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Returning to Elective Orthopedic Surgery During the COVID-19 Pandemic: A Multidisciplinary and Pragmatic Strategy for Initial Patient Selection

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Objective: The aim of the study was to design an objective, transparent, pragmatic, and flexible workflow to assist with patient selection during the initial phase of return to elective orthopedic surgery during the COVID-19 pandemic with the main purpose of enhancing patient safety.

Methods: A multidisciplinary working group was formed consisting of representatives for orthopedics, epidemiology, ethics, infectious diseases, cardiovascular diseases, and intensive care medicine. Preparation for upcoming meetings consisted of reading up on literature and testing of proposed methodologies on our own waiting lists.

Results: A workflow based on 3 domains, that is, required resources, patient fitness, and time sensitivity of the procedure, was considered most useful. All domains function as standalones, in a specific order, and no sum score is used. The domain of required resources demands input from the surgical team, results in a categorical (yes or no) outcome, and generates a list of potential patients who can be scheduled for surgery under these particular circumstances. The (weighted) items for the domain of patient fitness are the same for every patient, are scored on a numerical scale, but are likely to change during the pandemic as more data become available. Time sensitivity of the procedure is again scored on a numerical scale and becomes increasingly important when returning to elective surgery proves to be acceptably safe. After patient selection, an augmented informed consent, screening, and testing according to local guidelines will take place.

Conclusions: A workflow is proposed for patient selection aiming for the safest possible return to elective orthopedic surgery during the COVID-19 pandemic.

Key Words: elective surgery, risk stratification, patient safety, multidisciplinary, statement paper, orthopedic surgery, COVID-19, pandemic, workflow

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On March 11, 2020, the World Health Organization declared the outbreak of corona virus disease 2019 (COVID-19) a pandemic, and shortly after, elective orthopedic theaters worldwide came to a standstill.[1] Along with many other precautions and interventions, this has helped maximize resources in a time of imminent overflow of the healthcare system. However, elective surgery should not be confused with optional surgery, illustrated by the following example.[2] For most of our patients on the waiting list for joint replacement, conservative therapy has been tried extensively but no longer brings relief. While their surgery is being postponed, they experience pain during activity and at night, and lose function and autonomy. We know that 1 of 5 patients awaiting joint replacement defines his or her general health as a state "worse than death".[3] Development of flexion contractures, loss of muscle mass, and increasing use of opioids will make postoperative rehabilitation significantly more difficult.[4–6] Therefore, canceling all cases until the pandemic has ended is not sustainable.

Fortunately, in our part of the world, daily numbers of COVID-19–related admissions seem to be declining slowly but steadily and resources such as hospital beds, staff, personal protective equipment, and ventilator capacity are becoming available again. Thus, we are now presented with a unique situation where we can start preparing for a modest but incremental return to elective orthopedic procedures, something even the most senior and seasoned staff member will have little to no experience with.

At present, there seems to be a sprawl of specific orthopedic guidelines suggesting how this process must take place; however, we feel that there is room for improvement and a wider approach. So far, the participation of other disciplines when drafting these orthopedic guidelines seems very limited. If we want to *do no further harm*, there inescapably are some important ethical, epidemiological, and virological issues to be addressed. Furthermore, there seems to be a tendency for guidelines to either remain vague or provide very rigid and strict directions and scoring systems. With regard to the latter, we must realize that long-term and unequivocal data are still very limited, yet fast evolving, and whatever scoring system still requires validation during and after this pandemic. Lastly, a significant number of recommendations, although ideal, will turn out not to be feasible for many, such as switching to a COVID-19–free hospital for elective surgery.

In this article, we would like to illustrate the strategy for patient selection that we currently use and test in our university hospital. It is designed as a flexible, transparent, objective, but also pragmatic framework, based on a single thorough analysis of one's waiting list and can be adjusted as new insights come to the table.

METHODS

A multidisciplinary working group was formed consisting of representatives for orthopedics including the head of the department, epidemiology, ethics, infectious diseases, cardiovascular

TABLE 1. The Philosophy of the 3 Domains

	Required Resources	Patient Fitness	Time Sensitivity
Question	Are the minimally required resources available?	How fit is the patient?	What is the impact of delay on outcome and surgical difficulty?
Answer	Categorical: Y/N	Numerical	Numerical
Similar for every (sub)speciality?	No	Yes	More or less
Assessment likely to change during the pandemic?	No	Yes	Unlikely

N, no; Y, yes.

diseases, and intensive care medicine. Preparation for upcoming discussions and brainstorm sessions consisted of reading up on available literature and testing of proposed methodologies on our own waiting lists.[7–9] The goal from the start was to generate a road map that would be practical during the initial and uncertain phase of returning to elective orthopedic procedures. Answers to questions for which we currently have insufficient data were not sought.

RESULTS

Of all scoring systems tried, the philosophy of the medically necessary time-sensitive or MeNTS triage tool was found to be the most useful and sensible.[9] It uses 21 risk factors, each scored on a 1 to 5 scale, with higher scores indicating poorer perioperative patient outcome, increased risk of COVID-19 transmission, and/or increased hospital resource utilization during the pandemic. A total score on a 21 to 105 scale will decide the order in which procedures will take place.

For it to fulfill our aims of a flexible and pragmatic strategy, we kept its philosophy of 3 domains, that is, required resources, patient fitness, and time sensitivity but decided that these would follow each other in a specific order. Using a sum score proved to be unpractical as this averaged out the differences on the domain scores. For example, patient A awaiting the second stage of his prosthetic joint infection treatment (high resources required, low level of fitness, but rather urgent) scored more or less similar as patient B awaiting a primary total hip arthroplasty (THA; medium resources required, high fitness, but less urgent). Therefore, in our workflow, all 3 domains function as standalones and no sum score is used (Table 1). The overall score on the domain of required resources is scored on a categorical (yes or no) scale, whereas the overall scores on the other 2 domains, that is, patient fitness and time sensitivity of the procedure, are scored on a numerical scale (percentage). The domain of required resources requires input from each surgical team. This domain will therefore differ between (sub)specialties and hospitals but is unlikely to change over time. The items scored for the domains of time sensitivity of the procedure and patient fitness are similar for each patient but, for the latter items (and their relative weights), will likely change over time as new literature on risk factors becomes available during the pandemic. In addition, surgeons can adjust the weight of items on the time sensitivity domain as there will be important differences between (sub)specialties.

An overview of our devised workflow can be found in Figure 1 and will be explained in further detail hereinafter. In short, each patient will be scored for the 3 domains mentioned previously. In our experience, this process takes half a day for a waiting list of 50 patients.

First, a top-down instruction informs on the resources available. As all the patients are scored for their minimally acceptable prerequisites, surgical teams can easily generate lists of all the cases that can take place under those particular circumstances.

Next, the scores for these patients for fitness and time sensitivity of the scheduled procedures are assessed. To facilitate this process, we use 2-dimensional scatter plots with cutoff points that are of necessarily (still) arbitrary (Fig. 2). Unfit patients with



FIGURE 1. Overview proposed workflow. IC, informed consent; ICU, Intensive Care Unit; Rehab., rehabilitation.

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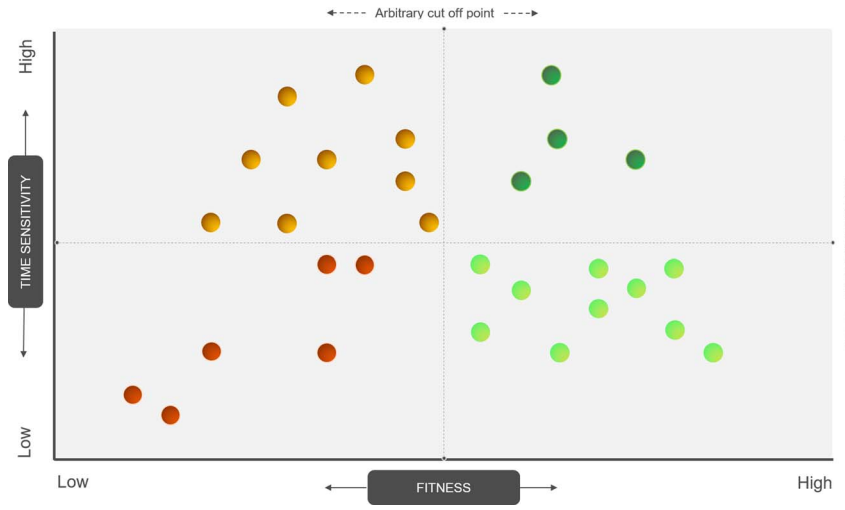

FIGURE 2. Two-dimensional scatter plot for patient fitness versus time sensitivity of the procedure as assessed for the patients awaiting hip surgery.

procedures that can wait will not be offered surgical intervention under any circumstances at this point in time (Fig. 2: red). During phase 1 of our relaunch strategy fitter patients will be scheduled for surgery. Naturally, fit patients with high time-sensitive procedures (Fig. 2: dark green) take priority over fit patients with low time-sensitive procedures (Fig. 2: light green). For fit patients with low time-sensitive procedures, obtaining an augmented informed consent (see hereinafter) becomes ever more important as these patients, from a medical point of view, have the opportunity to postpone their surgical intervention until more data on safety come available.

In our orthopedic division, we plan on imposing the following strategy when deciding whether it is safe to proceed to phase 2. After an arbitrary 6 weeks from the start, a thorough prospective observational cohort study (S64092) with regard to COVID-19 infections and related complications of all patients who underwent elective surgery during phase 1 (estimated number 50) will be performed, including over-the-phone interviews with patients. We realize that this time estimate is subject to change based on local and national alterations in the pandemic.

In the absence of safety concerns, we will start planning operations for less fit patients with high time-sensitive procedures (Fig. 2: orange). During this phase 2, less fit patients with high time-sensitive procedures take priority over fit patients with low time-sensitive procedures.

After prioritizing cases based on the resources that are available to you, an augmented informed consent needs to be obtained. Finally, patients need to be screened and tested according to local rules and regulations. If informed consent cannot be obtained or if there is any reasonable doubt that a patient might be in a presymptomatic or (a)symptomatic phase of COVID-19, the surgery will be postponed and the next suitable patient takes his or her place. Of course, as some time will pass between scheduling the case and actually performing the operation, one needs to check whether resources are indeed still available, as circumstances might change quickly. This conditional nature of the scheduling also needs to be clearly communicated to the patient.

Available Resources

In this time of paucity, we have to take full advantage of resources when they are available. It is not practicable to score the total amount of resources needed for a certain procedure on a numerical scale. Even procedures that require a relatively small amount of resources need to be canceled because of the pandemic if certain prerequisites cannot be met. Furthermore, resources deemed necessary will differ significantly from one (sub)specialty to the other and therefore scoring the impact a certain procedure has on resources against a rigid list of generalized factors is not desirable. In our hospital, surgeons per (sub)specialty need to provide a list of terms that have to be met before a certain case can be scheduled for surgery. In Figures 3A and B, examples of a patient awaiting primary THA (scored for the terms set by the hip unit) and of a patient awaiting pedicle subtraction osteotomy (scored for the terms set by the spine unit) are provided. Making the most of available resources will require constant communication between representatives of (sub)specialties, anesthesia, intensive care medicine, floor managers, and the overarching COVID-19 crisis team. This approach allows great flexibility. For instance, if top-down instructions tell us that only patients with a maximum stay of 3 days can be scheduled during the upcoming week and intensive care unit (ICU) admission is not possible, all (sub)specialties can easily provide a list of patients who meet these demands. Next, patient fitness and time sensitivity of the procedure can be assessed as demonstrated below.

Patient Fitness

It may seem counter-intuitive that patient fitness takes precedent over the time sensitivity of the procedure. However, we have to realize that currently, we do not have a waterproof method (screening/testing/personal protective equipment) to ensure that (1) a patient truly is COVID-19 negative when entering the hospital (which if not the case, would potentially put him or herself, staff, and fellow inpatients at risk) and (2) there is zero risk of nosocomial COVID-19 infection during admission. Therefore, the consensus of our meetings was that it is sensible to start with the patients who have the lowest risk of developing severe symptoms if they do become infected with COVID-19 in the perioperative period. Especially, considering the potential catalytic effect surgical stress might have on the course of disease in case of concomitant COVID-19 infection.[10–12] This phenomenon is probably illustrated best by the article by Lei et al,[10] although criticism regarding their study design and statistical analysis has been

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FIGURE 3. A, Estimated resources required for a patient awaiting primary total hip arthroplasty. Although overall requirements are low, if due to the pandemic no rehabilitation facility is available, the procedure cannot take place for this particular patient. B, Estimated resources required for a patient awaiting pedicle subtraction osteotomy. CT, computed tomography; OR, operating room; Rep, representative.

expressed.[13] They report on 34 patients who unintentionally underwent elective surgery during the incubation period of COVID-19 and all developed COVID-19 pneumonia shortly after. Of these patients, 44.1% required ICU admission and 20.5% died, numbers significantly higher than those reported for the general population.

Therefore, assessing patient fitness becomes more important than it already is. The problem that presents itself is that validated scoring systems, for example, the Charlson Comorbidity Index score, might not be applicable to the COVID-19 pandemic. On the other hand, scoring systems that take into account risk factors that seem to be associated with a more fulminant course of COVID-19 disease, ICU admission, and death are not yet validated. Furthermore, a substantial number of important risk factors for outcome can only be assessed after becoming infected, for example, D-dimer level of greater than 1 μg/mL or Sequential Organ Failure Assessment scores. The parameters we currently use for risk stratification (a mix of risk factors for death but also for ICU admission and/or prolonged hospital stay) can be found in Figure 4.[14–16] They are the same for all our patients, regardless of (sub)specialty and result in an overall score on a numerical scale. We furthermore use these graphs when informing patients about potential risks of elective orthopedic surgery during the pandemic. The main difficulty is determining how much weight should be appointed to each individual risk factor. This is subject to further research and validation will only be possible in hindsight. Over time, we will need to re-evaluate the risk factors we use, potentially add or remove some, and change the relative weights.

Time Sensitivity of the Procedure

Determining the factors that contribute to the time sensitivity of a procedure turned out to be the part generating the most discussion, both among surgeons as well as during the multidisciplinary input meetings. If we remember the pre–COVID-19 era, no such tool that was validated and widely accepted existed either. In times of paucity (e.g., Friday 9:00 P.M.) 2 parties (e.g., orthopedic surgeon versus general surgeon) would for their patients (e.g., patient with a neck of femur fracture versus patient with an appendicitis) make a plea (e.g., worse outcome if not operated on within 24 hours versus chance of rupturing) and an objective referee (e.g., anesthesiologist) would decide who takes priority. Aside from the occasional moping, this system has proven itself for decades and is overall considered fair. We therefore created a rather

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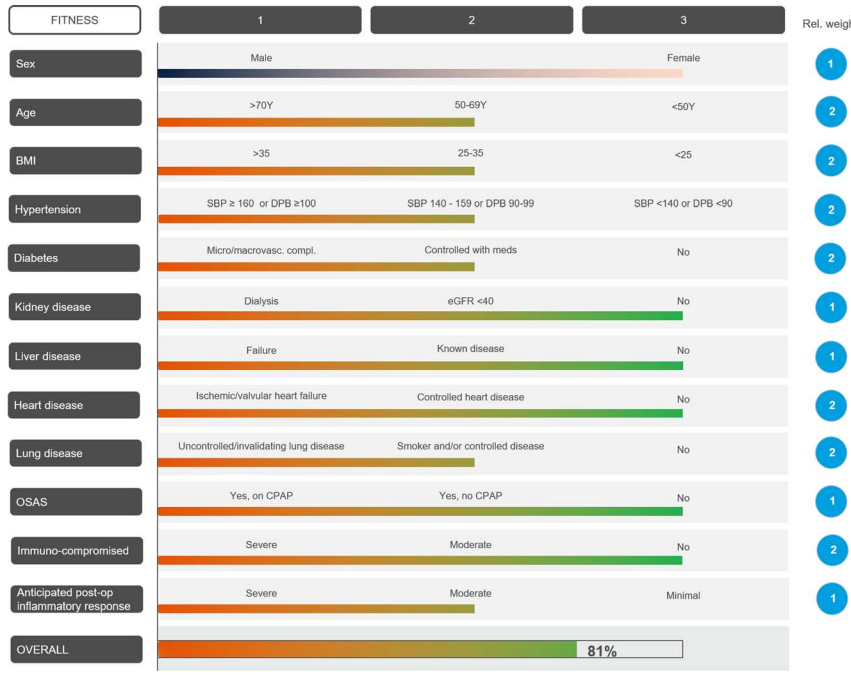

FIGURE 4. Fitness of the patient scheduled for primary THA. We realize this list is not exhaustive, but was generated based on consensus after many multidisciplinary input meetings, and found to be pragmatic. As early epidemiological studies suggest that increased age, BMI, diabetes, lung disease and smoking, diabetes, and cardiovascular comorbidities predispose for a more severe course of the disease, a higher weight was attributed to these parameters. Some items benefit from further explanation. For diabetes, patients with oral antidiabetic medication and patients on insulin both get assigned a score of 2. For liver disease, patients with liver inflammation, fibrosis, or cirrhosis all get assigned a score of 2. For heart disease, an example of controlled heart disease would be the patient who had a previous coronary stenting but is well controlled by means of regular medication. For lung disease, an example of uncontrolled/invalidating lung disease would be the patient that continuous to have exacerbations of chronic obstructive pulmonary disease attacks despite adequate treatment. An example of a severely immunocompromised patient would be the oncologic patient recovering from chemotherapy, the rheumatoid patient using anti–tumor necrosis factor α drugs, or the patients with AIDS. For the anticipated postoperative inflammatory response, an example of minimal, mild, or severe would be a patient undergoing a knee arthroscopy, primary THA, or an extensive scoliosis correction with thorax drain in situ at the end of the operation, respectively. Rel, relative.

generic list of (weighted) items that is the same for every patient but leaves room for interpretation, so each surgeon can use his or her expertise to capture the subtle but vital differences between individual patients and their pathologies.

An example for the patient awaiting primary THA is provided in Figure 5. To accommodate for the impact of further delay on outcome and surgical difficulty seems sensible. Furthermore, just as under normal conditions, patients who have been on the waiting list since the beginning should have an edge over those added on later. Contrary to many other scoring systems, quality of life (including pain and loss of functionality) is included as an important item.

Surgeons are allowed to change the weights allocated to each item. In that way, the sports surgeons for example contributed more weight to the item scoring impact of further delay on return to sports, whereas the pediatric surgeons did the same for impact of further delay on return to school.



FIGURE 5. Time sensitivity of the patient scheduled for primary THA with relative weights set by the hip team. Rel, relative.

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An Augmented Informed Consent

Restoring trust will be important. Many patients have not been in contact with his or her treating surgeon since the cancellation of the planned procedure and understandably can be hesitant to come to the hospital during a pandemic. It should be made clear that the go-ahead for the procedure is based on the fact that after careful consideration, the pros outweighed the cons and adequate safety measures are in place. This statement can be reinforced by providing patients, their family, and their general practitioners with information such as brochures and links to Web sites of several institutions held in high regard, before shared decision making whether or not to proceed with the planned procedure.

We realize that obtaining informed consent will be more labor intensive than usual. We strongly advice using the various new methods of telemedicine we are now discovering as healthcare providers out of necessity.[17] In our practice, we put emphasis on discussing the following items.

First, in these uncertain times, there is more scope for nonoperative treatment options, and these should once again be discussed with the patient. However, some nonoperative options might not be available (e.g., physiotherapy) or may carry risks as well (e.g., intra-articular injections as a day case procedure).

Second, the patient has to be aware of the potential consequences of concomitant COVID-19 infection on postoperative outcome. For this, the generated fitness graph (Fig. 4) can be used. It would be very useful to be able to provide specific numbers, for example, on the risk of becoming infected in the hospital, subsequent severe disease, ICU admission, and death. However, numbers found in the literature are extremely variable because of differences in testing strategy, a priori chances per region, and definitions used. At present, but subject to change, we tell our patients that approximately 20% of people of the general population that test positive for COVID-19 will require hospital admission and, of that group, 20% will be admitted to ICU.[18] If that happens, case fatality rate is likely to be substantial, especially for postoperative patients, considering the effect of surgical stress on cell-mediated immunity and systemic inflammatory response. We therefore now also explain in more detail what it would mean to be admitted to ICU, something we previously did not regularly do for elective orthopedic procedures. As always, but now more than ever, (do not) attempt cardiopulmonary resuscitation status and treatment escalation plans are discussed and documented carefully in advance.

Third, patients need to understand that at present, our diagnostic modalities do not allow us to guarantee with 100% certainty that he or she is not in the presymptomatic or asymptomatic phase of a COVID-19 infection before committing to the physiological stress of surgery. This risk can most likely be lowered by strict self-isolation for 2 weeks before surgery, something we advise our patients, but do not demand.

Fourth, it could be possible that the patient is asked to make certain concessions for the procedure to take place, for example, willing to accept that the surgery will be performed by a colleague as the original surgeon is placed home because of a positive testing result, keeping length of hospital stay to the bare minimum, going home instead of to a rehabilitation center, having a regional anesthetic (without sedation) instead of a general anesthetic, not having visitors, and so on. It should be made explicitly clear that the patient has to comply with all instructions, as he or she can unwittingly be shedding virus, therefore potentially becoming a feared super spreader leading to a cluster phenomenon as we still remember from the SARS-CoV-1 outbreak.[19,20]

Finally, the decision of whether or not to proceed with an elective orthopedic procedure during this pandemic, where data are still scarce and the future is uncertain, is ultimately in the hands of the patient.

Screening and Testing

After informed consent has been obtained, patients are screened for symptoms shortly before the operation, either over the phone or using an electronic questionnaire. The list of questions regarding symptoms and potential exposure we currently use can be found in Figure 6. If there is significant concern that a patient might be in the presymptomatic or (a)symptomatic phase of a COVID-19

	Asked?	Any concerns?
Do you feel well in yourself?	☐	☐
Are you having fevers?	☐	☐
Are you experiencing shortness of breath?	☐	☐
Are you having a (productive) cough and/or sore throat?	☐	☐
Are you experiencing a loss of smell and/or taste?	☐	☐
Are you suffering from diarrhea?	☐	☐
Do your muscles feel sore?	☐	☐
Do you experience severe fatigue?	☐	☐
Did you recently travel to an area with high COVID-19 prevalence? (provide local examples)	☐	☐
Have you been in close contact with people that have either tested positive for COVID-19 or have been under investigation?	☐	☐

FIGURE 6. Questions to be asked during the screening process. COVID-19, corona virus disease 2019.

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infection, we do not proceed with testing and surgery is deferred. For patients already recovered from COVID-19 infection, we have to make sure that potential residual decreases in fitness level do not pose an additional risk for a poorer outcome.

If answering the questions in Figure 6 raises no concerns, patients will be tested using real-time polymerase chain reaction tests shortly before surgery. However, other protocols may be in place because of differences in local, regional, and federal guidelines. Nevertheless, the conception should be to confirm to the maximum degree possible a COVID-19–free status and postpone surgery in case of reasonable doubt instead of continuing with repeat testing.

DISCUSSION

This proposed strategy for (initial) patient selection was generated on the basis of multiple discussions, research of literature, multidisciplinary input meetings, and trial and error testing of alternative methodologies on our own waiting lists. Its aim is to provide a flexible, transparent, and objective framework, based on a single thorough analysis of a surgeon's waiting list, which can be easily adjusted as new insights come to the table. We have incorporated it into our electronic patient record system, but simple data management programs will suffice as well.

We believe that this methodology can help clinicians make undoubtedly morally and ethically difficult decisions in an efficient manner. Safety is put first by carefully assessing benefit/risk for all patients and transparently informing them about their choices. It also forces surgeons to go over the cases awaiting surgery, thereby undermining the illusion that one knows all cases and indications by heart. If unhoped for complications start to develop because of on-going delays and lack of resources and lead to litigation, these scoring systems can help the clinician prove that time and effort have been put into defining priorities and optimal patient safety was pursued to the best of our knowledge. Most importantly, analyzing your waiting list for the 3 domains suggested, that is, required resources, patient fitness, and time sensitivity of procedures, allows for great flexibility to deal with changing circumstances. Furthermore, during the pandemic, we will adjust and optimize our workflow based on the data that we gather but also become available in the literature, allowing us to be even better prepared in case of a second or third wave, which may or may not coincide with the influenza season.

CONCLUSIONS

A multidisciplinary proposal is made for an objective, transparent, and flexible workflow for initial patient selection aiming for the safest possible return to elective orthopedic surgery during the COVID-19 pandemic.

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