COVID-19 and the Pediatric Population: Risk factors for severe infection and hospitalization

Matthew D. McGraw, MD
Department of Pediatrics, Division of Pulmonary Medicine
University of Rochester Medical Center
Rochester, NY
Disclosures

I have no financial disclosures or conflicts of interest related to this topic.

However, my implicit biases remain:

- Father, pediatrician, and physician scientist
- No significant training in epidemiology nor population biostatistics
Outline

- Coronaviruses and COVID-19
- COVID-19 in the Pediatric Population
  - Prevalence
  - Transmission
- Susceptibility & Risk Factors in Pediatrics
  - Underlying conditions
  - Racial Disparities
Let’s Take a Moment to Pause

Coronavirus

- Named as spokes look like a crown
- Seven human coronaviruses
- Coronaviruses HKU1 NL63, 229, OC43
  - Most common symptoms – common cold
  - Winter and early spring
  - Outbreak every 2 to 4 years
Coronavirus 2019 (COVID-19)

- Illness: 80% mild, 15% severe, 5% critical
- Mainly adults with symptoms
- Fever, cough, sore throat, shortness of breath
- Strongest risk factor: Age (>65 years of age)
- Overall fatality rate: 2.3%; ~15% > 80 years

Wu Z *JAMA* Feb 2020; Dong Y *Pediatrics* 2020
COVID-19 Transmissibility

- Incubation Period
  - 2-14 days (Median: 5 days)

- Basic Reproductive Number (R₀)
  - $R₀ = \text{How many secondary cases are infected on average by each person who is infected}$
How does SAR-CoV-2 $R_0$ compare to other well-known viruses?
Epidemiology of COVID-19: Pediatric Population

- 1-8% of laboratory-confirmed cases
- US: 9-11%
Critical illness is rare, but is disproportionate to <1 year of age

<table>
<thead>
<tr>
<th>Age group*</th>
<th>Asymptomatic</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
<th>Critical</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1</td>
<td>7 (7.4)</td>
<td>205 (18.8)</td>
<td>127 (15.3)</td>
<td>33 (29.5)</td>
<td>7 (53.8)</td>
<td>379 (17.7)</td>
</tr>
<tr>
<td>1-5</td>
<td>15 (16.0)</td>
<td>245 (22.5)</td>
<td>197 (23.7)</td>
<td>34 (30.4)</td>
<td>2 (15.4)</td>
<td>493 (23.0)</td>
</tr>
<tr>
<td>6-10</td>
<td>30 (31.9)</td>
<td>278 (25.5)</td>
<td>191 (23.0)</td>
<td>22 (19.6)</td>
<td>0 (0)</td>
<td>521 (24.3)</td>
</tr>
<tr>
<td>11-15</td>
<td>27 (28.7)</td>
<td>199 (18.2)</td>
<td>170 (20.5)</td>
<td>14 (12.5)</td>
<td>3 (23.1)</td>
<td>413 (19.3)</td>
</tr>
<tr>
<td>&gt;15</td>
<td>15 (16.0)</td>
<td>164 (15.0)</td>
<td>146 (17.5)</td>
<td>9 (8.0)</td>
<td>1 (7.7)</td>
<td>335 (15.7)</td>
</tr>
<tr>
<td>Total</td>
<td>94</td>
<td>1091</td>
<td>831</td>
<td>112</td>
<td>13</td>
<td>2141 (100)</td>
</tr>
</tbody>
</table>

Data were presented with number and percent (%); *Two cases had missing values.
US: Hospitalization remains low in pediatrics, but is increasing

- Hospitalization Rate: 8 of 100,000 infected

(US) Kim L. MMWR August 14 2020
Pediatric Population and COVID-19
(as of November 12th, 2020)

- >1 million COVID-19 positive children
  - 49 states, DC, PR, and Guam reporting
- 11.5% of all cases by age
- 11/6-11/12: >112,000 new cases – highest yet!
- Hospitalization rate: 0.5%-6.1%
- Death rate: 0.00%-0.21%
Bimodal Distribution of Death in Pediatric Patients with COVID-19

391,814 cases in the US – Feb – July 2020
121 deaths; 15 met criteria for MIS-C

(US) Blythe D, CDC COVID-19 Response Team Sept 18 2020
How do children acquire COVID-19?

- Household exposure, usually from an adult
- Secondary: teachers and school staff

Brown NE *Emerg Infect Dis* 2020
McCartney K *Lancet Child Adol* 2020
Do children transmit to each other?

- Household transmission: limited
  - More common: adult to family
  - Adolescent >> Pre-school
- Child care settings: uncommon

However, common for adolescent and college-age students to transmit!
Which pediatric patients are at risk for hospitalization?


Lindsay Kim, MD1,2; Michael Whitaker, MPH1,3; Alissa O’Halloran, MSPH1; Anita Kambhampati, MPH1,4; Shua J. Chai, MD1,5; Arthur Reingold, MD3,6; Isaac Armistead, MD7; Breanna Kawasaki, MPH8; James Meek, MPH9; Kimberly Yousey-Hindes, MPH9; Evan J. Anderson, MD10,11; Kyle P. Openo, DrPH11; Andy Weigel, MSW12; Patricia Ryan, MSc13; Maya L. Monroe, MPH13; Kimberly Fox, MPH14; Sue Kim, MPH14; Ruth Lynfield, MD15; Erica Bye, MPH15; Sarah Shrum Davis, MPH16; Chad Smelser, MD17; Grant Barney, MPH18; Nancy L. Spina, MPH18; Nancy M. Bennett, MD19; Christina B. Felsen, MPH19; Laurie M. Billing, MPH20; Jessica Shiltz, MPH20; Melissa Sutton, MD21; Nicole West, MPH21; H. Keipp Talbot, MD22; William Schaffner, MD22; Ilene Risk, MPA23; Andrea Price23; Lynnette Brammer, MPH1; Alicia M. Fry, MD1,2; Aron J. Hall, DVM1; Gayle E. Langley, MD1; Shikha Garg, MD1,2; COVID-NET Surveillance Team
Who are at risk for severe illness in pediatrics?

Confirmed List

- Underlying medical condition (≥1)
  - Obesity
  - Prematurity
  - Chronic lung disease

(US) Kim L. MMWR August 14 2020
Significant Racial Disparities: Higher prevalence of severe disease in the Hispanic and Black populations

(US) Kim L. MMWR August 14 2020
Why is COVID-19 less common and less severe in children than adults?

- Remains unclear
- Proposed mechanisms:
  - Less intense immune response?
  - Viral interference in the respiratory tract?
  - Lower viral load?
  - Different expression of ACE2 with age?
  - Healthier blood vessels?
COVID-19
Resources and References

- CDC: COVID-19 Information for healthcare professionals
- World Health Organization: Coronavirus
- AAP home page: AAP COVID-19
- HealthyChildren.org: 2019 Novel Coronavirus (COVID-19)
- Brown NE Emerg Infect Dis 2020
- McCartney K Lancet Child Adolesc 2020
- Kim L. MMWR August 14 2020
- Blythe D, CDC COVID-19 Response Team Sept 18 2020
- Dong Y et al. Pediatrics 2020
- Wu Z. Pediatrics 2020;
- Posfay-Barbe KM Pediatrics 2020; Docherty AB BMJ 2020
Multisystemic Inflammatory Syndrome in Childhood (MIS-C)

- Mean age: 10-11 years
- GI, Nephrology, Musculoskeletal
- Increased NT-pro-BNP, troponin (muscle)
- + prior (2-4 weeks) SAR-CoV2 infection
- > in Non-Hispanic Black