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Paediatric orthopaedic surgery during the SARS-CoV-2 pandemic. A safe and pragmatic approach to service provision

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ABSTRACT

The SARS-COV-2 pandemic has brought unparalleled challenges to healthcare provision. Being a newly discovered virus, there is a lack of previous experience and published evidence to guide healthcare providers on how to deliver services. We would like to share our approach to service delivery in a newly open children's hospital in the United Arab Emirates with a particular focus on paediatric orthopaedic services.

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Introduction

The world is currently facing one of the most challenging healthcare crisis in memorable history. The identification and subsequent spread of the novel Corona virus has brought an unprecedented healthcare, social and economic crisis. It started as a pneumonia of unknown cause detected in Wuhan, China. This was first reported to the WHO Country Office in China on 31 December 2019. The spread was so alarming that the outbreak was declared a Public Health Emergency of International Concern on 30 January 2020; only one month from the first case report. On 11 February 2020, the WHO announced a name for the new coronavirus disease:

COVID-19 and on 11 March 2020, the WHO characterized SARS-COV-2 as a pandemic.¹ On 3 May 2020 the WHO reported that 3.27 million people have been infected with the virus and 229,971 have died.²

Governments, healthcare organizations, hospitals and healthcare providers have taken extreme measures to curb the devastating effect of SARS-COV-2. Many countries imposed total or partial lockdown. Some countries closed their borders and national spaces. Airlines were grounded and public transports stopped services; restaurants, malls, social clubs and gyms were closed.^{3,4} In Northern Italy, for instance, the overwhelming number of SARS-COV-2 patients required a complete reorganization of the healthcare system.^{5,6}

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Hospitals and healthcare providers have faced three main challenges during the current wave. First, to provide treatment to the ever rising number of patients with SARS-COV-2 while protecting their staff. Second, to continue a safe level of care to non SARS-COV-2 patients. Third, to maintain adequate revenue to cover fixed and ongoing costs, including staff salaries.⁷ Furthermore, while healthcare providers are dealing with the ongoing pandemic, preparation for the next wave must not be ignored.⁸

With little evidence or previous experience of a newly emerged disease whose clinical features have not been deeply analysed,⁹ hospitals have adopted various crises management strategies to deal with this unprecedented situation. As a newly opened children's hospital in the United Arab Emirates, we were facing several challenges in initiating services from the scratch, writing local policies, clinical guidelines and standard operating procedures of daily practices. Most of our doctors and nurses were recruited from various parts of the world and majority relocated to the country within a year or two. The whole situation was surreal.

In this article, we describe our hospital strategy to deal with the SARS-COV-2 pandemic crises with a particular focus on paediatric orthopaedic services. The simplicity of our approach was a key to accurate execution and compliance. The prompt collaboration between front line staff, managers and healthcare regulatory bodies to create patients centered guidelines and pathways secured legal protection should mistakes happened.

Methods

The hospital has responded to the crises by setting up three command and control committees (Gold, Silver and Bronze). Each committee has proportionate representations from various services and was assigned with specific tasks related to the three aforementioned challenges. The department of infectious disease took the lead in establishing the work flow for patients and staff safety.

The hospital has been divided into SARS-COV-2 specific areas and SARS-COV-2 free areas. The hospital corridors and lifts have been designated accordingly so that SARS-COV-2 patients and staff caring for them do not mix with other patients and staff. Staff who are at higher risk of SARS-COV-2 such as the elderly, those with diabetes, high blood pressure or immune-compromised staff were asked to work from home as is the case with all non-clinical staff who can perform their duties without being on hospital premises. The level of personal protection and the appropriate personal protective equipment (PPE) were enshrined in hospital policy. Enforcement steps were instituted to ensure compliance.^{10–12}

All non-urgent hospital attendances were triaged by treating physicians into one of three categories: postpone attendance, telemedicine virtual video consultation or face to face attendance. Patients and parents' preferences were considered in the triage process. The decision to which category a patient was assigned followed the same principle for the surgical screening tool below. Patients who were asked to attend in person underwent a screening process to indicate

their risk of having SARS-COV-2 (Fig. 1). Patients were classified into higher risk or lower risk. High risk patients were seen with staff wearing full SARS-COV-2 PPE (Appendix 1) whereas patients in the lower risk group required routine handwashing, face mask and gloves.¹³

A surgical screening tool was developed to triage patients who required surgery (Fig. 2). The tool was based on several international and national recommendations and is compliant with our health regulatory body; the Dubai Healthcare City Regulation Authority (DHCRA).^{10,14,15}

The tool concept is simple. It has four layers of urgency:

1. Life or limb saving surgery
2. Surgery to prevent incapacitating complications or disabilities.
3. Surgery to relieve pain.
4. Cosmetic or aesthetic surgery.

All patients who are undergoing surgery were tested for SARS-COV-2 using nasopharyngeal and oropharyngeal PCR swabs. Surgery should be performed in a timely manner if it is life or limb saving. Surgery should also be performed if delays could lead to incapacitating complications or disabilities. Patients who underwent emergency surgery were considered SARS-COV-2 positive from a cross infection point of view. All cosmetic and aesthetic surgery were postponed for three months. Patients who present with painful conditions not contained within the first two categories are triaged

**This algorithm does not supercede clinical judgement.
Any atypical case should trigger ID Consultation**

COVID Screening (Higher Risk)

- 1) Has the child had contact with COVID-19 positive individual?
- 2) Is there a parent or family member/caregiver with cold symptoms, cough, or fever?
- 3) Is there a parent or household member that is being tested for COVID 19, results are pending?
- 4) Has the patient has been tested for COVID-19 with a negative result and continues to have respiratory symptoms or fever?
- 5) Does the child has a severe acute respiratory illness that requires hospital admission (SARI)?

COVID Screening (Lower Risk)

- 1) Is there a household member who works in a high risk environment (healthcare worker, police, airport, taxi, etc)?
- 2) Is there a household member who has been diagnosed with Influenza or Group A Streptococcus?

Fig. 1 – SARS-COV-2 Screening tool. This has been used to categories patients into those of higher risk of having SARS-COV-2 or lower risk.

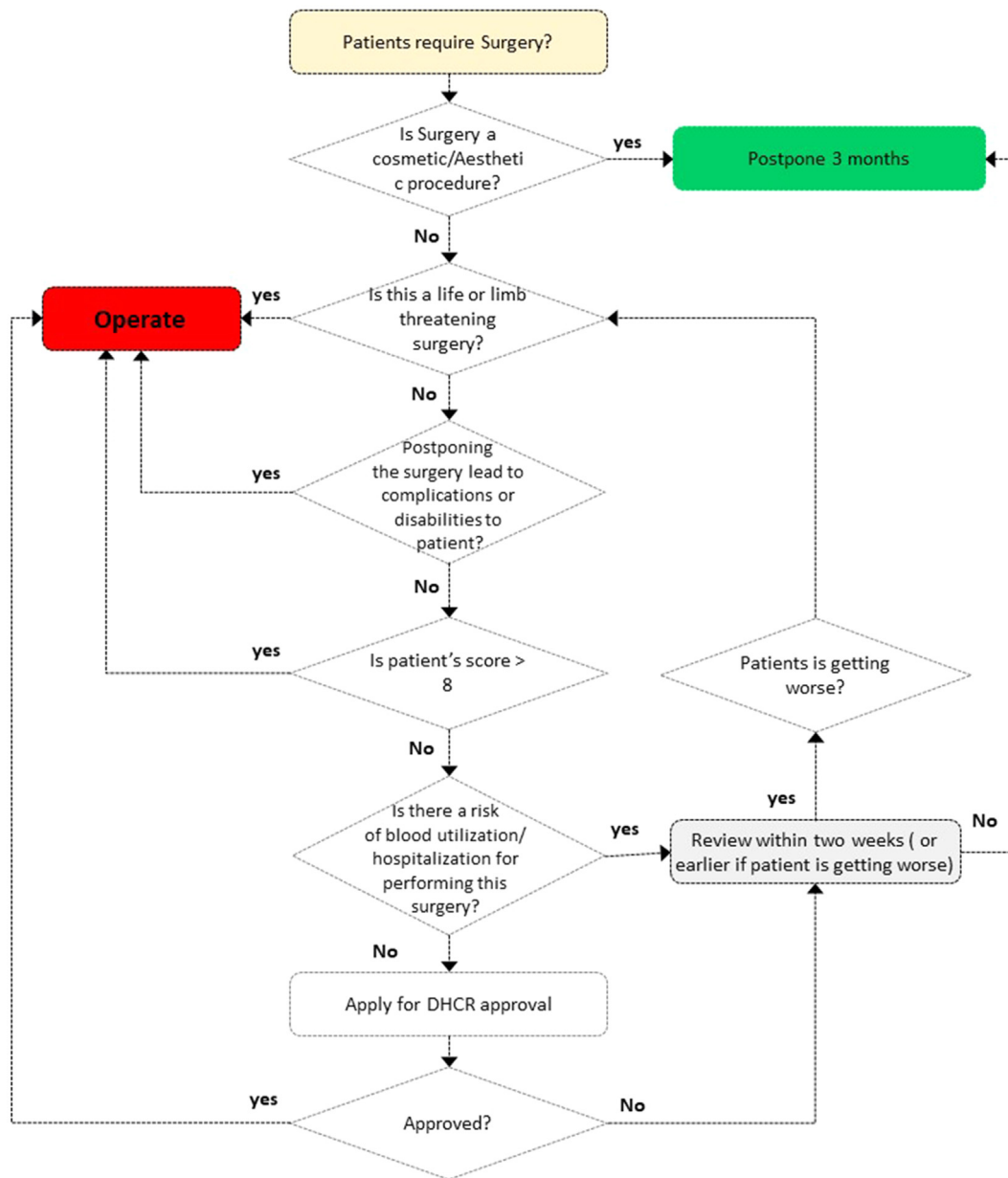


Fig. 2 – Surgery Screening Pathway. This flow chart is used to triage patients who require surgery.

based on their pain score and impact on hospital resources (Fig. 3).^{16,17} A pain score of ≥ 8 is considered substantially high and pain relieving surgery should be sanctioned.¹⁸ Patients who have a lower pain score and surgery has very low impact on hospital resources (can be done as a day case, they do not require a high dependency unit bed or blood transfusion) are offered surgery after DHCR approval. However, if surgery for these patients with low pain score would have impact on the hospital resources, it will be postponed. Patients will be reviewed at regular intervals determined by the treating physicians.

It was anticipated that some patients may present with conditions that do not fit the pathway neatly or patients get triaged inappropriately. Therefore, a subcommittee comprising of three surgeons, two anaesthetists and a theatre manager was created to advise on these patients.

Results

The pathway and work flows were communicated to staff through hospital wide communications and supplemented with several virtual meetings to ensure thorough understanding. Various departments developed workflows based on the pathway to streamline services. Here, we describe the application of workflows relevant to pediatric orthopedic services.

Traumatic injuries

Most of these patients come through the pediatric emergency department. They are already screened for SARS-COV-2 using the screening tool (Fig. 1), triaged for their injuries and seen by



Fig. 3 – Wong-Baker Faces Pain Rating Scale to score pain severity of patients with painful conditions that require surgery.

emergency physicians. This group of patients is always a heterogeneous mix, ranging from those who needed an immediate operation to save their life or limb, to children with trivial injuries who only need re-assurance and discharge. Children with severe injuries are often referred to the paediatric orthopaedic team immediately; however, all children including those with less substantive injuries are discussed with the on call team, and are referred to fracture clinic to be seen, either face to face or via video consultation, by a paediatric orthopaedic surgeon within a week.

The application of the pathway meant that all these patients are either seen by, or discussed with, the orthopaedic team on the day of presentation. Injuries are triaged according to the pathway and treatment is instigated by the appropriate experts to enhance outcomes, minimize complications and reduce any unnecessary visits. Substantive numbers of patients required a cast or a splint. These were applied by expert technicians, and where appropriate soft cast or splints were used rather than Plaster of Paris cast.^{19,20}

This approach has prevented a multitude of patients with clavicle fractures, ankle sprains, wrist fractures, knee injuries, shoulder injuries and back pain from attending fracture clinics as per previous workflows, and has also identified fractures that need early surgery.

Postoperative patients

Patients who underwent surgery and have a follow up clinic appointment were triaged and the above pathway was applied. If a patient was in a cast, or had wires that required removal, an appointment was made for them to attend for the cast to be removed to prevent stiffness or disuse atrophy, and wires to prevent infection. Similarly, for patients with wounds that needed physical dressing, or review, the physician would arrange a face to face appointment until such time as they could be moved to video consultations. For most other patients, including those who needed a timely post-operative

follow up, the default was to offer a video consultation. This allowed physicians to see the child and parent, speak with them about progress and address any concerns. If either parent or physician felt the video consultation was not satisfactory then arrangements were made for a face to face consultation.

A large number of patients required x-rays screening to confirm healing or alignment. The treating physicians would discuss the necessity of this x-ray with patients and parents and weigh the risk of patient's attendance to hospital. If x-ray was deemed important to progress to another stage of treatment, then the patient was asked to attend. In liaison with the radiology department, standard operating procedures for safe imaging were implemented for all modalities to reduce the risk of SARS-COV-2 infection both during initial visit to the emergency department and during the follow up visits (see Fig. 4).

Elective patients

Orthopaedic clinic attracts a very wide range of conditions. From children with normal variants to those with serious orthopaedic problems such as bone tumours, infections, joint dislocations or deformity. Even within these serious conditions, there are grades of seriousness. For example, a child who present with a swelling around the knee could have osteosarcoma or an osteochondroma. The former requires immediate investigations and treatment and the latter requires re-assurance and a follow up visit in a few months.

Two of the most common conditions seen in elective paediatric orthopaedics are the newborn with developmental dysplasia of the hip (DDH) and congenital talipes equinovarus (CTEV).^{21–24} In both these conditions early treatment is prognostic for better outcomes and fewer complication. However, we are able to defer Pavlik harness treatment for DDH in a two-week old child until they are three months old without significant sequelae, in a way we cannot do for a four-month

Before going to the patient room	Within the patient room	Post procedure
<ol style="list-style-type: none"> 1. Discuss logistic support with Nurse in ED and Team lead in PICU. 2. X-ray equipment is in ED (for ED cases only) and PICU. 3. Check the status of the equipment and check for appropriate PPE 4. Wear the lead apron before donning PPE 5. Wear appropriate PPE in equipment room or PPE room in PICU. 6. Cover the equipment with cling film (exposure button, handles, Gonad shields etc) 7. Place the detector in the detector cover and fasten a tape, make a good seal 8. Identify patient in the work list and set exposure parameters 9. Push the machine close to the isolation room and call for patient nurse, provide lead apron 10. Patient should have a face mask 	<ol style="list-style-type: none"> 1. In Ante room briefly discuss the steps for safe acquisition of x-ray. 2. Place the detector with help of patient nurse 3. Do Hand hygiene over the glove. 4. Position the tube. Expose the radiograph 5. Check the image. 6. Do not edit image or to send it to PACS. 7. If image OK, save and rest machine to home position 8. Retract the machine into anteroom, so that it can be easily pulled out of the room 9. Remove cassette with help of the patient nurse and perform hand hygiene over the glove 10. Ask the nurse to open the detector covers so that you can pull out the handle from the cover. Ask nurse to exercise caution, as to not to touch the cassette. 	<ol style="list-style-type: none"> 1. Place the detector inside machine 2. Remove the second pair of glove and discard in appropriate bin 3. Clean the machine in the anteroom (First Cleaning with CAVI bleach wipes) 4. Remove ALL PPE and discard in appropriate bin. 5. Perform hand hygiene and pull the machine out as you come out of the room. 6. Park the machine in the equipment room. 7. EDIT images and send Images to PACS 8. Perform second round of cleaning of the machine by wearing gloves. 9. Wash your hands thoroughly as prescribed. 10. Complete the examination in RIS by placing tech note that PPE was used, and machine was cleaned and your name.

Fig. 4 – Protocol for performing a plain x-ray during the COVID-19 pandemic at Al Jalila Children's Speciality Hospital.

old infant who presents for the first time with DDH, and would need immediate treatment with a Pavlik harness to ensure we do not lose the window of opportunity to employ this treatment modality. Similarly, the onset of treatment for CTEV deformities can be delayed up to three months post-partum if necessary without significant effects on outcome. In such cases, and others, the treating orthopaedic surgeon reviewed all available information and applied the above pathway to ascertain the level of harm that delaying appointments may have on these patients. If information was not optimum, a video consultation appointment would be arranged to gather more information to reach the correct decision. This also allowed the treating physician to meet with the parents, explain the condition to them, signpost them for further information, advice and support, and reassure them regarding the proposed treatment plan.

Discussions

Clinical guidelines and pathways have increasingly become a familiar part of clinical practice. They help clinicians, managers and hospital to provide evidence-based and high quality care for their patients.^{25,26} Since SARS-COV-2a plethora of guidelines have been published to inform clinical practice during this pandemic. As an example, the British Society for Children's Orthopaedic Surgery (BSCOS) have listed several very useful guidelines on its website.¹⁹ These are proven of great value; however, they should be modified to individual countries or institutes as one size does not fit all, and the impact of SARS-COV-2 and resources available can vary significantly.²⁷

Having critically reviewed the published and relevant guidelines, we considered several factors when we developed our local pathway and workflows.^{28–30} We strongly believe that the treating physicians are the best professionals to triage their patients. They were trusted to take the right decision for patients before the SARS-COV-2 pandemic and there are no reasons to believe that things should be different during the pandemic.

The second important factor that we considered is that the pathway should be simple enough to understand and apply.

Surgery that saves lives, limbs or prevent disabilities or complications should not require approval and surgeons should be given the autonomy to perform these surgeries without further approval. Painful conditions that are not life or limb threatening such as avascular necrosis, osteoarthritis or osteochondritis dissecans can theoretically wait until the operating situation is safer, but we feel it is inhumane to leave children with pain. We chose a score of eight and above out of ten as severe pain and a child with such pain should be considered for surgery. The cut off pain score can be modified according to local risk, belief, or practice.

The third consideration is that every condition can present with a spectrum of seriousness and complexity and treatment should be tailored to the presentation. One example is that the treatment of a closed minimally displaced clavicle fracture is different from open displaced clavicle fracture. Another example is that of DDH in a two week-old child is treated differently if the child is 13 months of age. The best people to understand these differences and are able to act accordingly are the treating physicians.³¹

The final consideration is the need for a perioperative committee to ensure compliance and continuous guidance. This committee should be representative of main stakeholders (surgeons, anaesthetists and theatre managers) but small enough to speed the decision making process. So far the pathway has worked well with only five cases that have been escalated to the committee.

The strength of our approach stems from its simplicity and the adherence to the three basic principles of healthcare management. Saving life or limbs requires urgency and takes a priority over other non-urgent medical conditions. There is a spectrum of urgency even within a single disease. Physicians, being the experts in their fields, must be involved in designing the hospital's response to healthcare crises.

In summary, planning is essential to overcome crises like the one we are facing. The lack of previous experience and published evidence necessitates innovation that is based on simple principles and developed by front line staff who know their resources, patient population and conditions they treat, and who work in a multi-disciplinary way to plan and deliver healthcare.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.surge.2021.08.004>.

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