



# Challenges to delivering pediatric surgery services in the midst of COVID 19 crisis: experience from a tertiary care hospital of Pakistan

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## Abstract

Covid-19 pandemic has significantly challenged the healthcare delivery across the world. Surgery departments across the country responded to this challenge by halting all non-emergency procedures. This delay in diagnosis and management of surgical disease could result in significant mortality and morbidity among the most vulnerable population—the children. In this manuscript, we discuss the measures adopted as well as the challenges faced by the pediatric surgery department at Aga Khan University Hospital, Karachi (AKUH), Pakistan, which is a private, not-for-profit entity and providing optimum surgical care to the patients. We also underscore the need for global strategies for tackling such crisis.

**Keywords** COVID-19 · Pediatric surgery · Challenges

## Introduction

On January 30th, 2020, the World Health Organization acknowledged a novel coronavirus (SARS-CoV-2) as a ‘public health emergency of international concern’ [1] and later declared coronavirus disease (COVID-19) a pandemic. The virus primarily affects the respiratory system and is transmitted between humans via respiratory droplets, secretions and direct contact [2]. The initial cases emerged in late December 2019, in Wuhan, Hubei Province of China [3]. As of July 9th, COVID-19 has infected more than 11.87 million people in more than 213 countries across the world and more than 545,000 people have lost their lives [4].

The disease is severe in elderly and people with underlying chronic diseases. The children though comprise a small fraction of the total people affected by COVID [5, 6], as a report of 73,214 covid-19 cases from the Chinese Center for Disease Control and Prevention showed that only 1–2% of the total cases were children under 19 years of age, in

contrast to 87% of the cases being adults aged 30–79 years [7]. The disease is also reportedly less severe in children [7, 8], with those infected experiencing mild symptoms characteristic of an acute respiratory tract infection [8]. However, in late April, reports of Kawasaki-like disease in COVID-19 positive children emerged, mostly in Europe and USA [9]. This has raised concerns surrounding the vulnerability of the children to the virus itself and its possible complications.

The first two cases of COVID-19 in Pakistan were confirmed on February 26th, 2020 and both had recently travelled to Iran for pilgrimage. Pakistan had its first case of local disease transmission on March 13th. As a countermeasure, a National Security Council meeting was held, and a country-wide lockdown was initiated on April 2nd with closure of all public places, transports, local businesses and markets as the national tally surpassed 2291 cases [10]. Currently there are more than 240,000 positive cases and more than 4900 deaths across the country [11], and the number of children affected are unknown.

## Disruptions due to COVID

COVID-19 has significantly impacted various sectors such as international trade, agriculture, financial markets, tourism etc. [12, 13]. The effects of COVID on the healthcare delivery system are also profound, especially in low-middle income countries where the system is already fragile

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[14]. The disruption in the healthcare systems is expected to threaten the healthcare delivery to the most vulnerable patient population—the children. In Pakistan, 39% of the total population is within the pediatric age group [15] but there are only 48 pediatric surgical centers throughout the country. Five of these centers are located in the city of Karachi, which has a total population of more than 16 million [16]. Among these, two are private facilities, two are governmental facilities and 1 is non-profit. Therefore, it is imperative for countries with limited infrastructure and funding to effectively mobilize resources not only for the management of COVID-19 patients but also to maintain essential surgical services for our pediatric population. A recent analysis estimates that an additional 1,157,000 child deaths and 56,700 maternal deaths could occur over the next 6 months across 118 low-middle income countries because of this disruption [17]. A surge in death by preventable diseases can be expected because of the temporary suspension of childhood immunization programs during this crisis [18]. The significant delay in the diagnosis and treatment of surgical disease because of the surge in COVID patients may also contribute to significant morbidity and mortality. Apart from acute surgical emergencies, there are some surgical conditions that require timely interventions or else a delay can be detrimental to a child's health, e.g. orchiopexy is best performed before 1 year of age to decrease the risk of infertility and testicular malignancy [19]. This paper highlights the challenges and measures adopted to ensure safe pediatric surgery services at Aga Khan University Hospital (AKUH), which is a private, not-for-profit hospital in Karachi, Pakistan.

## Setting

The AKUH is a tertiary care hospital in Karachi, Pakistan. It was established in 1985 and now comprises over 750 beds with various specialties and state-of-the-art operating rooms, emergency rooms as well as critical and intensive care units. In addition, AKUH has over four secondary hospitals located in different parts of Karachi and Hyderabad, and over 15 medical centers located across Pakistan, providing urgent medical care as well as specialized clinics. The department of pediatric surgery is a part of the Children's Hospital service line. It consists of pediatric surgeons working in close collaboration with pediatricians, pediatric intensivists and pediatric anesthesiologists. The department covers a wide range of surgical diseases among a diverse patient population- from newborns to young adolescents. It provides 24 h emergency services, outpatient clinics and inpatient facility comprising of a 65 bed general pediatric ward, 24 bed neonatal intensive care unit (NICU) and an eight bed pediatric intensive care unit (PICU).

## Preempt measures for pediatric surgical services

The onset of pandemic set into motion a series of essential changes in the hospital delivery of services including the pediatric surgery department. A multitude of factors were considered, and a comprehensive prioritization list of surgical procedures was devised with collaboration between the pediatric surgery faculty and the hospital administrative management. The considerations included the potential of significant morbidity in case of deferring the care and possible exacerbation of the underlying disease or a downward trend in quality of life. The list categorized the surgical procedures into either of the three groups (Elective, Semi-elective and Emergency) as shown in Table 1. Elective procedures comprised of conditions that could be postponed to four or more weeks; Semi-elective procedures required prioritizing upon the elective list; and Emergency procedure required immediate intervention within hours/days of diagnosis. Emergency procedures were further classified into 'Orange' and 'Red' emergencies; Red emergency meant a patient presenting with life threatening pathology and Orange emergency meant a patient with an organ/limb threatening situation.

Further, on March 20th, 2020 all elective and semi-elective procedures were put at a halt for 6 weeks to prevent overwhelming of resources required for critically ill patients and this was done to significantly reduce inpatient volume and to prepare for the influx of patients requiring critical care. The postponement of elective surgeries also decreased the nonessential patient contact to minimize infection transmission and only emergent cases were allowed during this time period. During this time span, none of the elective cases had to be done on urgent basis. On May 12th, 2020 this decision was modified and semi-elective surgeries were resumed in light of preventing worsening of pre-existing conditions. The following protocols were set-up for a patient booked for pediatric surgery.

## COVID-19 screening

COVID screening was made mandatory within 72 h for children booked for surgery. The screening was done using the patient under investigation (PUI) form, which was a verbal questionnaire comprising of two sections. The first section of the form explored symptoms related to COVID including history of fever, cough, shortness of breath, myalgias or sore throat within the last 14 days and the second section consisted of a checklist of possible exposures such as travel history, contact with a confirmed or probable case of Covid-19, occupational exposure such as

**Table 1** Classification of pediatric surgery procedures

Elective	Semi-elective	Emergency
Circumcision	Neonates born with congenital anomalies which cannot be delayed	Acute appendicitis
Hernia	Children with congenital anomalies presenting late in clinic	Intestinal obstruction
Hydrocele	Renal and ureteric stones	Testicular and ovarian torsion
Neck cyst and sinuses	Wilms tumor surgeries	Intestinal perforation
Perianal fistula	Biopsy for diagnosis	Esophageal and tracheal foreign body ingestion
Hypospadias	Diagnostic laparoscopy	Trauma with uncontrolled hemorrhage
Orchidopexy	Bleeding rectal polyp	
Cholecystectomy for gallstones	Incision and drainage	
Ambiguous genitalia	Exploratory laparotomy	
Stoma closure	CBD stone	
	Pyeloplasty	

health care worker or public dealing and a recent history of return from congregation.

### COVID hospital and operation rooms

A separate building within the hospital has been designated for admissions for COVID suspected and confirmed cases and this has been named as ‘COVID diagnostic and treatment zone (CDTZ)’. This is a separate ground with three floors building and consists of a total of 106 negative pressure rooms for individual patients. The ground floor has been reserved for children, first floor has the COVID ICU (mechanical ventilation) and the second and third floor comprises of general isolation beds and high dependency beds for suspected/confirmed COVID patients. All the suspected cases of COVID once deemed eligible for admission are admitted in CDTZ and if the test results are negative, they are shifted out to the main hospital area.

A previous ‘Day care surgery unit’ has also been designated for performing surgeries specifically of COVID confirmed cases. These comprises of three ORs and have a negative pressure system and laminar air flow ceilings coupled with high efficiency particulate air filters. In addition to this being situated in the low-traffic area of the hospital, the ORs share close proximity with the CDTZ.

### COVID-19 testing for orange/red emergency

All the booked patients for an emergency procedure have to go through a COVID testing (a real-time reverse transcription polymerase chain reaction (rRT-PCR)). For red-emergencies this is either done in the ER or OR, while for orange-emergencies, they are first admitted to CDTZ and then the test is performed. If the test results come out negative, patient is admitted in the routine ward and routine

protocols are followed (Fig. 1). However, if the test is positive and surgery cannot be deferred, the reason for the surgery is notified to the Chief Quality and Patient Safety Officer (CQSP), anesthesia department chair and the surgery department chair. After approval from all authorities, the patient is admitted in CDTZ and special protocols are followed and, in the OR, the surgery is performed in a negative pressure flow OR with proper personal protection equipment (PPE) comprising of N95 masks and proper face and eye shields.

### COVID-19 testing for elective surgery

The patients who are booked for elective procedures under local anesthesia and are ruled out during screening, are exempted for COVID testing. All the elective patients booked for procedures under general and regional anesthesia have to go through a COVID screening and testing (PCR) within 72 h of the planned procedure. The patients visit the ER or CDTZ specifically for screening and testing prior to the planned admission for surgery. Patients who are tested negative, are admitted to routine wards with general protocols. While patients who are tested positive for COVID are admitted to the CDTZ and proper approval are taken before proceeding with the surgery. The surgery is performed in the specific OR with appropriate gear for all health professionals present in the OR, including N95 mask, face and eye protection. Till this date, 48 pediatric COVID cases have been admitted under the children hospital service line at AKUH. Out of these; two developed Kawasaki-like symptoms and three experienced myocarditis, however, none of these required surgeries. At our center, a total of 13 patients with pediatric surgical diseases were tested positive for the virus. These patients were planned for procedures and their tests were sent pre-operatively as per hospital policy

## COVID TESTING ALGORITHM FOR SURGERY PATIENTS

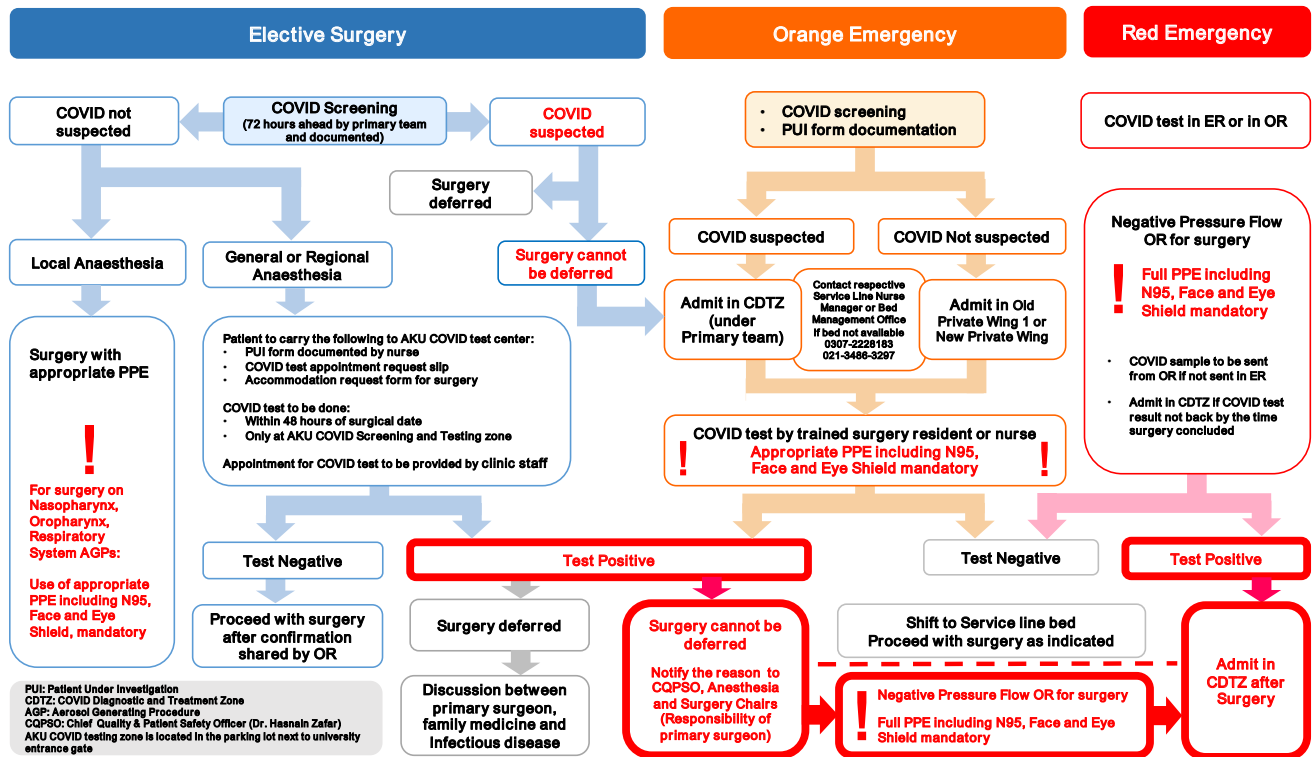


Fig. 1 COVID-19 algorithm for surgery patients at AKUH

and none of these surgical patients had any respiratory or other COVID related symptoms.

### Workforce division and safety

By late March, more than 20% of the hospital staff working in the Emergency Department and Covid-19 intensive care units had contracted the virus, including 29 surgical residents and interns across three different surgical specialties. As a result, new policies were created regarding the weekly scheduling of all health care staff present in the ward and ORs including the pediatric surgery residents. The pediatric surgery team was divided into two teams (both in-patient and on-call), with alternate rotations of for 1 week each. The wearing an N-95 was made mandatory in high risk areas such as Emergency Room, ORs and ICU. In addition, contingency plans were also devised for possible confirmed Covid-19 cases amongst the healthcare forces and PPE policies were reviewed and revised to ensure healthcare force safety.

### COVID specific pediatric surgery challenges

#### Reduced patient inflow

Global phenomenon such as pandemics or epidemics are known to cause increased fear and anxiety among the public [20–22]. It is understandable that people are concerned about contracting the virus, explaining the potential delays in seeking treatment of acute or chronic conditions. This state of fear, in addition to the ongoing practices of social distancing, self-isolation and country-wide lockdown has led to reduced patient inflow at our hospital. Moreover, AKUH serves as a tertiary referral hospital for advanced management and diagnostic procedures and due to the closure of public transport and strict travel restrictions following the lock-down, there was a significant decrease in referrals from other hospitals within Karachi and reduced health seeking from patients outside the city.

### Limited patient capacity of the CDTZ

Following the new hospital guidelines, postoperative management and admission of the COVID-positive patient is done at the CDTZ. Due to its finite capacity, and increasing workload with rising COVID cases, the provision of regular surgical care has become increasingly complex. The limited capacity prevents the surgery team from catering to the number of patients it was able to do so before the pandemic. Moreover, children needing emergency surgical intervention and those who are screened or tested positive have to be sent back or referred to other hospitals due to space constraints in the CDTZ, and children planned for elective procedures have to wait for longer period of time. As the government has started easing the lockdown and with resumption of regular activities at the hospital—the space constraints are escalating with more challenges in the weeks to come.

### Increased cost of patient care

Several efforts have been directed towards devising an elaborate plan to provide an optimal surgical care while ensuring the safety of patients as well as all healthcare workers. This plan included the establishment of separate COVID screening camp, allocation of COVID ORs, expansion of COVID testing capacity, provision of essential PPE and investment into tele-medicine. Moreover, hospital-wide regulations were set into place for the pre, peri and post-operative phase. Under these measures, a patient is required to be screened and tested at the hospital prior to surgery for COVID. The cost for diagnostic tests, in addition to the extra expenses incurred in following COVID-specific protocols in the CDTZ and the ORs by the hospital staff, had to be paid by the patient, which ultimately increased the total cost significantly. This rising cost of healthcare coupled with the ongoing economic recession may discourage several parents from seeking timely healthcare for their children.

### Patient and parental anxiety

The patients and parents are put under an increased psychological strain due to the initial closure of outpatient clinics and elective procedures, and subsequent scheduling of postponed surgeries. In addition, the fear of risk posed by COVID-19 to their children while visiting hospitals and undergoing surgery makes them hesitant to pursue treatment at the hospital, especially when the same facility is also catering to COVID-19 cases. Therefore, it is important for the healthcare providers to address the queries and issues of parents for effective management of the pediatric patients [23].

### Revenue issues for the hospital

The revenues for most of the private hospitals are dependent on the revenue generated from the various clinical activities including the inpatient, outpatient, laboratory and radiology services amongst others and elective procedures and outpatient services contribute significantly to overall hospital revenue [24, 25]. AKUH is also a non-profit hospital relying mostly on revenue from clinical activities and donations. The postponement of elective services including outpatient, inpatients, laboratory and radiology services along with decline of emergency services, has undeniably posed a financial challenge for the hospital. In addition to reduced revenue, the hospital is incurring increased cost to maintain adequate supply of PPE, establishment of CDTZ, investing in tele-clinics, strengthening ICU facilities and mobilization of the workforce.

### Resident education and training

The decline in the volume of surgical patients and its detrimental impact on post-graduate resident training was recognized. Although, being a part of the healthcare force in a pandemic was considered as a learning opportunity, multiple e-learning educational sources were quickly sought by the surgery department to make-up for the loss of exposure in the subspecialties. Many surgery residency programs have been able to transition to virtual learning in the form of video-lectures to maintain learning [26]. To keep up with the changing clinical atmosphere in the hospital, the department of pediatric surgery incorporated some changes to the residents' training program. These included using distance-learning technologies such as online journal clubs, surgical grand rounds and frequent educational sessions with the faculty over Zoom. The gap in the education can be bridged with the development of individualized mentorship avenues, possible extension in training period and reduction in administrative responsibilities assigned to our residents [27].

### Medical student education

Medical students rotate on the Pediatric surgery service for 3 weeks as a part of their General Surgery rotation in final year. During this time, they participate in the wide spectrum of patient care- inpatient, out-patient and in the OR. In line of social distancing and following the restrictions placed by the federal government, medical studies were discontinued. These included the basic science years (years 1 and 2) and clinical years (years 3–5). Interruption in the medical students' education was met with a prompt shift to continuing it via online modalities. At our institution, despite the closure of medical college, lectures and discussions conducted via Microsoft Teams and Zoom provided



uninterrupted education in the time of pandemic. It has been a considerable challenge to provide accurate patient experiences for the medical students [28]. The lack of clinical exposure was compensated with virtual patient exposure via CyberPatient app. Further opportunities for students include involvement in tele-health and volunteering at call centers for COVID-screening.

### Resident and staff wellness

The department recognized the need to safeguard the psychosocial health of the residents. Recognizing the risk for emotional exhaustion, multiple wellness sessions were conducted with the residents by the pediatric surgery department leadership in collaboration with the department of psychiatry. Pediatric surgery trainees have exhibited concerns regarding the emotional burden related to the risk of transmission of COVID to their family members [27]. Studies demonstrate additional factors causing stress among healthcare professionals and these include being doubtful of the ability to provide optimum care in case of deployment to a new service, rapidly evolving information and the shortage of intensive care units to treat critically ill patients [29].

### Learnings and way forward

Access to healthcare is a fundamental human right, but the strain that the COVID-19 pandemic has placed on healthcare systems everywhere has, in turn, affected many people's primary care provision and health, in more ways than one. Around the world, doctors' offices have closed their doors and many elective surgeries have been postponed. Alternate strategies like telemedicine have been introduced and trainees teaching is highly reliant on online channels.

Covid-19 has had a major impact on children and also on provision of essential pediatric surgery services amongst others. These are unprecedented and challenging times, for healthcare providers, medical educators and the patients. But these challenging times have also reinvigorated the fact that a broader lens is needed to address this pandemic, as a study published in *Lancet Global Health* has shown the huge additional child and maternal deaths that could occur due to lack of access to primary health care services in developing countries [17] and a study in *BMJ* has shown that two-thirds of the deaths in UK could be due to reduced access to healthcare services [30].

These disruptions have posed additional challenges to resource limiting countries which already have a greater burden of childhood diseases coupled with greater morbidity and mortality when compared to the developed world.

In the city of Karachi during this pandemic; all the government and private hospitals have stopped offering elective pediatric surgery services. Hence only emergency pediatric surgery services are being offered in the whole city of Karachi which not only caters to the children of Karachi but to the whole province of Sindh and some cases from other provinces. The challenges are far greater in Government facilities which already are resource constraint and lack means to take additional measures like ensuring PPE of all health care providers, creating negative pressure ORs and wards and ensuring enforcement of the new protocols which has discouraged the health providers to even providing emergency care. As most surgical departments across the country are now planning to move into the transition phase of resumption of elective surgery, surgical practices need to be periodically evaluated and upgraded to ensure safety of our patients and healthcare workers as the number of cases of COVID are on a rise in Pakistan and we are now seeing pediatric surgical patients with COVID. There is a continuous struggle around the world in finding the balance between preventing the spread of COVID-19 and continuing essentials of life and regular health service delivery. At the same time, the focus on continuing training of the residents and students cannot be further underscored, as multiple studies recommend the use of operative videos in an attempt to increase surgical exposure. This can be done either by gaining access to online, open access, peer reviewed operative video libraries [31] or utilizing the archived surgery videos from the home institution, followed with explanation from faculty [26].

Though it was necessary to prevent the spread of the pandemic and lock-downs emerged the most essential way to tackle this catastrophe, but these strategies have had far reaching effects and hence underscore the need to comprehensively explore such strategies and find a right balance in varying contexts. It is imperative to learn from the evidence-based data from other countries especially from the developing world to ensure provision of safe and timely healthcare delivery for all patients. Though it is premature to suggest any specific strategies but this crisis has provided an opportunity for thinking and devising global policies, so that future such circumstances can be tackled more comprehensively and uniformly. Together, and better equipped with advancing knowledge, we can fight this.

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## Compliance with ethical standards

**Conflict of interest** None.

## References

- World Health Organization. Novel Coronavirus (2019-nCoV), Situation Report–11, [https://www.who.int/docs/default-source/coronavirus/situation-reports/20200131-sitrep-11-ncov.pdf?sfvrsn=de7c0f7\\_4](https://www.who.int/docs/default-source/coronavirus/situation-reports/20200131-sitrep-11-ncov.pdf?sfvrsn=de7c0f7_4). 2020. Accessed 15 May 2020
- Li Q, Guan X, Wu P, Wang X, Zhou L, Tong Y et al (2020) Early transmission dynamics in Wuhan, China, of novel coronavirus-infected pneumonia. *N Engl J Med*. <https://doi.org/10.1056/NEJMoa2001316>
- Lu H, Stratton CW, Tang YW (2020) Outbreak of pneumonia of unknown etiology in Wuhan, China: the mystery and the miracle. *J Med Virol*. <https://doi.org/10.1002/jmv.25678>
- World Health Organization. Novel Coronavirus (2019-nCoV), Situation Report-171, [https://www.who.int/docs/default-source/coronavirus/situation-reports/20200709-covid-19-sitrep-171.pdf?sfvrsn=9aba7ec7\\_2](https://www.who.int/docs/default-source/coronavirus/situation-reports/20200709-covid-19-sitrep-171.pdf?sfvrsn=9aba7ec7_2), 2020. Accessed 9 July 2020
- Docherty AB, Harrison EM, Green CA, Hardwick HE, Pius R, Norman L et al (2020) Features of 16,749 hospitalised UK patients with COVID-19 using the ISARIC WHO Clinical Characterisation Protocol. *MedRxiv*. <https://doi.org/10.1101/2020.04.23.20076042>
- CDC COVID-19 Response Team (2019) Coronavirus Disease 2019 in children - United States, February 12–April 2, 2020. *MMWR Morb Mortal Wkly Rep*. <https://doi.org/10.15585/mmwr.mm6914e4>
- Wu Z, McGoogan JM (2020) Characteristics of and important lessons from the coronavirus disease, (COVID-19) outbreak in China. *JAMA*. <https://doi.org/10.1001/jama.2020.2648>
- Dong Y, Mo X, Hu Y, Qi X, Jiang F, Jiang Z et al (2020) Epidemiology of COVID-19 among children in China. *Pediatrics*. <https://doi.org/10.1542/peds.2020-0702>
- Verdoni L, Mazza A, Gervasoni A, Martelli L, Ruggeri M, Ciuffreda M et al (2020) An outbreak of severe Kawasaki-like disease at the Italian epicentre of the SARS-CoV-2 epidemic: an observational cohort study. *Lancet*. [https://doi.org/10.1016/S0140-6736\(20\)31103-X](https://doi.org/10.1016/S0140-6736(20)31103-X)
- Ministry of National Health Services. Regulations and Coordination, Daily Situation Report – Pakistan COVID-19, <https://www.nih.org.pk/wp-content/uploads/2020/04/COVID-19-DailyUpdatedSitRepNew02-April-2020-1.pdf>, 2020. Accessed 15 May 2020
- Government of Pakistan. See the real time Pakistan and Worldwide COVID-19 situation, <http://covid.gov.pk/>, 2020. Accessed 9 July 2020
- Nicola M, Alsafi Z, Sohrabi C, Kerwan A, Al-Jabir A, Iosifidis C et al (2020) The socio-economic implications of the coronavirus and COVID-19 pandemic: a review. *Int J Surg*. <https://doi.org/10.1016/j.ijssu.2020.04.018>
- Bizoza A, Sibomana S. Indicative socio-economic impacts of the novel coronavirus (Covid-19) outbreak in Eastern Africa: Case of Rwanda. [April 27, 2020] <http://dx.doi.org/10.2139/ssrn.3586622> (In Press)
- Bong CL, Brasher C, Chikumba E, McDougall R, Mellin-Olsen J, Enright A (2020) The COVID-19 pandemic: effects on low and middle-income countries. *Anesth Analg*. <https://doi.org/10.1213/ANE.0000000000004846>
- UNICEF. The Situational analysis of children in Pakistan-report, <https://www.unicef.org/pakistan/reports/situation-analysis-children-pakistan>, 2017. Accessed 9 July 2020
- Pakistan Bureau of Statistics. Province wise provisional results of census-2017, [http://www.pbs.gov.pk/sites/default/files/PAKISTAN%20TEHSIL%20WISE%20FOR%20WEB%20CENSUS\\_2017.pdf](http://www.pbs.gov.pk/sites/default/files/PAKISTAN%20TEHSIL%20WISE%20FOR%20WEB%20CENSUS_2017.pdf). Accessed 9 July 2020
- Robertson T, Carter ED, Chou VB, Stegmuller AR, Jackson BD, Tam Y et al (2020) Early estimates of indirect effects of the COVID-19 pandemic on maternal and child mortality in low-income and middle-income countries: a modelling study. *Lancet Glob Health*. [https://doi.org/10.1016/S2214-109X\(20\)30229-1](https://doi.org/10.1016/S2214-109X(20)30229-1)
- Nelson R (2020) COVID-19 disrupts vaccine delivery. *Lancet Infect Dis*. [https://doi.org/10.1016/s1473-3099\(20\)30304-2](https://doi.org/10.1016/s1473-3099(20)30304-2)
- Chan E, Wayne C, Nasr A (2014) Ideal timing of orchiopexy: a systematic review. *Pediatr Surg Int*. <https://doi.org/10.1007/s00383-013-3429-y>
- Leung GM, Lam TH, Ho LM, Ho SY, Chan BHY, Wong IOL et al (2003) The impact of community psychological responses on outbreak control for severe acute respiratory syndrome in Hong Kong. *J Epidemiol Community Health*. <https://doi.org/10.1136/jech.57.11.857>
- Rubin GJ, Potts HWW, Michie S (2010) The impact of communications about swine flu (influenza A H1N1v) on public responses to the outbreak: results from 36 national telephone surveys in the UK. *Health Technol Assess (Rockv)*. <https://doi.org/10.3310/hta14340-03>
- Wang C, Pan R, Wan X, Tan Y, Xu L, Ho CS et al (2020) Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in China. *Int J Environ Res Public Health*. <https://doi.org/10.3390/ijerph17051729>
- Sullivan M, Bouffet E, Rodriguez-Galindo C, Luna-Fineman S, Khan MS, Kearns P et al (2020) The COVID-19 pandemic: a rapid global response for children with cancer from SIOP, COG, SIOP-E, SIOP-PODC, IPSO, PROS, CCI, and St Jude Global. *Pediatr Blood Cancer*. <https://doi.org/10.1002/pbc.28409>
- Weiss AJ, Elixhauser A, Andrews RM. Characteristics of operating room procedures in US Hospitals, 2011. *HCUP Stat Br #170 2014*
- McHugh M, Regenstein M, Siegel B (2008) The profitability of Medicare admissions based on source of admission. *Acad Emerg Med*. <https://doi.org/10.1111/j.1553-2712.2008.00238.x>
- Kanneganti A, Sia CH, Ashokka B, Ooi SBS (2020) Continuing medical education during a pandemic: an academic institution's experience. *Postgrad Med J*. <https://doi.org/10.1136/postgradmedj-2020-137840>
- Davenport M, Pakarinen MP, Tam P, Laje P, Holcomb GW (2020) From the editors: the COVID-19 crisis and its implications for pediatric surgeons. *J Pediatr Surg*. <https://doi.org/10.1016/j.jpedsurg.2020.04.009>
- Rose S (2020) Medical Student Education in the Time of COVID-19. *JAMA*. <https://doi.org/10.1001/jama.2020.5227>
- El-Hage W, Hingray C, Lemogne C, Yrondi A, Brunault P, Biennu T et al (2020) Les professionnels de santé face à la pandémie de la maladie à coronavirus (COVID-19): quels risques pour leur santé mentale? Health professionals facing the coronavirus disease, (COVID-19) pandemic: what are the mental health risks? *L'Encephale*. <https://doi.org/10.1016/j.encep.2020.04.008>
- Shaun Griffin (2020) Covid-19: “Staggering number” of extra deaths in community is not explained by covid-19. *BMJ*. <https://doi.org/10.1136/bmj.m1931>
- Coe TM, Jogerst KM, Sell NM, Cassidy DJ, Eurboonyanun C, Gee D et al (2020) Practical Techniques to Adapt Surgical Resident Education to the COVID-19 Era. *Ann Surg*. <https://doi.org/10.1097/SLA.0000000000003993>

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