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Crisis change management during COVID-19 in the elective orthopaedic hospital: Easing the trauma burden of acute hospitals

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ARTICLE INFO

Article history:

Received 6 May 2020

Received in revised form

11 August 2020

Accepted 22 August 2020

Available online 8 September 2020

Keyword:

Crisis change management

Orthopaedic trauma surgery

2019 novel coronavirus

COVID-19

ABSTRACT

Introduction: With the emergence of the 2019 novel coronavirus and its resulting pandemic status in March 2020 all routine elective orthopaedic surgery was cancelled in our institution. The developing picture in Italy, of acute hospitals becoming overwhelmed with treating patients suffering with severe and life-threatening symptoms from the disease, prompted the orthopaedic surgeons to formulate a plan to transfer trauma patients requiring surgery to the elective hospital to unburden the acute hospital system.

Methods: Under the threat of this pandemic, protocols and algorithms were established for referral, acceptance and care of trauma patients from acute hospitals in the region. Each day, as new guidance on COVID-19 emerged, our process and algorithms were adjusted to reflect pertinent change.

Results: The screening of all patients referred, worked well in keeping our hospital “COVID-free” with respect to patients undergoing operations. An upward trend in cases referred reflected the decreased capacity in the acute hospitals due to rising cases of COVID-19 within the hospital network. During the first 7 weeks of the pandemic 308 operations were performed, (31.1% upper limb, 33.4% lower limb, 4.1% spine, 14.1% urgent elective, 17.4% plastic surgery cases). Regular review and audit of the activity in the hospital as well as communication with the referring teams enabled appropriate planning to accommodate the increase in case-mix as the need arose.

Discussion: This paper details the steps that were taken in planning for such a change in management specific to the orthopaedic surgery setting and the lessons learnt during this process. The success of the development of this pathway was facilitated by clear communication channels, flexibility to adapt to changing process and feedback from all stakeholders. The implementation of this pathway allowed the unburdening of acute hospitals dealing with the pandemic that was steadily reducing access to operating theatres and anaesthetic resources.

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<https://doi.org/10.1016/j.surge.2020.08.008>

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Introduction

The emergence of the 2019 novel coronavirus disease (COVID-19) globally was declared as a pandemic in March 2020 by the World Health Organisation (WHO).¹ This pandemic follows the 2009 H1N1 pandemic, however, this outbreak has already had an impact beyond anything dealt with before in modern times, and as such, every facet of life is adapting to the new threat, and subsequently, the new measures to reduce the spread and impact of SARS-CoV-2 virus.² Clearly, acute hospitals are at the forefront of the crisis dealing with the severe cases. However, despite social distancing, curtailment of services, working from home and closure of businesses that facilitate social gathering, there will be ongoing need to deal with musculoskeletal trauma as well as all other aspects of regular medical services in hospitals.^{3,4}

Our institution is a hospital dealing with elective orthopaedic surgeries in Ireland, running operating theatres 5-days a week, averaging over 65 overnight cases per week, over 100 day-cases per week as well as a radiology service and outpatient clinics in orthopaedics, sports medicine and rheumatology. In keeping with the measures to “flatten the curve” in Ireland all non-urgent elective operations and clinics were cancelled in our institution from the second week in March 2020. In an effort to reduce pressure on the acute general hospitals in the region; a decision was made to transfer their ambulatory patients for surgery to our service for operation. We were cognisant that should the acute hospitals become overwhelmed with the outbreak, (as was seen in Italy), the threshold for transfer of trauma would decrease and could escalate to the point of patients with clinically diagnosed fracture arriving directly to the centre.^{5,6}

In the setting of a pandemic there was a need to change the hospital structure and function, from planned orthopaedic surgery in pre-booked, pre-assessed patients, to unplanned acute trauma and orthopaedic care. Foreseeing the possibility of this from the emerging picture in Italy, the orthopaedic surgeons, anaesthetists, medical physicians and nursing staff worked together to formulate drafts of the possible pathways that would be needed to facilitate the change.^{6,7}

It is important to note that the unprecedented nature of this crisis meant that there was constant discussion and reliance on international experience communicated both formally and informally, to help guide this change in management of an entire organisation, from patient journey, to staff safety, to patient review and out-patient management. Coupled with this change, was the need to do so with COVID-19 risk assessment protocols to avoid the possible spread of infection, whilst balancing the need to perform trauma surgery in a safe and effective manner. In so far as was possible, the use of screening for COVID-19 at referral, the night before surgery and on admission to the hospital, the aim was to maintain this unit operating at maximum capacity by reducing the incidence of COVID-19 patients being admitted and for those that screen as a suspected case to have operation delayed pending COVID-19 swab results. The aim of this paper is to disseminate lessons learnt and to detail the algorithms and communication pathways that need to be established quickly to deal with such a crisis by the orthopaedic community.

Methods

Stakeholders analysis

Before the development of any algorithm to institute change, it is pertinent to perform a stakeholder analysis. This involves going through the entire process of a virtual referral from the point of view of the referring hospital, the patient journey and the accepting hospital. Through this process one will identify as many aspects as can be anticipated prior to the initial draft of the algorithms. This is, of course, a dynamic process and there must be an initial iterative process before finalization of the algorithms and all parties must be informed and updated of changes. Changes that may be required must be stepwise to avoid the confusion of multiple iterations and this can be incorporated into individual referrals that if effective can be rolled out into newly disseminated iterations of the algorithm to the network.

The stakeholders identified in this process were as follows:

- Referring hospital: Consultant orthopaedic surgeons who are initially responsible for the care of the patients, the orthopaedic/plastic surgery residents in the referring hospital, administrative staff from the referring hospital, theatre staff in referring hospital who may need to coordinate transfer of sets/resources to the accepting hospital, infectious diseases (ID) team in referring hospital
- Accepting hospital: Consultant surgeon and anaesthetist rota for communication and acceptance of the patients, residents involved in the receiving hospital (orthopaedic/medical/anaesthetists), administrative staff, nursing administration, theatre staff, company representatives for equipment, trauma co-ordinator(s), recording of cases for audit purposes, hospital security and reception, infection control co-ordinator, isolation protocols for suspected infected and confirmed positive patients, theatre protocols for same, IT team, radiology management and radiographers, laboratory, pharmacy and phlebotomy.
- Patient journey: information about what to expect on arrival, patient information regarding preparation for surgery, risk assessment information for patient, self-filled pre-assessment form to ease same day admission administrative duties

Communication

Initial algorithms were drawn up to grossly formulate a plan of action to present to the various representatives of both clinical and administrative staff within the hospital and to referring hospitals. These started off as plans drawn out and refined through collaboration between lead surgeons and physicians and then formal drafts submitted to the management forum, see Fig. 1. There is a wide spectrum of urgent and time sensitive cases that need consideration for surgery and a number of institutions have given guidance on what needs surgery and what can be managed conservatively or deferred.^{8–11} Given the nature of orthopaedic trauma and need for sub-specialist surgeons to deal with cases the

Trauma Pathway Algorithm

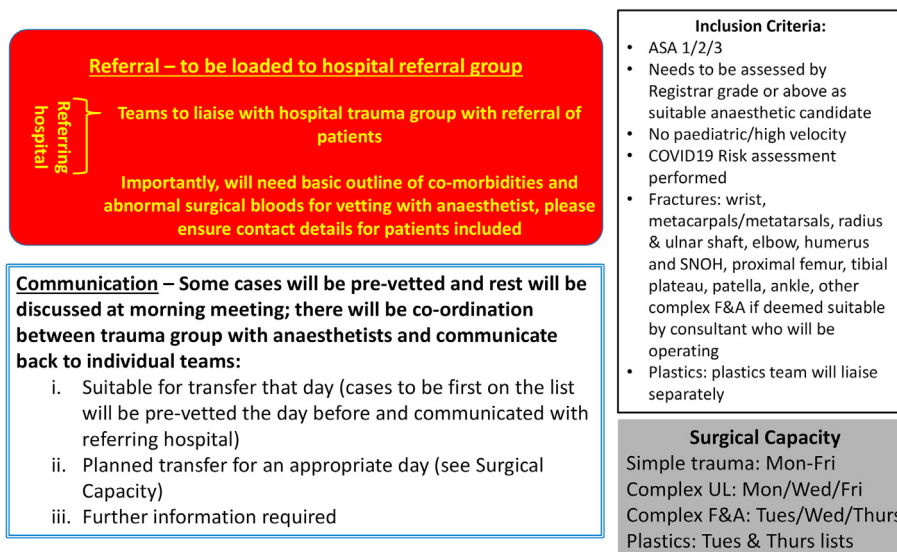


Fig. 1 – Initial algorithm to communicate to referring hospitals and accepting hospitals the plan for change.

algorithms included pathways for complex upper limb and lower limb surgery for scheduling.

Concomitantly, communication links were established amongst residents in the adult hospitals in the region. The GDPR compliant, medical messaging app Siilo®, a platform for referral of cases, was selected for communication amongst the referring hospitals. Initially, this was amongst the orthopaedic community of residents and consultants but upon discussion at an ortho-plastics unit in the city the plastic surgeons were also brought into the fold; a recognition of the interdisciplinary cooperation that has been developing between the two specialties.

IT support was imperative to facilitate distribution of the referrals and evolving trauma lists to the relevant stakeholders including: surgical day admissions, bed management, nursing administration, anaesthetists, theatre resource managers.

The algorithms for communication of referrals and subsequent transfer were then formalised, see Fig. 2. As the picture of the impact this new disease was going to have upon our lives and systems was emerging, the first transfers of patients to our institution began on 18th March 2020. To facilitate this in as safe a manner as possible, and reduce opportunity for disease spread, protocols for screening the referred patients were distributed to all referring doctors and nurses involved with referral and acceptance of patients. Information packs for referred patients, (given on discharge from the referring emergency department), to inform them of precautions to be taken and advice to bring pertinent medical imaging and medications on the day of proposed surgery were disseminated electronically, see Supporting information. The patients were contacted, by telephone, by nursing staff the day prior to presentation to surgery and triaged regarding their medical history. A COVID-19 screening questionnaire was undertaken at this time. This was repeated at presentation to the hospital and included standard screening

questions related to travel, contacts, symptoms and clinically observed vital signs.

On arrival to the hospital patients were instructed to stay in their cars, in assigned spaces in front of the Trauma Unit entrance, until called by the nursing personnel who were suitably attired in personal protective equipment (PPE) to administer the questionnaire and take vitals. After screening patients were either deemed not suspected or suspected for COVID19, see Supporting information for screening questionnaire. Non-suspected cases were then admitted into the ward for preparation for theatre by one member of the surgical team and ward nursing staff in keeping with WHO guidelines on the rational use of PPE.¹² Those with suspected infection were advised to return to their vehicle. Their case was discussed with the medical, anaesthetic and surgical teams with regard to the urgency of surgery and need for admission. Prior to testing being available in our hospital the patient had a swab taken in the referring hospital. While waiting result they were advised to self-isolate until further communication from the team. In house testing became available 4 weeks post commencement of the service, allowing test turnaround within 90 min using GeneXpert® system, Xpert® Xpress, SARS-CoV-2 assay (Cepheid®, USA). Our management protocols were changed to reflect this. At the time of writing this paper there were 16 cases that were suspected of COVID-19 who required PCR testing in the referring hospital (this typically took at least one day to get a result), and of those 8 had clear tests allowing for surgery in our hospital of the other eight patients, 6 were treated in the referring hospital as suspected cases and 2 were confirmed positives and had their surgery in the referring hospital.

Most cases were suitable for day of surgery admissions. Ultimately, cases such as open fractures, complex foot and ankle fractures, hip, periprosthetic and long bone fractures needed to be facilitated; requiring ambulance transfer to the

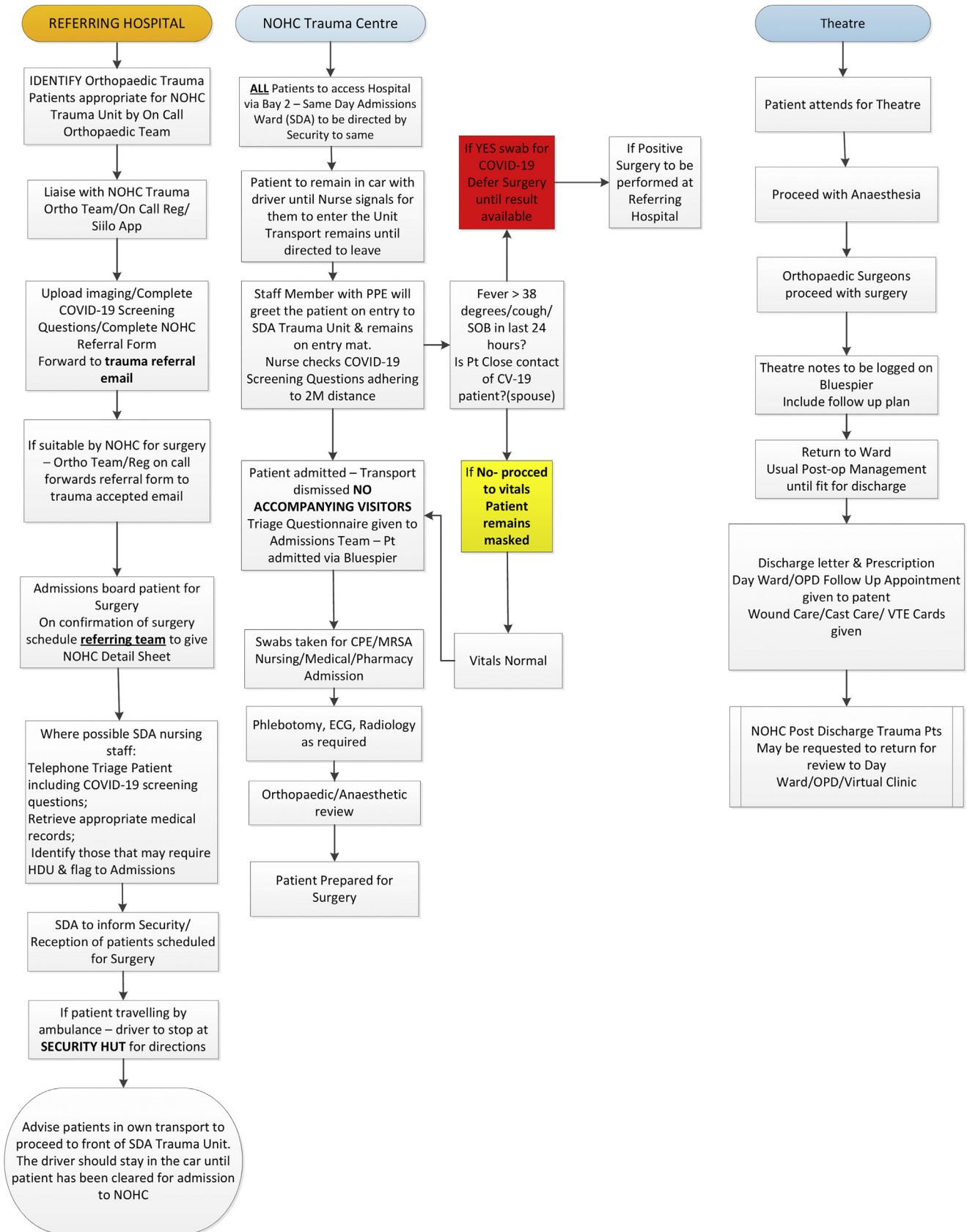


Fig. 2 – Flowchart representing patient journey from referring hospital to discharge.

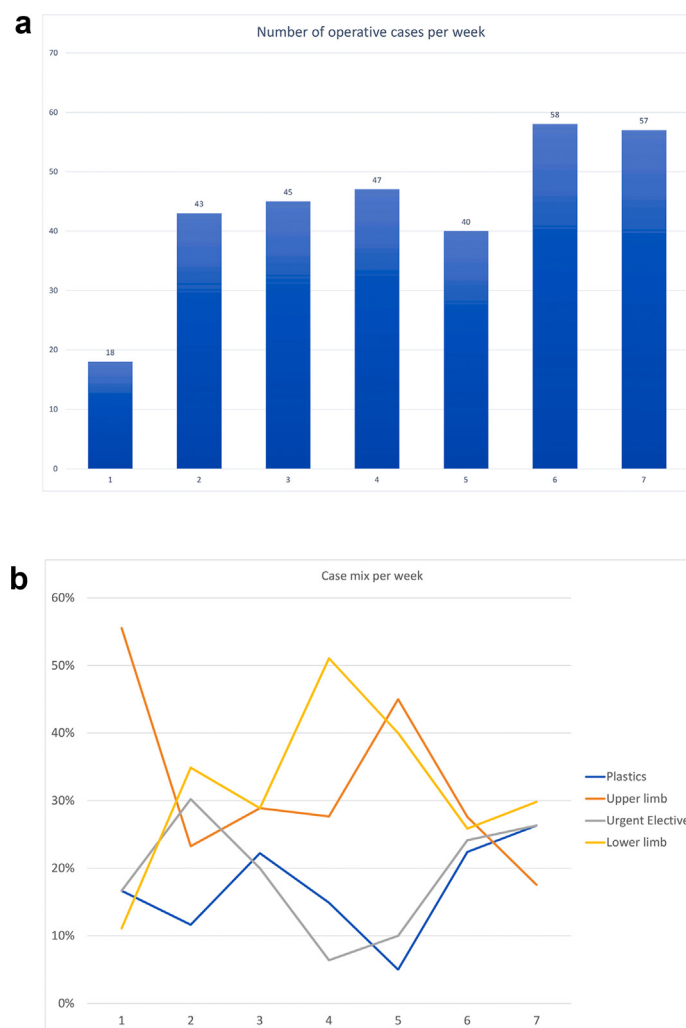


Fig. 3 – (a) Number of cases performed each week (b) Case mix by region each week.

hospital for overnight stay.⁵ The algorithms did account for complex region-specific trauma which could be accommodated and scheduled for a day with a trauma surgeon with the appropriate subspecialty interest.

Theatre organisation

As highlighted in Fig. 2, there was a co-ordination of all those involved in the patient flow each morning with any new advice or emerging guidance discussed with relevance to the organisation in this hospital. There were senior representatives from each of nursing administration, orthopaedic and plastic surgery teams, anaesthetists, and theatre administration; whereby each case would be discussed in terms of order and timing, positioning, equipment, anaesthesia and discharge planning. With regard to the operation the anaesthetists are in the position of highest risk for contraction of the virus when performing general anaesthetic due to the manipulation of airway. It was important to have daily dialogue with our anaesthetic colleagues about updates from experience locally and internationally about what is deemed safe practice for all those involved in theatre.^{13,14} Local policies from acute hospitals, essentially assimilated guidance

from international experience, were put in place and implemented, see [Supporting information](#).

From a theatre scheduling perspective, the implication was that the turn around on a general anaesthetic was significantly increased and to reduce exposure, as well as the consumption of PPE, all cases that could be done under spinal or regional anaesthetic were discussed at the morning meeting between surgeons and anaesthetists to ensure that patient safety, staff safety, and case turn-around was optimised.¹⁵ Each evening there would be a similar meeting as in the morning to discuss lessons learnt from each day and how to incorporate this into the management of the process going forward. As experience grew the efficiency of the case turn-over increased.

Cases for specific surgical sub-specialization were listed for the appropriate surgeons and the anaesthetists with more experience in regional blocks were linked with upper limb lists to reduce the need for general anaesthetic. The theatre suite of 7 theatres was reduced to 3 functioning theatres with the possibility of changing theatres to an otherwise empty theatre to enhance turnover when needed. There was a fourth theatre used for cases performed under local anaesthetic. With the reduced throughput of cases the post op

recovery bay had the capacity in space to facilitate a “blocking bay” to have regional upper-limb blocks administered prior to arrival to the theatre.

Each theatre team were assigned one of three colours of scrubs, green, navy and blue. Each colour code had separate changing rooms, (one being newly constructed in the first week of operation of the new system), and toilet facilities were separated by colour code. This all served to isolate the teams into pods, for infection control purposes, to reduce possible interaction of teams, thereby, reducing the impact should a team member develop symptoms on the number of close contacts within the operating team.

Post-operative care

The procedures needed for the patients was the most straight forward part of the changes invoked, as all orthopaedic residents and consultants are trained in trauma (trauma accounting for the majority of orthopaedic residents' training and consultants' work in the acute hospitals). However, follow up of all operatively and conservatively managed patients needed to be arranged bearing in mind the new risk that pertains to a simple outpatient clinic visit. As outlined in the now published BOAST guidelines on orthopaedic management during the COVID19 pandemic there are difficult choices that the treating surgeon must make: “*reasoned pragmatic decision-making in these extraordinary circumstances and acknowledges that non-operative management of many injuries and reduced face to face follow up will be increasingly the norm*”.¹⁰

Accordingly, it was imperative that operative notes included specific instructions for all outpatient visits for the 6–12 weeks so that the doctor reviewing the patient could make the decisions on behalf of the consultant surgeon in routine cases reducing the need for multiple doctors attending an outpatient review. All outpatient follow-up was carried out using the same screening questionnaire prior to the patient entering the outpatient department.

Quality control

With regard to the surgical management, there was a daily “trauma huddle” at the end of the operating lists to make sure that any concerns from individual anaesthetists/surgeons/nurses were addressed to ensure continuous improvement of the system. There was a weekly trauma conference to audit the work done in the department and reports to referring hospitals were made available. As the “surge” was anticipated the unit increased its operating capacity to include hip fractures, periprosthetic fractures and similar time urgent injuries that could be facilitated on weekends. Clearly hip fracture patients present a more challenging patient due to comorbidities, need for more medical specialties and higher demand on the ancillary speciality support such as occupational therapy, physiotherapy and social work during their rehabilitation. For this reason, each hip fracture patient or similar injury was discussed with the local medical team to ensure that there would be available care for individual needs and for those that surpassed the capacity of the local capabilities those cases would not be accepted and their surgery would be facilitated in their referring hospital.

Results

Theatre activity

At the time of writing this article the pathway had been running for 7 weeks (the first week trauma case started from Wednesday 18/03/20–22/03/20), with a total of 308 operative cases on 291 patients, including urgent elective cases of which there were 49. The demographics of the patients undergoing operation in our institution for this period was as follows: mean age was 50.2 years old (range 6–91 years); 45.6% male 54.4% female. At the time of writing this paper there were 18 in-patients in the hospital; of those discharged during the 7 weeks: 38.1% were day cases, 33.1% had one overnight stay in the hospital, the remaining 22.9% had more than one overnight stay. The number of cases performed each week are shown in Fig. 3(a). The breakdown in cases overall were 31.1% upper limb, 33.4% lower limb, 4.1% spine, 14.1% urgent elective (includes musculoskeletal tumour, paediatric orthopaedic surgery and urgent arthroplasty for infection or severe deterioration in mobility as agreed by a panel of consultant orthopaedic surgeons), the remaining 17.4% were plastic surgery cases, Fig. 3(b) shows the running weekly breakdown of cases performed.

In total, during this period, there were 289 referrals for trauma and plastic surgery cases with 47 cases that did not undergo surgery in the unit. The reasons for these decisions were mostly due to existing comorbidities that were decided to be better managed in the acute hospitals. At the start of the pandemic some of the trauma cases referred to the pathway, could still have their surgery accommodated in the acute hospital, and this was the case if it was deemed their medical needs would be better served there. As the pressure increased in the acute hospitals, there was increasing need for the patients with more complex needs to be facilitated for surgery in our institution, and this was duly communicated to the management team. At this point the decision was made to increase theatre activity from 5-day to 7-day operating. Subsequently only 6 referrals were advised not for surgery in our institution due to medical complexity better suited to management within an acute hospital setting.

There were 4 cases referred for surgery, that, on the day of surgery were adjudged better suited to conservative management by the operating surgeon. There were no cases of COVID-19 associated with any patients admitted, however, there were 6 cases who underwent surgery had been initially deferred following screening positive via questionnaire. Negative results were awaited prior to being rescheduled. 2 cases referred, screened positive using the questionnaire that subsequently tested COVID positive - these patients had their surgery performed in the referring hospital.

Post operatively it is important for the operating surgeon to document the entire plan for the following 6–12 weeks in the operative note and to consider, what OPD appointment, is absolutely necessary.¹⁰ Feedback from the nursing, physiotherapists and occupational therapists was very positive regarding the clarity of the care plans documented. It is also pertinent to document that this care-plan is made in the setting of the COVID19 pandemic and once restrictions are lifted the management plan might need to be reconsidered. At the time

of writing, there were no surgical site infections recorded in the follow-up visits. There was revision of one case surgically for early construct failure. Typical post-operative medical issues occurred in some of the hip fracture patients including delirium, hypotension, anaemia and urinary tract infection. There were two patients that required transfer to a general hospital for a cardiac arrhythmia and one pulmonary embolus, both of whom were discharged from the general hospital after management of these complications. 3 patients were treated for LRTI (each of whom was managed as potential COVID at commencement of symptoms and subsequently tested negative). An additional feature of taking trauma patients in the COVID setting is that the hospital is required to rehabilitate all patients onsite as there is no access to step down facilities.

Screening

The decision regarding screening for COVID-19 and thus reducing the chances of COVID-19 spreading to the hospital was a pragmatic one, as it would potentially shut down the operation as it was intended; to act to release pressure from the acute hospitals who were dealing with COVID positive patients. The screening questionnaire used is included in the [Supporting information](#), this was formulated on the basis of emerging international evidence with regard to the most common symptoms and risk factors that would require swab testing.^{16,17} Any patients who screened as potential positives were not initially accepted for surgery, nor admitted at presentation to the day-ward. Testing was performed in the referring hospital initially and subsequently undertaken onsite in the laboratory. Suspect positive patients were redirected from the exterior of the ward, having not been admitted, to a testing area outside the hospital building by appropriately donned PPE nurse. The patient would return home and self-isolate to await results. If negative, they could proceed to surgery within our unit and if positive would return to referring hospital for surgery there. With onsite testing the patients can await results and proceed directly to surgery if negative. This practice was essential to negotiate with referring surgeons and hospitals in order for the hospital to remain operational in a non-COVID setting and remain efficient in managing the city's trauma burden. Plans were made for the possibility of operating on COVID positive patients within the unit should the need arise, as well as contact tracing structures being used by the national public health services. The screening programme functioned well and resulted in no confirmed positive cases being admitted to the hospital and there were no clusters of infection related to any admitted patients at the time of writing this paper.

With regard to staff there was availability of testing for COVID-19 within the hospital and occupational health performed contact tracing and appropriate management of contacts, with regard to self-isolation at home, in keeping with guidelines from the National Public Health Emergency Team.

Discussion

The COVID-19 pandemic is an evolving situation and every day there are further updates pertaining to everyday life as

well as working life in the hospitals. What has been evident is that this crisis has united all sectors of the health-care community and there is cross-hospital, cross-departmental and inter-disciplinary collaboration on a scale of efficiency that reminds us why we work in this vocation. Crisis tends to create the need for an all-at-once change in management, and this has been evident in the COVID-19 crisis.

In every crisis there is opportunity, and this crisis is no different. The lessons learnt through the setting up of this pathway are being incorporated into plans for national trauma management in this country. To manage this change in the orthopaedic setting it is vitally important that this is done in as safe a manner as possible and that the patient's safety, from both an exposure perspective as well as the issues involved in trauma care, are front and centre of the plans with guidance from ID for the management of the safety of all health-care workers in the system. The steps outlined in this paper are what was used as the foundation of the planning for this change, and through an iterative process of audit and feedback from all participants in the process, it is being refined and updated with the evolving evidence internationally.

Conclusion

The learning points from this process were brought about through continuous re-evaluation of the entire pathway of what was working well and improving upon points that caused preventable delays:

- Screening and provision of information to patients prior to surgery
- Coordination of pre-hospital patient journey
- Scheduling of patients for surgery with appropriate anaesthetists coupled with the sub-speciality surgeons
- The use of “trauma huddles” before and after lists to plan cases appropriately with regard to the previous point as well as resource planning, including equipment turnover and radiographic imaging required
- Post-operative planning documented from the writing of detailed post-operative instructions incorporating all required out-patient requirements to reduce visits required and number of health care worker exposure as well as the screening of patients on the day prior to entering the out-patient review clinic
- Continual communication with the referring hospitals with regard to the need for this pathway as well as anticipation of changing the thresholds for patients with more complex medical needs for transfer to the hospital to facilitate time-urgent surgeries.

Going forward, there will be a need to resume to the “new normal” functioning of elective services. This will be introduced with advice and emerging evidence from international and national literature.^{6,18} The future phasing-in of elective work is already under discussion at our institute and the success of this pathway ensures that it will endure for however long that the need is present. The use of the screening policy has been successful and the current plans will incorporate all patients attending the hospital for either surgery or outpatient

clinics undergoing screening, and appropriate subsequent testing for all patients undergoing surgery. Education regarding social distancing and hand hygiene of patients and staff, avoiding gathering in common areas, scheduling of out-patients to reduce time spent in waiting rooms and facilitate radiological investigations, and appropriate bed planning are also covered in this plan. With the possibility that we will be living with this virus into the future, admission and consent for surgery will need to consider the added risk of attending hospitals with regard to an increased exposure to health care workers as well as possible need of transfer to an acute hospital, that may still be considered a hospital for COVID-19 management, should there be post-operative complications requiring medical interventions beyond the capability of an elective orthopaedic hospital. The continual evaluation and development of this pathway has proven to be successful, and will form a template for future audit and plans should there be a second wave of the pandemic.

Acknowledgements

There was no funding source involved in the production of this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.surge.2020.08.008>.

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