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Commentary

Pediatric Peri-Operative Care in the COVID-19 Era

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Less than 3% of coronavirus disease 2019 (COVID-19) cases in America occur in patients younger than 18 years old [1]. Globally, pediatric deaths from this pandemic are exceedingly rare. Still, viral suppression and mitigation are paramount, particularly in the perioperative setting. Hospitals across the United States have developed various strategies to manage patient care during the COVID-19 pandemic [2]. At the time of this article, the availability of consensus guidelines for the care of children in this pandemic is limited.

Social disruption caused by the COVID-19 pandemic has changed every step in the cycle of care for a child requiring surgery. Furthermore, although COVID-19 is less common in the pediatric population, adverse health outcomes resulting from disruption in schooling, reduced household income, and the possibility that children may represent an asymptomatic or pre-symptomatic means of disease spread all indicate that the role of children in the pandemic is complex. Here, we offer commentary on selected issues unique to child health, well-being, and pediatric perioperative care as we navigate the COVID-19 pandemic.

Pediatric Prevalence of COVID-19 in the United States

COVID-19 has affected children far less severely than adults [1,3–6]. In the United States, 17,982 cases occurred in those younger than 18 of the 846,992 cases at that time (2.1%) [1]. In a report of March 2020 cases, 147 (5.7%) children with COVID-19 were hospitalized and 15 (0.58%) were admitted to an intensive care unit (ICU) [5]. Based on U.S. Centers for Disease Control and Prevention (CDC) reporting at the beginning of May 2020, 0.1% of deaths occurred in individuals younger than 24 years of age [7].

Severity of COVID-19

In China, there were 2,141 individuals younger than 18 years old from January to February 2020 with confirmed or suspected cases of COVID-19. They found that 94 (4.4%), 1,091 (50.9%), 831 (38.8%), 112 (5.2%), and 13 (0.6%) of children were asymptomatic, mild, moderate, severe, or critical cases, respectively [3].

The risk of children becoming severely ill with COVID-19 is low [3,8,9]. Symptomatic children can present with fever, dry cough, fatigue, and rarely rhinorrhea, congestion, or gastrointestinal symptoms [10]. These conditions are not uncommon for a pediatric provider.

Adults

Prevalence of COVID-19

In the United States, more than 1,000,000 adults have been diagnosed with COVID-19 as of May 1, 2020 [1]. Their symptoms can include fever, dry cough, myalgia, fatigue, dyspnea, headache, loss of smell, and diarrhea [6,11,12]. In March 2020, 12.1% of U.S. adults with confirmed COVID-19 required hospital admission compared with 0.3% and 0.1% for children aged 0–4 years and 5–17 years, respectively [13]. Similar to children, the presence of chronic diseases in adults increases the likelihood of poor outcomes [14]. Furthermore, age is associated with the increasing likelihood of severe disease progression, particularly in the elderly [8,13,14].

Healthcare Workers

Healthcare workers who interact with the community and healthcare systems are at higher risk. The CDC reports from February 13, 2020 to April 9, 2020 indicate that there were 9,282 (2.9%) cases among healthcare workers. Although some information was unavailable, 780 (8.4%) of the healthcare workers were exposed to patients with COVID-19 within 14 days of the onset of their symptoms. Of these 9,282 workers, 723 (7.8%) were hospitalized, 184 (2%) were admitted to an ICU, and 27 (0.3%) died. Ten (0.1%) deaths occurred in individuals older than 65 [12]. As the epidemiology suggests, the impact on adults who care for pediatric patients and the indirect effect on children inside and outside of the surgical care setting may be substantial.

Pediatric Surgical Care

Contingency plans effect on case volume

Because COVID-19 is more likely to affect healthcare workers, pediatric hospitals have implemented plans to limit the spread of the disease and conserve needed resources. The reduced administration of healthcare to children—particularly in the number of surgical procedures—reduces revenue and may result in the diversion of pediatric healthcare workers to affiliated ''adult'' institutions. In a large pediatric hospital, the two-month backlog of cases could account for thousands of patients eventually needing procedures across the United States. Worse still, if pediatric healthcare facilities close, the limited capacity

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will be crippling to local economies and lead to long-term gaps in care and this can vary from rural to urban settings [15].

Effect of cancelling cases

As we return to performing elective procedures, physicians will prioritize patients. Families attempting to be evaluated for an elective procedure will experience delays. This will result in queuing for procedures that could displace patients with less urgent needs. Parents may resort to other strategies to mitigate delays or, even worse, the natural history of their surgical problems could progress such that they require urgent intervention. All of these pressures are occurring with the realities of a failing economy and uncertain future with social supports such as schools. Another likely constraint on delivering timely care may be limitations in health insurance because of the millions who have and are expected to lose employment or the insurance industry being overwhelmed with a deluge of COVID-19–related claims [16,17].

Impact on Healthcare Workers

Given the stress brought about by fear of this virus, there is concern for how healthcare workers will be impacted. Already hospitals have experienced decreased staffing and increased utilization of employee assistance programs. After the 2003 severe acute respiratory syndrome (SARS) outbreak, healthcare workers were found to have similar or lower incidence of psychiatric disorders than the general population [18]. However, despite the resilience of healthcare workers, there is need for support with psychiatric disorders during and after the epidemic [18,19]. With this knowledge, we as individuals and organizations must prioritize mental well-being. We must also consider the stress that parents and guardians will have regarding the safety of their children as we open our hospitals.

Threat of COVID

Threat of a child to healthcare worker

In a typical academic center operating room there are five to six people in the room. To mitigate spread, parents or guardians of all children undergoing elective procedures should be screened pre-operatively for COVID-19 risk factors. Some centers are conducting pre-operative COVID-19 testing within days or hours of the scheduled procedure. If possible, cancellation of operations when of children or family members test or screen positive for COVID-19 can limit the chance of endangering a child undergoing an invasive procedure. In addition, cancellation also mitigates viral spread to healthcare workers in the perioperative period. If testing is negative, the proceduralist and anesthesiology team are potentially spared from using resource-limited personal protective equipment (PPE). Ultimately, screening and testing provide a safe environment for families in the hospital.

Implications of Home-Bound Children

Education

COVID-19 is a pervasive and lethal pandemic of which our knowledge is limited. Schools across the country have transitioned to home-based education models. Closing schools comes with an effect on children, parents, the economy, and the healthcare workforce [20]. Although the benefit can be extrapolated to decreasing the spread of COVID-19, we must also consider its impact on development. Children will miss meals that school provided, have new or worsened mental health problems, and potentially not meet standardized assessments leading to increased rates of drop out [21]. One must also consider that non-accidental trauma (abuse) may be escalating but underreported because children are not in school as has been seen in Ohio and California [22,23]. Mitigation policies must consider the tradeoffs so that we do not make it through this pandemic only to face a national fallout from school closures.

Economy

Social distancing has altered how our economy functions. Many have lost their jobs or have retained jobs without income. Each day we see that the effect of COVID-19 on the markets is profound [24]. Furthermore, many companies including healthcare with international interests have production lines based in China and must find other means to maintain their supply [25]. Our nation's economic response to COVID-19 will depend greatly on government policy and business strategies to avoid a prolonged recession similar to 2008 or the Great Depression [26].

New Normal or Transformation

Key drivers for change

Given the impact this virus has on daily lives and healthcare, returning to business as usual will be difficult. We anticipate essential drivers to this new normal to be the economy and public health. Our nation has seen that the suppression of COVID-19 with social isolation has led to a severe decrease in the economy because of a loss of human capital; however, these two drivers are not inversely related as we will discuss with the use of the Grossman Model.

Blended model?

There are tradeoffs that we must consider to find the optimal point in health and the economy. Consider the Grossman Model as a representation of the tradeoffs between the economy and public health (Fig. 1) [27]. In Figure 1, we see that as health

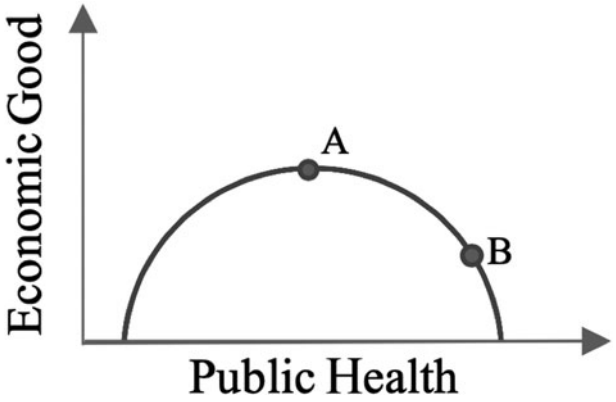

FIG. 1. Grossman Model depicting public health and economic good.

increases economic good increases to point A, but after point A economic good decreases. When we choose to prioritize health over economic good, we approach point B and vice versa.

As we have moved through managing the COVID-19 pandemic, we have seen the Grossman Model in effect. With social distancing, we support public health yet hinder the economy. Likewise, as we consider decreasing the public health suppression strategies, we see the potential of improving economic good. It is imperative that we strongly consider the impact our decisions will have as we prepare to return to normal.

Social versus economic?

These two drivers should be considered at the individual and national level. Nationally, the virus has the potential to affect millions of lives directly and indirectly. To date, the virus has a case fatality ratio of 5.7%. Because of testing limitations, this estimation does not include the individuals who are asymptomatic or have had the virus but did not meet criteria for testing. There is a glimmer of hope in this information. Perhaps the case fatality is considerably lower than what we are seeing and, in that case, is it time to reopen our economy? With the threat of another recession, such thoughts are likely to plague the governmental leadership as much as the virus plagues health leaders, nationally.

Taken at the individual level, people affected by COVID-19 may experience varied symptoms or complications. Because of the concerns raised by the virus, children are often kept away from doting grandparents to prevent the chance of spreading the virus to those more likely to have worse outcomes.

On top of the consequences of viral contact, there is the impact of decreased income and education. Those most likely to be impacted substantially by these losses are people of lower socioeconomic status. There are children across the nation who depend on free and reduced lunches served at school. Not only are they denied an education because of this virus, but they now have lost meals. Families who may have no source of income secondary to COVID-19 must now find means to provide education and nutrition that the government previously helped them provide.

Where is the greatest effect of COVID-19? Is it on the people or the economy? It appears that the two are tightly intertwined. Therefore, policies governing public health and the economy in this pandemic must be considered at the national and individual level as we prepare to turn to normal.

Recommendations

Pre-operative testing

Our readiness for the return to normal should be data driven. Cases should be declining before considering reopening. Without full understanding of our immunity to COVID-19, the full extent of its spread, and treatment, preoperative testing should be performed to decrease the chances of viral spread in perioperative spaces.

Hospitals must ensure they have access to enough tests and the ability to run tests and get results in a timely fashion. Healthcare organizations must determine the appropriate timing of testing prior to proceeding with elective procedures. Testing should be performed pre-operatively at a location that allows for safe screening of temperatures and symptoms. For hospitals where test results take hours to return, we recommend performing tests at least 48 hours prior to procedures to allow for time to interpret results and plan in the case of positive test results.

Pre-Operative Admission

Patient management

Routine screening practices should be performed prior to allowing entrance into hospitals. Evidence of fevers or upper respiratory tract infections concerning for COVID-19 should not be allowed admittance for elective procedures. Once the patient has a negative test and both patient and guardian pass admission screening, they should be taken to the perioperative suite immediately. Traffic by patients and family should be minimized pending further information on COVID-19 spread after re-opening of elective procedures.

PPE

The likelihood of a patient being a carrier of COVID-19 after screening and testing negative is low, however, it would be prudent to continue routine use of surgical masks, gloves, and hand hygiene during pre-operative patient care. All efforts should be made to maximize the supply chain to ensure equipment availability. In addition, several options are now available for safe re-use of N95 respirators through disinfection.

Intra-Operative Considerations

Procedure and risks

Risk of viral spread increases for procedures that result in aerosolization, particularly where viral titers are higher. Areas that are known to have high viral titers include the nasopharyngeal surfaces and the bronchial tree [28]. There is increasing concern about transmission via the fecal-oral route suggesting increased viral titers in the gastrointestinal tract [29]. Furthermore, the risk of electrocautery resulting in aerosolization is also a consideration the proceduralist must consider, however, prior studies in human papilloma virus infection risk from surgical smoke have shown mixed results [30]. Further studies will be needed to assess this risk in relation to COVID-19.

We would recommend all staff wear N95s or powered air-purifying respirators (PAPRs) in rooms in which ear, nose, and throat (ENT) and thoracic procedures are performed on confirmed or suspected COVID-19–positive patients. Consideration should be given to wearing N95s and PAPRs for laparoscopic and endoscopic procedures in patients with confirmed or suspected COVID-19. Surgical masks are appropriate for patients who test negative particularly in situations in which respirators are in short supply.

Intubation

For all pediatric patients who require intubation and have not undergone pre-operative testing for COVID-19 or have a positive test result, an N95 mask should be worn by all staff for the duration of the procedure. The Anesthesia Patient Safety Foundation has clear guidelines for airway management for these suspected or confirmed cases [31]. In the case of a negative COVID-19 test result pre-operatively, the likelihood of viral spread is low and mandatory use of a N95 is not necessary.

Post-Operative Considerations

For patients with confirmed of suspected COVID-19, they can be extubated in the procedure room or taken to an isolated negative pressure room for further care. Deciding when to enter a room potentially contaminated with airborne contamination should be based on procedure room ventilation specifications. If extubation is performed in the procedure room, the room should not be entered by environmental service personnel starting at the time of extubation until the time the room has reach 99% clearance based on the ventilation specifications. The CDC environmental infection control has recommendations for time to 99% removal of airborne contaminants [32]. Once enough time has passed, the room should then be thoroughly cleaned by environmental services staff wearing full PPE. Patients with negative tests can be extubated and taken to the post-operative unit and their rooms can be cleaned without delay.

Summary

COVID-19 has impacted the United States substantially. The virus, unlike other recent epidemics, has resulted in the closing of many schools, businesses, and healthcare facilities. Much of the virus's impact is yet to be determined, however, what has been observed is that children are much less affected than adults and their case fatality is low across the world. Although the adults who care for children at home and in healthcare settings may be at risk, there are many strategies that are being implemented across the nation to address viral spread and move toward business as usual. Government policies that are currently being developed should consider the impact they will have on public health and the economy because they are both intimately intertwined in the daily workings of our nation. We urge consideration of the long-term impact that the pandemic may have on children. Furthermore, we insist that public and private institutions at all levels consider policies and programs that account for children and the indirect and direct deleterious effects that the pandemic is having on their development and well-being. Children in need of surgery have different considerations compared with adult patients with regard to decision-making, convalescence, and long-term outcomes. As children are our future, let us consider mitigation strategies and solutions that can give them the best chance at success.

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