Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Severe Coronavirus Disease-2019 in Children and Young Adults in the Washington, DC, Metropolitan Region

Roberta L. DeBiasi, MD, MS[1,2,3], Xiaoyan Song, MBBS, PhD[2,4], Meghan Delaney, MD[2,5], Michael Bell, MD[2,6], Karen Smith, MD[2,7], Jay Pershad, MD[2,8], Emily Ansusinha, MA[1], Andrea Hahn, MD, MS[1,2], Rana Hamdy, MD, MPH[1,2], Nada Harik, MD[1,2], Benjamin Hanisch, MD[1,2], Barbara Jantausch, MD[1,2], Adeline Koay, MBBS[1,2], Robin Steinhorn, MD[2,9], Kurt Newman, MD[2,10], and David Wessel, MD[2,6]

Despite worldwide spread of severe acute respiratory syndrome coronavirus-2, few publications have reported the potential for severe disease in the pediatric population. We report 177 infected children and young adults, including 44 hospitalized and 9 critically ill patients, with a comparison of patient characteristics between infected hospitalized and nonhospitalized cohorts, as well as critically ill and noncritically ill cohorts. Children <1 year and adolescents and young adults >15 years of age were over-represented among hospitalized patients (P = .07). Adolescents and young adults were over-represented among the critically ill cohort (P = .02). *(J Pediatr 2020;223:199-203).*

Since the emergence and worldwide spread of severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), published summaries have predominantly highlighted that children represent a small proportion (<2%) of coronavirus disease 2019 (COVID-19) cases, including hospitalizations and deaths.[1-3] Although children and young adults clearly are susceptible to SARS-CoV-2 infection, attention has focused primarily on their potential role in influencing spread and community transmission rather than the potential severity of infection in children and young adults themselves. Reanalyzed data from the epicenter of the Chinese outbreak noted that children represented 12% of infections.[4] To date, reports of severe disease in international pediatric populations have been limited, primarily descriptive; in the US, reports are limited only to incomplete public health epidemiologic data.[5-9]

See related article, p 14

Methods

This observational retrospective cohort study included 177 children and young adults with clinical symptoms and laboratory confirmed (177 of 1804; 9.8% of tested) SARS-CoV-2 infections treated between March 15 and April 30, 2020, at the Children's National Hospital, a large freestanding medical center located in Washington, DC. These 177 patients came to medical attention for clinical evaluation of symptoms to our emergency departments, ambulatory clinics, inpatient units, or by referral for admission from external facilities. From these 177 infected patients, we identified cohorts of nonhospitalized (n = 133) and hospitalized (n = 44) patients. Of the 44 hospitalized patients, we identified cohorts of noncritically ill (n = 35) and critically ill (n = 9) patients. The objective of this study was to determine if specific epidemiologic and clinical patient characteristics were more likely to be associated with hospitalization and/or critical care.

Data were extracted from medical records and recorded in a RedCap database, including age, sex, presence or absence of underlying medical condition, and presence or absence of fever or respiratory symptoms (rhinorrhea, sore throat, cough, shortness of breath), as well as other symptoms (diarrhea/vomiting, myalgia, chest pain, loss of sense of taste or smell, headache). The Fisher exact test was performed to examine differences in the distribution of categorical variables between hospitalized and nonhospitalized patients, as well as between hospitalized critically ill patients and noncritically ill patients. Continuous variables were evaluated using logistic regression. This project was submitted to the institutional review board and was determined to be a quality improvement initiative and not human subjects research.

Results

Of the 177 pediatric and young adult patients with SARS-CoV-2 infection, 44 (25%) required hospitalization. Of these

COVID-19	Coronavirus disease 2019
MIS-C	Multisystem Inflammatory Syndrome of Children
SARS-CoV-2	Severe acute respiratory syndrome coronavirus-2

From the [1]Division of Pediatric Infectious Diseases, Children's National Hospital, Washington, DC; [2]Department of Pediatrics, and [3]Department of Microbiology, Immunology and Tropical Medicine, The George Washington University School of Medicine and Health Sciences, Washington, DC; and [4]Division of Infection Control and Epidemiology; [5]Division of Laboratory Medicine and Pathology; [6]Division of Critical Care Medicine; [7]Division of Hospitalist Medicine; [8]Division of Emergency Medicine; [9]Division of Neonatology; and [10]Chief Executive Officer, Division of Pediatric Surgery, Children's National Hospital, Washington, DC

R.S. serves as an Associate Editor for *The Journal of Pediatrics*. The other authors declare no conflicts of interest.

https://doi.org/10.1016/j.jpeds.2020.05.007

44, 35 patients (80%) were noncritically ill and 9 (20%) were critically ill.

Age

Children and young adults from all age groups were infected by SARS-CoV-2, with a median age of 9.6 years (range, 0.1-34.2 years). The median age of hospitalized patients with SARS-CoV-2 infection-compared with nonhospitalized patients was not significantly different (9.6 years vs 9.5 years), but the median age of critically ill patients compared with noncritically ill patients was significantly higher (17.3 years vs 3.6 years; $P = .04$) (Table I). We found no overall difference in the representation of different age groups within the hospitalized and nonhospitalized cohorts, nor between the critically ill and noncritically ill cohorts. However, we noted a bimodal distribution of patients less than one year of age and patients >15 years of age representing the greatest proportion of patients within the SARS-CoV-2-infected hospitalized and critically ill cohorts. Children <1 year of age and children and young adults >15 years of age each represented 32% (14/44) of all hospitalized patients, accounting for a total of 64% of hospitalizations ($P = .07$). Adolescents and young adults >15 years of age represented 66% (6/9) of critical care admissions ($P = .02$) (Figure).

Sex

Males and females were equally represented within the total SARS-CoV-2-infected cohort (52% male, 48% female), as well as the infected hospitalized cohort (50% male, 50% female). There was a predominance of males in the critically ill hospitalized cohort (67% male, 33% female), but this difference was not statistically significant ($P = .26$)

Underlying Medical Conditions

Underlying medical conditions were also present in 69 of 177 patients (39%) with SARS-CoV-2 infection. The most frequent underlying diagnosis overall was asthma (35/177; 20%), but also included neurologic (6%), diabetes (3%), obesity (2%), cardiac (3%), hematologic (3%), and oncologic (1%) underlying conditions Underlying conditions were more common as a whole in the SARS-CoV-2-infected hospitalized cohort (27/44; 63%) compared with the infected nonhospitalized cohort (42/133; 32%;

Table I. Epidemiologic characteristics and clinical features of 177 children and young adults with symptomatic SARS-CoV-2 infection

Characteristics	Total, nonhospitalized and hospitalized (n = 177)	Nonhospitalized (n = 133)	Hospitalized (n = 44)	*P* value	Hospitalized, noncritical care (n = 35)	Hospitalized, critical care (n = 9)	*P* value
Age (y)							
Median (range)	9.6 (0.1-34.2)	9.5 (0.1-34.2)	9.6 (0.1-25.6)	.75	3.6 (0.1-21.5)	17.3 (0.1-25.6)	**.04**
Distribution, y							
<1	43 (24)	29 (22)	14 (32)	.22	13 (37)	1 (11)	.15
1-4	26 (15)	19 (14)	7 (16)		6 (17)	1 (11)	
5-9	23 (13)	21 (16)	2 (5)		2 (6)	0 (0)	
10-14	36 (21)	29 (22)	7 (16)		6 (17)	1 (11)	
15-20	37 (21)	28 (21)	9 (20)		6 (17)	3 (33)	
>20	12 (7)	7 (5)	5 (11)		2 (6)	3 (33)	
Sex							
Male	92 (52)	70 (53)	22 (50)	.76	16 (46)	6 (67)	.26
Female	85 (48)	63 (47)	22 (50)		19 (54)	3 (33)	
Underlying medical condition							
Yes	69 (39)	42 (32)	27 (63)	**.001**	20 (57)	7 (78)	.45
No	96 (55)	80 (60)	16 (37)		14 (40)	2 (22)	
Unknown	11 (6)	11 (8)	0	–	0	0	–
Reported underlying medical condition							
Asthma	35 (20)	28 (21)	7 (16)	.46	5 (14)	2 (22)	.62
Diabetes	5 (3)	3 (2)	2 (5)	.43	1 (3)	1 (11)	.37
Neurologic	11 (6)	3 (2)	8 (19)	**<.001**	5 (14)	3 (33)	.33
Obesity	4 (2)	3 (2)	1 (2)	1.00	0 (0)	1 (11)	.21
Cardiac	5 (3)	1 (1)	4 (9)	**.004**	2 (6)	2 (22)	.18
Hematologic	6 (3)	2 (2)	4 (9)	**.004**	4 (11)	0 (0)	.57
Oncologic	2 (1)	0 (0)	2 (5)	**.013**	2 (6)	0 (0)	1.00
Symptoms present at the time of visit							
Fever	116 (66)	82 (62)	34 (77)	.06	27 (77)	7 (78)	.97
Sore throat or congestion	77 (44)	66 (50)	11 (25)	**.004**	10 (29)	1 (11)	.28
Cough	99 (56)	83 (62)	16 (37)	**.003**	12 (34)	4 (44)	.57
Shortness of breath	27 (15)	16 (12)	11 (26)	**.04**	7 (20)	4 (44)	.13
Diarrhea or vomiting	27 (15)	20 (15)	7 (15)	.89	5 (14)	2 (22)	.56
Myalgia	25 (14)	21 (16)	4 (9)	.27	2 (6)	2 (22)	.59
Chest pain	16 (9)	10 (8)	6 (14)	.22	4 (11)	2 (22)	.40
Loss of sense of taste and/or smell	15 (9)	13 (10)	2 (5)	.28	2 (6)	0 (0)	1.00
Headache	25 (14)	24 (18)	1 (2)	**.01**	1 (3)	0 (0)	1.00

Values are number (%) unless otherwise indicated.
Bold indicates a statistically signficant $P < .05$.

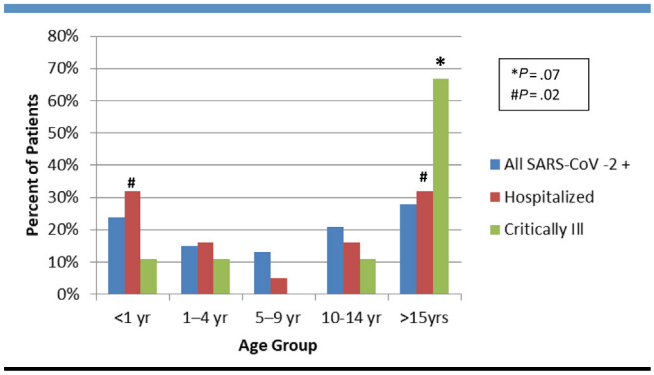

Figure. Age distribution of SARS-CoV-2-infected, hospitalized, and critically ill cases.

$P = .001$). Several specific underlying conditions were more common in the hospitalized as nonhospitalized patients. Specifically, neurologic disorders were more common in the hospitalized cohort (8/44; 19%; $P < .001$) compared with the nonhospitalized cohort (3/133; 2%; $P < .001$). Additionally, cardiac ($P = .004$), hematologic ($P = .004$), and oncologic ($P = .013$) diagnoses were more common in the hospitalized as compared with the nonhospitalized cohort. Although asthma was the most prevalent underlying condition overall, it was not more common in the hospitalized cohort (7/44; 16%) compared with the nonhospitalized cohort (28/133; 21%; $P = .46$) or in the critically ill cohort (2/11; 22%) compared with the noncritically ill cohort (5/35; 14%; $P = .62$). Comparing the SARS-CoV-2-infected noncritically ill and critically ill hospitalized patients, there were no significant difference in the presence of underlying conditions overall or any specific underlying diagnosis. Of note, there was no underlying condition present in 96 of 177 (55%) patients with SARS-CoV-2 infection overall, 16 of 44 (37%) hospitalized patients, and 2 of 9 (22%) critically ill patients.

Symptoms

The majority (134/177; 76%) of patients with SARS-CoV-2 infection came to medical attention with respiratory symptoms (rhinorrhea, congestion, sore throat, cough, or shortness of breath) with or without fever. However, only 85 of 177 (48%) had both fever and respiratory symptoms present. Fever was present in 116 of 177 (66%) of patients with SARS-CoV-2 infection, but was not more common in the infected hospitalized cohort (34/44; 77%) compared with the infected nonhospitalized cohort (82/133; 62%; $P = .46$). Shortness of breath was more common in the hospitalized cohort (11/44; 26%) compared with nonhospitalized (16/133; 12%; $P = .04$). However, less severe respiratory symptoms including sore throat and congestion ($P = .004$), or cough ($P = .003$), as well as headache ($P = .01$), were more common in the nonhospitalized cohort. Other symptoms were also present, including diarrhea and vomiting (27/177; 15%), myalgia (25/177; 14%), chest pain (16/177; 9%), and loss of sense of smell or taste (15/177; 9%), but presence of these symptoms did not vary significantly between cohorts. Patients in the critically ill cohort were not more likely to have fever or any other specific symptom compared with the noncritically ill cohort.

Critically Ill Cohort

Eight of 9 (89%) critically ill patients with SARS-CoV-2 infection required some level of respiratory support, with 4 requiring mechanical ventilation (3 meeting the definition of acute respiratory distress syndrome, 2 meeting the definition of multiple organ failure), 3 requiring bilevel positive airway pressure, 1 requiring nasal noninvasive ventilation via a RAM cannula and 1 via high-flow nasal cannula. One patient had features consistent with the recently emerged Multisystem Inflammatory Syndrome of Children (MIS-C) with Kawasaki disease shock- like presentation including hyperinflammatory state, hypotension, and profound myocardial depression. One addtional patient had MIS-C features without Kawasaki disease-like features and an additional patient with MIS-C global multisystem organ dysfunction. Details regarding these critically ill patients including the maximum respiratory support required are summarized in the **Table II** (available at www.jpeds.com).

Co-infection

Sixty-three of the first 105 patients with SARS-CoV-2 infection (60%) underwent concomitant multiplex molecular testing for respiratory pathogens; 59 of these 63 (94%) had no evidence of coinfection. Four of the 63 (6%) had codetection of routine coronavirus, respiratory syncytial virus, or rhinovirus/enterovirus, of unclear clinical significance.

Discussion

The Washington, DC, metropolitan region (Maryland, Virginia, and the District of Colombia) is in the midst of a steady increase of SARS-CoV-2 circulation in the 6 weeks since March 15, 2020. In contrast with published and anecdotal reports from other countries and regions of the US, our freestanding Children's Hospital has already evaluated and cared for a large number of children infected with SARS-CoV-2, including a significant number of children and young adults requiring hospitalization and critical care. This has occurred even before reaching the predicted peak surge of cases in our region at the time of this interim report. Twenty-five percent of patients presenting to our hospital with symptoms required hospitalization and 5% required critical care, including the need for intubation and mechanical ventilation, bilevel positive airway pressure, and high-flow nasal cannula. No deaths have been reported to date, but critically ill patients remain hospitalized on mechanical ventilation at the time of this interim report.

Although all age groups were infected with SARs-CoV-2, the youngest (<1 year) and oldest children/young adults (15-25 years of age) were more likely to be hospitalized,

and the oldest were the most likely to require critical care. Underlying conditions were also present in 39% of patients with SARS-CoV-2 infection overall but hospitalized and critically ill patients were more likely to have underlying conditions. Conversely, approximately 55% overall, 37% of hospitalized and 22% of critically ill patients had no underlying conditions, reinforcing the concept that social distancing and hygienic measures to avoid infection should be taken seriously in the pediatric age group, as well as adults.

Although asthma was the most common underlying diagnosis present in the overall group of children and young adults with SARS-CoV-2 infection, children and young adults with asthma were not over-represented in the hospitalized cohort or in the critically ill cohort. This suggests that although children and young adults with asthma may commonly experience exacerbation in response to SARS-CoV-2 infection, asthma exacerbation is not the primary determinant of more severe disease requiring hospitalization. Many underlying diagnoses that have been associated with more severe disease in adults were also present in our pediatric and young adult patients. However, only neurologic, cardiac, hematologic, and oncologic underlying diagnoses were significantly more common in the hospitalized cohort compared with the nonhospitalized cohort, and none was more common in the critically ill compared with the noncritically-ill cohort.

With regard to symptoms, shortness of breath was more common in hospitalized compared with nonhospitalized children and young adults, but other features did not clearly distinguish them from less ill children, including the presence of fever. Minor symptoms such as congestion, rhinorrhea, sore throat, cough, and headache were also present more commonly in the nonhospitalized cohort. As has been the case in adult reports, fewer than one-half of the patients had both fever and respiratory symptoms present at the time of their diagnosis, but the majorities have one or the other. Our critically ill cohort includes a previously well child with the newly emerged MIS-C hyperinflammatory phenotype of SARS-CoV-2-associated Kawasaki disease-like shock syndrome that has been identified concurrently within the same time frame at other centers internationally. An additional patient meeting MIS-C criteria in absence of Kawasaki features was also part of this critically ill cohort. The pathogenesis of this phenotype is not yet fully characterized, but it is important to recognize as yet another potential severe presentation in the pediatric population, However, the majority of critically ill patients had primary respiratory illness.

Coinfection with other viruses was distinctly uncommon in children and young adults with SARS-CoV-2 infection; 94% of those in whom this was assessed had no coinfection detected. Of the 6% who had an additional virus detected, enterovirus or rhinovirus was responsible for one-half, which is of unclear significance because enteroviruses are known to be shed asymptomatically and detectable for months after initial infection. There was no association between viral codetection and severity of disease.

The reasons for the observed increased severity of disease in our pediatric and young adult cohort requires additional detailed analysis, but potentially includes the comparatively higher population density in our region compared with the Western US and/or the higher representation of African American race and/or Latino/Hispanic ethnicity in our patient population, which has recently emerged as a risk factor for more severe disease in adult populations. It recently has been noted that introduction of SARS-CoV-2 to the Eastern US most likely occurred as a result of importation of European strains, rather than Asian strains, which were introduced to the Western US. Although no significant mutations conferring increased pathogenicity have yet been described, this potential difference merits further analysis.

Limitations of this study include the retrospective design and the fact that transmission is ongoing at a steady rate of increase in our region; thus, this analysis presents interim data, which will only be augmented further in the coming weeks. We plan to address the role of race and ethnicity after validation of current administrative data and have elected to defer this analysis until completed. One potential bias of this study is our regional role in providing critical care for young adults age 21-35 years of age with COVID-19. However only 2 such hospitalized patients were present in this study at the time of this interim report. Our study results would be expected to be generalizable to other regions on the East Coast with similar patient populations and population density, but may differ from other regions in the US that have yet to experience expansion and surge of SARS-CoV-2 cases, including rural areas.

In summary, our findings highlight the potential for severe disease in this age group and inform other regions to anticipate and prepare their COVID-19 response to include a significant burden of hospitalized and critically ill children and young adults. As SARS-CoV-2 spreads within the US, regional differences may be apparent based on virus and host factors that are yet to be identified. ■

We thank additional members of the Children's National Hospital COVID-19 Task Force including Joelle Simpson, MD; Rahul Shah, MD; Kathleen Gorman, RN; Linda Talley, RN; and Denice Cora-Bramble, MD. We also acknowledge the implementation of rapid SARS-CoV-2 testing by the Children's National Microbiology laboratory and Joe Campos, PhD.

Submitted for publication Apr 25, 2020; last revision received May 4, 2020; accepted May 6, 2020.

Reprint requests: Roberta L. DeBiasi, MD, MS, Chief, Division of Pediatric Infectious Diseases, Professor of Pediatrics, Microbiology, Immunology and Tropical Medicine, Children's National Hospital, 111 Michigan Ave NW, West Wing 3.5 Suite 100, Washington, DC 20010. E-mail: rdebiasi@childrensnational.org

References

1. CDC COVID-19 Response Team. Severe outcomes among patients with coronavirus disease 2019 (COVID-19) - United States, February 12-March 16, 2020. MMWR Morb Mortal Wkly Rep 2020;69:343-6.

2. Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72 314 cases from the Chinese Center for Disease Control and Prevention. JAMA 2020 [Epub ahead of print].
3. Dong Y, Mo X, Hu Y, Qi X, Jiang F, Jiang Z, et al. Epidemiology of COVID-19 among children in China. Pediatrics 2020;145:e20200702.
4. Sun D, Li H, Lu XX, Xiao H, Ren J, Zhang FR, et al. Clinical features of severe pediatric patients with coronavirus disease 2019 in Wuhan: a single center's observational study. World J Pediatr 2020;16:251-9.
5. CDC COVID-19 Response Team. Coronavirus disease 2019 in children - United States, February 12-April 2, 2020. MMWR Morb Mortal Wkly Rep 2020;69:422-6.
6. Tagarro A, Epalza C, Santos M, Sanz-Santaeufemia FJ, Otheo E, Moraleda C, et al. Screening and severity of coronavirus disease 2019 (COVID-19) in children in Madrid, Spain. JAMA Pediatr 2020 [Epub ahead of print].
7. She J, Liu L, Liu W. COVID-19 epidemic: disease characteristics in children. J Med Virol 2020;92:747-54.
8. Lu X, Zhang L, Du H, Zhang J, Li YY, Qu J, et al. SARS-CoV-2 infection in children. N Engl J Med 2020;382:1663-5.
9. Castagnoli R, Votto M, Licari A, Brambilla I, Bruno R, Perlini S, et al. Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection in children and adolescents: a systematic review. JAMA Pediatr 2020 [Epub ahead of print].

Table II. Details of critically ill children and young adults with SARS-CoV-2 infection

Age	Sex	Underlying diagnosis	Clinical features	Ventilatory support
7 weeks	Female	Trisomy 21, atrial septal defect	Symptom onset 12 days before admission: tachypnea, vomiting, diarrhea. Admitted on days 3-5 of symptoms for NC O_2; SARS-CoV-2 PCR negative. Readmission 3 days later due to progressive tachypnea, fever. CXR with right lower lobe pneumonia. Repeat SARS-CoV-2 PCR positive.	RAM cannula
4 years	Male	None	Symptom onset 5 days before admission: consistent with Kawasaki disease (fever, rash, strawberry tongue, cervical lymphadenopathy) presenting in hypotensive shock. Markedly decreased myocardial function consistent with myocardial injury. Initial 2 COVID tests negative, third positive (lower respiratory specimen). Presentation consistent with severe hyper-inflammatory state (affecting myocardium). Treated with IVIG, aspirin, and anakinra.	Intubated—PRVC support Highest FiO_2: 1.00 at intubation, but stabilized to 0.40 FiO_2 PEEP of 8
10 years	Male	Static encephalopathy, global developmental delay, chronic lung disease, seizure disorder, asthma	Acute-onset fever, increased work of breathing and decreased oxygen saturation from baseline 1-2 L oxygen overnight requirement (no baseline daytime oxygen requirement).	BiPAP Highest FiO_2: 0.50
16 years	Male	Microcephaly, global developmental delay, seizures, gastrostomy	Symptom onset 3 days before admission: fevers. Admitted after seizures, presented in septic shock. CXR with lobar pneumonia. Elevated troponin, acute kidney injury, liver injury, hypotensive (required pressors), hemodialysis. Treated with hydroxychloroquine.	Intubated—PRVC Highest FiO_2: 0.60 Highest PEEP: 10
17 years	Female	None	Symptom onset several days before admission: cough, congestion, myalgia. Presented with fever and dyspnea, shortness of breath. COVID+ exposure.	BiPAP Highest FiO_2: 0.35
19 years	Female	Type 1 diabetes, brain injury from prior DKA, mild cognitive impairment	Symptom onset 5 days before admission: fever, CXR with LLL consolidation. COVID+ exposure in group home setting.	Nasal cannula Highest O_2: 100% 4 L/min flow
20 years	Male	Static encephalopathy, traumatic brain injury	Symptom onset 2-3 days before admission: cough, dyspnea, fever. COVID+ exposure (father)	BiPAP Highest FiO_2: 0.35
23 years	Male	None	Symptom onset 5 days before CNH admission: cough, fever, progressing to shortness of breath, pleuritic chest pain, fatigue, chills, sputum production. Admitted to outside hospital 2 days before transfer and received hydroxychloroquine and azithromycin, tocilzumab, but progressed to intubation and transferred to Children's National on day 5 of illness. Multifocal pneumonia, MRSA bacteremia, multiorgan dysfunction, venous thrombosis, pulmonary embolism. Received second dose tocilzumab, antibiotics.	Intubated—PRVC Highest FiO_2: −1.00 (not weaned below 50% O_2 since admission) Highest PEEP: 20 (while on 100% O_2) Nitrous oxide × 6 days
25 years	Male	Morbid obesity, asthma, hypertension, tobacco use	Symptom onset 11 days before admission: mylagias, cough. Progressive respiratory distress, hypotension leading to admission, intubation, pressor support 5 days before transfer to CNH. Hypotension, diarrhea, hypokalemia, elevated troponin. Treated with antibiotics, hydroxychloroquine, azithromycin, tocilzumab. Transferred to CNH on day 11 of illness. Treated with convalescent immune plasma.	Intubated—PRVC Highest FiO_2: 0.60 Highest PEEP: 12

BiPAP, Bilevel positive airway pressure; *CNH*, Children's National Hospital; *CXR*, chest radiograph; *DKA*, diabetic ketoacidosis; *IVIG*, intravenous immunoglobulin; *LLL*, left lower lobe; *MRSA*, methicillin-resistant *Staphylococcus aureus*; *NC*, nasal cannula; *PCR*, polymerase chain reaction; *PEEP*, positive end-expiratory pressure; *PRVC*, pressure-regulated volume control.