	Omicron
LCH-1016	EPI_ISL_9513540	BA.1.1	21K	Omicron
LCH-1017	EPI_ISL_9513541	BA.1	21K	Omicron
LCH-1018	EPI_ISL_9513542	BA.1	21K	Omicron
LCH-1020	EPI_ISL_9513543	BA.1	21K	Omicron
LCH-1021	EPI_ISL_9513544	BA.1	21K	Omicron
LCH-1022	EPI_ISL_9513545	BA.1	21K	Omicron
LCH-1023	EPI_ISL_9513546	BA.1	21K	Omicron
LCH-1024	EPI_ISL_9513547	BA.1	21K	Omicron
LCH-1025	EPI_ISL_9513548	BA.1	21K	Omicron
LCH-1029	EPI_ISL_9513549	BA.1	21K	Omicron
LCH-1030	EPI_ISL_9513550	BA.1	21K	Omicron
LCH-1032	EPI_ISL_9513551	BA.1.1	21K	Omicron
LCH-1033	EPI_ISL_9303291	BA.1.1	21K	Omicron
LCH-1034	EPI_ISL_9303292	BA.1	21K	Omicron
LCH-1035	EPI_ISL_9303293	BA.1	21K	Omicron
LCH-1036	EPI_ISL_9303294	BA.1	21K	Omicron
LCH-1037	EPI_ISL_9303295	BA.1.1	21K	Omicron
LCH-1038	EPI_ISL_9303296	BA.1	21K	Omicron
LCH-1039	EPI_ISL_9303297	BA.1	21K	Omicron
LCH-1040	EPI_ISL_9303298	BA.1	21K	Omicron
LCH-1041	EPI_ISL_9303299	BA.1	21K	Omicron
LCH-1042	EPI_ISL_9303300	BA.1	21K	Omicron
LCH-1043	EPI_ISL_9303301	BA.1	21K	Omicron
LCH-1044	EPI_ISL_9303302	BA.1.1	21K	Omicron
LCH-1045	EPI_ISL_9303303	BA.1	21K	Omicron
LCH-1046	EPI_ISL_9303304	BA.1	21K	Omicron
LCH-1050	EPI_ISL_9513552	BA.1	21K	Omicron
LCH-1051	EPI_ISL_9513553	BA.1.1	21K	Omicron
LCH-1053	EPI_ISL_9513554	BA.1.1	21K	Omicron
LCH-1055	EPI_ISL_9513555	BA.1	21K	Omicron
LCH-1057	EPI_ISL_9513556	BA.1	21K	Omicron
LCH-1058	EPI_ISL_9513557	BA.1	21K	Omicron
LCH-1059	EPI_ISL_9513558	BA.1.1	21K	Omicron
LCH-1060	EPI_ISL_9513559	BA.1	21K	Omicron
LCH-1062	EPI_ISL_9513560	BA.1	21K	Omicron
LCH-1064	EPI_ISL_9513561	BA.1	21K	Omicron
LCH-1067	EPI_ISL_9513562	BA.1	21K	Omicron
LCH-1068	EPI_ISL_9513563	BA.1.1	21K	Omicron
LCH-1069	EPI_ISL_9513564	BA.1	21K	Omicron
LCH-1070	EPI_ISL_9513565	BA.1	21K	Omicron
LCH-1071	EPI_ISL_9513566	BA.1.1	21K	Omicron
LCH-1072	EPI_ISL_9513567	BA.1	21K	Omicron

(*Continued*)

Table I. Continued

ID	GISAID accession	Pango lineage	NextClade clade	Variant classification
LCH-1075	EPI_ISL_9513569	BA.1	21K	Omicron
LCH-1076	EPI_ISL_9513570	BA.1	21K	Omicron
LCH-1078	EPI_ISL_9513571	BA.1	21K	Omicron
LCH-1079	EPI_ISL_9513572	BA.1	21K	Omicron
LCH-1080	EPI_ISL_9513573	BA.1	21K	Omicron
LCH-1081	EPI_ISL_9513574	BA.1	21K	Omicron
LCH-1082	EPI_ISL_9513575	BA.1	21K	Omicron
LCH-1084	EPI_ISL_9513576	BA.1	21K	Omicron
LCH-1087	EPI_ISL_9303305	BA.1	21K	Omicron
LCH-1088	EPI_ISL_9303306	BA.1	21K	Omicron
LCH-1138	EPI_ISL_9912753	P.1	20J	Gamma
LCH-1139	EPI_ISL_9912754	AY.26	21I	Delta
LCH-1141	EPI_ISL_9912757	AY.103	21J	Delta
LCH-1142	EPI_ISL_9912758	AY.103	21J	Delta
LCH-1145	EPI_ISL_9912759	AY.25	21J	Delta
LCH-1146	EPI_ISL_9912760	AY.100	21J	Delta
LCH-1147	EPI_ISL_9912761	AY.44	21J	Delta
LCH-1148	EPI_ISL_9912762	BA.1	21K	Omicron
LCH-1149	EPI_ISL_9912764	BA.1	21K	Omicron
LCH-1150	EPI_ISL_9912806	BA.1.1	21K	Omicron
LCH-1151	EPI_ISL_9912808	BA.1.1	21K	Omicron
LCH-1152	EPI_ISL_9912811	BA.1	21K	Omicron
LCH-1153	EPI_ISL_9912813	BA.1.1	21K	Omicron
LCH-1154	EPI_ISL_9912815	BA.1	21K	Omicron
LCH-1155	EPI_ISL_9912817	BA.1	21K	Omicron
LCH-1156	EPI_ISL_9912818	BA.1	21K	Omicron
LCH-1158	EPI_ISL_9912819	BA.1.1	21K	Omicron
LCH-1159	EPI_ISL_9912820	BA.1	21K	Omicron
20 157	EPI_ISL_9648695	BA.1	21K	Omicron

GISAID, Global Initiative on Sharing Avian Influenza Data.

Table III. Demographic and clinical characteristics of patients hospitalized because of COVID-19 following vaccination

Age, y	Sex	Patient medical history	Hospital course	Hospital length of stay	COVID-19 therapies
18	Female	Premature ventricular contractions	Symptoms: fever, cough, dyspnea, chest pain, vomiting, diarrhea Supportive care: admitted for observation and intravenous fluids because of dehydration; no supplemental oxygen requirement	24 h	No specific COVID-19 therapies
18	Female	Heart transplantation for congenital heart disease complicated by heterotaxy and polysplenia Patient has history of COVID-19 complicated by MIS-C in late 2020	Symptoms: fatigue, dyspnea, cough, sore throat Supportive care: no supplemental oxygen requirement	4 d	Remdesivir × 4 doses* Dexamethasone × 2 doses*
20	Female	Connective tissue disorder requiring methotrexate	Symptoms: congestion, cough, diarrhea Supportive care: admitted for observation and intravenous fluids because of dehydration; no supplemental oxygen requirement	48 h	No specific COVID-19 therapies
17	Male	Inherited endocrinopathy complicated by adrenal insufficiency	Symptoms: fever, cough Supportive care: in Emergency Department, developed hypotension and treated with stress-dose corticosteroids; no supplemental oxygen requirement	48 h	No specific COVID-19 therapies

MIS-C, multisystem inflammatory syndrome in children. None of these patients experienced a coinfection caused by another respiratory virus.
*Despite the lack of oxygen requirement, the patient was hospitalized for observation and received targeted COVID-19 treatment at the provider's discretion because of immunocompromising conditions and history of COVID-19 complicated by MIS-C.