

Understanding SARS-COV- 2 In Children: A Review

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Abstract: *Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV- 2) is the causative organism for COVID-19. It transmits through direct or indirect inhalation of respiratory droplets from an infected person. The incubation period in children is 2 to 10 days. Compared to adults children may present with less severe symptoms and so all suspected cases required a laboratory confirmation by reverse transcription-polymerase chain reaction (RT-PCR). Clinical features are the same as other respiratory illnesses like rhinorrhea, headache, myalgia, cough, shortness of breath, fever, sore throat, poor feeding, diarrhea, nausea, and vomiting. All symptomatic children with a history of international travel and hospitalized children who experience severe acute respiratory illness should be tested for coronavirus. Young children experience more severe illnesses than older children. Respiratory specimens are used to diagnose the disease. Currently, no specific treatment is available. Children are treated symptomatically if admitted with the prevention and management of complications. Multisystem Inflammatory Syndrome in Children (MIS-C) is one of the severe complications reported. Mild cases are recommended to manage at home with precautions to prevent the spread of infection. Newborn children born to suspected/ confirmed Covid-19 positive mothers tested between 24 to 48 hours of life and keep separate from others. Breastfeeding is allowed for mothers with Covid-19 if their condition permits as there is no evidence that infection spreads through breast milk but take precautions to prevent the spread of infection to the child by other means. Many children missed their routine vaccines as OPDs are closed and there is a risk for infection from these diseases.*

Keywords: *Severe Acute Respiratory Syndrome Coronavirus-2; COVID-19; Children;*

Background

COVID-19 is a viral infectious disease caused by a newly discovered coronavirus. Coronavirus group of viruses can cause respiratory infections like common cold and rhinorrhoea to the severe acute respiratory syndrome. It is believed that the virus arose in bats and passed on to humans via some unidentified animals in Wuhan, China in December 2019¹. From there it spread throughout the world and on 11th March 2020 WHO characterized SARS-COVID-19 as a Pandemic¹. So far, more than 14 million cases and around 6 lakhs death reported worldwide. In India, around 1.2 million cases have been reported and 30,000 deaths also attributed to this virus². Even though it is considered mild infection in 80% of cases, elderly people and those with comorbidities may progress to SARS and multi-organ dysfunction and so fatality rate in the elderly and those with comorbidities are much higher than others^{3,4}. Children and adolescents are as likely as any other age group to be infected and spread the disease.

Incidence: Compared to adults, the number of children infected with coronavirus is less. In the United States, only 2% of all confirmed cases were children and in China, it is 2.2%. In Italy, it is 1.2% and in Spain only 0.8% of the confirmed cases were children³.

As asymptomatic children are routinely not tested, the incidence of asymptomatic cases and the duration of the pre-symptomatic period are not documented properly.

Incubation period: Studies from China reported that the incubation period ranges from 2 to 10 days in pediatric patients³. However WHO states that the incubation period in the pediatric population is the same as adults like 1 to 14 days².

Mode of transmission

Direct inhalation: Direct inhalation of droplets produced by an infected person while coughing or sneezing leads to the transmission of infection. Aerosol generation procedures like nebulization, open suctioning, cardiopulmonary resuscitation, bronchoscopy, use of non-invasive ventilation and endotracheal intubation also leads to spread of infection^{1,2}

Direct contact: Respiratory secretions of infected individuals may soil the surfaces and direct contact with these surfaces also can lead to the spread of infection¹. The life span of viruses on these surfaces ranges from few hours to few days.

Feco-oral route: virus has been isolated from stools of infected patients, but the contribution of the fecal-oral route to infection is not yet established³.

Covid-19 in children

Covid-19 suspected in all symptomatic (fever, cough, or shortness of breath) children who traveled abroad in the last 14 days and a hospital admitted child who exhibit acute severe respiratory distress. A child stays in the same house with a confirmed positive case or has direct contact with a confirmed case, even if asymptomatic, should suspect Covid-19 positive³. Irrespective of clinical signs and symptoms, if a child test positive by laboratory test RT-PCR, it will be considered as a confirmed case.

Clinical features

Most of the time, children if affected would be asymptomatic or less severe. Frequently reported signs and symptoms include rhinorrhoea, cough, shortness of breath, poor feeding, myalgia, fatigue, vomiting, nausea, fever, sore throat, and malaise¹⁻³. These signs and symptoms may present at any time during the illness and not necessarily present in the initial stage as adults. Other respiratory viral infections also present with these symptoms. So it must be considered while examining these children³⁻⁷.

In severe cases, acute respiratory distress syndrome, septic shock, liver dysfunction, hypoxemia, disseminated intravascular coagulopathy, hypoperfusion, myocarditis, and acute kidney injury can happen¹. Infants and children with any underlying condition may progress to severe cases than other healthy children³⁻⁸.

Laboratory diagnosis

Confirmation of the disease is through the identification of SARS-CoV-2 RNA in respiratory samples like nasopharyngeal/oropharyngeal swab, endotracheal secretion or broncho-alveolar lavage (BAL) using 'RT-PCR' testing¹⁻⁴

Sample collection

Health care practitioners trained to collect the samples should wear appropriate PPE and practice infection control precautions including waste disposal³. Synthetic fiber swabs with plastic shafts use to collect samples. To collect nasopharyngeal swab, tilt the head of the child back 70° and then insert the swab stick into one nostril, push it deep inside along the floor of the septum of the nose until a resistance felt. Rotate it several times against the nasopharyngeal wall, and withdraw it without touching any other surfaces of the nostril and keep the tip of the swab into the viral transport medium (VTM) and cut out the outer part of the stick¹. VTM must be transported on the ice packet to the testing center. For the oro-pharyngeal sample, insert the stick into the mouth and take the swab from the posterior part of the pharynx. Do not touch the tonsils, gums, and tongue¹. Keep the tip in the VTM and remove the outer portion of the swab stick. Sputum samples are not recommended as sputum induction may cause the risk of aerosol generation and leads to the spread of infection. In intubated children BAL or endotracheal aspirate to collect 2-3 ml and it will be mixed with VTM and transported on ice³.

Common lab findings

All admitted children should be tested for CBC, RFT, LFT, Coagulation profile, D-dimer, Fibrinogen, Procalcitonin, Blood culture, and chest X-ray.

Unlike adult patients, there are no consistent leukocyte abnormalities reported in pediatric patients¹⁻³. Normal or low white cell count and increased CRP is usually represented. Procalcitonin is more frequently elevated in children than CRP¹⁻⁵. More studies are required to understand other changes in lab values in children with Covid-19. X-rays and CT scans may show diffuse bilateral involvement of lungs. Chest X-rays reveal patchy infiltrates as of viral pneumonia, and CT scans of the chest reveal

nodular ground-glass opacities¹⁻³. But these findings are not just related to COVID-19 and few children may not have any radiographic abnormalities. Chest X rays or CT scans alone are not recommended for the confirmation of COVID-19⁸.

Clinical Course and Complications in Children

Studies suggest that the severity of illness in the pediatric population ranges from asymptomatic to critical. Studies conducted in China in more than 2000 children revealed that 4% of children were asymptomatic and 51% with mild symptoms. Around 39% were with moderate symptoms like pneumonia and abnormal chest X-rays. Severe cases with dyspnoea, hypoxia, and cyanosis were at 5% and 0.6% of children became critical with ARDS, respiratory failure, shock, or multi-organ dysfunction¹⁻⁴. Children of all ages, even if the incidence is higher in infants and young children, are at risk for COVID 19 infection, but the risk for complications appear to be less common compared to adults. Compared to adults, fewer children required hospitalization and ICU care. Wherever deaths of children reported with laboratory-confirmed SARS-CoV-2 infection, the contribution of this infection to the cause of death is still unclear⁷.

Multisystem Inflammatory Syndrome in Children (MIS-C): Child with MIS-C reported continuous fever and the signs and symptoms involved various organs and systems like cardiac, gastrointestinal, renal, hematologic, dermatologic, and neurologic involvement and elevated inflammatory markers³.

Management

Currently, there are no specific drugs found to be effective in the management or prevention of COVID-19 infection. Treatment remains supportive of prevention and control of complications. The option to manage patients with less severe illnesses in the hospital or home depends upon the cases, after considering the condition of the child, necessity of supportive care, underlying medical problems, and ability of the parents to take care of the child at home¹⁻². Which underlying conditions can complicate with COVID-19 infection is still unclear. So it is considered that children with chronic kidney disease on dialysis, lung diseases like moderate to severe asthma, liver disease, serious cardiac problems, diabetes, immunocompromised illnesses like on chemotherapy, or severe obesity are at high risk for complications from COVID-19, and so they have to be admitted in hospital and monitored closely³⁻¹⁰.

Quarantine: All suspected children have to be isolated either at their house or at the institution as per the policy of the government. Parents should be with the child and take precautions to prevent the spread of infection.

Mild/ asymptomatic infection: According to the current guidelines mild or asymptomatic children can be managed at home with proper monitoring if facilities are available at the house. In case if it is not possible, admit in hospital

- Mild illness is considered when the child breaths normally, feeds well and SpO₂ >92%
- Antibiotics used when respiratory rate is high
- Manage fever with Paracetamol (10–15 mg/kg/ dose)
- Ensure hydration
- Explain danger signs to parents
- The parent/ caregiver should take proper precautions¹⁻⁴.

Duration of isolation: No fever for 3 days and a minimum seven days after symptoms resolved or two negative test reports 24 hours apart¹⁻²

Moderate, severe and critical illnesses: The management of severe and critical cases of children with COVID-19 in the hospital include management of respiratory failure, pneumonia, sepsis or septic shock, secondary bacterial infection or exacerbation of underlying conditions¹⁻². If anyone of the following criteria present, the child needs to be admitted into a health care facility;

- ✚ Respiratory distress
- ✚ SpO₂ < 92% on room air
- ✚ Shock/ poor peripheral perfusion
- ✚ Poor oral intake, especially infants and young children
- ✚ Lethargic, especially infants and young children
- ✚ Seizures/ encephalopathy

Management of Hospitalized children

- Administer oxygen and maintain SpO₂ > 92%. Use low flow oxygen nasal cannula to administer oxygen.
- Symptomatic treatment: Paracetamol for fever
- Antibiotics to start within one hour of admission if sepsis or septic shock is suspected and blood culture to send before starting antibiotics
- Oseltamivir may be considered if influenza is suspected
- Inhaled medications to be administered using MDI with spacer, as nebulization causes the aerosol generation
- Monitor closely for worsening symptoms
- Manage sick patients requires other organ support, intubation and mechanical ventilation in PICU¹
- Viral-suppressive therapy (Hydroxychloroquine or Lopinavir/Ritonavir) may be considered only in patients with severe illness
- Hydroxychloroquine: administered twice on the first day at 7–8 mg/kg/dose and 7–8 mg/kg once a day up to day 5¹.
- Lopinavir/Ritonavir-10 mg:2.5 mg/ kg two times a day for 14 days.
- Lopinavir:ritonavir and Hydroxychloroquine not to administer together as the drug interaction may cause Hydroxychloroquine toxicity¹⁻⁵.

At present, there are no special guidelines to follow for the children with any other underlying medical problems like chronic respiratory illnesses, immune-compromised state, renal abnormalities, uncorrected cardiac issues, etc. These children required more intensive and early therapies.

Breastfeeding children

Breast milk is the most important food for most of the young children and it prevents many illnesses too. Only on rare occasions breast milk or expressed milk is asked to avoid for small children. Till now it is not clear whether COVID 19 transmits through breast milk. Limited data available suggests it is unlikely. So a mother with a confirmed diagnosis of COVID 19 can continue breastfeeding if her medical condition permits, but should take precautions like hand washing and face mask to prevent the spread of infection to her child. Utensils or breast pumps if using should be sanitized. Breastfeeding health care workers who are at high risk for exposure to SARS-CoV-2 should also take some precautions. Mothers should be concerned about the surroundings where they feed their child or do express the milk as the virus can remain alive on surfaces¹¹.

Prevention

Among the cases reported in children, most of them had a household member with COVID-19 positive¹⁻³. So, individuals who are affected with COVID-19 but stays at home with the child needs to be extremely careful to prevent the spread of infection.

- ❖ The COVID positive person must stay separately and should wear a 3-layer surgical mask⁷. Children should not be in contact with these individuals.
- ❖ A family member can be assigned to take care of the person
- ❖ Soiled linen should not shake and prevent direct contact with the skin of an infected individual.
- ❖ Wash hands thoroughly with water and soap or with hand sanitizer-alcohol based
- ❖ Wash toys frequently
- ❖ Teach children to wash hands with soap and water and social distancing
- ❖ Train to cough into their elbows
- ❖ Instruct them don't shake hands or touch others
- ❖ Train to use the mask for children more than 2 years if they have to go out
- ❖ Help them not to touch their face, nose, eyes, and mouth without washing their hands
- ❖ Stay inside and train children to spend quality time inside the house
- ❖ Avoid gathering and visiting others. Be away from the family members who are sick
- ❖ At present prophylaxis treatment is not recommended for children. So, hydroxychloroquine should not be given to children

Newborn children

Routes of transmission

Transmission of SARS-CoV-2 virus to neonates occurs in the postnatal period through respiratory droplets when the newborns are exposed to their mothers, caregivers, or health care personnel with COVID-19. Till now vertical transmission of the virus is unclear. Neonates may present with fever, lethargy, rhinorrhea, cough, tachypnoea, increased work of breathing, vomiting, diarrhea, or feeding intolerance. But these symptoms may be present in children with other diseases and so how much is the role of SARS Cov-2 infection to these symptoms is still unclear. Limited studies on neonates reveal that term infant recovered without any complication⁵

Testing recommendations

Newborns born to suspected/ confirmed COVID-19 mothers tested regardless of signs of infection. Diagnosis confirmed by RT-PCR. Testing is done at 24 hours of age, and if the result is negative a repeat test to be done at 48 hours. However, the optimal timing for testing is unknown. If neonates' nasopharynx or oropharynx is contaminated with maternal fluids, early testing may give false-positive results and the virus may not be detectable immediately after exposure following delivery⁵.

All newborns born to suspected/ confirmed COVID-19 mothers considered as suspected COVID-19 and kept separately from others till the result is available and health care personnel should use appropriate PPE while caring for these children. COVID-19 suspected/ confirmed mothers also separated temporarily from their children until the results are available and if the child tests positive, no separation is required⁵.

Vaccination

As children visiting OPDs declined, routine vaccination became a problem. Many children missed their scheduled vaccines and it exposes them to vaccine-preventable diseases. Health care workers have to coordinate with families to identify these children to complete their vaccination. Sick children should be separated at vaccination rooms to prevent the spread of infection. Different timings or locations can be scheduled for the vaccination of healthy children. Crowds in the waiting area and rooms should be avoided.

Conclusion

Covid-19 in children is less severe compared to adults but can be dangerous in children with other underlying diseases or young children. Children can spread the infection to others as they interact with more people in the community. Symptoms may be the same as other respiratory infections and so children should be kept separately from adults with respiratory issues to prevent the potential risk of transmission. Treatment is supportive with constant monitoring for worsening of symptoms.

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References

1. Felsenstein S, Hedrich CM. SARS-CoV-2 infections in children and young people. *Clin Immunol.* 2020;220:108588. doi:10.1016/j.clim.2020.108588
2. Merckx J, Labrecque JA, Kaufman JS. Transmission of SARS-CoV-2 by Children. *DtschArztebl Int.* 2020;117(33-34):553-560. doi:10.3238/arztebl.2020.0553
3. Sankar J, Dhochak N, Kabra S, Lodha R. COVID-19 in Children: Clinical Approach and Management. *The Indian Journal of Pediatrics.* 2020;87(6):433-442.
4. Anastassopoulou C, Spanakis N, Tsakris A. SARS-CoV-2 transmission, the ambiguous role of children and considerations for the reopening of schools in the fall. *Future Microbiol.* 2020;15:1201-1206. doi:10.2217/fmb-2020-0195
5. Liguoro I, Pilotto C, Bonanni M, Ferrari M, Pusiolo A, Nocerino A et al. SARS-COV-2 infection in children and newborns: a systematic review. *European Journal of Pediatrics.* 2020;179(7):1029-1046.
6. Principi N, Bosis S, Esposito S. Effects of coronavirus infections in children. *Emerg Infect Dis.* 2010;16(2):183-188. doi:10.3201/eid1602.090469

7. Cao Q, Chen YC, Chen CL, Chiu CH. SARS-CoV-2 infection in children: Transmission dynamics and clinical characteristics. *J Formos Med Assoc.* 2020;119(3):670-673. doi:10.1016/j.jfma.2020.02.009
8. Sankar J, Dhochak N, Kabra SK, Lodha R. COVID-19 in Children: Clinical Approach and Management. *Indian J Pediatr.* 2020;87(6):433-442. doi:10.1007/s12098-020-03292-1
9. Balasubramanian S, Rao N, Goenka A, Roderick M, Ramanan A. Coronavirus Disease 2019 (COVID-19) in Children - What We Know So Far and What We Do Not. *Indian Pediatrics.* 2020;57(5):435-442
10. Choi SH, Kim HW, Kang JM, Kim DH, Cho EY. Epidemiology and clinical features of coronavirus disease 2019 in children. *Clin Exp Pediatr.* 2020;63(4):125-132. doi:10.3345/cep.2020.00535
11. Sachdeva RC, Jain S, Mukherjee S, Singh J. Ensuring Exclusive Human Milk Diet for All Babies in COVID-19 Times. *Indian Pediatr.* 2020;S097475591600191.