The response of a pediatric ED to COVID-19

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Abstract: At the beginning of the pandemic, little was known about the effect of COVID-19 on children, urging pediatric health care systems to rapidly, efficiently, and safely address new challenges. This article describes structural, procedural, and functional changes developed in a pediatric ED to respond to the COVID-19 pandemic. The discussion also includes case studies to illustrate the changes made.

Keywords: coronavirus, COVID-19, ED, pediatrics, SARS-CoV-2

In late 2019, the healthcare response to the emerging COVID-19 pandemic has required rapid adjustments to already stressed EDs. In this article, we share how our ED in a free-standing pediatric health system developed a proactive response despite limited data on COVID-19 in the pediatric population to decrease the risk of potential exposures, improve the department's overall operations, and provide appropriate care.

As a 44-bed, Level I pediatric trauma center that sees 60,000 patients annually, we recognized the need for prompt action. Early in the COVID-19 pandemic, opportunities emerged at our pediatric ED to mitigate challenges in the management of patients with unknown or suspected COVID-19. In March 2020, the ED leadership team, which was composed of the ED medical and nursing directors, nurse manager, coordinator of operations, director of process improvement, clinical nurse specialist, clinical nurse educator, continuous improvement coordinator, and the forensic nurse coordinator, established a daily ED COVID

Operations (Ops) huddle, wherein this team discussed updates on any required initiatives, processes, education, training, and status of personal protective equipment (PPE) and supplies. Updates from these huddles were communicated to the entire ED team via email and posted to a private ED-specific channel, which all ED team members could access on their personal devices. The ED COVID Ops team reported through the hospital incident command system.

While there was a decrease in the volume of pediatric patients who presented to the ED, there was an increased need to provide COVID screening to staff at the multiple hospital entrances. Pediatric patients and their families arriving in the ED were met by a screener stationed at the entrance. Screenings were performed via questions recommended by the CDC and our infectious-disease specialists.¹ After screening, patients were triaged and directly roomed in the ED's positive-screened side or in the negative-screened side. Patients received a full triage assessment in a room with the door closed and with

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staff wearing appropriate PPE. The ED space was divided in half, and any patient, regardless of illness/injury severity could be treated on either side.

To track the effectiveness of the ED's COVID-19 screening tool, 3,465 patients under the age of 21 were followed. Of the 1,714 who screened positive and for whom COVID-19 testing was indicated, 162 (9.4%) tested positive. Of the 1,562 patients who screened negative and for whom COVID-19 testing was indicated, only 27 (1.7%) ultimately tested positive. Although the screening tool was not foolproof, it had a higher prediction of positivity when linked to patients for whom testing was indicated as opposed to pre-tool use.

All patients who arrived by ambulance were screened if appropriate, and all unstable patients who presented were treated as patients suspected of having COVID-19. Patients who required a trauma evaluation were received by the trauma team in full PPE required for potential aerosol-generating procedures (AGP) in a resuscitation room. This PPE includes an appropriately fitted N95 mask, goggle eye protection, gloves, and a fluid-impermeable gown. Any nontrauma-related active resuscitation or patient with impending endotracheal intubation was received in an area directly inside the ambulance bay.

Resuscitation carries an increased risk of exposure to COVID-19.² Chest compressions, positive-pressure ventilation, and the placement of an advanced airway all cause viral particles to circulate in the air.³ As such, the area inside the ambulance bay was transformed into a negative-pressure room that allowed for a 20-minute room-air recycle when AGP was required. The updated American Heart Association cardiac arrest algorithm for patients with suspected or confirmed COVID-19 was used, which included performing endotracheal intubation by a

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highly experienced provider, holding chest compressions during intubation, and using a high-efficiency particulate air filter for any positive-pressure ventilations provided manually or mechanically.²

Simulations were performed to gauge the absolute minimum number of staff required in the room during resuscitation in order to limit exposure and develop a reliable process without breaching the negative-pressure enclosure. Backup staff members were required to stay outside of the infection containment space and be on call. Room turnover time was also done quickly related to the negative-pressure airflow. Once the process was finalized for the utilization of the new negative-pressure room, the ED's interprofessional team participated in ongoing simulation training. The hospital's critical care transport team was also involved in developing a process that used this area to minimize exposure risk and ensure care for decompensating pediatric patients while en route.

COVID-19 in pediatrics

Much of the available COVID-19 literature is related to the incidence of SARS-CoV-2 in adults. As the pandemic continues to evolve, more information is becoming available regarding its impact on pediatric patients. A review of literature found several studies that describe the epidemiology of SARS-CoV-2 in pediatric patients, along with clinical manifestations.³

Estimates vary, but the incidence of COVID-19 in pediatrics is believed to be low, with most studies toward the end of 2020 citing less than 10% of infections are in children.⁴ However, by the end of summer 2021, cases have risen to 28.9%.⁶

At our pediatric ED, the percentage of pediatric patients under 21 years of age who tested positive for COVID-19 is in line with national averages. From March 18, 2020, to December 21, 2020, we had a total of 24,947 ED visits and performed a total of 5,235 polymerase chain reaction (PCR) tests for COVID-19. Of all tested patients, 237 (4.5%) were positive. Those tests resulted in 2,204 patient admissions to the hospital. For all admitted patients, 57 (2.6%) were positive for COVID-19. Of note, admitted patients were not necessarily admitted due to COVID-19-related clinical findings. A total of 3,031 discharged patients who met the criteria of our hospital COVID-19 clinical pathway were also tested. Of the tested and discharged patients, 180 (5.9%) were positive for COVID-19.

Shekerdeman, et al., published a study on the characteristics and outcomes of children with COVID-19 infection admitted to US and Canadian pediatric ICUs.³ In their study, the authors report that 83% of pediatric ICU admissions had significant preexisting comorbidities.³ Additionally, the CDC reported that a review of 295 pediatric patients who were diagnosed with COVID-19

showed that 77% had one or more underlying medical conditions.⁴

The signs and symptoms of COVID-19 in pediatric patients may correlate with viral infections like influenza. These can include fever, cough, sore throat, fatigue, vomiting, and diarrhea. Of these, fever is the most commonly reported sign in children.⁵ In the pediatric population, “virus season” is often referred to as the time of year these patients present with similar signs and symptoms. This can make it difficult to accurately screen patients presenting to the pediatric ED for COVID-19. Our ED is proactively screening and administering seasonal influenza vaccines to minimize the impact of the virus season.

Multisystem inflammatory syndrome in children (MIS-C) is a rare but serious condition associated with COVID-19.⁴ Its presentation overlaps with Kawasaki disease, toxic shock syndrome, and severe sepsis.⁵ Some patients have presented with hypoperfusion or hypotension.⁵ However, much about MIS-C remains unknown (read “Multisystem inflammatory syndrome in children: A complication of COVID-19” in our October 2021 issue). Our pediatric health system developed a pathway for patients who present with these signs and symptoms.

Case studies

The following case studies provide examples of patients that have presented to the pediatric ED. These cases illustrate the changes made to accommodate pediatric patients with COVID-19.

Pediatric Case Study 1

An 11-year-old female presented to the ED via ambulance as a Trauma Alert due to a gunshot wound to the hip. All team members donned appropriate PPE before the patient's arrival due to unknown COVID-19 status. Upon arrival to the resuscitation room, the patient was awake, alert, and oriented, and answered ques-

tions appropriately. Bleeding from the wound was well controlled, and the patient's abdomen was soft. Initial vital signs were heart rate 96 beats/minute, BP 112/72, respirations 19 breaths/minute, and oral temperature of 98.2° F (36.8° C). The patient was hemodynamically stable.

While in the ED, venous access was established and a normal saline bolus and analgesia were administered. Radiographs of the hip, and subsequent computed tomography (CT) were obtained. CT showed an entrance wound in the right superior gluteal region and subcutaneous air extending along the bullet tract with a bullet lodged in the right rectus abdominis muscle. Subsequently, an exploratory laparotomy was scheduled to remove the foreign body, and in preparation for surgery, a rapid COVID-19 test was ordered.

To help guide providers in ordering the correct COVID-19 test, an algorithm was created in conjunction with Infection Prevention and Infectious Disease (see *COVID-19 evaluation and testing pathway*). When a patient presenting to the ED is either symptomatic or requires a surgical intervention, a rapid COVID-19 test is ordered, with results in less than 2 hours. If a patient is asymptomatic and is being admitted, a SARS-CoV-2 RNA PCR (COVID-19) test, which can take 12 hours for results, was ordered through the immunology lab.

In the case of this patient, her rapid COVID-19 test result was positive, which impacted her care and management. First, the patient was placed into a resuscitation room, which maintains a constant positive-pressure and can function as a full operating suite if needed. To mitigate the potential exposure from this patient, the care team and the patient's family member remained in surgical masks, which provide fluid resistance and protect the wearer from inhaling large droplet respiratory emissions. Additionally, the doors to

the room remained closed unless a team member had to enter or exit. Second, the OR was prepared to provide airway management and operative care to a patient who is COVID-19-positive. Because the patient was hemodynamically stable, it was determined that the patient could wait a few hours to go to the OR to minimize any disruption to the pre-planned schedule. The patient was transported to the OR wearing an ASTM Level 1 surgical mask with her parent and then afterward was admitted to the COVID unit of the hospital. This patient was discharged from the inpatient unit on day 2 of admission. The patient was scheduled for follow-up with our Trauma Clinic and her primary care provider.

Pediatric Case Study 2

A 16-year-old male with a chief complaint of flulike symptoms presented to the ED at approximately 1430. The patient reported tactile fevers and throat pain with cough for 5 days. He also reported a generalized red rash over his body and nausea, vomiting, and diarrhea for 3 days. This young man was a previously healthy, Spanish-speaking male with no significant health history. He was up-to-date on immunizations and had no known allergies.

Upon arrival to the ED, the patient had a low-grade fever and chills with cough, mild abdominal pain, and a generalized rash. He had a positive COVID-19 screen based on questions asked upon arrival and was escorted appropriately to our designated area for patients presenting with signs and/or symptoms of COVID-19. The bedside team wore appropriate PPE and assumed COVID-19-positive status until proven otherwise. The patient's initial vital signs included a temperature of 100° F (37.8°C) orally (acetaminophen given prior to arrival), heart rate 130 beats/minute, respirations 20 breaths/minute, BP 90/43, and oxygen saturation 99% on room

air. The patient was awake, alert, and oriented with clear lung sounds bilaterally; brisk capillary refill; with a red, blanchable, generalized rash.

After the ED providers evaluated this patient, initial orders included a COVID-19 PCR, respiratory viral panel PCR, complete blood cell (CBC) count with differential, comprehensive metabolic panel (CMP), a 1 liter bolus of 0.9% normal saline, and ondansetron. After the initial bolus, the patient re-

mained hypotensive, and an additional bolus was given. The patient's lab results included a positive COVID-19 PCR test, an unremarkable respiratory viral panel, CBC with leukocytosis at 14,000 cells/mcL (normal, 4,400 to 11,000 cells/mcL) and elevated neutrophils, and a normal CMP.

In conjunction with the patient's presentation and a confirmed positive COVID-19 PCR, the ED providers developed a pathway for MIS-C.

Our organization uses this pathway to screen all positive COVID-19 patients who require ICU-level care. Additional labs ordered included brain natriuretic peptide (BNP), C-reactive protein, blood cultures, disseminated intravascular coagulation screen, erythrocyte sedimentation rate (ESR), troponin, and a chest radiograph. Persistent hypotension was treated with fluid resuscitation. A consult with Critical Care was com-

COVID-19 evaluation and testing pathway

Presentation (prior to testing)	Aerosol Generating Procedure?	Precautions	Admission Guidance including Testing (if COVID PCR result within the last 72 hrs, do not retest- if negative, admit to appropriate non-COVID unit)
No symptoms ¹ AND No exposure ²	No	Ear loop mask-level 1 Tie mask-level 3 (for surgical procedures) + Standard Precautions (eye protection if eye splash risk from respiratory secretions or body fluids, gloves, and gown for blood or body fluids)	Admit to appropriate non-COVID unit • ED admit - Standard test³ in ED • Direct admit from specialty clinic or transfer from another facility: Standard tests³ after admission • Urgent OR cases: Rapid test in ED (await results if clinically safe), post-op admit to appropriate unit per test result • Non-urgent pre-procedure and other scheduled admits not tested prior to admission: Standard test³ after admission
	Yes	Enhanced Airborne + Contact Precautions N95 (or PAPR) Eye protection (face shield or goggles) Gown and gloves	Admit to appropriate non-COVID unit • ED admit - Standard test³ in ED • Direct admit from specialty clinic or transfer from other facility: Standard test³ after admission. • Urgent OR cases: Rapid tests in ED , (await results if clinically safe), post-op admit to appropriate unit per test result • Non-urgent pre-procedure and other scheduled admissions not tested prior to admission: Standard test³ after admission
At least 1 symptom ¹ OR Exposure ²	No	Enhanced Droplet + Contact Precautions Ear loop mask-level 1 (or Tie mask- level 3 for surgical procedures) Eye protection (face shield or goggles) Gown and gloves	• ED admit- Rapid test⁴ in ED: Keep in ED and result known, then admit to appropriate unit per test result. • Direct admit from specialty clinic or transfer from other facility: Admit to COVID unit. Standard test ³ after admission. Can be transferred if COVID-19 negative • Urgent OR cases: Rapid test in ED. (await results if clinically safe), post-op admit to appropriate unit per test result
	yes	Enhanced Airborne + Contact Precautions N95 (or PAPR) Eye protection (face shield or goggles) Gown and gloves	• ED admit - Rapid test in ED⁴: Keep in ED until result known, then admit to appropriate unit per test result. • Direct admit from specialty clinic or transfer from other facility: Admit to COVID unit. Rapid Test⁴ after admission. Can be transferred if COVID-19 negative • Urgent OR cases: Rapid test⁴ in ED. (await results if clinically safe), postop admit to appropriate and per test result

pleted with the suggestion to begin vasopressors in the ED. Further results included an elevated ESR, BNP, fibrinogen, d-dimer (as high as 21,684 ng/mL; normal, <500 ng/mL), and troponin, which is indicative of MIS-C.⁷ The chest radiograph was normal.

The patient was started on I.V. vasopressors and transferred to our Pediatric Intensive Care Unit (PICU) for continued management, including endotracheal intubation. During his PICU admission, he developed myocarditis and respiratory failure. His length of stay was 12 days, and he was discharged with clinical improvement and all necessary medications and follow-up with Hematology and Cardiology. While it was reported there were no known exposures or sick contacts, it was later reported this patient was playing soccer with a large group of teens. Of this group, nine report-

edly became ill, and one subsequently died at the age of 15 years.

Our pediatric ED has developed guidelines, algorithms, and clinical pathways to respond to the unique needs of pediatric patients amid the pandemic. Noting that there is still much to learn about the effects of COVID-19 on children, these countermeasures continue to evolve and incorporate the most current evidence-based recommendations from the CDC and emerging research. ■

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The authors have disclosed no financial relationships related to this article.

DOI-10.1097/01.NURSE.0000795276.93760.b7