

Low Prevalence of SARS-CoV-2 Detected in Symptomatic Children Admitted to Hospital

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Abstract

Aims

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) originated in Wuhan, China in 2019 and is responsible for the condition known as COVID-19. COVID-19 was first reported in Ireland in February 2020 with University Hospital Limerick's (UHL) first paediatric case reported on 4th March 2020. Studies have shown clinical manifestations of children's cases are generally less severe than those of adults.

UHL serves a catchment population of approximately 100,000 children. We aimed to describe the clinical presentation, and prevalence of SARS-CoV-2, in children requiring inpatient hospitalization during the initial phase of the pandemic in Ireland.

Methods

Data were examined relating to all inpatients aged 0 – 16 years admitted with a queried or confirmed diagnosis of COVID-19 from 8th February 2020 to 8th June 2020. Emergency Department notes and inpatient records along with laboratory and radiology records were reviewed.

Results

220 paediatric inpatients were tested by PCR for SARS-CoV-2 during this period; 101 (45.9%) were female. Ninety-five (43.2%) were diagnosed with 'viral illnesses'. Seven (3.2%) had laboratory-confirmed SARS-CoV-2, with an average age of 8.1 years (range: 0.59 years to 13.77 years). There were two Kawasaki-like illnesses admitted; both tested negative for SARS-CoV-2 on PCR. In our SARS-CoV-2 positive cohort, there was no associated significant morbidity and no associated mortality.

Conclusion

During the initial phase of the COVID-19 pandemic, prevalence of confirmed SARS-CoV-2 in symptomatic hospitalised children was low at 3.2%.

Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) originated in Wuhan, China in 2019 and is responsible for the condition known as COVID-19. COVID-19 was first reported in Ireland in February 2020, with the first paediatric cases reported in University Hospital Limerick (UHL) in March 2020¹.

During March 2020, the Irish government closed all schools, colleges, and childcare facilities and all non-essential businesses, venues, and public amenities, while banning all non-essential travel and contact with people outside the home².

Studies have shown clinical manifestations of children's cases are generally less severe than those of adults³. We aimed to describe the clinical condition, and prevalence of SARS-CoV-2, in children requiring inpatient hospitalization in a regional hospital during the initial phase of the pandemic in Ireland.

Methods

UHL is the Model 4 hospital for the Mid-West of Ireland. It serves a catchment population of 385,000, comprising of approximately 100,000 children. The Paediatric Emergency Department (ED) is one of the busiest in Ireland with approximately 16,500 attendances each year⁴. The Paediatric Department is a 50-bedded inpatient unit, providing surgical and paediatric care to children up to the age of sixteen years.

We included all paediatric admissions between February 8th, 2020 and June 8th, 2020 who were swabbed for SARS-CoV-2, using a clinical registry of all inpatients swabbed. February 8th 2020 was chosen as the starting date as our first query COVID-19 case was admitted on this date; June 8th 2020 was chosen as the end date as it coincided with the introduction of Phase Two of the Roadmap for Reopening Society and Business, reversing many restrictions⁵.

Patient charts were obtained via the Medical Records Department at UHL. Demographics, vitals in triage, ward of admission, length of stay, weight, Paediatric Early Warning Scores (PEWS), presenting symptoms, COVID-19 contact history, travel history, underlying conditions, treatments, discharge diagnosis, and tertiary care transfers from UHL were recorded. Nasopharyngeal swabs or combined oral/nasopharyngeal swabs were obtained and transported in a viral medium to the laboratory. Testing was performed initially at the National Virus Reference Laboratory in University College Dublin using RT-PCR. Local testing began 24th March 2020. A positive case was determined as a patient in whom SARS-CoV-2 was detected in upper respiratory tract sample. Highest/lowest values of white cell count, neutrophil count, lymphocyte count and C-reactive protein (CRP) were recorded. Radiology reports were collated from the radiology reporting system.

This study was reviewed and approved by the Research Ethics Committee at UHL. Positive cases were consented in a follow-up phone call in July 2020. For SARS-CoV-2-negative patients, the data are presented as summary data, to avoid inadvertent patient identification. Compliance with Data Protection Legislation was maintained at all times.

Results

During the study period, 220 inpatients were tested for SARS-CoV-2. Of these, 101 (45.9%) were female. 213 (96.8%) were admitted to the paediatric unit while seven (3.2%) were admitted to specified 'COVID Units' in UHL. Average length of stay was 2.5 days (range: 0-15) with a median length of stay of two days. The average age was 4.36 years (range: 0.01 years to 15.9 years). There were seven (3.2%) laboratory-confirmed cases of SARS-CoV-2.

Of the seven patients with Sars-CoV-2 detected, four (57%) were female. Of the seven tests, four (57%) occurred in March, one (14%) occurred in April and two (29%) occurred in May. Five (71%) were admitted to the paediatric unit while two (29%) were admitted to 'COVID Units'. Average age was 8.1 years with an age range of 0.59 years to 13.77 years. No laboratory-confirmed case required admission to the Paediatric High Dependency Unit (HDU) at UHL or transfer to a tertiary level centre. Mean length of admission was 3.2 days with the longest admission lasting seven days. Two patients required seven-day admission early in the pandemic as criteria at that time required a 'not detected' PCR result pre-discharge. The presenting complaints for the entire cohort are presented in Table 1.

Table 1: Presenting Complaints

	<i>Total Cohort (220)</i>	<i>Positive Cohort (7)</i>
Pyrexia	148 (67.2%)	6 (85.7%)
Cough	66 (30%)	2 (28.6%)
Vomiting	61 (27.7%)	0
Increased work of breathing	41 (18.6%)	1 (14.3%)
Reduced oral intake	40 (18.2%)	1 (14.3%)
Coryza	29 (13.5%)	0
Abdominal pain	25 (11.4%)	2 (28.6%)
Diarrhoea	22 (10%)	1 (14.3%)
Rash/skin infection	17 (7.7%)	0
Wheeze	13 (5.9%)	0
Seizure-like activity	12 (5.5%)	0
Lethargy	11 (5%)	0
Urinary symptoms	10 (4.5%)	0
Sore throat	9 (4.1%)	0
Other	8 (3.6%)	0
Irritability	5 (2.3%)	0
Chest pain	4 (1.8%)	0
Reduced output	4 (1.8%)	0

**Total cohort results are calculated as percentage of total population admitted. Positive cohort results are calculated as percentage of total SARS-CoV-2 positive patients.*

Ten (4.5%) patients had oxygen saturations less than 94%. As per PEWS, 127 patients' heart rates were outside the recommended range for their age while 28 patients' respiratory rates were outside their recommended range. On arrival, 79 (35.9%) patients had a PEWS score of zero. Highest PEWS during admission ranged from 0 to 12; median PEWS during admission was two. Of note, highest PEWS were not retrieved for 48 (21.8%) patients. When defining pyrexia as a temperature greater than 37.5C, 58 (26.4%) patients had pyrexia in triage.

In positive patients, two (28.6%) patients' heart rates were outside the normal range for their age. No respiratory rates were outside the recommended range. In triage, four (57%) of positive cases had PEWS of 0. Highest PEWS for this cohort was noted as three; both mean and median PEWS during admission was one. Two (28.6%) patients had a documented pyrexia in triage.

Blood results are presented in Table 2. Full blood count and CRP were performed in 193 (87.7%) patients. CRP was raised in 131 cases (range: 0-371) with a median of 15mg/L. Results were defined as normal, increased or decreased based on the normal range reported in the iLab system, which produces age-specific ranges for each parameter. Bloods were performed in five (71.4%) of our positive cases. CRP was mildly raised in two of our positive cohort. White cell count was abnormal in three of our positive cohort (60%), raised in two and decreased in one. Neutrophils were abnormal in one of our positive cohort (20%) while lymphocytes were increased in one case (20%) and decreased in one case (20%).

Table 2: Laboratory Investigations.

<i>Total Cohort Tested</i>	n = 193 (87.7%)		
	<i>Normal</i>	<i>Increased</i>	<i>Decreased</i>
White cell count (x10 ⁹ /L)	107 (55.4%)	68 (35.2%)	18 (9.3%)
Neutrophils (x10 ⁹ /L)	88 (45.6%)	91 (47.2%)	14 (7.3%)
Lymphocytes (x10 ⁹ /L)	117 (60.6%)	8 (4.1%)	68 (35.2%)
CRP (mg/L)	62 (32.1%)	131 (67.9%)	

104 (47.3%) patients had chest x-ray imaging; 52 (50%) were reported as normal. Peribronchial thickening was noted in 21 cases (20.2%), infiltration in eight (7.7%) and consolidation in eight (7.7%). Other reports included opacification (6.7%), interstitial changes (1.9%), hyperinflation (1.9%), atelectasis (1%), pleural effusion (1%), pneumothorax (1%) and bronchovascular prominence (1%). One positive patient underwent chest x-ray imaging which showed "patchy infiltrates in left lower zones".

Diagnoses at discharge were divided broadly as follows; 95 (43.2%) viral illnesses, 29 (13.2%) urinary tract infections, 30 (13.61%) lower respiratory tract infections, 18 (8.2%) neurological/seizures and 11 (5%) skin/eye infections. Nine (4.1%) were diagnosed with surgical issues (one was SARS-CoV-2 positive), eight (3.6%) with tonsillitis, four (1.8%) trauma injuries and two (0.9%) hip effusions; four had oncology-related diagnoses while two had haematological diagnoses. Three (1.3%) were treated for likely neonatal sepsis. Two (0.9%) patients had Kawasaki-like illnesses. Two patients received behavioural diagnoses, while one had constipation.

A diagnosis of 'viral illness' was made in 4 of our positive cases. One was a surgical patient with appendicitis; one had a diagnosis of post-streptococcal glomerulonephritis. Our final patient was asymptomatic and diagnosed as a result of being a close contact of a positive case. Neither of our Kawasaki-like illnesses had SARS-CoV-2 detected by RT-PCR. They have not undergone serology testing at this point. Both patients have fully recovered.

In total, six patients (2.7%) were known contacts of patients with COVID-19 while eight (3.6%) had recently returned from foreign travel. Of those known to be close contacts of cases, two had SARS-CoV-2 detected while inpatients at UHL; these two cases were also associated with recent travel abroad.

Underlying medical conditions were a feature in 85 (38.6%) admissions including asthma in 15, sequelae of prematurity in seven, cardiac lesions in seven, renal impairment in seven, epilepsy in six, malignancies in four, Trisomy 21 in three, haematological diagnoses in three and three with ventriculoperitoneal shunts. Two (28.6%) of our positive cases had underlying medical conditions; one had a history of atopy, the other had post-streptococcal glomerulonephritis.

Supplementary oxygen was required in 19 (8.6%) cases with one patient requiring high flow humidified oxygen via nasal cannula (HFNC) and one requiring non-invasive ventilation (NIV). Antibiotics were prescribed for 107 (48.6%) patients; the most commonly prescribed antibiotics were Co-Amoxiclav in 33 (30.8%) cases, Gentamicin in 30 (28%) and Ceftriaxone in 21 (19.6%). The antiviral Aciclovir was used for six (2.7%) of total patients. Tertiary care was required for nine (4.1%) patients.

There was no supplementary oxygen requirement for any positive patient, and no positive patient required HFNC or NIV. Co-Amoxiclav was prescribed in one case (14.3%). Antivirals were not utilised in these cases nor was tertiary care required.

On follow-up phone interview with our positive cohort, one patient reported ongoing symptoms of fatigue and headaches; the other six patients were well. There was no associated mortality.

Discussion

We present the first detailed study of children presenting with symptoms suggestive of COVID-19 to an Irish hospital. Our study of 220 inpatient swabs conducted at the Paediatric Department in UHL found 3.2% were positive for SARS-CoV-2 during a four-month period from February to June 2020, coinciding with the initial phase of the pandemic in Ireland. As of 8th June, 367,780 tests had been carried out in the Republic of Ireland with 25,215 positive results; this is a positive rate of 6.9%. Children aged 0-14 accounted for 1.91% of positive cases in Ireland and 1.14% of hospitalized positive patients⁶. There was a total of 1,691 COVID-19-related deaths in Ireland during this period; we had 0 mortalities in our cohort, in keeping with an extremely low mortality rate in the paediatric COVID-19 population, approximately 0.09%⁷.

There appears to be little symptomatically to differentiate COVID-19 from other childhood infections. Respiratory symptoms featured in 43.6% of total inpatients tested with a corresponding percentage (43%) diagnosed with a 'viral illness'. 28.5% of our positive cohort presented with respiratory symptoms with 57% presenting with gastrointestinal symptoms. Our COVID-19 cohort experienced a milder course of illness when compared to severity reported by adult populations⁹. 14.3% of our positive patients were asymptomatic; 85.7% received supportive care only. Average length of stay was two days, shorter than the usual length of stay reported for adult populations¹⁰. Testing pre-surgery resulted in an incidental finding of COVID-19 in one case.

COVID-19 was not associated with a significant rise in PEWS; our highest PEWS in a COVID-positive patient was three. Pyrexia was the most common symptom in our positive cohort (86%); however, pyrexia is a non-scoring parameter in PEWS¹¹.

Criteria for SARS-CoV-2 swabbing changed as understanding of this condition evolved. Similarly, radiology recommendations were amended over time to rely more on clinical signs and symptoms as opposed to chest x-ray findings. Our usage of chest x-ray decreased significantly in keeping with this; ultimately, 47.2% of our cohort obtained chest radiographs.

Multiple children with significant background diagnoses were admitted with queried COVID-19; none tested positive. The Mid-West has a significant population of children with cystic fibrosis, with 88 paediatric patients living with CF in the region; we had no COVID-19 admissions within this cohort, likely reflecting strict cocooning by this group. Schools in Ireland were closed from March 12th. All non-urgent outpatient services were postponed; 'telehealth' rose to the forefront of healthcare. Limerick is the third largest city in the Republic of Ireland; however, the UHL catchment area includes a large rural population with significant opportunity to social distance. These factors may all have contributed to a reduction of COVID-19 circulating in our population.

We had two Kawasaki-like illnesses admitted during this timeframe; these tested negative for COVID-19. The Paediatric Inflammatory Multi-System Syndrome (PIMS) associated with COVID-19 often presents with symptoms similar to Kawasaki Disease. A pre-print study at the University of Birmingham, showed that every child who had PIMS and tested negative for SARS-CoV-2 PCR subsequently showed high anti-SARS-CoV-2 antibody levels in their blood¹². We have not had the opportunity to perform serology testing on our two cases.

Laboratory findings were essentially non-specific in our population. Bloods were performed in 71% of our positive population with 60% showing abnormal white cell count; this was raised in 40% yet reduced in 20%. Lymphocytes were raised in 20% and reduced in 20%. These results are similar to Xia et al who report white cell count decreased in 20% with lymphocytes raised in 15% and reduced in 35%¹³.

Ten infants less than one month old were tested for SARS-CoV-2 with no positive cases. It should be noted that the maternity hospital in this region is located on a different site to UHL, possibly influencing our low numbers in this population.

Our study has several limitations. Only children admitted to hospital were included, introducing a clear selection bias, and so our findings cannot be generalised to the wider paediatric population in the community. However, the threshold to swab admitted patients was relatively low and, for the majority of the study, included children presenting with a pyrexia and/or respiratory symptoms and/or gastroenterology symptoms; therefore, if a child was symptomatic with COVID-19, they were likely to be detected. We cannot comment on the prevalence of SARS-CoV-2 in asymptomatic children. The prevalence of SARS-CoV-2 was low in children, even in this group presenting to hospital with symptoms. Therefore, we cannot comment on clinical factors that would predict positivity, nor can we comment with confidence on the clinical course of infection in children. The retrospective design of the study limits our ability to elicit an explanation for this, but one might hypothesise, as per other studies, that children are less severely affected when infected, or may be less likely to become infected altogether, or perhaps “lockdown” was effective at a national level¹⁴.

In conclusion, despite a low threshold for testing, our study demonstrates a low prevalence of SARS-CoV-2 in children requiring admission to hospital with symptoms suggestive of COVID-19 during the initial phase of the pandemic. Despite this, a high index of suspicion continues to be required to detect cases, and to minimise cross infection risk to patients and staff.

Declaration of Conflicts of Interest:

I can confirm that there are no conflicts of interest related to this paper.

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