The Kids Will be Alright…Right?
A Primer and Update on Pediatric SARS-CoV2 Exposure

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Director of Research, Critical Care Medicine
@BasuND22

FORCE COLLABORATIVE
3.12.21
Disclosures

- BioPorto Diagnostics
- Baxter Acute Therapies Institute
- bioMerieux
- Potrero Medical
- BD Medical
- CHF Solutions
Acknowledgements

the choice of topic today was intentional

• March 11, 2020
  • WHO declares pandemic
  • NBA cancels season
  • President Trump addresses nation
  • Congress cannot pass coronavirus relief
  • COVID Figures (US/World)
    • Cases (1267/118000)
    • Deaths (38/4300)

• March 11, 2021
  • Three different vaccines
  • NHL, NFL to complete seasons
  • President Biden addresses nation
  • Congress passes coronavirus relief
  • COVID Figures (US/World)
    • Cases (29.3M/118M)
    • Deaths (530K/2.63M)
Acknowledgements

for the children we have lost

CDC.gov: 3.12.21 – 8:30am
Acknowledgements

- CHOA Teams, Nurses, Staff, Physicians
- Special thanks to the ED / PICU / CICU teams
Pensa.

**will the kids be alright? - a prospectus**

- Adults are Not Kids: The Unique Pathology of Pediatric SARS-CoV2
- Time Equals Data: The Trajectory of the Epidemiology
- Kids Are Often Not Alright: Organ Damage in SARS-CoV2
- The Pediatric COVID-19: Multi-inflammatory Syndrome in Children
- Stop the Blame! : Asymptomatic Carrier and Transmission
- The Future: The choir needs to preach
Pensa.

*will the kids be alright? - a prospectus*

- Kids are not adults: The Unique Pathology of Pediatric SARS-CoV2
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Transmission/Communication of Virus across Hosts
SARS-CoV2 Spike Protein → Infiltration into Endothelium
Intracellular viral transcription
Pro-inflammatory messaging
Induction of host response – dysregulated immunity
End-organ effects

Viral factors
SARS-like bat CoVs
Intermediate host(s)?
Domestic animals?

SARS-CoV-2
S protein, attaching to host receptor ACE2, including two subunits S1 and S2:
• S1 determines the virus host range and cellular tropism by RBD
• S2 mediates virus-cell membrane fusion by HR1 and HR2

M Protein, responsible for the transmembrane transport of nutrients, the bud release and the formation of envelope

N Protein
E Protein
16 non-structure proteins: nsp1-nsp16

Pro-inflammatory messaging
Induction of host response – dysregulated immunity
End-organ effects

Host factors
SARS-COV-2 receptor: Human angiotensin converting enzyme 2 (hACE2)
Individuals who are more susceptible to severe disease:
• Elderly (> 65 years of age)
• People with underlying diseases

Severe complications:
• Respiratory distress syndrome
• Septic shock
• Metabolic acidosis hard to correct
• Coagulation dysfunction
• Multiple organs failure

Cytopathic effect (CPE) and cytokine storm or sustained inflammatory responses, hypoxia, septic shock, etc. may be related to the critical conditions of SARS-CoV-2 infected patients
Understanding the age divide in COVID-19: why are children overwhelmingly spared?

K. Lingappan,1 H. Karmouty-Quintana,2 J. Davies,1 B. Akkanti,3 and M. T. Harting4
1Division of Nephrology, Department of Pediatrics, Baylor College of Medicine, Houston, Texas; 2Department of Biochemistry and Molecular Biology, McGovern Medical School, The University of Texas Health Science Center at Houston, Houston, Texas; 3Divisions of Pulmonary, Critical Care, Sleep Medicine, McGovern Medical School, The University of Texas Health Science Center at Houston, Houston, Texas; and 4Department of Pediatric Surgery, McGovern Medical School, The University of Texas Health Science Center at Houston, Houston, Texas

Submitted 26 April 2020; acc
The Pathophysiology of SARS-CoV2
Are Children Unique?

Pathophysiology of COVID-19: Why Children Fare Better than Adults?

Nitin Dhochak¹ · Tanu Singhal² · S. K. Kabra³ · Rakesh ¹

Table 2 Potential factors protecting children against severe SARS-CoV-2 infection

<table>
<thead>
<tr>
<th>Potential protective factor</th>
<th>Mechanisms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevention of virus exposure</td>
<td>Early isolation and movement restriction</td>
</tr>
<tr>
<td></td>
<td>- Closing schools and day-care centers in epidemics</td>
</tr>
<tr>
<td>Appropriate infection handling</td>
<td>Trained immunity (strong innate response) due to</td>
</tr>
<tr>
<td></td>
<td>- Live vaccines (BCG, live virus vaccines)</td>
</tr>
<tr>
<td></td>
<td>- Frequent virus infections</td>
</tr>
<tr>
<td></td>
<td>High ACE-2 expression metabolizing angiotensin-2</td>
</tr>
<tr>
<td>Absence of high-risk factors</td>
<td>Lack of immune-senescence</td>
</tr>
<tr>
<td></td>
<td>Good lung regeneration capacity</td>
</tr>
<tr>
<td>High-risk group</td>
<td>Absence of age related co-morbidities,</td>
</tr>
<tr>
<td></td>
<td>Less degree of obesity, smoking</td>
</tr>
</tbody>
</table>

¹. Infants (< 1 y)
². Children with pre-existing illnesses (neurological disorders, chronic lung diseases including asthma, uncorrected heart diseases, and genetic disorders)
But does the differential biology mean that kids do not get sick?

That the kids will be...alright?
Pensa.

will the kids be alright? - a prospectus

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- Kids Are Often Not Alright: Organ Damage in SARS-CoV2
- The Pediatric COVID-19: Multi-inflammatory Syndrome in Children
- Stop the Blame! : Asymptomatic Carrier and Transmission
- The Future: The choir needs to preach
Important to acknowledge:
Tremendous surge of “data”
Changes in understanding over time

Knowledge = ∫ Data dt
Clinical and epidemiological features of 36 children with coronavirus disease 2019 (COVID-19) in Zhejiang, China: an observational cohort study

Haiyan Qiu*, Junhua Wu*, Liang Hong, Yunling Luo, Qifa Song, Dong Chen

<table>
<thead>
<tr>
<th></th>
<th>Children with COVID-19 (n=36)</th>
<th>Adults with COVID-19 (n=175)*</th>
<th>Children with SARS (n=44)*</th>
<th>Children with H1N1 influenza (n=167)*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age, years</strong></td>
<td>8 (3.5)</td>
<td>45 (14)</td>
<td>12.2 (4.1)</td>
<td>4.1 (3.5)</td>
</tr>
<tr>
<td><strong>Fever</strong></td>
<td>13 (36%)</td>
<td>150 (86%)</td>
<td>44 (100%)</td>
<td>153 (92%)</td>
</tr>
<tr>
<td><strong>Cough</strong></td>
<td>7 (19%)</td>
<td>109 (62%)</td>
<td>28 (64%)</td>
<td>138 (83%)</td>
</tr>
<tr>
<td><strong>Pharyngeal congestion or sore throat</strong></td>
<td>1 (3%)</td>
<td>8 (5%)</td>
<td>6 (14%)</td>
<td>159 (95%)</td>
</tr>
<tr>
<td><strong>Dyspnoea</strong></td>
<td>1 (3%)</td>
<td>23 (13%)</td>
<td>4 (9%)</td>
<td>12 (7%)</td>
</tr>
<tr>
<td><strong>Asymptomatic</strong></td>
<td>10 (28%)</td>
<td>5 (5%)</td>
<td>0</td>
<td>&lt;5%</td>
</tr>
<tr>
<td><strong>Pneumonia</strong></td>
<td>19 (53%)</td>
<td>166 (95%)</td>
<td>40 (62%)*</td>
<td>18 (11%)</td>
</tr>
<tr>
<td><strong>Comorbidities or complications (except pneumonia and bronchitis)</strong></td>
<td>0 (5%)</td>
<td>10 (6%)</td>
<td>11 (4%)</td>
<td>7 (4%)</td>
</tr>
<tr>
<td><strong>Mild and moderate cases</strong></td>
<td>36 (100%)</td>
<td>136 (77%)</td>
<td>35 (79%)</td>
<td>135 (81%)</td>
</tr>
<tr>
<td><strong>Severe cases</strong></td>
<td>0 (5%)</td>
<td>39 (23%)</td>
<td>9 (21%)</td>
<td>32 (19%)</td>
</tr>
<tr>
<td><strong>Leucopenia</strong></td>
<td>7 (19%)</td>
<td>44 (25%)</td>
<td>15 (34%)</td>
<td>65 (39%)</td>
</tr>
<tr>
<td><strong>Lymphopenia</strong></td>
<td>11 (31%)</td>
<td>61 (35%)</td>
<td>34 (77%)</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Myocardial enzymes elevated</strong></td>
<td>11 (31%)</td>
<td>39 (22%)</td>
<td>3 (7%)</td>
<td>18 (11%)</td>
</tr>
<tr>
<td><strong>Liver enzymes elevated</strong></td>
<td>2 (6%)</td>
<td>32 (18%)</td>
<td>21 (48%)</td>
<td>12 (7%)</td>
</tr>
<tr>
<td><strong>Elevated C-reactive protein</strong></td>
<td>1 (3%)</td>
<td>86 (49%)</td>
<td>NA</td>
<td>42 (25%)</td>
</tr>
<tr>
<td><strong>Antiviral therapy</strong></td>
<td>14 (39%)</td>
<td>170 (97%)</td>
<td>42 (96%)</td>
<td>167 (100%)</td>
</tr>
</tbody>
</table>

(Continued from previous page)

<table>
<thead>
<tr>
<th></th>
<th>Total (n=36)</th>
<th>Mild cases (n=17)</th>
<th>Moderate cases (n=19)</th>
<th>p value*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Treatment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Oxygen inhalation</strong></td>
<td>6 (17%)</td>
<td>1 (6%)</td>
<td>5 (26%)</td>
<td></td>
</tr>
<tr>
<td><strong>Interferon alfa</strong></td>
<td>36 (100%)</td>
<td>17 (100%)</td>
<td>19 (100%)</td>
<td></td>
</tr>
<tr>
<td><strong>Lopinavir-ritonavir</strong></td>
<td>14 (39%)</td>
<td>2 (12%)</td>
<td>12 (63%)</td>
<td></td>
</tr>
<tr>
<td><strong>Time taken to become SARS-CoV-2 PCR-negative, days (SD, range)</strong></td>
<td>10 (2.7-22)</td>
<td>9 (2.7-12)</td>
<td>11 (2.8-22)</td>
<td>0.0050</td>
</tr>
<tr>
<td><strong>Duration of fever after admission, days (SD, range)</strong></td>
<td>3 (2-5)</td>
<td>2 (2-4)</td>
<td>3 (2-5)</td>
<td>0.14</td>
</tr>
<tr>
<td><strong>Duration of hospitalisation, days (SD, range)</strong></td>
<td>14 (3-10-20)</td>
<td>12 (3, 10-16)</td>
<td>15 (4, 12-20)</td>
<td>0.017</td>
</tr>
</tbody>
</table>

Data are n (%) or mean (SD). COVID-19=coronavirus disease 2019. SARS-CoV-2=severe acute respiratory syndrome coronavirus 2. *p values indicate the difference between paediatric patients with mild clinical type (asymptomatic or upper respiratory infection) and those with moderate clinical type with pneumonia. †Data for 13 patients.

**Table 1:** Epidemiological and clinical features of paediatric patients with COVID-19 stratified by two clinical types

1st Report – Zhejiang (China) Published in JUNE N=36
Compared to SARS and H1N1 COVID in kids is “mild”
Epidemiology of COVID-19 Among Children in China

Yuanxuan Dong, MD,*** Xi Mo, PhD,** Yabin Hu, MD,* Xin Qi, PhD,* Fan Jiang, MD, PhD,* Zhongyi Jiang, MD,* Shihong Tong, MD, PhD*-

Broader Epidemiology from China
N=2133
Asymptomatic <10%
Critical < 2%
Most with mild-moderate

### TABLE 2 Different Severity of Illness by Age Group

<table>
<thead>
<tr>
<th>Age Group, y</th>
<th>Asymptomatic, n (%)</th>
<th>Mild, n (%)</th>
<th>Moderate, n (%)</th>
<th>Severe, n (%)</th>
<th>Critical, n (%)</th>
<th>Total, n</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1</td>
<td>14 (1.9)</td>
<td>28 (18.8)</td>
<td>19 (13.8)</td>
<td>4 (2.7)</td>
<td>1 (2.7)</td>
<td>59 (2.7)</td>
</tr>
<tr>
<td>1–5</td>
<td>15 (3.1)</td>
<td>248 (49.9)</td>
<td>195 (38.7)</td>
<td>44 (8.7)</td>
<td>2 (0.4)</td>
<td>491 (23.3)</td>
</tr>
<tr>
<td>6–10</td>
<td>30 (5.8)</td>
<td>277 (53.3)</td>
<td>191 (36.7)</td>
<td>22 (4.2)</td>
<td>0 (0.0)</td>
<td>520 (24.3)</td>
</tr>
<tr>
<td>11–15</td>
<td>27 (6.5)</td>
<td>198 (48.1)</td>
<td>170 (41.3)</td>
<td>14 (3.4)</td>
<td>3 (0.7)</td>
<td>412 (19.5)</td>
</tr>
<tr>
<td>&gt;15</td>
<td>15 (4.5)</td>
<td>164 (49.1)</td>
<td>145 (43.4)</td>
<td>9 (2.7)</td>
<td>1 (0.3)</td>
<td>334 (15.8)</td>
</tr>
<tr>
<td>Total</td>
<td>94 (4.4)</td>
<td>1088 (51.0)</td>
<td>826 (38.7)</td>
<td>112 (5.3)</td>
<td>13 (0.6)</td>
<td>2133 (100)</td>
</tr>
</tbody>
</table>

See also Supplemental Table 3.
* Two cases had missing values.
Like a petri dish of spread....
Early UK Systematic Review
Low Case Rate
Mild Symptomatology in Children

SARS-CoV-2 (COVID-19): What Do We Know About Children? A Systematic Review

Nisha S. Mehta,1 Oliver T. Mytton,2 Edward W. S. Mullins,3,4 Tom A. Fowler,5 Catherine L. Falconer,6 Oria B. Murphy,1 Claudia Langenberg,7,8,9 Wikum J. P. Jayatunga,8,9 Danielle H. Eddy,8 and Jonathan S. Nguyen-Van-Tam1,10

1Department of Health and Social Care (England), London, United Kingdom, 2University of Cambridge, Cambridge, United Kingdom, 3Imperial College London, London, United Kingdom, 4Obstetrics and Gynaecology, Queen Charlotte’s and Chelsea Hospital, London, United Kingdom, 5Genomics England, London, United Kingdom, 6Somerset County Council, Taunton, United Kingdom, 7MRC Epidemiology Unit, University of Cambridge, Cambridge, United Kingdom, 8Public Health England, London, United Kingdom, 9The Francis Crick Institute, London, United Kingdom, and 10University of Nottingham School of Medicine, Nottingham, United Kingdom

Background. Few pediatric cases of coronavirus disease 2019 (COVID-19) have been reported and we know little about the epidemiology in children, although more is known about other coronaviruses. We aimed to understand the infection rate, clinical presentation, clinical outcomes, and transmission dynamics for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), in order to inform clinical and public health measures.

Methods. We undertook a rapid systematic review and narrative synthesis of all literature relating to SARS-CoV-2 in pediatric populations. The search terms also included SARS-CoV and MERS-CoV. We searched 3 databases and the COVID-19 resource centers of 11 major journals and publishers. English abstracts of Chinese-language papers were included. Data were extracted and narrative syntheses conducted.

Results. Twenty-four studies relating to COVID-19 were included in the review. Children appear to be less affected by COVID-19 than adults by observed rate of cases in large epidemiological studies. Limited data on attack rate indicate that children are just as susceptible to infection. Data on clinical outcomes are scarce but include several reports of asymptomatic infection and a milder course of disease in young children, although radiological abnormalities are noted. Severe cases are not reported in detail and there are few data relating to transmission.

Conclusions. Children appear to have a low observed case rate of COVID-19 but may have rates similar to adults of infection with SARS-CoV-2. This discrepancy may be because children are asymptomatic or too mildly infected to draw medical attention and be tested and counted in observed cases of COVID-19.

Keywords. coronavirus; SARS-CoV-2; COVID-19; children; infection.

Transmission
There is limited evidence relating to transmission of SARS-CoV-2 by children. Many of the childhood cases are from familial clusters, with the children tending to be identified through contact tracing of adult cases [6, 9, 21, 22]. While people interviewed by the WHO-China Joint Mission could not recall episodes of a child infecting an adult were cases (7.6%) [18]. Rarely, pediatric deaths have also been reported [19]. We found no detailed studies of transmission of SARS-CoV-2 from children. Many of the childhood cases are from familial clusters with children identified through contact tracing of adult cases [20, 21]. There is only 1 case describing likely transmission from a 3-month-old infant to her parents after they looked after the unwell infant without personal protective measures [12]. Of note is the high frequency of chest radiographic abnormality described in both mild and asymptomatic infections in children. Longitudinal data will be required to understand the duration, persistence, and functional deficit related to these findings.

We detected only a weak signal that children with comorbidities are at increased risk or are overrepresented...
show that COVID-19 is generally a mild disease in children, including infants. Second, the study found that a substantial proportion (8%) of children develop severe disease, requiring intensive care support and prolonged ventilation. Several predisposing factors for requiring intensive care support were identified. Third, the study confirms that fatal outcome is rare in children. There was considerable variability in the use of drugs with antiviral activity as well as immunomodulatory medication, reflecting current uncertainties regarding specific treatment options.
NY Collaborative  
N=281  
41% Required ICU  
No associations with race and COVID  
Kids with co-morbid disease → COVID
COVID-19 Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection in children and adolescents: a systematic review of critically unwell children and the association with underlying comorbidities

Nia Williams¹ · Trisha Radia¹ · Katharine Harman² · Pankaj Agrawal¹ · James Cook² · Atul Gupta³

Table 3  Demographics of patients who died

<table>
<thead>
<tr>
<th>First author</th>
<th>Number who died</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDC</td>
<td>3</td>
<td>11 y M</td>
</tr>
<tr>
<td>Chao</td>
<td>1</td>
<td>5 m M</td>
</tr>
<tr>
<td>Climent</td>
<td>1</td>
<td>17 y M African American</td>
</tr>
<tr>
<td>Craver</td>
<td>1</td>
<td>14 y M</td>
</tr>
<tr>
<td>Dong</td>
<td>1</td>
<td>10 m –</td>
</tr>
<tr>
<td>Lu</td>
<td>1</td>
<td>16 y F</td>
</tr>
<tr>
<td>Otulha</td>
<td>5</td>
<td>16 y M</td>
</tr>
<tr>
<td>Shekderian</td>
<td>2</td>
<td>12 y –</td>
</tr>
<tr>
<td>Wang</td>
<td>1</td>
<td>8 y M</td>
</tr>
<tr>
<td>Zachariah</td>
<td>1</td>
<td>–</td>
</tr>
</tbody>
</table>

CARDIOVASCULAR
- Cardiovascular including congenital heart disease and cardiomyopathy: 10/48 (21%)
- Hypertension: 1/48 (2%)
- Marcapolyarthritis with cardiac failure: 1/48 (2%)

NEUROLOGICAL
- Epilepsy, neurodegenerative disorders and cerebral palsy: 5/48 (10%)

RESPIRATORY
- Asthma or reactive airway disease: 5/48 (10%)
- Recurrent chest infections: 1/48 (2%)
- OSA: 1/48 (2%)

IMMUNOSUPPRESSED/Oncology/Haematology
- ALL: 1/48 (2%)
- Leukaemia on maintenance chemotherapy: 1/48 (2%)
- Immunosuppression: 3/48 (6%)
- Sickle cell disease: 1/48 (2%)
- Metastatic cancer: 1/48 (2%)
- Neoplasms: 1/48 (2%)

GENETIC SYNDROMES
- Genetic syndrome unspecified: 2/48 (4%)
- T21: 2/48 (4%)
- 18q deletion: 1/48 (2%)
- cfadrenaline: 2/48 (4%)
- Diabetes: 2/48 (4%)
- Obesity: 7/48 (15%)
- Prematurity: 2/48 (4%)
- Intussusception: 1 (2%)
- Hydrocephalus: 1 (2%)
- No comorbidity: 12 (25%)

Metastatic cancer
Was on ACE inhibitor prior to admission
Eosinophilic myocarditis was treated with corticosteroids
Sphenoidal sinusitis with cavernous sinus thrombosis.
Blood culture positive for Fusobacterium necrophorum and Strep. constellatus. Left middle cerebral artery stroke.
ARDS and multiorgan failure
Multiorgan failure
Multiorgan failure
ALL in remission
Racial and/or Ethnic and Socioeconomic Disparities of SARS-CoV-2 Infection Among Children


OBJECTIVES: To evaluate racial and/or ethnic and socioeconomic differences in rates of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection among children.

METHODS: We performed a cross-sectional study of children tested for SARS-CoV-2 at an exclusively pediatric drive-through and walk-up SARS-CoV-2 testing site from March 21, 2020, to April 28, 2020. We performed bivariate and multivariable logistic regression to measure the association of patient race and/or ethnicity and estimated median family income (based on census block group estimates) with (1) SARS-CoV-2 infection and (2) reported exposure to SARS-CoV-2.

RESULTS: Of 1000 children tested for SARS-CoV-2 infection, 20.7% tested positive for SARS-CoV-2. In comparison with non-Hispanic white children (7.3%), minority children had higher rates of infection (non-Hispanic Black: 30.0%, adjusted odds ratio [aOR] 2.3 [95% confidence interval (CI) 1.2–4.4]; Hispanic: 46.4%, aOR 6.3 [95% CI 3.3–11.9]). In comparison with children in the highest median family income quartile (8.7%), infection rates were higher among children in quartile 3 (23.7%; aOR 2.6 [95% CI 1.4–4.9]), quartile 2 (27.1%; aOR 2.3 [95% CI 1.2–4.3]), and quartile 1 (37.7%; aOR 2.4 [95% CI 1.3–4.6]). Rates of reported exposure to SARS-CoV-2 also differed by race and/or ethnicity and socioeconomic status.

CONCLUSIONS: In this large cohort of children tested for SARS-CoV-2 through a community-based testing site, racial and/or ethnic minorities and socioeconomically disadvantaged children carry the highest burden of infection. Understanding and addressing the causes of these differences are needed to mitigate disparities and limit the spread of infection.

TABLE 3 Racial and/or Ethnic and Socioeconomic Factors Associated With Reported SARS-CoV-2 Exposure

<table>
<thead>
<tr>
<th>Demographic Characteristic</th>
<th>OR (95% CI)</th>
<th>aOR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Race and/or ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NH white</td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>NH Black</td>
<td>2.2 (1.1–4.4)</td>
<td>2.3 (1.0–5.1)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>2.2 (1.1–4.5)</td>
<td>1.9 (0.8–4.4)</td>
</tr>
<tr>
<td>Other</td>
<td>2.0 (1.0–4.5)</td>
<td>2.5 (1.1–5.8)</td>
</tr>
<tr>
<td>MFI (quartiles)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quartile 4: $157 679–$250 000</td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>Quartile 3: $107 321–$157 308</td>
<td>2.0 (1.0–4.1)</td>
<td>1.9 (0.9–4.1)</td>
</tr>
<tr>
<td>Quartile 2: $70 341–$107 292</td>
<td>2.6 (1.3–5.1)</td>
<td>2.4 (1.1–5.2)</td>
</tr>
<tr>
<td>Quartile 1: $11 687–$70 300</td>
<td>2.5 (1.3–4.9)</td>
<td>2.1 (0.9–4.6)</td>
</tr>
</tbody>
</table>

*a Models were adjusted for age, sex, race and/or ethnicity, and MFI.

SARS-CoV-2 testing and positivity by MFI: patients positive for SARS-CoV-2 and MFI are higher in their respective quartiles than in the other quartiles. OR: odd ratio; aOR: adjusted odd ratio; CI: confidence interval; MFI: median family income; N: number of participants.

DC-Washington Area
N=1000
Racial and Socioeconomic disparities DO exist with which kids are +
Characteristics and outcomes of neonatal SARS-CoV-2 infection in the UK: a prospective national cohort study using active surveillance

Findings: We identified 66 babies with confirmed SARS-CoV-2 infection (incidence 5.6 [95% CI 4.3–7.1] per 10,000 livebirths), of whom 28 (42%) had severe neonatal SARS-CoV-2 infection (incidence 2.4 [1.6–3.4] per 10,000 livebirths). 16 (24%) of these babies were born preterm. 36 (55%) babies were from white ethnic groups (SARS-CoV-2 infection incidence 4.6 [3.2–6.4] per 10,000 livebirths), 14 (21%) were from Asian ethnic groups (15.2 [8.3–25.5] per 10,000 livebirths), eight (12%) were from Black ethnic groups (18.0 [7.8–35.5] per 10,000 livebirths), and seven (11%) were from mixed or other ethnic groups (5.6 [2.2–11.5] per 10,000 livebirths). 17 (26%) babies with confirmed infection were born to mothers with known perinatal SARS-CoV-2 infection, two (3%) were considered to have possible vertically acquired infection (SARS-CoV-2-positive sample within 12 h of birth where the mother was also positive). Eight (12%) babies had suspected nosocomially acquired infection. As of July 28, 2020, 58 (88%) babies had been discharged home, seven (11%) were still admitted, and one (2%) had died of a cause unrelated to SARS-CoV-2 infection.

Interpretation: Neonatal SARS-CoV-2 infection is uncommon in babies admitted to hospital. Infection with neonatal admission following birth to a mother with perinatal SARS-CoV-2 infection was unlikely, and possible vertical transmission rare, supporting international guidance to avoid separation of mother and baby. The high proportion of babies from Black, Asian, or minority ethnic groups requires investigation.

Early UK Neonatal Registry
N=66 (positive cases)
“Maternal – neonatal spread “uncommon”
“High proportion of Black/Asian/minority ethnic groups requires investigation”
SARS-CoV2 vertical transmission with adverse effects on the newborn revealed through integrated immunohistochemical, electron microscopy and molecular analyses of Placenta

Fabio Facchetti\textsuperscript{a,*,#}, Mattia Bugatti\textsuperscript{a,#}, Emma Drera\textsuperscript{a}, Claudio Tripodo\textsuperscript{b}, Enrico Sartori\textsuperscript{c}, Valeria Cancila\textsuperscript{b}, Marta Papaccio\textsuperscript{c}, Roberta Castellani\textsuperscript{c}, Stefano Casola\textsuperscript{d}, Maria Beatrice Boniotti\textsuperscript{e}, Patrizia Cavadini\textsuperscript{e}, Antonio Lavazza\textsuperscript{e,#}

\textsuperscript{a} Pathology Unit, Department of Molecular and Translational Medicine, University of Brescia, 25123, Brescia, Italy
\textsuperscript{b} Tumor Immunology Unit, Department of Health Sciences, University of Palermo School of Medicine, 90134, Palermo, Italy
\textsuperscript{c} Department of Obstetrics and Gynaecology, University of Brescia, 25123, Brescia, Italy
\textsuperscript{d} The IRC Institute of Molecular Oncology (IOM), 20139, Milan, Italy
\textsuperscript{e} Istituto Zooprofilattico Sperimentale della Lombardia e dell’Emilia Romagna (I.Z.S.I.R.), 25124 Brescia, Italy

Italian Immunohistochemical study
Post-partum placental analysis

Viral infiltration in the placental endothelium
Pensa.

will the kids be alright? - a prospectus

- Adults are Not Kids: The Unique Pathology of Pediatric SARS-CoV2
- Time Equals Data: The Trajectory of the Epidemiology
- Kids Are Often Not Alright: Organ Damage in SARS-CoV2
- The Pediatric COVID-19: Multi-inflammatory Syndrome in Children
- Stop the Blame! : Asymptomatic Carrier and Transmission
- The Future: The choir needs to preach
Characteristics and Outcomes of Children With Coronavirus Disease 2019 (COVID-19) Infection Admitted to US and Canadian Pediatric Intensive Care Units

Lara S. Shekerdemian, MD, MHA; Nabihah R. Mahmood, MD; Katie K. Wolfe, MD; Becky J. Riggs, MD; Catherine E. Ross, MD; Christine A. McKiernan, MD; Sabrina M. Heidemann, MD; Lawrence C. Kleinman, MD, MPH; Anita I. Sen, MD; Mark W. Hall, MD; Margaret A. Priestley, MD; John K. McGuire, MD; Konstantinos Boukas, MD; Matthew P. Sharron, MD; Jeffrey P. Burns, MD, MPH; for the International COVID-19 PICU Collaborative

RESULTS Of the 48 children with COVID-19 admitted to participating PICUs, 25 (52%) were male, and the median (range) age was 13 (4.2-16.6) years. Forty patients (83%) had significant preexisting comorbidities; 35 (73%) presented with respiratory symptoms and 18 (38%) required invasive ventilation. Eleven patients (23%) had failure of 2 or more organ systems. Extracorporeal membrane oxygenation was required for 1 patient (2%). Targeted therapies were used in 28 patients (61%), with hydroxychloroquine being the most commonly used agent either alone (11 patients) or in combination (10 patients). At the completion of the follow-up period, 2 patients (4%) had died and 15 (31%) were still hospitalized, with 3 still requiring ventilatory support and 1 receiving extracorporeal membrane oxygenation. The median (range) PICU and hospital lengths of stay for those who had been discharged were 5 (3-9) days and 7 (4-13) days, respectively.
Multinational “CAKE” Study

ICU Related Features and Support of Pediatric COVID

Looks like septic shock
Factors Associated With Severe SARS-CoV-2 Infection

Naim Ouldali, MD, PhD,ab,c,d David Dawei Yang, MD,⁎ Fouad Medhi, MD,⁎ Michael Levy, MD, PhD,⁎ Jean Gaschignard, MD, PhD,⁎ Irina Craiu, MD,⁎ Tamazoust Buiddiri, MD,⁎ Cyril Schweitzer, MD, PhD,⁎ Arnaud Wiedemann, MD, PhD,⁎ Mathieu Lorrot, MD, PhD,⁎ Anne-Sophie Romain, MD, Aurélie Garraffo, MD,⁎ Hervé Haas, MD,⁎ Sébastien Rougé, MD,⁎ Loïc de Pontual, MD,⁎ Camille Aupiais, MD, PhD,⁎ Alix Martinot, MD, PhD,⁎ Julie Toubiana, MD, PhD,⁎ Laurent Dupic, MD,⁎ Philippe Mi Manon Passard, MD,⁎ Alexandre Belot, MD, PhD,⁎ Corinne Levy, MD,⁎ Stephane Bechet, MD,⁎ Camille Jung, MD,⁎ Mayssa Sarakbi, MD,⁎ Sarah Ducrocq, MD,⁎ Nevena Danekova, MD,⁎ Imen Jhauot, MD,⁎ Olivier Vignaud, MD,⁎ Nathalie Gerard, MD,⁎ Elisabeth Caron, MD,⁎ Robert Gher, MD,⁎,⁎⁎ Vincent Gadyos, MD, PhD,⁎⁎⁎ François Angoulvant, MD, PhD,⁎⁎⁎ on behalf of the investigator group of the PANDOR study

French “PANDOR” Study
N=250

Older age, obesity, co-morbid conditions → PICU and Severe COVID
Severe COVID-19 Infection and Pediatric Comorbidities: A Systematic Review and Meta-Analysis

Boyan K. Tsankov\textsuperscript{a,b,d,e}, Joannie M. Allaire\textsuperscript{a,b,d}, Michael A. Irvine\textsuperscript{d}, Alison A. Lopez\textsuperscript{a,c,d}, Laura J. Sauvé\textsuperscript{a,c,d}, Bruce A. Vallance\textsuperscript{a,b,d}, Kevan Jacobson\textsuperscript{a,b,d,f,*}

\textsuperscript{a} Department of Pediatrics, BC Children’s Hospital, Vancouver, BC, Canada
\textsuperscript{b} Division of Gastroenterology, Hepatology and Nutrition, BC Children’s Hospital, Vancouver, BC, Canada
\textsuperscript{c} Division of Infectious Diseases, BC Children’s Hospital, Vancouver, BC, Canada
\textsuperscript{d} BC Children’s Hospital Research Institute, University of British Columbia, Vancouver, BC, Canada
\textsuperscript{e} Department of Immunology, University of Toronto, Toronto, ON, Canada
\textsuperscript{f} Department of Cellular and Physiological Sciences, University of British Columbia, Vancouver, BC, Canada

Canadian Trials Group
42 studies, n=375000

Older age, obesity, co-morbid conditions → PICU and Severe COVID

Source & RR (95% CI) \\
--- & --- \\
Abdel-Mannan et al. & 1.00 [0.36; 2.75] \\
Chao et al. & 3.75 [0.44; 31.62] \\
Giacomet et al. & 5.10 [2.00; 13.01] \\
Moreno-Galaraga et al. & 0.44 [0.01; 27.76] \\
Swann et al. & 2.91 [1.57; 5.42] \\
Zachariah et al. & 9.27 [1.28; 66.92] \\
Total & 2.87 [1.16; 7.07] \\
Prediction interval & [0.31; 26.20] \\
Heterogeneity: $\chi^2_5 = 7.81 (P = .17)$, $I^2 = 36\%$

Fig. 4. Pooled estimate of the relative risk of COVID-19-associated mortality among pediatric patients with comorbidities.
Clinical Manifestations and Outcomes of Critically Ill Children and Adolescents with Coronavirus Disease 2019 in New York City

Kim R. Derespina, MD1,*, Shubhi Kaushik, MBBS2,*, Anna Plichta, MD3, Edward E. Conway, Jr., MD, MS3, Asher Barcow, MD3, Jaeun Choi, PhD4, Ruth Eisenberg, MS4, Jennifer Gillen, MD5, Anita I. Sen, MD5, Claire M. Hennigan, MD6, Lillian M. Zerihun, BS7, Sule Doymaz, MD8, Michael A. Keenaghan, MD9,10, Stephanie Jarrin, MD9,11, Franscine Oulds, MD12, Manoj Gupta, MBBS12,13, Louisdon Pierre, MD14, Melissa Grageda, MD15, H. Michael Ushay, MD, PhD1, Vinay M. Nadkarni, MD16, Michael S. D. Agus, MD17, and Shivanand S. Medar, MD1,13,*

Conclusions Critically ill children with COVID-19 predominantly are adolescents, have comorbidities, and require some form of respiratory support. The presence of ARDS is significantly associated with prolonged PICU and hospital stay. (J Pediatr 2020;226:55-63).

Table IV. Multivariable Cox proportional hazards model of outcome: time to PICU discharge (N = 70)

<table>
<thead>
<tr>
<th>Variables</th>
<th>AHR (95% CI)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARDS (reference = no)</td>
<td>0.08 (0.03-0.21)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Black/Latino (reference = white)</td>
<td>1.78 (0.71-4.48)</td>
<td>.2210</td>
</tr>
<tr>
<td>Other race (reference = white)</td>
<td>0.91 (0.33-2.51)</td>
<td>.8539</td>
</tr>
<tr>
<td>Any comorbidity (reference = no)</td>
<td>1.29 (0.68-2.45)</td>
<td>.4377</td>
</tr>
</tbody>
</table>
Cardiac Injury with SARS-CoV-2 / COVID-19

Pulmonary involvement/ARDS

SARS-CoV-2

Cytokine release

ACE2

Cardiomyocyte

Thrombotic state/
Cytokine-mediated plaque rupture

Low supply
(hypoxia, anemia, hypotension, etc.)

High demand
(fever, tachycardia, etc)

Stress cardiomyopathy
(uncommon)

Myocarditis
(uncommon, 0-14\% of autopsies)

Myocardial Infarction
(very uncommon)

Ischemia due to imbalance between supply and demand
(probably common)

Evidence of cardiac injury (troponin release)
10-45\% of hospitalized patients, higher in high-risk patients

Slide Courtesy of S. Basu
Neurologic Involvement in Children and Adolescents Hospitalized in the United States for COVID-19 or Multisystem Inflammatory Syndrome

Table 1. Characteristics and Outcomes of 1695 Patients (Age <21 Years) Hospitalized for COVID-19-Related Illness by Reported Neurologic Involvement (continued)

<table>
<thead>
<tr>
<th>Clinical characteristics</th>
<th>All patients (N = 1695)</th>
<th>Neurological involvement</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes (n = 365)</td>
<td>No (n = 1330)</td>
<td></td>
</tr>
<tr>
<td>Outcomes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICU</td>
<td>836 (49)</td>
<td>227 (62)</td>
<td>609 (46)</td>
</tr>
<tr>
<td>ECMO</td>
<td>32 (2)</td>
<td>16 (4)</td>
<td>18 (1)</td>
</tr>
<tr>
<td>Mechanical ventilation</td>
<td>225 (13)</td>
<td>103 (28)</td>
<td>122 (9)</td>
</tr>
<tr>
<td>Length of stay, median (IQR), d</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICU</td>
<td>4 (2-7)</td>
<td>4 (2-9)</td>
<td>4 (2-6)</td>
</tr>
<tr>
<td>Hospital</td>
<td>5 (2-9)</td>
<td>5 (2-11)</td>
<td>5 (2-8)</td>
</tr>
<tr>
<td>Died</td>
<td>22 (1)</td>
<td>14 (4)</td>
<td>8 (1)</td>
</tr>
<tr>
<td>Survived, new neurological deficit</td>
<td>22 (1)</td>
<td>20 (5)</td>
<td>2 (0.2)</td>
</tr>
<tr>
<td>Discharged to rehabilitation</td>
<td>25 (1)</td>
<td>13 (4)</td>
<td>12 (1)</td>
</tr>
</tbody>
</table>

A Presenting symptoms by age

- Difficulty walking or crawling
- Seizures or status epilepticus
- Loss of sense of taste
- Loss of sense of smell
- Headache
- Alerted awareness or confusion
- Fatigue/weakness

Patients, %

- 0 to 20
- 21 to 40
- 41 to 60
- 61 to 80
- 81 to 100
SPARC: SARS-CoV2 and Pediatric AKI, Registry-Collaborative

- 58 participating centers
- 6 continents, 18 countries (USA, Canada, Mexico, Brazil, England, Italy, France, Spain, Germany, Serbia, Israel, Japan, S Korea, Turkey, Singapore, Taiwan, South Africa, India, Australia)

N=331
AKI – 41.4%
Severe AKI: 19.6%
COVID-19 INFECTION IN PEDIATRICS

COVID PATHOPHYSIOLOGY

1. Increased [angiotensin II]
2. 5-protein of SARS-CoV-2 binds to ACE 2 receptor
3. Vasculitis, endothelial injury, pro-inflammatory state in pulmonary vascular system
4. Acute kidney injury, leukocyte recruitment, hypoxic pulmonary vasoconstriction
5. Vascular edema causing organ dysfunction
6. Ventilation/necrosis of distal lung due to vascular plugging
7. Respiratory failure

COVID ORGAN DYSFUNCTION IN PEDIATRICS

1. 16%-50% may be asymptomatic
2. Most common symptoms in children: cough and/or fever
3. In 3 hospitalized with COVID-19 in the US, were admitted to the intensive care unit.
4. Children with medical complexity (i.e., genetic, neurologic, asthma, sickle cell, immunosuppressed) may be at increased risk for severe illness.
5. Hospitalization rates are higher in Hispanic and African American populations > White children.
6. Obesity was the most prevalent underlying condition.

SEVERE COVID 19 IN PEDIATRICS

RESPIRATORY FAILURE (MOST COMMON)

44% requiring non-invasive positive pressure
38% requiring intubation/tracheostomy
Ventilation/MV (median duration of 9 days).

Other presentations in PICU setting: vasodilatory crisis, diabetic ketoacidosis, and circulatory collapse.

MEICATIONS & MANAGEMENT

Dexamethasone may be beneficial in critically ill children (decreased mortality in critically ill adult patients in COVID-19 trials).

RELEVENT DRUGS

Dosing:
- Pediatric: PO or IV 0.3 mg/kg/day (maximum dose 2 mg/kg/day) for 2-3 days.

RELEVENT MEDICATIONS

Approved by US Food and Drug Administration for the treatment of children requiring hospitalization for COVID-19 (≥ 12 years old, ≤ 44 kg) emergency authorization for 36 kg.

Mechanism:
- Inhibits the SARS-CoV-2 spike protease.

DOSING:
- <40 kg: IV 5 mg/day/total 1 day; IV 35 mg/day/total 4 days.
- >40 kg: IV 300 mg/day/total 1 day; IV 300 mg/day/total 4 days.

MONITOR:
- Hemodynamic (systolic BP, HR, pulse oximetry, capillary refill, skin color, and temperature).
- Laboratory (complete blood count, electrolytes, liver function tests, creatine phosphokinase).
- Urinalysis (protein, creatinine).
- Chest radiography (to rule out bacterial infection).

Damania et al, Curr Opin Peds 2021
Pensa.

*will the kids be alright? - a prospectus*

- Adults are Not Kids: The Unique Pathology of Pediatric SARS-CoV2
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- The Pediatric COVID-19: Multi-inflammatory Syndrome in Children
- Stop the Blame! : Asymptomatic Carrier and Transmission
- The Future: The choir needs to preach
MULTISYSTEM INFLAMMATORY SYNDROME IN CHILDREN (MIS-C)

MIS-C PATHOPHYSIOLOGY
- Pathophysiology not well understood.
- Pathophysiology is similar to Kawasaki Disease, Macrophage Activation Syndrome, and Cytokine Release Syndrome.

MIS-C RELATED ORGAN DYSFUNCTION
- Median age: 8-11 years old.
- >70% of children are previously healthy.
- Hospitalization rates are higher in Hispanic and African American populations vs. White children.
- Obesity & attherosclerosis most prevalent underlying condition.

Severe MIS-C in Pediatrics:
- Phenotypic overlap with Kawasaki disease differentiated by:
  - Gastrointestinal symptoms
  - Myocardial dysfunction

Shock:
- 32-76%

Myocardial dysfunction:
- 51-90%
- LV EF <55%

Anosmia:
- 12%

Acute respiratory failure:
- 28-52%

Medications and Management
- Epinephrine when there is LV dysfunction with addition of milrinone.
- Intravenous immunoglobulin (IVIg) – especially with cardiac dysfunction
  - 2 g/kg over 3-12hrs
  - Maximum 100 grams

Aspirin (especially if coronary involvement)

Gluocorticoids

Empiric broad-spectrum antibiotics (Ceftriaxone & Vancomycin) for suspected bacterial co-infection.

VTE prophylaxis

Adjunctive therapies:
- IL-1 inhibitors (anakinra)
- IL-6 inhibitors (tocilizumab)

Serial laboratory markers and echocardiographic study are crucial

Damania et al, Curr Opin Peds 2021
Characteristics and Outcomes of US Children and Adolescents With Multisystem Inflammatory Syndrome in Children (MIS-C) Compared With Severe Acute COVID-19

Leora R. Feldstein, PhD; Mark W. Tenforde, MD; Kevin G. Friedman, MD; Margaret Newhams, MPH; Erica Billig Rose, PhD; Heda Dapul, MD; Vijaya L. Soma, MD; Alaine B. Maddux, MD; Peter M. Mourani, MD; Cindy Bowens, MD; Mia Maamari, MD; Mark W. Hall, MD; Becky J. Riggs, MD; John S. Giuliano Jr, MD; Aalok R. Singh, MD; Simon Li, MD; Michele Kong, MD; Jennifer E. Schuster, MD; Gwenn E. McLaughlin, MD; Stephanie P. Schwartz, MD; Tracie C. Walker, MD; Laura L. Lofts, MD; Charlotte V. Hobbs, MD; Natasha B. Halasa, MD; Sule Doymaz, MD; Christopher J. Babbitt, MD; Janet R. Hume, MD; Shira J. Gertz, MD; Katherine Iry, MD; Katharine N. Clouser, MD; Natalie Z. Cvijanovich, MD; Tamara T. Bradford, MD; Lincoln S. Smith, MD; Sabrina M. Heidemann, MD; Sheemon P. Zackai, MD; Kari Weltlinzit, MD; Ryan A. Nofziger, MD; Steven M. Horwitz, MD; Ryan W. Carroll, MD; Courtaney M. Rowan, MD; Kielo M. Tarquinio, MD; Elizabeth H. Mack, MD; Julie C. Fitzgerald, MD; Bria M. Coates, MD; Ashley M. Jackson, MPH; Cameron C. Young; Mary Beth F. Son, MD; Manish M. Patel, MD; Jane W. Newburger, MD; Adrienne G. Randolph, MD; for the Overcoming COVID-19 Investigators

Box 1. Centers for Disease Control and Prevention Case-Definition for MIS-C

- Age <21 y
- Fever ≥38.0 °C for ≥24 h or report of subjective fever lasting ≥24 h
- Laboratory evidence of inflammation\textsuperscript{b}
- Evidence of clinically severe illness requiring hospitalization with multisystem (≥2) organ involvement (cardiac, kidney, respiratory, hematologic, gastrointestinal, dermatologic, or neurological)
- No alternative plausible diagnoses
- Positive for current or recent SARS-CoV-2 infection by RT-PCR, antibody, or antigen test; or exposure to a suspected or confirmed COVID-19 case within the 4 wk prior to the onset of symptoms\textsuperscript{c}


Key Points

**Question** How do the characteristics and outcomes of children and adolescents with multisystem inflammatory syndrome in children (MIS-C) compare with severe coronavirus disease 2019 (COVID-19)?

**Findings** In this case series that included 539 patients with MIS-C, children and adolescents more likely to be mucocutaneous present.

**Box 2. Case-Definition for Severe Acute COVID-19\textsuperscript{a,b}

- Admitted to the hospital with symptoms suspected to be related to COVID-19
- Evidence of infection with SARS-CoV-2 based on a positive RT-PCR test result during current illness
- Severe organ system involvement including at least 1 of the following: Respiratory: Receipt of mechanical ventilation or any type of supplemental oxygen (or increased support for patients receiving respiratory support at baseline)
- Severe bronchospasm requiring continuous bronchodilators
- Pulmonary infiltrates on chest radiograph
- Lower respiratory infection
  - Pneumonia
  - Postinfectious

Gastrointestinal Appendicitis
Pancreatitis
Hepatitis or hepatomegaly
Gallbladder hydrops or edema
Other complications as determined by site clinicians
- Abnormalities in blood work
  - Absolute lymphocyte count <1 × 10^9 cells/L
  - Absolute neutrophil count >0.5 × 10^9 cells/L excluding therapy patients
- Severe anemia

Meaning and 57 more likely, be mucocutaneous present.

Meaning and 57 more likely, be mucocutaneous present.
<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Study cohort from the Overcoming COVID-19 registry (N = 1116)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MIS-C (n = 539)</td>
</tr>
<tr>
<td>Age, median (IQR), y</td>
<td>8.9 (4.7-13.2)</td>
</tr>
<tr>
<td>Sex, No. (%)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>312 (57.7)</td>
</tr>
<tr>
<td>Female</td>
<td>227 (42.1)</td>
</tr>
<tr>
<td>Race/ethnicity, No. (%)^d</td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>421</td>
</tr>
<tr>
<td>White, non-Hispanic (n = 174)</td>
<td>66 (13.3)</td>
</tr>
<tr>
<td>Black, non-Hispanic (n = 310)</td>
<td>181 (34.7)</td>
</tr>
<tr>
<td>Hispanic or Latino (n = 455)</td>
<td>193 (35.9)</td>
</tr>
<tr>
<td>Other, non-Hispanic (n = 67)</td>
<td>27 (5.5)</td>
</tr>
<tr>
<td>Underlying medical conditions, No. (%)</td>
<td></td>
</tr>
<tr>
<td>At least 1 underlying condition^e</td>
<td>167 (30.9)</td>
</tr>
<tr>
<td>Obesity^f</td>
<td>176 (36.2)</td>
</tr>
<tr>
<td>Respiratory</td>
<td>72 (13.4)</td>
</tr>
<tr>
<td>Other^d</td>
<td>52 (9.6)</td>
</tr>
<tr>
<td>Neurological/neuromuscular</td>
<td>30 (5.6)</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>17 (3.2)</td>
</tr>
</tbody>
</table>
Table 2. Clinical Course of Patients With MIS-C and Severe Acute COVID-19<sup>ab</sup>

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Study cohort from the Overcoming COVID-19 registry (n = 1116)</th>
<th>Difference (95% CI)&lt;sup&gt;f&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No. (%)</strong></td>
<td>MIS-C (n = 539 [48%])</td>
<td>Severe acute COVID-19 (n = 577 [52%])</td>
</tr>
<tr>
<td><strong>Treatments</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intravenous immunoglobulin</td>
<td>415 (77.0)</td>
<td>24 (4.2)</td>
</tr>
<tr>
<td>Steroids</td>
<td>224 (40.8)</td>
<td>141 (24.4)</td>
</tr>
<tr>
<td><strong>Critical care interventions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any respiratory support</td>
<td>303 (56.2)</td>
<td>292 (50.6)</td>
</tr>
<tr>
<td>Noninvasive positive pressure ventilation</td>
<td>192 (35.6)</td>
<td>188 (32.6)</td>
</tr>
<tr>
<td>Invasive mechanical ventilation</td>
<td>95 (17.6)</td>
<td>84 (14.6)</td>
</tr>
<tr>
<td>Vasopressor use</td>
<td>244 (45.3)</td>
<td>50 (8.7)</td>
</tr>
<tr>
<td>Extracorporeal membrane oxygenation</td>
<td>18 (3.3)</td>
<td>8 (1.4)</td>
</tr>
<tr>
<td><strong>Clinical outcomes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length of admission, d (n = 1083)&lt;sup&gt;f&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>523</td>
<td>560</td>
</tr>
<tr>
<td>Median (IQR)</td>
<td>7.0 (5.0 to 11.0)</td>
<td>3.0 (2.0 to 8.0)</td>
</tr>
<tr>
<td>Intensive care unit admission&lt;sup&gt;f&lt;/sup&gt;</td>
<td>398 (73.8)</td>
<td>253 (43.8)</td>
</tr>
<tr>
<td>Length of ICU stay, d (n = 639)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>388</td>
<td>251</td>
</tr>
<tr>
<td>Median (IQR)</td>
<td>4.0 (2.0 to 7.0)</td>
<td>4.0 (2.0 to 8.0)</td>
</tr>
<tr>
<td>Died</td>
<td>10 (1.9)</td>
<td>8 (1.4)</td>
</tr>
</tbody>
</table>

Gastrointestinal

<table>
<thead>
<tr>
<th>Subcategory</th>
<th>No. (%)</th>
<th>No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe cardiorespiratory involvement</td>
<td>302 (56.0)</td>
<td>51 (8.8)</td>
</tr>
<tr>
<td>Severe respiratory without cardiovascular involvement</td>
<td>130 (24.1)</td>
<td>408 (70.7)</td>
</tr>
<tr>
<td>Severe cardiovascular without respiratory involvement</td>
<td>57 (10.6)</td>
<td>17 (2.9)</td>
</tr>
<tr>
<td>Mucocutaneous without severe cardiorespiratory involvement</td>
<td>38 (7.1)</td>
<td>13 (2.3)</td>
</tr>
<tr>
<td>Hematologic, neurologic, or gastrointestinal severe involvement only</td>
<td>12 (2.2)</td>
<td>88 (15.3)</td>
</tr>
</tbody>
</table>

**Note:**
- Table 2 (continued)
Figure 2. Multivariable Analyses of MIS-C vs COVID-19

<table>
<thead>
<tr>
<th>Clinical group by complication</th>
<th>MIS-C (n=539)</th>
<th>Severe acute COVID-19 (n=577)</th>
<th>Absolute risk difference, % (95% CI)</th>
<th>Adjusted risk ratio (95% CI)</th>
<th>More likely COVID-19</th>
<th>More likely MIS-C</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory without cardiovascular</td>
<td>130/539 (24.1)</td>
<td>408/577 (70.7)</td>
<td>-46.6 (-51.8 to -41.4)</td>
<td>1</td>
<td>[Reference]</td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Cardiorespiratory</td>
<td>302/539 (56.0)</td>
<td>51/577 (8.8)</td>
<td>47.2 (42.4 to 52.0)</td>
<td>2.99 (2.55 to 3.50)</td>
<td></td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Cardiovascular without respiratory</td>
<td>57/539 (10.6)</td>
<td>17/577 (2.9)</td>
<td>7.7 (4.7 to 10.6)</td>
<td>2.49 (2.05 to 3.02)</td>
<td></td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Mucocutaneous without respiratory or cardiovascular</td>
<td>38/539 (7.1)</td>
<td>13/577 (2.3)</td>
<td>4.8 (2.3 to 7.3)</td>
<td>2.29 (1.84 to 2.85)</td>
<td></td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Other without respiratory, cardiovascular, or mucocutaneous</td>
<td>12/539 (2.2)</td>
<td>88/577 (15.3)</td>
<td>-13.1 (-16.2 to -9.8)</td>
<td>0.43 (0.25 to 0.74)</td>
<td></td>
<td></td>
<td>.002</td>
</tr>
<tr>
<td>Laboratory value within first 48 h</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neutrophil to lymphocyte ratio &gt;5</td>
<td>321/515 (62.3)</td>
<td>154/464 (33.2)</td>
<td>29.1 (23.2 to 35.1)</td>
<td>1.59 (1.40 to 1.80)</td>
<td></td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Platelets &lt;150 \times 10^3/μL</td>
<td>212/523 (40.5)</td>
<td>84/486 (17.3)</td>
<td>23.2 (17.9 to 28.6)</td>
<td>1.58 (1.43 to 1.75)</td>
<td></td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>C-reactive protein level &gt;100 mg/L</td>
<td>325/491 (66.2)</td>
<td>67/285 (23.5)</td>
<td>42.7 (36.2 to 49.1)</td>
<td>1.70 (1.51 to 1.92)</td>
<td></td>
<td></td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>
Figure 3. Clinical Outcomes by Day of Hospitalization for Patients With MIS-C and Severe COVID-19

B Vasopressor support and death

<table>
<thead>
<tr>
<th>Day of hospitalization</th>
<th>Patients receiving vasopressor support, %</th>
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<tbody>
<tr>
<td>1</td>
<td>24</td>
</tr>
<tr>
<td>2</td>
<td>16</td>
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<tr>
<td>3</td>
<td>12</td>
</tr>
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<td>4</td>
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</tr>
<tr>
<td>28</td>
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</tr>
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</table>

<table>
<thead>
<tr>
<th>Hospitalized patients</th>
<th>MIS-C</th>
<th>Severe COVID-19</th>
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<tbody>
<tr>
<td></td>
<td>528</td>
<td>565</td>
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<tr>
<td></td>
<td>24</td>
<td>37</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Receiving vasopressors</th>
<th>MIS-C</th>
<th>Severe COVID-19</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>120</td>
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<td>3</td>
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<table>
<thead>
<tr>
<th>Cumulative deaths</th>
<th>MIS-C</th>
<th>Severe COVID-19</th>
</tr>
</thead>
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<tr>
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<td>8</td>
<td>4</td>
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</tbody>
</table>
Pensa.

will the kids be alright? - a prospectus

• Adults are Not Kids: The Unique Pathology of Pediatric SARS-CoV2
• Time Equals Data: The Trajectory of the Epidemiology
• Kids Are Often Not Alright: Organ Damage in SARS-CoV2
• The Pediatric COVID-19: Multi-inflammatory Syndrome in Children
• Stop the Blame! : Asymptomatic Carrier and Transmission
• The Future: The choir needs to preach
Symptomatic and Asymptomatic Viral Shedding in Pediatric Patients Infected With Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) 
Under the Surface

Roberta L. DeBiasi, MD, MS; Meghan Delaney, DO, MPH

Despite the value of the study by Han et al., there are limitations that leave important remaining knowledge gaps that are ripe for investigation. The first limitation is due to qualitative molecular detection methods, which are the standard clinical approach for testing of nasopharyngeal swab specimens. Qualitative positive or negative findings for molecular detection of virus may not necessarily correlate with infectivity. Sensitive molecular detection methods may detect viable, infective virus but also nonviable or fragments of RNA with no capability for transmission. Additionally, even if vi-
Dynamic surveillance of SARS-CoV-2 shedding and neutralizing antibody in children with COVID-19

Pengcheng Liu, Jiehao Cai, Ran Jia, Shuai Xia, Xiangshi Wang, Lingfeng Cao, Mei Zeng, and Jin Xu

Department of Clinical Laboratory, Children’s Hospital of Fudan University, Shanghai, People’s Republic of China; Department of Infectious Diseases, Children’s Hospital of Fudan University, Shanghai, People’s Republic of China; Key Laboratory of Medical Molecular Virology (MOE/NHC/CAMS), School of Basic Medical Sciences, Fudan University, Shanghai, People’s Republic of China

ABSTRACT
Coronavirus disease 2019 (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) emerged in China and quickly spread globally. In this study, we investigated the characteristics of viral shedding from different sites and the neutralizing antibody (NAb) response during the acute and convalescent phases of nine children with COVID-19. SARS-CoV-2 was detected in their nasopharyngeal swabs (9/9, 100%), stool samples (8/9, 89%), and oropharyngeal swabs (3/9, 33%) but was not detected in their serum and urine samples. The median duration of viral shedding detected in nasopharyngeal swabs, oropharyngeal swabs, and stools was 13, 4, and 43 days respectively, and the maximum duration of viral shedding detected from stools was 46 days after discharge. In children, nasopharyngeal swabs appear to be a more sensitive specimen type for the diagnosis of COVID-19 compared with oropharyngeal swabs. Three of eight patients produced NABs in the acute phase, and NABs were detected in all eight patients with convalescent sera. The results of this study provide valuable information for the diagnosis and surveillance of COVID-19 and development of SARS-CoV-2 vaccines for use in children.
Clinical Characteristics and Viral RNA Detection in Children With Coronavirus Disease 2019 in the Republic of Korea

Key Points

Figure 1. Epidemic Curve of Children With Coronavirus Disease 2019 in Korea From February 14 to March 31, 2020

Other contacts indicates close contact with a kindergarten teacher, care helper at a rehabilitation center, or with other individual with a confirmed case without a social relationship.
Comparison of onset of symptoms and duration with test positivity

Majority of kids are symptomatic at diagnosis or shortly thereafter
Prolonged viral shedding in feces of pediatric patients with coronavirus disease 2019

Yu-Han Xing a,1, Wei Ni b,1, Qin Wu b, Wen-Jie Li b, Guo-Ju Li b, Wen-Di Wang b, Jian-Ning Tong b, Xiu-Feng Song b, Gary Wing-Kin Wong a,*, Quan-Sheng Xing b,*


Methods: From January 17, 2020 to February 23, 2020, three paediatric cases of COVID-19 were reported in Qingdao, Shandong Province, China. Epidemiological, clinical, laboratory, and radiological characteristics and treatment data were collected. Patients were followed up to March 10, 2020, and dynamic profiles of nucleic acid testing results in throat swabs and fecal specimens were closely monitored.

Results: Clearance of SARS-CoV-2 in respiratory tract occurred within two weeks after abatement of fever, whereas viral RNA remained detectable in stools of pediatric patients for longer than 4 weeks. Two children had fecal SARS-CoV-2 undetectable 20 days after throat swabs showing negative, while that of another child lagged behind for 8 days.

Conclusions: SARS-CoV-2 may exist in children’s gastrointestinal tract for a longer time than respiratory system. Persistent shedding of SARS-CoV-2 in stools of infected children raises the possibility that the virus might be transmitted through contaminated fomites. Massive efforts should be made at all levels to prevent spreading of the infection among children after reopening of kindergartens and schools.

Figure 4. Chronological changes in RT-PCR testing results after hospital admission.
Viral loads in throat and anal swabs in children infected with SARS-CoV-2

Chunhui Yuan, Hongmin Zhu, Yuan Yang, Xiaonan Cai, Feiyuan Xiang, Huan Wu, Cong Yao, Yun Xiang and Han Xiao

Department of Laboratory Medicine, Wuhan Children’s Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, People’s Republic of China; Department of Neurology, Wuhan Children’s Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, People’s Republic of China; Institute of Maternal and Child Health, Wuhan Children’s Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, People’s Republic of China.

Figure 1. The difference and correlation of Ct value between throat and anal swabs-testing. (A) The difference between Ct value obtained by RT-PCR-testing on throat swabs (200 cases) and anal swabs (41 cases). (B) The difference between Ct value obtained by RT-PCR-testing on paired throat swabs and anal swabs in 24 cases. The data were normally distributed and a paired t-test was used to compare statistical differences. (C) The pearson correlation between Ct value obtained by RT-PCR-testing on paired throat swabs and anal swabs in 24 cases.
Pensa.

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- The Future: The choir needs to preach
The Future

Addressing the Knowledge Gap

• In the absence of a pediatric vaccine…
• Are we prepared to continue working in our own pandemic?

• Significance is compounded by:
  • Less spotlight
  • Less industry sponsorship (remember H1N1?)
  • Growing “ease” and sentiment of “I’m over it”
More research is needed on the long-term effects of COVID-19 on children and adolescents

Significance is compounded by:

Less spotlight
Less industry sponsorship (remember H1N1?)
Growing “ease” and sentiment of “I’m over it”
Cardiovascular Outcomes in MIS-C

LV systolic dysfunction ~ 91%
Coronary aneurysms ~ 79%

Outpatient pediatric cardiology follow-up:
1-2 weeks following hospital discharge then 4-6 weeks following initial visit
Further follow-up & management based on clinical status and echocardiogram findings
<table>
<thead>
<tr>
<th>Variable</th>
<th>Life-threatening COVID-19-related neurologic conditions, No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>43</td>
</tr>
<tr>
<td>Age, median (IQR), y[^a]</td>
<td>12 (7-15)</td>
</tr>
<tr>
<td>Male</td>
<td>27 (63)</td>
</tr>
<tr>
<td>RT-PCR or antibody results</td>
<td></td>
</tr>
<tr>
<td>Positive RT-PCR result only</td>
<td>19 (44)</td>
</tr>
<tr>
<td>Positive antibody result only</td>
<td>11 (26)</td>
</tr>
<tr>
<td>Positive RT-PCR and antibody results</td>
<td>13 (30)</td>
</tr>
<tr>
<td>MIS-C diagnosis</td>
<td>20 (47)</td>
</tr>
<tr>
<td>No major underlying conditions</td>
<td>34 (79)</td>
</tr>
<tr>
<td>Underlying neurologic disorder</td>
<td>3 (7)</td>
</tr>
<tr>
<td>Death</td>
<td>11 (26)</td>
</tr>
<tr>
<td>Discharged alive, new CNS deficit</td>
<td>17 (40)</td>
</tr>
</tbody>
</table>
Return to Play After COVID-19 Infection in Pediatric Patients

Pediatric patient with history of COVID-19 infection AND asymptomatic for >14 days

- Asymptomatic or mild symptoms (no fever, <3 days of symptoms)
  - Clear for participation

- Moderate symptoms (prolonged fever and bedrest, no hospitalization, no abnormal cardiac testing)
  - Age <12 years: Follow myocarditis return to play guidelines
  - Age >12 years: ECG prior to participation

- Severe symptoms (hospitalized, abnormal cardiac testing, multisystem inflammatory syndrome in children (MIS-C))
  - Follow myocarditis return to play guidelines

Normal ECG
- Clear for participation

Abnormal ECG
- Evaluation by pediatric cardiologist and testing as dictated by the abnormal ECG
  - Concern for myocarditis

Dean et al (2020)
Mental Health for Children

What is the residual effect of a pandemic?

• What are the long-lasting effects of:
  • Being quarantined
  • Wearing masks
  • Not being in school
  • The virus??

• On Children…
• On Adults…
Mental Health–Related Emergency Department Visits Among Children Aged <18 Years During the COVID-19 Pandemic — United States, January 1–October 17, 2020

Rebecca T. Leeb, PhD¹; Rebecca H. Bisko, PhD¹; Lakshmi Radhakrishnan, MPH²; Pedro Martinez, MPH³; Rashid Njai, PhD⁴; Kristin M. Holland, PhD⁵

Summary

What is already known about this topic?
Emergency departments (EDs) are often the first point of care for children's mental health emergencies. U.S. ED visits for persons of all ages declined during the early COVID-19 pandemic (March–April 2020).

What is added by this report?
Beginning in April 2020, the proportion of children's mental health–related ED visits among all pediatric ED visits increased and remained elevated through October. Compared with 2019, the proportion of mental health–related visits for children aged 5–11 and 12–17 years increased approximately 24% and 31%, respectively.

What are the implications for public health practice?
Monitoring indicators of children's mental health, promoting coping and resilience, and expanding access to services to support children's mental health are critical during the COVID-19 pandemic.
**Abstract**

**BACKGROUND:** As the coronavirus disease pandemic spread across the United States and protective measures to mitigate its impact were enacted, parents and children experienced widespread disruptions in daily life. Our objective with this national survey was to determine how the pandemic and mitigation efforts affected the physical and emotional well-being of parents and children in the United States through early June 2020.

**METHODS:** In June 2020, we conducted a national survey of parents with children age <18 to measure changes in health status, insurance status, food security, use of public food assistance resources, child care, and use of health care services since the pandemic began.

**RESULTS:** Since March 2020, 27% of parents reported worsening mental health for themselves, and 14% reported worsening behavioral health for their children. The proportion of families with moderate or severe food insecurity increased from 6% before March 2020 to 8% after, employer-sponsored insurance coverage of children decreased from 63% to 60%, and 24% of parents reported a loss of regular child care. Worsening mental health for parents occurred alongside worsening behavioral health for children in nearly 1 in 10 families, among whom 48% reported loss of regular child care, 16% reported change in insurance status, and 11% reported worsening food security.

**CONCLUSIONS:** The coronavirus disease pandemic has had a substantial tandem impact on parents and children in the United States. As policy makers consider additional measures to mitigate the health and economic effects of the pandemic, they should consider the unique needs of families with children.
NIH effort seeks to understand MIS-C, range of SARS-CoV-2 effects on children

The National Institutes of Health has launched a new research effort to understand how SARS-CoV-2, the virus that causes COVID-19, affects children, who account for roughly 13% of the total cases of COVID-19 in the United States. The effort is called the Collaboration to Assess Risk and Identify Long-term Outcomes for Children with COVID (CARING for Children with COVID). This research program is developing and funding studies to investigate why some children are at greater risk for SARS-CoV-2 infection than others, why symptoms vary among children who are infected, and how to identify children at risk for severe illness from SARS-CoV-2 infection. Research on the latter question is focused particularly on multisystem inflammatory syndrome in children (MIS-C), a life-threatening condition marked by severe inflammation of one or more parts of the body, including the heart, lungs, kidneys, brain, skin, eyes and gastrointestinal organs.
COVID FORCE Team
Leadership: Stacy Heilman, PhD & Ann Chahroudi, MD, PhD
Committee meets to discuss new project submissions and guide investigators to new collaborators/existing IRB’s to capitalize on expertise and conserve resources.

New COVID Seminar Series
Co-sponsored by CCIV and CCTR and ACME-POCT (see slide 6)
Virtual seminar series to highlight COVID research at Emory & Children’s. Each seminar will be 1 hour with up to three talks per seminar. Speakers are invited to share their research in a 10-15 minute talk. Click here to submit your interest and availability/nominate someone to present.

Children’s Provider and Staff Vaccination Status
- 8,031 COVID-19 vaccines to employees and physicians.
- Both Pfizer and Moderna vaccines are being administered

RADx Testing Update:
Test Site: Go-Live Date: Updates: Enrolled:
Satellite Boulevard Drive-Thru 6/22/20 • 8 devices tested • 1000th patient enrolled in August • Interim results look promising • Egleston ED has begun enrolling for the UMass study so far contributing 5 patients 3242
Egleston ED 7/13/20 125
Scottish Rite 7/16/20 31
Total Enrolled: 3398

We enrolled our first participants at Atlanta Public Schools on 3/4/21 alongside the adult team and the RADx Tech Program will continue working into 2022

Investigators, Studies, Publications, Awards & Proposals At-a-Glance
- PIs with COVID-19 projects underway or in development within DOP/Children’s Healthcare of Atlanta (see slide 3)
  - 19 of these PIs are leading more than one project
  - PIs represent 22 different Divisions/Specialties
- Studies from all phases (early development to IRB-approved clinical trials) being tracked by COVID FORCE
- COVID-19 Publications (see slides 6-14)
- Proposals submitted by DOP faculty as PI or MPI totaling $100M and received $54M in awards (see slides 15-19)
- Proposals submitted by DOP Faculty as co-investigators totaling $48M & received $12M in awards (see slides 20-21)
- Intramural awards for DOP Faculty (see slides 22-23)

Wilbur Lam, MD, PhD, and Greg Martin, MD, received a $31 million NIH supplement to lead the national effort in testing validation through the Atlanta Center for Microsystems Engineered Point-of-Care Technologies (ACME-POCT).

Data as of 3/8/21
COVID-Related Research

3D Printed PPE
• Over 1 million face shields donated to protect healthcare workers nationwide
• Current capacity 160K face shield per week
• $2M Aflac, Inc. gift

COVID-19 Research Grants
• 19 grants awarded to date totaling $54M
• $31 million NIH with additional supplement of $18.2M to lead the national effort in testing validation (RADx)

COVID-19 Research Proposals
• 70 proposals submitted totaling $100M in funding
• A total of 60 PIs with COVID-19 projects already underway or in development

COVID-19 Publications
• 72 Publications
• Evan Anderson’s Vaccine study featured in New England Journal of Medicine

RADx Testing & Test Core
• Dr. Mimi Le new Technical Director of Children’s Clinical Translational Discovery Core (CTDC)
• We enrolled our first participants at Atlanta Public Schools on 3/4/21 alongside the adult team
• The adult team enrolled over 1,000 participants by the end of December 2020
• The peds team enrolled close to 3400 participants by the end of February 2021
• 34 devices tested

Serology and Neutralizing Assays
• Ongoing immunological studies of innate and adaptive immune responses in acute and convalescent patients
• Plasma infusion therapy
• Various diagnostic development projects

Multisystem Inflammatory Disease
• 566 patients with symptomatic disease due to SARS-CoV2 seeking care
• 130 hospitalized
• MIS-c in 22 patients (majority are PCR-, serology positive)
• MIS-C serology manuscript was formally accepted to Pediatrics Journal

Drug Discovery
• Designed a large randomized controlled study of remdesivir versus baricitinib plus remdesivir (ACCT).
• FDA authorizes EUA for baricitinib/remdesiver combo use for COVID-19 treatment in hospitalized adults and pediatric patients

Provider Immune Response
• Study aims to determine prevalence of antibodies to COVID-19 in healthcare workers

Vaccines for SARS CoV-2
• Moderna – Emory participated in all three phases and enrolled 700 in Phase 3 showing vaccine as 94.5% effective
• Janssen – Emory recently began enrollment for this first Phase 3 single dose trial
• 8,031 employees, clinical staff and physicians vaccinated.
• Both Pfizer and Moderna vaccines are being administered

As of 3/8/21
Pensa.
will the kids be alright? - a prospectus

- Adults are Not Kids: The Unique Pathology of Pediatric SARS-CoV2
- Time Equals Data: The Trajectory of the Epidemiology
- Kids Are Often Not Alright: Organ Damage in SARS-CoV2
- The Pediatric COVID-19: Multi-inflammatory Syndrome in Children
- Stop the Blame! : Asymptomatic Carrier and Transmission
- The Future: The choir needs to preach

Conjecturae.
1. Kids have unique pathophysiology
2. Data has shifted considerably, pediatric SARS-CoV2 exposure deserves respect!
3. Organ dysfunction can be significant in children
4. MIS-C...the pediatric shockwave
5. Kids should not be blamed!
6. The kids WILL be alright – but it’s up to us
Final Acknowledgements

• All the other people that could have given this talk
• Special thanks to the COVID FORCE