Multisystemic Inflammatory Syndrome in Pediatric Patients
AI and Analytics in the Fight Against COVID-19
A SCALABLE HEALTH WHITE PAPER
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INTRODUCTION

Coronavirus disease 2019 (COVID-19) is an infectious disease caused by the newly discovered coronavirus, SARS-CoV-2. The virus was first identified in Wuhan, China, in December 2019 after an outbreak of unidentified pneumonia and reported to the WHO on December 31, 2019. Although most people experience mild to moderate respiratory symptoms, it was initially believed that only adult populations and those with underlying medical problems were susceptible to worsening symptoms. Yet, cases started to appear in pediatric instances across the world in April and now makeup approximately 2% of the total cases worldwide. By early February 2020, the Chinese CDC reported pediatric patients diagnosed with COVID-19, although data remained limited due to low case volume. However, in April, physicians in the UK were first alerted about the multisystem inflammatory syndrome, after which physicians in other European countries reported clusters of similar cases. On May 14, the United States CDC issued a health advisory to thousands of doctors stating that an inflammatory syndrome has been associated with COVID-19 infection among children and young adults. The CDC is currently collaborating with domestic and international partners to investigate reports of a multisystem inflammatory syndrome associated with coronavirus. As of now, recommendations state that all pediatric patients presenting with the clinical manifestations should get COVID PCR if negative, antibody testing, and other laboratory studies and cardiac testing. However, another critical tool, artificial intelligence, has played a crucial role in helping combat COVID-19. As a result, research groups and institutions are exploring the use of AI and analytics in the prevention and spread of COVID-19 and may even assist in the diagnosis of multisystemic inflammatory syndrome in future studies.

Epidemiology of MIS-C

MARCH 15 – MAY 20, 2020

NUMBER OF CASES IDENTIFIED IN REPORTING STATES

- State not reporting
- 1-6
- 7-14
- 15-21
- 22-29

Hospital-reported MIS-C Cases by State
In April 2020, pediatric specialists began to notice an increase in the number of patients diagnosed with Kawasaki disease as compared to the previous years. Kawasaki disease is an acute, self-limited febrile illness of unknown cause that predominantly affects children less than five years of age. Yet, many of the recent patients presented were up to 21 years of age but still tested positive for elevated inflammatory markers. Ultimately, positive antibody testing for each of the patients combined with a set of symptoms consistent with other patients around the world led to the diagnosis of the multisystemic inflammatory syndrome. Multisystem inflammatory syndrome (MIS-C), formerly referred to as pediatric inflammatory multisystem syndrome (PIMS), is a rare inflammatory disease in the blood vessels affecting various organs, including the heart, lungs, kidney, brain, skin, eyes, or GI. It affects approximately 0.6% of the severe cases of pediatric patients infected with COVID-19. MIS-C shares common features with other pediatric inflammatory conditions, including Kawasaki disease and toxic shock syndrome (TSS). At this time, the CDC is still attempting to understand MIS-C and why some children are symptomatic while others are not. However, it is established that most children who initially presented with MIS-C had been exposed to COVID-19 or around someone with COVID-19.

**WHAT IS MULTISYSTEMIC INFLAMMATORY SYNDROME?**

- **Headache**
- **Meningism’s Lethargy**
- **Nausea Vomiting Abd pain diarrhea AST/ALT**
- **Hyponatremia Renal Failure**
- **Thrombocytopenia Neutrophilia Lymphopenia**

**Lab evidence of current or past infection with SARS-CoV-2**

- High ESR, CRP, Ferritin, LDH, IL-6, Fibrinogen, Procalcitonin, CPK, D-dimers etc.,

**Fever Myalgia Conjunctivitis Rash, Lymphadenopathy, Stomatitis, Extremity swelling with erythema Skin peeling**

- **Myocarditis, Troponin, Pro-BNP Coronary aneurysms, Hypotension Hypoperfusion, Tachycardia**

- **Hypoxemia Pulmonary infiltrates Chest pain**

- **Multisystem inflammatory Syndrome in Children (MIS-C)**

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THE LINK BETWEEN MIS-C AND COVID-19

Although the case definition is still undefined, there are multiple features seen in critical pediatric cases, including negative COVID-19 testing, shock, and cardiac dysfunction, and MIS-C. These patients' clinical presentations may include TSS-like refractory vasodilatory shock with normal cardiac function, septic, cardiogenic shock with impaired cardiac function (mostly likely left ventricular function), either typical or atypical presentation of Kawasaki-like disease, or any of the above combination. The time of the display of symptoms usually occurs one month after infection, which is why most cases test negative for COVID-19, although positive for antibodies. Based on early studies, it appears that children of all ages are at risk for COVID-19, although complications still seem to be less common among children than adults. However, abdominal symptoms appear more often than the respiratory symptoms seen in adult patients, and children may present with other symptoms, including fever, sore throat, headache, rash, or conjunctivitis.
Since 2013, the CDC has been hosting an annual competition to most accurately predict the severity and spread of influenza. The competition received dozens of entries, many of which used machine learning algorithms that have been trained to determine correlations on large datasets. However, many of those teams that used to be involved in the influenza challenge are now moving their focus towards spread of COVID-19. In response to the COVID-19 pandemic, the White House and other leading research groups have prepared the COVID-19 Open Research Dataset (CORD-19), a resource available to global research communities to apply analytics and AI techniques to generate insight in support of the fight against COVID-19. The goal in this global pandemic is to use AI tools to identify the first signs of a new disease outbreak, assess the current state of an epidemic, and help recover the disease.
Before the world was even aware of the threat posed by COVID-19, AI systems had first detected the outbreak, which has become a global pandemic. Boston Children’s Hospital’s website, HealthMap, is an artificial intelligence system that acts as an early warning system and is the first to raise attention to the COVID-19 pandemic. HealthMap uses AI to scan for signs of COVID-19 outbreak in media reports, news reports, internet search queries, and other information streams. Across the globe, AI researchers have been teaming up with tech companies to monitor for signs of outbreaks using similar methods to watch mainstream news, online content, and other information channels in multiple languages. Other institutions such as Johns Hopkins University and OECD have also made available interactive dashboards that track the virus spread through news and real-time data on confirmed cases, recoveries, and deaths.
Early studies have shown AI as a potential tool for rapidly diagnosing COVID-19 patients. With the assistance of AI algorithms, integrating chest CT findings with clinical symptoms, exposure history, and laboratory testing can lead to the rapid diagnosis of patients positive for COVID-19. Therefore, AI algorithms have an essential role and can help triage the health system and combat the current pandemic. The implementation of a joint algorithm could decrease the overburden in the health system and identify any abnormal morphology and severity of pathological findings on imaging. A recent study of 20 pediatric patients with COVID-19 reported that the chest CT demonstrated abnormalities, with 100% of the patients showing subpleural lesions, unilateral (30%) or bilateral (50%), GGO (60%), and consolidation with a halo sign (50%). Thus, AI algorithms can be integrated as a tool to quickly diagnose pediatric patients positive for COVID-19 given their exposure history and laboratory testing to identify abnormal morphologies that tend to be present in pediatric patients.

Using three CT scans from a single coronavirus patient, the RADLogics algorithms quantifies the amount of recovery with a “corona score.”
CONCLUSION

Further research must be conducted to evaluate the efficacy of AI in COVID-19 pediatric patients, given the low case numbers. However, AI could have great potential in the prevention and spread of COVID-19 in pediatric patients and quickly diagnose MIS-C. Although AI cannot replace traditional public health monitoring, it can certainly be used to analyze the data being collected and help prevent the spread of the disease, diagnosis, and recovery. As the pandemic continues, social distancing and school closures remain in place to prevent further spread of the disease in children. However, modeling studies of COVID-19 have predicted that school closures alone would only prevent 2-4% of death, far less than other social distancing interventions. Therefore, utilizing AI technology in pediatric patients can assist with surveillance and contact tracing to prevent the spread of the virus in children, paving a safe and sound future for the upcoming generations.

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