

Hospital preparedness and management of pediatric population during COVID-19 outbreak

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Submission: 02-05-2020

Accepted: 06-05-2020

Published: 18-06-2020

Access this article online

Quick Response Code:



Website:

www.thoracicmedicine.org

DOI:

10.4103/atm.ATM_212_20

Abstract:

With the recent pandemic of Coronavirus disease-2019 (COVID-19), there has been a higher number of reported cases in children more than to the prior Corona Virus-related diseases, namely, severe acute respiratory syndrome and the Middle East respiratory syndrome. The rate of COVID-19 in children is lower than adults; however, due to high transmission rate, the number of reported cases in children has been increasing. With the rising numbers among children, it is imperative to develop preparedness plans for the pediatric population at the hospital level, departmental level, and patient care areas. This paper summarizes important considerations for pediatric hospital preparedness at the hospital level that includes workforce, equipment, supply; capacity planning, and infection prevention strategies, it also span over the management of COVID-19 pediatric patients in high-risk areas such as critical care areas, Emergency Department and operative rooms.

Keywords:

Coronavirus disease 2019, outbreak response, severe acute respiratory syndrome coronavirus 2, Saudi Arabia, viral pneumonia

Coronavirus disease-2019 (COVID-19) is caused by a novel Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) that was first reported in Wuhan, China, late December 2019. Since then, it was declared by the World Health Organization to be a public health emergency of international concern on January 30, 2020, and recognized as a pandemic on March 11, 2020.^[1] Although COVID-19 is mainly a disease that affects adults, it caused a higher number of cases in children in comparison with other Coronaviruses, namely, SARS-CoV-1

and Middle East respiratory syndrome coronavirus (MERS-CoV). Current epidemiological data related to COVID-19 vary among countries. Data from Spain, Italy, China, and the United States of America (USA) show that pediatric patients account for 0.8%–2% of confirmed cases.^[2-5] On the other side, confirmed SARS has been reported in 80 children from a literature review of six case series.^[6] While the incidence of MERS-CoV in pediatrics has been reported to be 31 cases between 2012 and 2016.^[7] Until present, there is no clear exact reason for the low prevalence of the disease in children. Nonetheless, recent evidence suggests that angiotensin-converting enzyme II (ACE2)

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How to cite this article: Kazzaz YM, Alkhalaf H, Alharbi M, Al Shaalan M, Almuneef M, Alshehri A, *et al.* Hospital preparedness and management of pediatric population during COVID-19 outbreak. *Ann Thorac Med* 2020;15:107-17.

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acts as a binding site for COVID-19 and that ACE2 receptors are less mature in children.^[8]

The available literature reports that pediatric cases have mostly been diagnosed after family cluster transmissions and that they present with a milder course of illness compared to adults.^[9] In a case series of 2143 pediatric patients that included 731 confirmed and 1412 suspected, moderate to severe cases and cases requiring critical care admission reached 40% and 0.6%, respectively.^[9] The Center for Disease Control and Prevention had reported 2572 cases among children in the USA, of which 5.7%–20% required hospital admission and 0.6%–2% were admitted to the pediatric intensive care unit (PICU).^[2] In Spain, 41 confirmed cases were reported among children, of which 60% required hospital admission and 9.7% required PICU admission.^[5]

Kingdom of Saudi Arabia (KSA) reported the first case of COVID-19 on March 2, 2020.^[10] Up to April 25, 2020, there have been 17,522 confirmed cases. The health-care system in KSA is delivered by the Ministry of Health and other governmental and private sectors.^[11] A Royal decree has mandated free medical care for Saudi nationals not covered by the governmental sectors and expatriates including any illegal immigrants. KSA has taken major precautions at the national level to prevent the spread of COVID-19, linking all health-care providers through the National Health Emergency Operations Center, which functions as a command and control center for orchestrating all the efforts to deal with COVID-19. Furthermore, other measures were taken, including placing restrictions on Umrah pilgrimage, closure of schools and universities, suspending international and local flights, and imposing a curfew and lockdown on several cities.^[10,12]

The Ministry of National Guard Health Affairs (MNGHA), a governmental and teaching health care system in Saudi Arabia, provides care across 5 hospitals and >70 primary care centers, the main hospital is King Abdulaziz Medical City located in Riyadh (KAMC-R).^[11] KAMC-R had the second-largest outbreak of MERS-CoV taking place in 2015.^[13] Following the MERS-CoV outbreak, MNGHA updated its crisis management plan based on five pillars, leadership and communication, patient management, staff management, infection control, and recovery plan for any potential outbreaks.^[14,15] However, this plan mainly focused on the adult population. Due to the rarity of children's infection before COVID-19 epidemics, we could not identify a preparedness plan for the children population. Therefore, this statement is prepared by a panel of experts from King Saud bin Abdulaziz University for Health Sciences and MNGHA with the aim of to present the recommended

preparedness plans for the children population at the hospital level, departmental level, and patient care areas.

Guidance for Pediatric Services and Hospitals

One of the best practices in hospital management is the availability of hospital preparedness plans. At the MNGHA, there is a detailed plan that was updated following the MERS-CoV endemic. It is focused on the macro level with more attention to the adult population. This preparedness plan composed of three domains that were related to human resources, equipment/supplies, and capacity.^[16] We have expanded the prior experience gained from MERS-CoV outbreak in 2015 to a new domain related to hospital management for the pediatric population by adopting the aforementioned three domains.

Human resources

To achieve and enhance efficiency during the spread of the virus, hospitals need to operate with the minimum possible number of staff members depending on the workforce to mitigate the reported high risk of COVID-19 transmission among health-care workers (HCWs).^[17] An adequate number of staff members should be prepared to be called in when there is a surge of admissions or if anticipated.^[18] It is thus important to consider that medical and nursing coverage is modified to allow for at least two separate teams that are segregated (if staff numbers allow) with no crossover between the two teams.^[19,20] This will allow one team to have a 2-week off-duty period that is equivalent to the wash-out period after each period of coverage.^[19] Thus, it is recommended that hospitals operate at approximately 50% of normal staff levels on an alternative basis if achievable. The remaining staff can take over patient care in case the first group needs to be isolated from infected health personnel. It is also recommended to have consistency in in-service health care teams by avoiding frequent changes in duty scheduling. Furthermore, additional training and upskilling is a requirement for HCWs to be prepared to carry out tasks outside their normal responsibilities if needed, such as intensive sessions for suitable HCWs to ensure continuous care of ventilated patients during difficult times. Anesthesiologists, pediatricians, and pediatric surgeons can also be prepared to perform intensivists' duties in case they are needed during disasters.^[21] It is advisable that the Infection Control Department to be supported with additional infectious disease specialists or infection control link nurses.^[22] Whenever the peak of admissions is reached, one of the essential requirements is the availability of enough case managers and housekeepers

to ensure a rapid turnover of beds.^[23] In this situation, it is advisable to have additional security staff to ensure preventing visitors from entering the hospital and also to ensure social distancing and no in-person socialization among sitters on the pediatrics floors.

Equipment and supplies

It is crucial to review the current and expected amount of equipment and supplies based on the forecasted patient volume.^[24] Thus, a regular inventory audit of available and expected needed hospital equipment and supplies should be performed, including the number of ventilators needed for COVID-19 patients and an adequate number of high-efficiency particulate air (HEPA) filters for rooms that cannot be switched to negative pressure mode. Furthermore, regular maintenance checkups are recommended to be performed for additional equipment and supplies available in other areas, such as Emergency Medical Services and simulation laboratories. It is also essential to evaluate outlets in all inpatient rooms and enhanced them in case they are needed during surge capacity.^[25] If deemed necessary, it is important to review and to modify all existing policies regulating the routine usage of the equipment and supplies to maintain their availability at all times. This includes the prevention of personal protective equipment (PPEs) waste by limiting the unnecessary assessment of patients by multiple medical providers. There should also be strict sterilization processes for equipment used by technology-dependent pediatric patients.

Capacity

To prepare for epidemic/pandemic diseases, it is vital that all institutions define their own Infectious Disease Epidemic Plan (IDEP).^[26] The IDEP considers

forecasted needs as per the national and city epidemic situation and the number of expected cases and assessed capacity in terms of available HCWs. IDEP focuses on capacity in terms of available HCWs and supplies with special attention to ventilators' availability and hospital occupancy status. The outcome of IDEP is expected to facilitate the smooth and safe patient flow across the hospital. The plan is based on the number of admitted patients with COVID-19 in different clinical settings, as shown in Table 1. Hence, on the predetermined level as per the IDEP plan, it is critical to plan for spaces to be designated for confirmed COVID-19 pediatrics cases in the emergency room (ER) on pediatrics floors and in the PICU based.

Additional interventions should be considered, including limiting elective medical and surgical admissions as guided by IDEP to guarantee a sufficient number of vacant beds and evaluating the readiness of floors and ICUs to accommodate increasing demand.^[27] The evaluation should also include both physical capacity and oxygen and electricity outlets as directed by the safety measures in the hospital. Moreover, additional space should be allocated and made available to operate as pediatric floors during a crisis such as daycare units, endoscopy areas, playrooms, treatment rooms, waiting areas, and other noninpatient areas.

In the hospital-based outpatient clinics, the primary goal is to protect patients from acquiring infection from the hospital during the pandemic through reducing the number of patients presenting to the hospital. This approach must be managed carefully in order not to compromise care for patients with non-COVID-19 related diseases and manage COVID-19 patients who

Table 1: Example of an infectious disease epidemic plan

Phase	Proposed number of COVID 19 cases [§]	Recommended actions at different clinical settings	
0	No admitted patients with COVID 19	Emergency department Elective medical admissions Elective surgical procedures Outpatient clinics	Normal operation
1	1-5: COVID 19 cases	Emergency department Elective medical admissions Elective surgical procedures Outpatient clinics	Consider diversion of low and no urgent cases to clinics Reschedule all simple medical admissions Limited to semi-urgent and urgent surgical procedures Reschedule routine and nonurgent visits
2	6-30: COVID 19 cases	Emergency department Elective medical admissions Elective surgical procedures Outpatient clinics	Consider diversion of low and no urgent cases to clinics Accept only urgent medical conditions Limited to only urgent surgical procedures Limited to urgent outpatient care e.g., oncology clinic
3	More than 30: COVID 19 cases	Emergency department Elective medical admissions Elective surgical procedures Outpatient clinics	Consider mobile hospital, diversion of CTAS Level 3 cases to different facility Suspend all elective medical admissions Suspend all elective surgical procedures Same as Stage 2

[§]Each hospital determine the number of cases based on bed capacity, *Acute respiratory infection ARI screening is required at all phases and in all settings. ARI=Acute respiratory illnesses, COVID-12=Coronavirus disease-2019, CTAS=Canadian triage and acuity scale

do not require admission. Physicians have to review medical records of scheduled patients, and triage patients based on the need for urgent care, intermediate care, or routine follow-ups.^[28] Protocols can be developed per specialties to assist physicians in the triaging process. Patients who need to present physically for appointment should undergo acute respiratory illness (ARI) screening with their sitters before appointment by phone. Patients with positive screening or tested positive for COVID-19 should be segregated and directed to designated isolation clinic or equivalent as per hospital policy with the necessary precautions such as face mask for patient and PPE for health-care workers. Other patients who do not require immediate care can be rescheduled or have their visit managed by phone or telemedicine.^[14,29]

Infection Control Measures

Strict compliance with hand hygiene and the proper use of PPEs must be applied for suspected or confirmed cases. PPEs include isolation gowns, N95 respirators or powered air-purifying respirators or surgical face masks that are an acceptable alternative to N95, face shields or goggles, and one pair of clean on-sterile disposable gloves.^[30] An N95 respirator is a face mask that filters at least 95% of airborne particles that is not resistant to oil.

Aerosol Generating Medical Procedures

An aerosol-generating medical procedure is any procedure conducted on a patient that can induce the production of aerosols of various sizes, including droplet nuclei. Examples include intubation and related procedures (e.g. manual ventilation, extubation, open endotracheal suctioning), tracheostomy, cardiopulmonary resuscitation (CPR), bronchoscopic procedures, sputum induction, nebulized therapy, autopsy, continuous positive airway pressure (CPAP) or bi-level positive airway pressure (BiPAP) noninvasive ventilation (NIV), high flow nasal cannula (HFNC), high-frequency oscillation (HFO), and respiratory specimen collection procedures, such as nasopharyngeal swabbing.^[31] To avoid procedure-generated infectious aerosols, the procedure should take place in a negative pressure room or in a room with a HEPA filter, HCWs should wear proper PPEs, and the number of HCWs in the room should be minimized.^[32]

Transportation of Suspected and Confirmed Coronavirus Disease-2019 Cases

Inter or intra-hospital transportation carries the risk of breaching infection control.^[33] Table 2 shows the transportation procedures that can be divided into three phases, pretransfer preparation, transfer, and posttransfer

Table 2: Transportation phases

Pretransfer phase
Transport team configuration
Transport team members are trained and fitted for needed personal protective equipment
Transport equipment (continuous monitoring, defibrillator, isolation transportation pod)
Transport medications
Identification of transport route
Assessment of patient condition e.g., intubation prior to transportation
Transfer phase
Patient to wear surgical mask/maintain closed circuit with high efficiency particulate air filter for intubated patients
Identified personnel/security team to clear bystander and ensure clear route
Posttransfer phase
Decontamination of transportation route and ambulance
Debriefing of transportation

decontamination. Pretransfer preparation includes briefing checklist of the needed team configuration to provide patient care during transfer. HCWs should assess patient condition before transportation with special attention to the need for securing airway. It is expected that such HCWs should be trained and fitted for the needed PPE, monitoring equipment, transport medication, and identify preplanned dedicated transportation routes.^[34] Transportation route is recommended to be preplanned and separated from regular patients routes if possible.^[35]

During the transportation phase, the patient should be wearing surgical masks. If the patient is ventilated, a closed ventilation system should be maintained with HEPA filters, and the use of an isolation transportation unit should be considered.^[36] Identified personnel or security teams should clear bystanders and facilitate the movement of the team to the designated area. Posttransfer should include decontamination of route and ambulance.

Presentation of Coronavirus Disease-2019 in Pediatric Population

To date, there are no unique clinical or laboratory findings that can differentiate COVID-19 from other ARIs. For that reason, the high index of suspicion and early clinical recognition of the disease depends on a combination of clinical and epidemiologic factors. Despite the fact that the contact history is the main influence in the diagnosis, many COVID-19 patients may share the same clinical characteristics with other ARI. The common signs include fever, dry cough and dyspnea followed by sore throat, anorexia, myalgia, and headache.^[5,9] Gastrointestinal symptoms, such as diarrhea and vomiting, had also been reported.^[37,38] Lower respiratory tract infection is

also a known presentation of COVID-19. Radiological findings are nonspecific such as ground glass and bilateral segmental opacities in computed tomography of the chest.^[38] Complete blood count tends to show a normal white leukocyte count or leukocytosis, in contrast to the finding of lymphopenia reported in adults.^[38,39] In a case series of 32 patients, more children were found to have elevated creatine kinase in comparison to adults.^[38] Other abnormal blood workup includes elevated liver enzymes, C-reactive protein, and lactate dehydrogenase (LDH). It should be noted that elevated C-reactive protein and LDH are associated with severity.^[37,38]

Severity Classification

The WHO has classified COVID-19 severity into mild illness, pneumonia, severe pneumonia, pediatric acute respiratory distress syndrome (PARDS), and sepsis.^[40] Severe pneumonia could manifest by the inability to breastfeed or drink, lethargy, unconsciousness, or convulsions. The presentation could be accompanied by either hypoxemia with peripheral oxygen saturation (SpO₂) <90%, severe respiratory distress, or both. PARDS is a life-threatening acute lung disease characterized by hypoxemia, radiographic opacities, increased physiologic dead space, and decreased lung compliance as per the criteria proposed by Pediatric Acute Lung Injury Consensus Conference Group (PALICC).^[41] Sepsis is defined as a suspected or proven infection with systemic inflammatory response syndrome.^[42]

Pathway and Management of Suspected or Confirmed Patients

Triage

Pediatric patients presenting to the Emergency Department must be screened for ARI and other COVID-19 symptoms before entering the health-care facility. Screening is recommended at two points to ensure that no patients are missed when visiting the ER. First screening to be done at the first access to a health-care facility at a location before triage and to be repeated at the designated ER evaluation area. Positive screening patients must be transported to predefined designated areas according to the triage acuity level without mixing with other patients or staff in the other areas. The ER stay for suspected patients should be minimized by early discharge or expedited admissions to the inpatient area.

Medications

Till date, there is no sufficient evidence for effective COVID-19 treatment in pediatrics. Management guidance is not based on strong clinical evidence, and the treatment approach may change if future studies are conducted.

Some of the following recommendations are extrapolated from an adult's literature. Hydroxychloroquine off label use has been advocated in COVID-19 based on the initial open-label nonrandomized trial of 36 adult patients of whom 20 received hydroxychloroquine.^[43] The French investigators reported a significant reduction of the viral carriage with hydroxychloroquine. Further research is undergoing to confirm this benefit.

A multi-drug regimen is suggested for patients with pneumonia. Hydroxychloroquine can be considered based on the available data with a regimen of 10 mg/kg (maximum 600 mg/dose) administered enterally every 12 h on the 1st day followed by 3 mg/kg (maximum dose 200 mg/dose) enterally every 8 h for the remaining days.^[43] If hydroxychloroquine is not available, chloroquine can be used as an alternative regimen based on the chloroquine base, which consists of a loading dose of 10 mg/kg (maximum 600 mg) enterally followed by 5 mg/kg (maximum 300 mg) enterally 6 h after the loading dose and every 24 h thereafter.^[44] The duration of the multi-drug regimen is determined according to patient response. A baseline electrocardiogram is recommended to rule out prolonged QT in addition to a full ophthalmological examination to rule out pre-existing maculopathy.^[45]

For severe cases, remdesivir can be considered at 5 mg/kg/dose (maximum 200 mg) on day 1 followed by a 2.5 mg/kg/dose (maximum 100 mg) once daily for total 10 days.^[46] Remdesivir is a broad spectrum experimental antiviral agent that has been shown *in vitro* to inhibit coronaviruses.^[47] A multicenter cohort showed clinical improvement in 68% (36 of 53 patients) of patients who received remdesivir.^[48]

Furthermore, cytokine storm syndrome had been claimed to be one of the severe complications of COVID-19. There is encouraging data about the positive effect of tocilizumab in ameliorating symptoms of patient with pneumonia and elevated interleukin-6.^[49]

Management in the Critical Care Unit

Management in critical care aims to maintain oxygenation while minimizing ventilation-induced lung injury (VILI). It has been proposed that adult COVID-19 respiratory illness has two phenotypes: a low compliance ARDS-like phenotype and a normal compliance phenotype with low ventilation to perfusion ratio.^[50] The normal compliance phenotype is theorized to be due to a loss of Hypoxic pulmonary vasoconstriction. Although the pediatric presentations in critical care have not been reported yet, the adult phenotype could be taken into consideration when managing pediatric patients with severe COVID-19.

Noninvasive Respiratory Support

HFNC or NIV by CPAP or BiPAP, has been used successfully in pediatric patients with respiratory distress from different etiologies with a good safety profile.^[51,52] NIV aims to avoid invasive mechanical ventilation and its related side effects such as ventilator-induced lung injury, the need for sedation and endotracheal tube (ETT) related laryngeal injuries.^[53,54] Current experience suggests that NIV for COVID-19 respiratory failure possibly increases the risk of aerosolization and airborne transmission.^[55,56] To avoid potential morbidities of intubation in children, NIV can be the initial choice to support respiratory failure with strict airborne precautions and continuous monitoring to ensure a good response. If NIV cannot be tolerated, intubation should be considered to support the patients.^[57]

Endotracheal intubation

Endotracheal intubation is an aerosolized procedure with a high risk of transmission to HCWs. Therefore, preparedness and performance with caution are key factors for successful intubation to protect HCWs and ensure patient safety. The intubation procedure can be divided into preintubation, intubation, and postintubation procedures.

Preintubation procedure preparations include planning for the personnel and equipment needed. The procedure should be performed in a negative pressure room. If this is not available, a single-bedroom with a portable HEPA filter is a reasonable alternative.^[32] The number of personnel in an airborne isolation room should be minimized with a back-up team outside the room [Table 3]. All attending personnel should apply to airborne isolation precautions. Equipment and consumables in the room should be minimized as needed, and disposable items should be utilized [Table 4].

To ensure patient safety, the most experienced health care staff member should attempt intubation. The procedure should begin with preoxygenation with a fraction of inspired oxygen of 100% while performing a rapid sequence induction without bag mask-ventilation (BMV) if possible. If BMV is needed to be performed, a two-hand technique should be utilized to ensure a tight seal with a small tidal volume along with a positive end-expiratory pressure valve and a HEPA filter.^[58] Intubation should be performed with video-laryngoscopy and transparent plastic hoods if available to keep the operator as far as possible from the patient's airway.^[59] Airway manipulation should be attempted only after ensuring paralysis with a muscle relaxant to avoid coughing.^[58] Ventilation should be performed after

Table 3: Intubation suggested team members and roles

Intubation team members	Roles and responsibilities
Inside the room	
Pediatric senior intensivist	Team leader, direct medication administration, double-check medications and provide rapid sequence intubation
Primary nurse	Monitoring and medication administration
Primary respiratory therapist	Prepare equipment and airway management
Outside the room	
Helper nurse	Prepare medication doses, complete documentation and maintain communication between the team inside and outside patient's room
Circulating nurse	Provide items as needed and observe infection control practice during the procedure
Helper respiratory therapist	Provide equipment and supply as needed

Table 4: Intubation equipment checklist

Video - Laryngoscopy (preferred)/laryngoscope
Blade - Appropriate size and kind
Endotracheal tube - Appropriate size and kind with stylet
Oropharyngeal airway
Positive end expiratory pressure valve
Endotracheal tube securing tape
High efficiency particulate air filter for bag mask ventilation

inflating the balloon. The postintubation period includes the disposal, cleaning, and disinfection of the equipment used during the procedure. Disposable equipment must be disposed of appropriately in the patient's room using a biohazard waste bag, and all unused drugs must be discarded.

Mechanical Ventilation

The PALICC recommendations are applicable for patients with COVID-19 who manifest with PARDS.^[41] To minimize VILI, it is recommended to allow for a permissive hypercapnia strategy and titrated oxygenation.^[41] Evidence-based interventions should be implemented to improve mechanical ventilation care and minimize associated adverse events.^[60] Prone position and HFO ventilation (HFOV) are mostly utilized as rescue therapy when conventional ventilation fails to improve oxygenation.^[41] Prone positioning has been used as an adjunct therapy in adult patients with COVID 19 as chest computed tomography shows ground-glass appearance and dependent lung injury.^[61] Pediatric evidence supporting prone ventilation is scarce; however, there have been promising results with improved ventilation in dependent lung regions.^[62,63] If HFOV is considered in patients with COVID 19, it should be utilized cautiously due to the high risk of aerosolization.

Management of Pediatric Arrest

CPR is a resource stressful procedure with a high risk of infection transmission. Children with preexisting comorbidities such as pulmonary disease and immunosuppression are at higher risk of severe respiratory illnesses, associated arrests, and mortality.^[64] Those comorbidities might be advanced medical conditions that require goals of care decisions.^[65] While goals of care decisions are based on preexisting conditions and terminal illnesses, they are needed during pandemics as nonbeneficial resuscitation will add further burden on already stressed health-care systems and poses high risk of infection transmission.^[66]

If resuscitation is performed, airborne precautions must be practiced by HCWs. The most experienced staff member should handle resuscitation while limiting the number of HCWs performing resuscitation as much as possible.^[67] Suggestions regarding resuscitation team members and responsibilities are provided in Table 5. Early intubation with a cuffed ETT is recommended to minimize the high risk of aerosolization. Before intubation, bag, and mask ventilation, if necessary, must be done with an appropriate HEPA filter and tight seal.^[67] Otherwise, resuscitation should follow the Pediatric Advanced Life Support guidelines by the American Heart Association.^[68]

Management of Patients in Operative Rooms

A negative pressure operative room (OR) is ideally needed to prevent infection. Alternatively, a specific standard positive pressure OR is recommended to be designed for COVID-19 patients where a high frequency of air circulation is an essential requirement to reduce the viral load.^[20,69] Hence, an integrated HEPA filter in the ventilation system or a portable HEPA filter should only be used during intubation and extubation and turned off during surgery. For the OR setup, essential equipment should only be kept in the room. Frequently touched equipment, such as anesthesia machines, ultrasound machines, laptops, and workstations, should be wrapped and covered with transparent plastic. Disposable equipment should be used whenever possible.^[70,71] Mobile airway trolleys, drugs (induction, emergency), and airway equipment should be well-prepared and on standby for usage to minimize induction time. These should be clearly labeled and kept inside the OR with signage to identify them.

The number of personnel should be minimized in the OR. Table 6 shares a suggested OR team members and responsibilities. During anesthesia induction and in addition to the endotracheal intubation recommendations provided, the time between induction

Table 5: Resuscitation team members and responsibilities

Resuscitation Team	Roles and responsibilities
Inside the room	
Physician	Team leader
Physician	Stand by for chest compression or airway management, if needed
Primary nurse	Medication administration
Helper nurse	Alternating chest compression with physician
Circulating nurse	For defibrillator and record resuscitation
Primary respiratory therapist	Airway management
Outside the room	
Circulating nurse-2	Prepare medications, maintain communication between outside and inside teams, and obtain supply from outside the room
Helper respiratory therapist	Provide equipment and supply as needed
Clinical pharmacist	Provide medication if needed

Table 6: Operative room team members and responsibilities

OR team	Roles and responsibilities
Inside the room	
Anesthesia team physician	Team leader
Anesthesia team technologist	
Nurse	Scrub nurse
Nurse	Circulating
Nurse	Documentation
Outside the room	
Nurse	Helper: Support the team inside if things are required from outside the operating room and eliminate the need for staff inside the OR to exit
Anesthesia team technologist	

OR=Operative room

and securing the airway with ETT should be minimized. The use of ETT with micro-cuffs is highly recommended, and video-assisted laryngoscopy is recommended over direct laryngoscopy to keep the operator as far as possible from the patient's airway.^[16] Moreover, a portable HEPA filter should be used during intubation and extubation only and turned off during surgery.^[70] Furthermore, an unnecessary high flow or a closure of the adjustable pressure-limiting valve should be avoided, and intravenous induction with a rapid sequence technique should be implemented.^[58] Airway manipulation should be attempted after ensuring the patient is completely paralyzed to avoid coughing. A closed inline suction should be connected whenever possible.^[70] For anesthesia emergence, it is essential to extubate the patient while the HEPA filter is on,^[70] and reversal should be given. Whenever possible, deep extubation should be considered as a first option.

When transporting patients outside the OR, the circulating nurse and anesthesiologist should wear new

appropriate PPEs. The patient should wear a surgical mask and should be covered with one disposable operating sheet. Furthermore, the transfer is advisable to be provided by the managing team in OR to minimize contamination. It should also be in a dedicated space ward through a dedicated lobby and elevator, and the surfaces of passageways and the elevator should be cleaned and covered. If the patient is kept intubated, a single-patient-use Ambu bag must be used during transfer as it is not recommended to use a ventilator during transfer.

Management of Immunocompromised Patients

Special concern is raised for immunocompromised pediatric patients including patients with rheumatological diseases, immunodeficiency, transplant recipients, and patients receiving chemotherapy or immunomodulatory therapy during COVID-19 pandemic. This concern is supported by the experience for previous corona viruses outbreak in this category of patients.^[72-74]

The impact of COVID-19 pandemic on this population is not limited to the severity of the illness but might also be extended to their ability to access the health-care system. Immunocompromised patients with COVID-19 infection might present with different symptoms and course of illness compared to healthy individuals, due to the presumed protective effects of the immunosuppressive drugs those patients are receiving.^[75,76]

In addition to the outpatient clinics business model during pandemic outlined previously, immunocompromised population requires further arrangement due to the need of frequent blood workup and infusions of biologic or chemo-therapy medications. If available, home health-care visits are recommended to be utilized for blood extractions and medication infusion if available in prefilled format. Moreover, less frequent treatment's sessions or reduction in infusion times may be considered if clinically feasible in patients who attends hospital for day care treatment for biological agents or chemotherapies.^[77-79]

Psychological and Mental Health Support

A cross-sectional study was conducted in 194 cities in China during the initial COVID-19 epidemic revealed that 53.8% had moderate-to-severe psychological impact and 28.8% showed moderate-to-severe anxiety symptoms.^[80] HCWs are at risk of psychological illnesses as well as due to the fear of personal safety and the well-being of colleagues and family.^[81] A special Mental Health team is recommend to be created to reduce the risk of these negative psychological outcomes for

patients, families, health-care providers, and the general population.^[82] This team is required to adopt emergency psychological crisis interventions and psychological counseling. The team is recommended to be responsible for offering psychoeducational services to children, families, and HCWs to provide coping strategies to deal with stress related to the outbreak.

Quarantine measures have been taken for centuries to contain the spread of infectious diseases, including the SARS.^[83] Quarantines are associated with negative psychological adverse effects.^[84] The adverse effects of quarantines have not previously been determined in a systematic manner. Psychological support and counseling sessions could be provided through telehealth services, especially for those quarantined, their families, and the HCWs caring for them to ensure their mental well-being during periods of quarantine. Past emerging infections outbreaks had been associated with significant levels of stress among HCWs due to perceived personal health risks and the fear of spreading the infection to family members.^[85,86] This should be mitigated by coping strategy education and by establishing a hotline for staff to provide confidential psychological support services. Moreover, specific attention should be given to children with preexisting conditions because patients with mental health issues are at risk of developing anxiety related to COVID-19 and of worsening their preexisting mental disorders. This risk is recommended to be addressed via the provision of psychological interventions and/or adjustments of medications.^[80] Children and adolescents with cognitive impairments, intellectual disabilities, and autism spectrum disorders are recommend to be provided with suitable and easy-to-read information. Structured time activities and routines should be developed for them as well.

With rising numbers of COVID-19 pediatric patients, it is necessary for pediatric service providers and specialized pediatric hospitals to develop preparedness plans to manage this pandemic. Plans should detail the management of COVID-19 patients without compromising non-COVID-19 patients care. With the large amount of research currently been done, it is expected that our understanding of this illness will increase and hence our management will improve.

Acknowledgment

We would like to thank HE Dr Bandar A. Al Knawy, Chief Executive Officer, Ministry of National Guard-Health Affairs for inspiring the team to carry out this statement and for his continuous support. We are also grateful to Saudi Health Council with special thanks to the Secretary General, Dr. Nahar M Al-Azemi for the support received from the council to endorse this statement.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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