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COVID-19: Impacts and Implications for Pediatric Practice CE

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OBJECTIVES

1. Distinguish risk factors for coronavirus disease 2019 (COVID-19)—related morbidity and mortality and identify modes of transmission.
2. Appraise appropriate COVID-19 testing parameters and procedures for children.
3. Compare pediatric clinical presentation to adults with COVID-19 infection and recommend appropriate treatment measures.
4. State appropriate infection-control measures to reduce transmission.
5. Describe measures to reduce the risk of infection spread, mitigate adverse health effects in high-risk children, and to promote general health through preventive care.

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ABSTRACT

Since the rapid emergence of the novel coronavirus in December of 2019 and subsequent development of a global pandemic, clinicians around the world have struggled to understand and respond effectively in health care systems already strained before this latest viral outbreak. Leaders are making policy decisions while balancing the slow and precise nature of science with the rapid need for life-saving information.Pediatric nurse practitioners are ideally situated

as a trusted source of health information for children. This continuing education article summarizes the latest evidence on the rapidly developing coronavirus pandemic. J Pediatr Health Care. (2020) *34*, 619–629

KEY WORDS

COVID-19, pandemic, public health emergency, pediatric infectious disease

INTRODUCTION

The coronavirus disease 2019 (COVID-19) is caused by a novel *Betacoronavirus* strain in the severe acute respiratory syndrome family and is also referred to as severe acute respiratory syndrome coronavirus 2. COVID-19 is a zoonotic, enveloped, and single-stranded ribonucleic acid (RNA) virus that can quickly mutate and recombine, creating novel virus strains that spread from animals to humans. There are four strains of coronavirus circulating in humans, all thought to originate in bats. COVID-19 was first reported in Wuhan, China, with controversial reports on the nature of its origin. Coronaviruses are known for causing severe respiratory distress and respiratory failure, along with coagulopathies, multisystem organ failure, and death (Zimmerman & Curtis, 2020).

The timeline (see Figure) of the COVID-19 outbreak is astonishing, as China first reported a cluster of cases of pneumonia in Wuhan on December 31, 2019. Just a month later, the World Health Organization declared a public health emergency of international concern and, by March 11th, assessed the crisis as a global pandemic (World Health Organization, 2020). Response in the United States evolved rapidly as President Trump declared a state of national emergency under the Stafford Act on March 13th. Six days later, California became the first state to issue a statewide stay-at-home order. The following week, the U.S. National Guard was activated in all 50 states. By the end of March, New York City emerged as the epicenter in the United States, and by the end of April, the United States reported more than 1 million cases, the highest number in the world (Kantis, Kiernan, & Bardi, 2020).

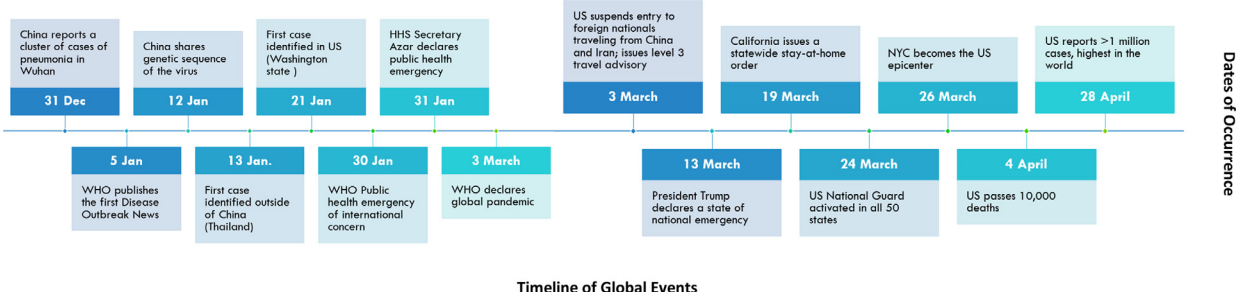
With global response encompassing social, political, organizational, and economic realms, world leaders are struggling to keep pace with the rapid changes. Challenges within the global health care system and the health care profession itself include rationing supplies and services within health care systems, many of which were stretched to the brink before this latest viral outbreak (American Hospital Association, 2020). Considering the urgency of the situation, shortcuts on research are occurring to accelerate outbreak response and inconsistencies are loudly and publicly debated. Social media and lurid reporting bolster feelings of mistrust and panic buying while burgeoning conspiracy theories commandeer national dialogue. This is a time in history to prioritize global health and thoughtful pandemic preparedness. Pediatric Nurse Practitioners are ideally situated to be a trusted source of accurate health information for children. This continuing education article summarizes the latest evidence-based information on the rapidly developing coronavirus pandemic, equipping PNPs for clinical preparation and response.

Declaration of a public health emergency has directed the entire health care system to initiate population-based triage, the management of massive numbers of individuals seeking care. Tasks in this strategy include providing crisis leadership, sustaining organizational response, and achieving disease containment. Triage-based categories include addressing susceptible, exposed, infectious, removed, and/or vaccinated populations, usually through an incident command system. Goals are divided into two phases (see Table 1). Phase 1 addresses broad generic interventions based on best public health practices, whereas phase 2 management decisions are surge-dependent and specific to the five aforementioned triage categories (Burkle, 2006).

RISK FACTORS

Children are a population who have been spared the significant burden of severe illness. To date, two studies ($n = 2{,}143$ and $n = 171$) have described similar COVID-19 findings in pediatric patients. Boys are more commonly affected than

FIGURE. Timeline of coronavirus pandemic of 2019. WHO, World Health Organization; HHS, Health and Human Services; US, United States; NYC, New York City. The timeline of events represented in this figure are from the following sources: Kantis, Kiernan, and Bardi (2020) and World Health Organization (2020).



This figure appears in color online at www.jpedhc.org.

TABLE 1. Phases of public health emergency management

Phase 1 goals	Phase 2 goals
Immediate safety of the community	Surge-capacity dependence
Coordination of experts and leaders	Allocation of scarce resources
Establishing situational awareness	Compliance with agency
Effective resource management	Recommendations and/or orders
Effective communication	Data collection to measure outcomes
Volunteer training	Equitable, fair, and transparent practice

girls, and most children were either asymptomatic or mildly symptomatic. Children aged younger than 3 years and those with congenital heart disease seem to be disproportionately impacted (Yagnik et al., 2020).

Social determinants of health are emerging as a predictor of health disparity in COVID-19, many of which impact pediatric populations. Essential workers are less likely to be able to work from home and financially tolerate furlough. Persons with crowded housing, inconsistent access to care, chronic conditions, and high-stress levels impacting immune function are more susceptible to adverse outcomes as are those who experience racial or ethnic prejudice and/or discrimination (Golden, 2020). People of color, particularly African Americans, experience more serious COVID-19-related morbidity and mortality. Although African Americans make up 13% of the U.S. population, they account for approximately 30% of deaths, and up to 75% of COVID-19-related deaths in Chicago. Asian Americans show similar disparity at 18% of the U.S. population and 23% of COVID-19 deaths (Golden, 2020). Other populations at significant risk include older adults (> 65 years of age), persons with underlying medical conditions (e.g., asthma, cardiovascular disease, kidney disease), persons with immunocompromise, persons with severe obesity (body mass index > 40), persons with diabetes, persons undergoing dialysis, and persons residing in long-term care or nursing homes (Centers for Disease Control and Prevention [CDC], 2020c). Care must be taken to ensure the equitable, transparent provision of services during this pandemic.

TRANSMISSION

COVID-19 is thought to spread mainly from person-to-person, primarily through close contact and droplet exposure from distances of 6 ft or less (Zimmerman & Curtis, 2020). Children carry the COVID-19 virus in the upper respiratory tract, making it easier to spread in childcare centers, schools, and homes, in which pediatric respiratory hygiene is inconsistent and problematic (Zimmerman & Curtis, 2020). R_0 (pronounced R-naught) is the average number of secondary cases attributable to an index case. In other words, it is the average number of persons someone with COVID-19 is predicted to infect. R_0 estimates for COVID-19 range from 2.0 to 5.7. Experts project 82% of the population needs immunity (antibody-induced or vaccine acquired) to stop transmission and achieve herd immunity (Ramirez, 2020). Early analysis suggests active public health surveillance, contact tracing, quarantine implementation, and coordinated social distancing efforts are critical in stopping the spread of COVID-19 (Sanche et al., 2020).

As of June 25, 2020, there were no confirmed cases of COVID-19 intrauterine transmission, although there were concerns over possible correlation to miscarriage, intrauterine growth restriction, and preterm delivery (Zimmerman & Curtis, 2020). However, in the weeks following this report, there is growing evidence maternal-fetal transmission is occurring (Alzamora et al., 2020). Unlike earlier outbreaks of severe acute respiratory syndrome, COVID-19 yields fewer maternal mortalities (Schwartz, 2020). COVID-19 outcomes of pregnant women are similar to women who are not pregnant, including the need for intensive care. As of May 1st, seven maternal deaths have been reported (D'Ambrosio, 2020).

There is currently no evidence to suggest COVID-19 transmission is foodborne, although early reports indicate the virus can live up to 24 hr on cardboard and paper (i.e., food packaging containers) and up to 3 days on harder surfaces (CDC, 2020h). Current advice to reduce transmission associated with grocery shopping or take-out food includes handwashing before and after handling food packaging, removing packaging before eating, limiting trips to the grocery store, and ensuring food preparers (including grocers and restaurants) are complying with health guidance such as wearing masks and screening workers for illness (CDC, 2020h).

There are no reports of domestic pets as vectors, although one tiger at a New York City zoo tested positive (CDC, 2020e). If persons are ill with known or suspected COVID-19, it is wise to self-isolate from pets if possible. To lower the risk of transmission, dogs should be walked on a leash, keeping a 6-ft distance from other people and animals. Crowds should be avoided, and pet owners should not allow strangers to pet their animals. If a pet shows signs of illness, the veterinarian should be called for further instruction as opposed to arriving unannounced at an animal clinic (CDC, 2020e).

INFECTION-CONTROL MEASURES TO REDUCE TRANSMISSION

Pediatric health care providers have always demonstrated expertise in promoting general holistic health, and now that task is more critical than ever as persons with preexisting medical conditions are disproportionately affected by adverse outcomes from COVID-19. Table 2 offers strategies for targeted health interventions to optimize health and mitigate potential serious and life-threatening outcomes associated with COVID-19 infections.

TABLE 2. Strategies to promote general good health

Physical health	Social, emotional, and mental health
Promote regular physical activity	Provide guidance on mental health care
Consider vitamin D supplementation	Encourage early reporting of signs of mental distress to primary care providers
Enable safe access to preventive care	Emphasize the need to maintain social connections in a time of physical distancing
Advocate for healthy nutrition practices	Connect families to mental health services by telehealth to strengthen support and family connections
Ensure advocacy for and access to routine vaccinations	Provide guidance on mental health care
	Encourage early reporting of signs of mental distress to primary care providers

TABLE 3. Early analysis of the effectiveness of nonpharmaceutical interventions

Intervention	Estimated reduction in cases, %
Venue closures	36
Gathering bans	34
Border closures	31
Work bans on nonessential work activities	31
Event bans	23
School closures	8
Lockdowns	5

Note. *This analysis collected data using cross-country analysis from 20 countries to guide future health policy decision making. Banholzer et al. (2020).*

Nonpharmaceutical interventions (NPIs) are actions, apart from immunization and medication administration, that people and communities can take to help slow the spread of illness. The goals of NPIs are to prevent and/or minimize morbidity and mortality while minimizing social disruption and economic effects. Timing is crucial to ensure NPIs are applied with the least restrictive measures which provide the greatest public health benefit (Banholzer et al., 2020). The challenge of NPIS is that evidence of efficacy is always retrospective. Evidence concerning NPIS implemented to mitigate the spread of COVID-19 in the United States is to date, inconclusive, although early analysis conducted by Banholzer et al. (2020) is promising (see Table 3).

Social distancing (e.g., maintaining a physical distance in public at a minimum of 6 ft from persons not living together in the same household) has emerged as a critical NPI to slow the spread of COVID-19 (Messonier, Lipsitch, Stripling, & Markel, 2020). Families can be equipped by health care providers who emphasize the importance of promoting adherence. Role modeling from parents and other adults in the home is an effective way to encourage children to adhere to public health guidelines. Parents should emphasize personal responsibility, especially with adolescents, by establishing clear expectations and firm guidelines with instruction, including ways in which a lack of personal responsibility can adversely impact the lives of others. Families should also consider postponing visits to see older family members or grandparents and consider the use of technology to maintain emotional and relational connections (Inouye, Schuchat, Aiello, Galea, & Nuzzo, 2020).

On April 3, 2020, the Centers for Disease Control and Prevention (CDC) departed from previously issued guidance with a broad recommendation for anyone aged over 2 years to wear face masks or coverings while in public. This guidance does not replace recommendations for social distancing or personal hygiene measures to control the spread of COVID-19 (CDC, 2020b). Persons excluded from mask usage include babies aged less than 2 years, and persons who have trouble breathing, are incapacitated, or are unable to remove a mask without assistance. Mask use is more effective in protecting others from the spread of viral pathogens than protecting the wearer from infection. Ideal fabrics for do-it-yourself masks include denim, canvas, and paper towels, with scarves as a last resort. Layering adds potential protection but also can decrease the ability to breathe easily (CDC, 2020b). In general, surgical masks and N95 respirators should be reserved for health care workers and other first responders. In health care settings, N95 masks should be reserved for high-risk aerosolizing procedures such as intubation and endotracheal suction and high-risk health care workers, including those with a history of asthma. The use of expired N95 masks may be acceptable in some circumstances. Fit-testing and seal-check are recommended for all N95 mask use, expired or not (CDC 2020a; McMillan & Rebman, 2020). The straps and bridge of the nose are usually the first areas to break down and should be visually inspected before use. To preserve masks and maximize usage, longer usage is preferred over reuse. A face shield used over a mask is preferred and may help extend the life of the mask (McMillan & Rebman, 2020).

Lack of adequate personal protective equipment (PPE) has been a widely publicized and broadly discussed concern of health care providers, first responders, and essential workers. Ideal PPE when caring for a patient with known or suspected COVID-19 infection includes: a new N95 mask, gown, medical-grade gloves, and eye covers and/or a face shield (CDC, 2020b). Proper donning and doffing of PPE are essential to prevent viral spread. Institutions should take care to implement protocols and training to equip personnel

TABLE 4. Measures to reduce nosocomial COVID-19 infection

Policy	Procedure
Effective triage of arriving patients	Limit aerosol-generating procedures
Initiation of contact and/or droplet precautions	Prompt individual or cohort isolation
Infection-control measures spanning arrival to discharge	Use negative pressure rooms when available
Prioritization of PPE distribution and use	Wear recommended PPE with proper donning and doffing
Limitation of visitors	Suction with closed-circuit systems and viral filters
Assign COVID-19 recovered workers to COVID-19 cohorts	Limit room re-entry
Protection of high-risk workers	Practice scrupulous hand hygiene

Note. *COVID-19, coronavirus disease 2019; PPE, personal protective equipment*.

adequately. Hand hygiene should be performed before and after removal, and masks should be removed by the straps and handled with gloves. If PPE is limited or not available in a health care setting, usage should be reserved for high-risk persons (e.g., persons aged > 60 years, with chronic medical conditions, or pregnant) or those performing high-risk aerosolizing procedures such as intubation, endotracheal suction, or cardiopulmonary resuscitation. Limiting visitors in the health care setting can be a measure to reduce PPE usage (McMillan & Rebman, 2020). The CDC has issued guidelines for reuse of surgical gloves, masks, and other PPE should new items not be available. Homemade PPE should be used as a last resort. The CDC has a PPE burn rate calculator tool available online to help estimate usage and ordering needs for health care settings (CDC, 2020b).

Frontline personnel and essential workers are concerned about COVID-19 transmission to family members and household contacts. Self-quarantine should be considered, particularly if there are persons in the home at a high risk for adverse outcomes from COVID-19 (Little et al., 2020). Several hotel chains are offering free lodging to frontline personnel, and many other community efforts include the donation of vacation homes or recreational vehicle use. If self-isolation is not possible, a separate room and bathroom are ideal if available for symptomatic persons, with delivery of meals using disposable plates and utensils.

Frontline workers should remove all clothing and shower at their place of employment if possible. Alternatively, stripping clothing in the garage or designated entry spot of the home while placing soiled clothing in a garbage bag for laundering is preferred. Shoes should be removed and placed in a plastic bin at the home entrance. Cleaning soles of shoes with bleach is not recommended, as it may increase the risk of exposure.

Frontline workers should regularly self-monitor for symptoms, including temperature, and promptly report any potential signs of illness (Charbonneau, 2020). Evidence is still emerging on the efficacy of these efforts, but early results point to handwashing, disinfecting carefully, avoiding sharing rooms and surfaces, managing home deliveries with caution, and ensuring adequate ventilation as most efficacious. Health care providers can help families plan for modifications of behavior and factors in the home environment with assistance in problem-solving to overcome barriers (Little et al., 2020). In addition to consideration in the home setting, careful attention should be given to measures within the health care setting to minimize the risk of nosocomial infection (see Table 4).

TESTING

The gold standard of diagnosis for COVID-19 remains the reverse transcriptase-polymerase chain reaction (RT-PCR) using a nasopharyngeal swab, which demonstrates greater reliability over salivary or oropharyngeal specimen analysis (Sethuraman, Jeremiah, & Ryo, 2020). RT-PCR positivity is estimated to persist approximately 3 weeks beyond the onset of illness, indicating only the detection of viral RNA and not necessarily viable transmittable virus (Sethuraman et al., 2020). At the end of May 2020, the United States is performing approximately 150,000 tests per day, with a daily goal of 500,000. Nationally, the positivity rate is around 20%, whereas Germany is reporting 6% and South Korea 3%. Positivity rates of more than 10% indicate less than ideal conditions and inadequate testing (Relman, Jha, Taylor, & Benjamin, 2020). Currently, there are approximately 70 assays commercially available with wide variability in length of testing and significant supply chain issues affecting the availability of cotton swabs, reagents, and other items necessary to complete testing. As rapid point-of-care tests emerge on the market (currently there are three), they arrive with a disadvantage of threats of inconsistency in reporting, creating more challenges with contact tracing. Currently, sensitivity and specificity vary widely and need further investigation (Relman et al., 2020). In clinical cases with a high index of suspicion and an initial negative nasopharyngeal RT-PCR, repeat testing should be pursued (Zimmerman & Curtis, 2020).

Testing of children is variable by region related to state and county guidelines, testing availability and accessibility, and community prevalence. Time estimations of RT-PCR positivity and seroconversion are still unknown in children because largely adult populations have been studied to date. Some concern has emerged after reports of persistent polymerase chain reaction in stool specimens, suggesting possible implications for high-risk caregivers of children who need assistance with elimination needs (Sethuraman et al., 2020).

Serology testing for COVID-19 antibodies is rapidly emerging to explore individual immunity as well as the use of convalescent plasma in therapy for persons with active infection. The Food and Drug Administration (FDA) issued rapidly changing guidance on antibody testing, initially waiving the

need to apply for an emergency use authorization but later requiring application within 10 days of appearance on the commercial market. If the test does not meet FDA standards, testing must be suspended (Shah & Shuren, 2020). Experts advocate for a thoughtful, deliberate approach to ensure the utmost standards of scientific rigor and safety to guide high-stakes policy decisions (Altmann et al., 2020).

Barriers to testing are influenced by social determinants of health. Although the federal government passed legislation to cover the cost of COVID-19 testing, the cost of care associated with the diagnostic test may not be covered. Locations of testing centers should be accessible to the community, and drive-through testing centers should make accommodations for those who do not have a car (Relman et al., 2020). Testing times should provide flexibility in consideration of employment hours of essential workers. Efforts should be made to eliminate racial or ethnic discrimination while providing reassurance and anticipatory guidance to counter the fear of stigma resulting from a positive test. Many primary care systems are severely impaired, and many overwhelmed emergency centers may turn patients away. There is much work to be done to ensure equitable access for all to COVID-19 related care (Relman et al., 2020).

CLINICAL PRESENTATION

It appears children present with similar symptoms described in adults with active COVID-19 infection, although most are either asymptomatic or mildly symptomatic. In late April 2020, the CDC added six symptoms now believed to be associated with COVID-19, including chills, shivering, muscle aches, headache, sore throat, and a loss of taste and/or smell (Neuman, 2020). These were added to previously identified symptoms of fever (91%–100%), cough (43%–80%), and rhinitis (33%–60%); 50%–80% of reported cases reported an ill family contact and 30% reported nosocomial contact (Zimmerman & Curtis, 2020). Although much has been discussed in the media concerning gastrointestinal symptoms as a pediatric presentation, the reported study referenced had five subjects, leaving much to be discovered (Feder, 2020). Emerging characteristics of serology and radiologic findings are listed in Table 5.

Recent developments include concern about what is being called "COVID-toes." Initially, dermatologists had concern for children with preexisting skin conditions, particularly those taking biologics or immunomodulators, who might be at increased risk for COVID-19-associated morbidity and mortality. Anecdotal reports were channeled to a registry development with the Global Rheumatology Alliance, in which more organized reports of pernio-like lesions on the toes began to coalesce. These lesions are characteristic of chilblains but without any cold exposure. Children report a burning sensation, pain, and/or tenderness lasting approximately 2 weeks. There is no correlation currently between dermatologic manifestation and severity of illness (Forand, 2020). As skin eruptions are common with viral illnesses of childhood, it is important to reassure parents COVID-toes seem to be an uncommon occurrence and to seek care with any health concerns (Cleveland Clinic, 2020). Concerned providers may report possible cases to http://www.aad.org/covidregistry.

In addition, of concern are reports of a Kawasaki-like syndrome (referred to by the CDC as a multisystem inflammatory syndrome in children [MIS-C]) in 15 children aged 2–15 years hospitalized in New York City (Hester, 2020). Although none of these children have died related to MIS-C, five have required ventilator support, and six have died of other COVID-19 complications. Reports of MIS-C in Europe include 20 cases in Italy, 20 in Paris, and 12 in Britain (Goldstein, 2020). Some children appear to have signs of initial recovery, followed by a secondary inflammatory response. Clinical implications include increased vigilance of potential manifestations of systemic vasculitis with appropriate clinical assessment and public health reporting for COVID-19 (Hester, 2020). Parents can be reassured MIS-C still appears quite rare as a complication, and in and of itself, is not contagious (Steenhuysen, 2020). Other vascular complications include higher than previously indicated coagulopathies, possibly initiated by a cytokine storm. Retrospective autopsy findings suggest mortality related to undiagnosed deep vein thrombosis. Further exploration is needed to investigate the molecular mechanism, incidence, and clinical implications of these findings (Bandyopadhyay et al., 2020, Beusekom, 2020).

TREATMENT

The National Institutes of Health published the first COVID-19 Treatment Guidelines in May of 2020. There

TABLE 5. Common laboratory and radiologic findings in COVID-19

Serology	Radiographic findings
WBC normal or decreased	Bilateral, multiple patchy nodular ground-glass opacities
Decreased neutrophils and/or lymphocytes	Speckled ground-glass opacities
Thrombocytopenia	Infiltrating shadows in the middle and/or outer zone of the lung or under the pleura
CRP and procalcitonin normal	Findings are often nonspecific
Severe cases	Children have milder presentations than adults
Elevated liver enzymes	Chest abnormalities may persist for several months
Abnormal coagulation studies	
Elevated D-dimer	

Note. *COVID-19, coronavirus disease 2019; WBC, white blood cells; CRP, C-reactive protein.* Zimmermann and Nigel (2020).

are some special considerations for pediatric populations, but most of the guidance includes statements iterating that insufficient data exists for or against the use of pharmacological therapies to treat COVID-19 infections in children (National Institutes of Health [NIH], 2020). Treatment mainly consists of supportive care with the provision of sufficient fluid and calorie intake, along with oxygen supplementation and airway support. Most cases appear to be mild and can be treated at home following clinician determination of minor illness with appropriate anticipatory guidance and evaluation of available resources. Vitamin D supplementation may play a role in reducing the risk of COVID-19 infections, but there is insufficient evidence to support a universal recommendation for children (Grant et al., 2020).

Children who are ill enough to require hospitalization need observation for the progression of respiratory distress, multisystem organ failure, and development of secondary nosocomial infections (Zimmerman & Curtis, 2020). Other COVID-19 pharmacological treatment explorations include monoclonal antibodies, protease inhibitors, and RNA synthesis inhibitors (Zimmerman & Curtis, 2020). In particular, chloroquine has been widely publicized and publicly debated. Emerging recommendations include prioritizing available supply for rigorous, scientific clinical trials, preventing treatment interruptions for those on chloroquine for chronic rheumatic diseases, and provision of clear messages with transparent and accurate interpretation of available data concerning COVID-19 treatment (Yazdany & Kim, 2020).

If a child has a laboratory-confirmed or clinically suspected case of COVID-19, isolation should be initiated. Discontinuing isolation can be test-based with two or more negative tests (with emergency use authorization approval from the FDA) more than 24 hr apart and meeting requirements for symptom-based strategy. If testing is not available, isolation may be discontinued solely with a symptom-based strategy after a minimum of 10 days from the onset of symptoms and more than 3 days from recovery (defined as a minimum of 72 hr afebrile without antipyretics and improvement in respiratory symptoms [CDC, 2020f]).

THE POSTPANDEMIC FUTURE OF COVID-19

The world is waiting with bated breath for a COVID-19 vaccine. With more than 100 potential vaccines in development, safety, and scientific rigor in the process will need to take the highest priority (Altmann et al., 2020). Many approaches are being studied, including live-attenuated, inactivated, subunit, recombinant, viral vector, and deoxyribonucleic acid vaccines (Zimmerman & Curtis, 2020). Vaccine development is a process that customarily takes over 20 years, but for COVID-19, it is being attempted in 12–18 months. Comparatively, other vaccines for children have gone through rigorous clinical trials with more than 70,000 subjects studied over 4 years or more, a difficult bar to clear in these conditions. In biologics, the process is the product, and it is essential the process is the same for every dose (Offit, 2020).

On May 4, 2020, the National Institute of Allergy and Infectious Disease announced the Human Epidemiology and Response to severe acute respiratory syndrome coronavirus 2 study. More than 6,000 children in 2,000 families currently enrolled in National Institutes of Health-funded pediatric research in 11 cities will participate in the effort to provide answers as to why most children with acute COVID-19 infection are not seriously ill. Families will be studied remotely with caregiver collection of specimens. Questions to be addressed include (1) do infection rates differ in children with asthma?, (2) how many children infected with COVID-19 develop symptoms?, and (3) are children resistant to COVID-19 infection? (NIH, 2020).

Primary care access has been severely disrupted by restrictions implemented to prevent COVID-19 transmission. Challenges include limited PPE, limited availability of COVID-19 tests, patient workflow disruptions with closed waiting rooms and drive-through services, dramatic patient census drops and revenue shortfalls, and parental fears resulting in hesitance to present for care. In addition, rapid changes in telehealth in the last 2 months have exceeded changes made in the last two decades, with many practices quickly adapting from little-to-no telehealth to most services being delivered remotely (Mostashari, 2020). Long-term health impacts and outcomes remain to be seen.

IMPLICATIONS FOR PEDIATRIC NURSE PRACTITIONERS

Many pediatric nurse practitioners (PNPs) have been called upon to care for young adults, converting inpatient critical care units to house persons aged into their 30s (Philips et al., 2020; Renke et al., 2020). In times of emergency, this may be necessary. The National Association of Pediatric Nurse Practitioners (NAPNAP) asserted this is appropriate in certain circumstances but clarified certain conditions for consideration including (1) individual state nurse practice acts should be consulted and followed, (2) the PNP has education and training to give appropriate care to the assigned patient, (3) safe harbor protections are in place to protect the PNP from being forced to accept unsafe assignment, and (4) care will transition to an adult provider as soon as possible (NAPNAP, 2020a).

Early estimates suggest measles vaccination rates have fallen by up to 60% since the onset of the COVID-19 pandemic (Dunleavy, 2020). PNPs play an important role in promoting vaccination by encouraging and equipping families to stay on schedule to avoid vaccine-preventable illness (Goza, 2020). NAPNAP recommends innovative solutions to provide safe opportunities to keep vaccination schedules on time including (1) separating well and sick visit hours, (2) staggering appointment times, (3) closing waiting rooms, (4)

reminding families about upcoming vaccines, (5) using every patient encounter as an opportunity to administer vaccines, and (6) administering as many simultaneous vaccines as possible (NAPNAP, 2020b).

Schools are struggling to adapt rapidly, making high-stakes decisions with the little information available. The American Academy of Pediatrics issued guidance regarding return to school to shape conversations around holistic health and equity (Hester, 2020). Specific guidance provided includes overarching principles of flexibility to respond to quickly changing information in individual communities, advocacy for vulnerable and disadvantaged children, equity in school inclusion, and policies to support the overall health of children, their families, and their communities (AAP, 2020). NAPNAP also released a statement urging leaders and policymakers to prioritize planning and funding efforts to allow children to return to school safely as soon as possible. The impact of widespread school closures means millions of children are left without a safety net for critical support services, increasing widening disparity gaps, enhancing the potential for online exploitation of children, and growing concerns over the rise of mental health distress following prolonged isolation as well as distress emerging from rising tensions surrounding discrimination, racism, and prejudice (NAPNAP, 2020d).

The world has changed in the weeks after the rapid spread of COVID-19 on a scale similar to that after the September 11 attacks. This pandemic is likely to change society in several ways, with long-term implications still largely unknown. Professional experts in science, medicine, nursing, economics, business, journalism, and others are offering professional opinions of their expectations of world changes and paradigm shifts (Politico, 2020). PNPs play a critical role in navigating significant amounts of changing information to help equip families to keep their children healthy and safe in these uncertain times. Important considerations for children include sharing everyday preventive health behaviors; promoting physical activity; maintaining social connections; watching for signs of stress, anxiety, and depression; and promoting adequate support systems (CDC 2020d; CDC 2020g)

NAPNAP (2020c) issued a statement concerning child health and wellness during COVID-19. Recommendations for families include (1) supporting children as they ask questions about the pandemic, (2) close monitoring of child health and well-being with prompt contact of primary health care providers if changes are noticed, and (3) continuing to seek care in-person or using telehealth to maintain well visits and immunization schedules while receiving anticipatory guidance and necessary screenings. Recommendations for providers include (1) increasing the use of telehealth and telemedicine, (2) designing office experiences to support social distancing in a developmentally appropriate way, (3) increasing access to hand sanitation, (4) providing masks as indicated, (5) ensuring PPE is available for all staff, (6) advocating for mental health awareness and connection to resources, (7) referring families to credible sources of health information, (8) reminding families to present for well care, and (9) considering participation in research efforts. PNPs will need to continue to be active learners, adaptive and flexible while serving as trusted sources of information for families with children who concerned about immediate and long-term impacts and implications of COVID-19.

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CE QUESTIONS

1. Which statement is most accurate concerning coronavirus disease 2019 (COVID-19) morbidity and mortality in the pediatric population?
   a Children have been disproportionately affected, with high rates of morbidity and mortality
   b Children have lower rates of infection, but higher rates of death than adult populations
   c Children with COVID-19 infection are mostly asymptomatic or mildly symptomatic
   d Children are at much higher risk for acquiring COVID-19 than adult populations
2. Which of the following statements are true about nonpharmaceutical interventions (NPIS)? Select all that apply.
   a The goal of NPIS is to eliminate all mortality associated with COVID-19
   b Timing is critical to ensure the least restrictive measures with the greatest public health benefit
   c Social distancing is the least effective measure to prevent the spread of COVID-19
   d Health care providers should emphasize personal accountability by establishing clear expectations and firm guidelines
   e School closures are one of the most effective NPIS in helping slow the spread of COVID-19
3. Which of the following represents the most appropriate mask usage according to the Centers for Disease Control and Prevention guidelines?
   a Cloth face coverings for infants aged less than 2 years
   b Surgical grade masks for school-aged children when in public
   c Do-it-yourself masks with scarves and coffee filters for primary care providers
   d N95 mask use for a pediatric nurse practitioner with a personal history of asthma
4. What actions should be taken to preserve personal protective equipment (PPE) supplies for health care workers? Select all that apply.
   a Use expired N95 masks for low-risk exposures
   b Removal, disinfection, and reuse of PPE is preferred overextended single periods of use
   c Ideal PPE for COVID-19 care includes a new N95 mask, gown, medical-grade surgical gloves, and eye covers and/or a face shield
   d Visitors to the health care setting should be limited
   e Mask removal should be preceded and followed by strict hand hygiene
5. What should health care or essential workers do to help prevent transmission of COVID-19 to household contacts?
   a All essential or frontline workers should remain in self-quarantine for 30 days after providing care
   b Soles of shoes worn in the health care setting should be cleaned with bleach after removing
   c Self-isolation at home should ideally occur in a separate room with private bathroom
   d N95 masks and PPE gowns should be worn at home
6. If a child presents to the clinical setting with symptoms of COVID-19 compatible illness, what test should the pediatric provider order?
   a Reverse transcriptase-polymerase chain reaction nasopharyngeal swab
   b Serology for COVID-19 antibodies
   c Chest computed tomography without contrast
   d Home-testing kit with saliva collection

7 Which of the following clinical presentation scenarios is most concerning for possible COVID-19?
   a A 6-year-old with one episode of diarrhea, two episodes nonbilious emesis, and no ill contacts
   b An 18-year-old with a body mass index greater than 40 and prior history of type 2 diabetes mellitus who presents with cough, chills, fever, and loss of smell
   c A 12-year-old with sore throat, lymphadenopathy, and nausea
   d A 1-year-old with a maculopapular rash to the hands, feet, and buccal mucosa
8 What is the most appropriate response to parental concerns over multisystem inflammatory syndrome in children?
   a This is a life-threatening illness becoming common in children
   b This is a rare and usually treatable complication from a viral illness
   c This is a contagious illness that can easily spread from child-to-child
   d This complication is a systemic vasculitis that causes permanent heart damage
9 What pharmacological interventions should be considered to treat hospitalized children with COVID-19?
   a Third-generation cephalosporins for nosocomial infections
   b Monoclonal antibodies
   c Protease inhibitors
   d Antivirals
10 What actions can pediatric nurse practitioners take to promote child health and wellness during COVID-19? Select all that apply.
   a Support children as they ask questions about the pandemic
   b Encourage parents to contact their health care provider with any changes in health status
   c Use telehealth or in-person care to maintain well visits and immunization schedules
   d Design office experiences to promote social distancing and good hand hygiene
   e Refer families to credible sources of information on health and wellness

Answers available online at ce.napnap.org.