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COVID-19 Pandemic: Consensus Opinions for Resuming Elective Orthopedic Surgery

Introduction:

As the COVID-19 pandemic begins to loosen its initial grip on the globe and we contemplate starting the long road back towards normalcy, the medical community will be facing many challenges, none more paramount than preventing the further spread of COVID-19 and limiting the possibility and the extent of a potential ‘second wave.’

The purpose of this document is to provide a list of recommendations aimed at reducing pathogen transfer during the reintroduction of elective orthopaedic surgeries, with a specific focus on preventing spread of SARS-CoV-2 infection. Although we are assuming that we will be operating on patients without SARS-CoV-2 infection, because of the complexities involved in accurate diagnosis of SARS-CoV-2 infection, including false negative results of the RT-PCR tests, we believe precautions need to be in place that will minimize the chance of infection transmission by potentially infected patients.

Elective surgery specifically refers to medically-necessary, time-sensitive procedures. Examples of these include the treatment of osteoarthritis, infection or malignancy, alleviation of pain, or other procedures designed to improve function and quality of life for the patient. Elective surgery includes only those surgical procedures that are scheduled in advance and does not include medical emergencies. We specify this definition to provide clarity of scope for these recommendations.

We realize that the situation is evolving on a daily basis and some of the recommendations in the document may need to be altered as new evidence emerges. In addition, we are aware that the infection prevention measures stated in the document will highly depend upon the prevalence of COVID-19 in the affected areas and the ability to implement the recommended diagnostic tests to properly rule out COVID-19 prior to surgery. We will continue to monitor the literature and update the document as needed.

I. General

Question I.1: When will the SARS-CoV-2 pandemic end?

Response/Recommendation: Unknown. Epidemics/Pandemics end when:

- a) A large portion of the society has acquired immunity with neutralizing antibodies to the pandemic agent after being infected, leaving a small percentage of individuals susceptible to infection (herd immunity). This occurred with the Spanish Flu in 1918 caused by Influenza A (H1N1), when over 60% of the population were infected and to some extent with the following Swine flu in 2009 that infected over 60 million people in the United States;
- b) The pathogen (virus) mutates sufficiently to become non-virulent;
- c) An effective treatment against the disease is available; or
- d) An effective vaccine against the virus is developed and delivered to the population.

Grade of Recommendation: Moderate

Delegate vote: Agree (100%)

Rationale: There are multiple models being constructed to try to determine answers related to this question. Many of these answers depend on whether the virus mutates, whether it can proliferate at any time of the year, whether people are able to develop long or short-term immunity to the disease and what treatments or vaccines are developed for SARS-CoV-2¹. SARS-CoV-2, like all coronaviruses, and unlike other classes of RNA viruses, possesses a proof-reading RNA polymerase that greatly reduces mutation. Although the virus does mutate, it does so at a far lower frequency than traditional seasonal viruses such as influenza and rhinoviruses.

Question I.2: How can hospitals or surgery centers know when they should resume elective procedures?

Response/Recommendation: Elective surgery may be resumed when:

- a) Lock-down in the region has been lifted and a mandate allowing return to elective surgery has been issued by local/state/provincial/governmental authorities
- b) The number of COVID-19 cases in the region have been consistently declining
- c) The hospital/surgical facility has the capacity to admit non-COVID patients to an area of the hospital separated from COVID-19 positive patients
- d) The facility has an adequate supply of effective personal protection equipment (PPE), RT-PCR-testing kits for SARS-CoV-2 virus, and is able to perform the surgery safely with low risk of transmission of SARS-CoV-2 virus
- e) The facility is able to maintain social distancing throughout the process in all phases (pre-intra- and postoperatively)
- f) The facility has an adequate stockpile of necessary equipment for a potential second wave

Grade of Recommendation: Moderate

Delegate vote: Agree (97.5%), Disagree (2.5%)

Rationale: In most regions of the world elective surgery was halted as the SARS-CoV-2 pandemic started to gain momentum. Elective surgeries were cancelled in order to: a) free up capacity in the hospital systems including hospital beds, intensive care unit (ICU) beds and mechanical ventilators in anticipation of a surge in the number of COVID-19 cases that would require respiratory support; b) preserve PPE, which has been and is still in short supply in some areas of the world; c) reduce human contact and the risk of nosocomial transmission of the disease between staff, visitors and patients.

The American College of Surgeons jointly with the American Society of Anesthesiologists (ASA), the Association of peri-Operative Registered Nurses (AORN), and the American Hospital Association (AHA) have suggested the following roadmap for resuming elective surgery²⁻⁴:

- a. Timing of resumption: There must be a sustained reduction in rate of new COVID-19 cases in the relevant geographic area for at least 14 days before the resumption of elective surgical procedures[1-4]
- b. Any resumption should be authorized by the appropriate municipal, county and state health authorities
- c. Facilities in the state are safely able to treat all patients requiring hospitalization without resorting to crisis standards of care
- d. The facility needs to have an appropriate number of ICU and non-ICU beds, PPE, ventilators, medications, anesthetics and medical surgical supplies to cope with a second wave of pandemic
- e. Appropriate decontamination of the hospital and necessary equipment has occurred
- f. The facility needs to have an adequate number of trained and educated staff available to handle the planned surgical procedures, patient population and facility resources. Given the known evidence supporting health care worker fatigue and the impact of stress, the facilities should be able to perform planned procedures without compromising patient safety or well-being of the staff
- g. Ideally all the staff who will be involved in patient care have been tested for SARS-CoV-2 (RT-PCR) on a regular basis and/or undergone serum antibody testing for the virus
- h. The facility should be able to organize two different pathways inside the structure for COVID and non-COVID patients, and to have two different, separated surgical blocks for the two categories of patients

Question I.3: Should patients with active COVID-19 undergo elective surgery?

Response/Recommendation: It is the opinion of this group that elective surgery should be delayed in patients with active COVID-19 until they are shown to have recovered from the infection as defined by local guidelines. The Centers for Disease Control (CDC) has guidelines based on testing and non-testing that are useful in defining recovery⁵ that includes 14 days of quarantine and the absence of fever and other symptoms.

Grade of Recommendation: Weak

Delegate vote: Agree (100%)

Rationale: The risk of infecting healthcare workers and spread of the infection through contact constitutes the main reason to avoid performing elective surgery in patients who are SARS-CoV-2 virus positive.

Despite the absence of high-level evidence reporting a higher rate of complications and a worse outcome in infected patients, the only current reasonable and ethical approach is to delay any elective surgery until the patient is totally free from the disease as determined by the local definition used. Several case reports have shown severe peri-operative complications in COVID-19 positive patients⁶ and a recent study on hip fracture COVID-19 positive patients, demonstrated that the patients may carry a very high mortality⁷.

Question I.4: Should elective surgery be delayed in elderly patients or those with comorbidities that places them at high risk for COVID-19?

Response/Recommendation: It is the opinion of this group that elective surgery should be risk-stratified and possibly deferred based upon a patient's age (>75 years), morbid obesity, diabetes, uncontrolled-hypertension, chronic pulmonary disease, obstructive sleep apnea, chronic heart disease and immunocompromised state (e.g. organ or bone marrow transplant patients, active cancer, those who are receiving or have recently received chemotherapy or radiotherapy) in the early days when elective surgery is resumed. Patients with significant comorbidities and risk factors should be scheduled after healthier patients have been treated and experience amassed from establishing screening, prevention, and treatment protocols.

Grade of Recommendation: Weak

Delegate vote: Agree (98.75%), Abstain (1.25%)

Rationale: Every elective orthopedic surgery should be planned and organized in advance to achieve optimal results. For instance, in arthroplasty procedures, diabetes, obesity or other known modifiable risk factors as described by the International Consensus Meeting (ICM) criteria should be optimized prior to the planned procedure to minimize postoperative complications⁸. However, there are no SARS-CoV-2 specific, evidence-based, risk-stratification systems in place for elective orthopedic procedures. Several studies have analyzed patient risk factors that may be associated with a more severe clinical course of the COVID-19 infection. Several groups of patients have been deemed to be extremely vulnerable to significant and potentially life-threatening illness if exposed to SARS-CoV-2⁹.

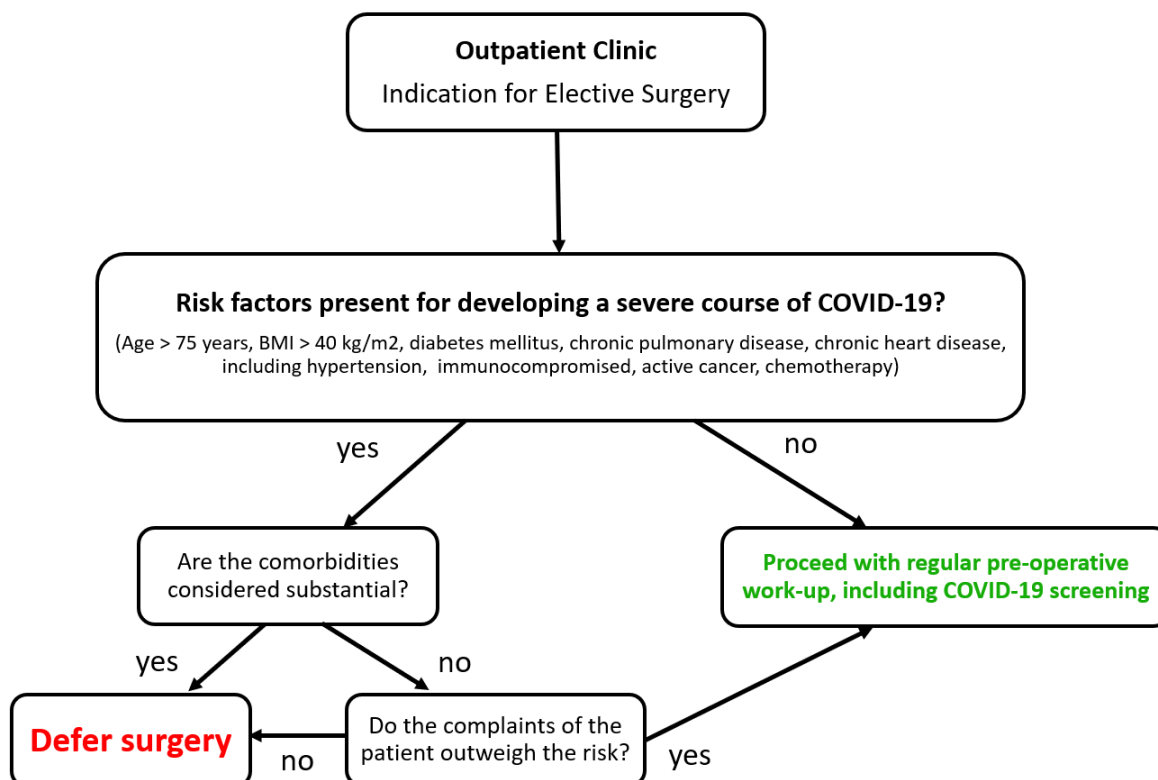
It is reasonable to offer surgical procedures to patients with the above comorbidities who have an emergent or urgent condition such as severely painful or loose implant, infection, impending fracture, fracture, soft-tissue compromise, and similar conditions.

Our recommendation is that elective surgery should be started with the healthiest patients and only life or limb threatening conditions would justify operating on higher risk patients during the pandemic and early weeks when elective surgery is resumed. It is paramount that enough ICU beds are available to accept patients, who may develop respiratory or severe systemic complications.

An important factor to be considered during this COVID-19 pandemic, which represents a major assistance bottleneck, is the number of ICU beds available, which can often be a determining factor in the management of severe cases. Since we still do not have a reliable projection for reducing the use of beds in ICUs during this pandemic, it is of utmost importance to control the scheduling of elective surgeries of all specialties so that excess ICU beds are not occupied, thus guaranteeing the technical reserve for the cases of COVID-19.

Specifically for major surgery in orthopedics, such as hip and knee arthroplasty, the need for beds in ICUs for these procedures can be as high as 19%.¹⁰ According to one study, patients that may require admission to ICU includes those with congestive heart failure, procedures with high blood loss such as revision hip arthroplasty, chronic obstructive pulmonary disease, and body mass index > 35 kg / m².¹¹

Patients with advanced age are at increased risk of a severe course of COVID-19, with a higher mortality described in several studies^{12-14 15}. Immunocompromised patients, including those with solid organ transplants, active cancers,^{15,16} those undergoing chemotherapy or radiotherapy, those with cancers of the blood or bone marrow, bone marrow transplant patients, those on immunosuppressants and those with cystic fibrosis, severe asthma and severe chronic obstructive pulmonary disease (COPD)¹⁵ are also at risk of severe infection. In addition, patients with genetic diseases which predispose them to infection such as severe combined immunodeficiencies (SCID), and homozygous sickle cell disease may be at higher risk. Fatality with COVID-19 has been reported to be higher for patients with comorbidities as follows: 10.5% for those with cardiovascular disease, 7.3% for diabetes, and approximately 6% each for chronic respiratory disease, hypertension and cancer¹⁷. Even if appropriate screening tools are incorporated into hospitals to rule out COVID-19 prior to surgery, hospital admission in and of itself probably places



patients at increased risk of contracting COVID-19, and thus should be avoided as much as possible in highly vulnerable patient groups.

Fig. 1: Patient selection criteria for elective orthopaedic procedures.

Question I.5: What type of education should patients receive prior to undergoing an elective surgery during the pandemic related to risk of SARS-CoV-2 transmission?

Response/Recommendation: It is critical that patients undergoing elective surgery are educated on the protocols in place to minimize SARS-CoV-2 transmission to themselves, family members, other patients, and hospital personnel. An overview of the protocols implemented by the hospital to reduce the risk of transmission of the infection should be included.

Grade of Recommendation: Strong

Delegate vote: Agree (100%)

Rationale: It is important for patients and their families to understand the precautions that the surgical team, hospital staff and administrators are taking to ensure everyone's safety with regard to SARS-CoV-2 transmission. While each hospital and surgical practice may differ in specific details of these protocols and procedures, patients should be informed of the generalized practices that are being utilized to decrease the risk of SARS-CoV-2 transmission. Patients should be made aware that practices adhere to local, state, provincial and federal government recommended guidelines, in addition to local practice considerations when determining which patients are able to undergo elective surgery¹⁸.

There are many reputable websites with updated information regarding COVID-19 that should be shared with patients who are considering a surgical procedure¹⁹. More specifically, patients should be educated about the steps they should take on the day of the operation, how they should enter the hospital, that a limited number of family members (one preferred) can accompany them, what the family member(s) should do during the procedure, and be informed of the expected pre-operative and post-operative course. It is also important to inform patients that screening is implemented for all patients and staff in an effort to decrease the risk of disease transmission²⁰. It is likely that such education will decrease confusion and anxiety amongst patients.

The need for inpatient rehabilitation after surgery should be discussed in advance with the patient and their family given the higher potential for increased SARS-CoV-2 transmission in congregated settings. During the early days of resuming elective surgery, priority must be given to patients who do not require admission to inpatient rehabilitation.

Question I.6: Can patients/individuals who were infected with SARS-CoV-2 be infected with SARS-CoV-2 again?

Response/Recommendation: Unclear. There are reports of individuals who contracted COVID-19, recovered, and then tested positive for SARS-CoV-2 again.

Grade of Recommendation: Strong

Delegate vote: Agree (95%), Abstain (5.0%)

Rationale: SARS-CoV-2 reinfection is currently unproven. Animal experiments suggest that reinfection with SARS-CoV-2 is not possible²¹. However, this may not hold true in a real-life situation due to viral dynamics and the concomitant host immune responses in humans. Indeed, there are some reports of patients having a positive RT-PCR testing for SARS-CoV-2 after previously contracting SARS-CoV-2 and supposedly recovering from the disease¹. There are a few possible explanations for this phenomenon:

- a. The individual did not develop immunity against the (mutated) virus
- b. The developed immunity expired. If this is the case, then a resurgence in SARS-CoV-2 can happen (second wave)
- c. The test is picking up residual RNA from a non-viable virus
- d. The test that was done to show the individual had recovered was false negative
- e. The new test to show re-infection is false positive
- f. The individual suffered a relapse of an infection that had previously progressed to a subclinical state
- g. Chronic infection and shedding by the virus may occur, similar to colonization by bacteria such *Staphylococcus aureus*

II. Pre-operative

Question II.1: What additional steps should be taken during the pre-admission process for patients undergoing elective surgery during the SARS-CoV-2 pandemic?

Response/Recommendation: This workgroup recommends that

- Information on TOCC (Travel, Occupation, Contact, Cluster) should be obtained and documented. Screening for symptoms (see Question II.3) of COVID-19 should be performed and documented.
- If tested, the Reverse-Transcriptase Polymerase Chain Reaction (RT-PCR) test for SARS-CoV-2 should be performed within 3-7 days of elective surgery and be documented in the clinical charts of the patient. Appropriate clinical and/or microbiological screening procedures for each patient should be undertaken.
- Additional education should be provided to the patients regarding infection prevention protocols (hand hygiene, wearing a mask, etc.).
- All patients and providers should use a surgical mask during encounters. Providers should use protective eye wear as well.
- The risk of infection and transmission should be minimized by utilizing general social distancing principles.
- “No eating or drinking” rules in restricted areas need to be enforced.
- Patients should avoid the use of common spaces or surfaces (e.g. check-in desks), where possible, and these surfaces should be thoroughly cleaned between patients. Bedside check-in should be encouraged.
- The use of waiting rooms should be minimized. Social distancing in the waiting room and other communal areas should be exercised. Frequent cleaning is also recommended.
- Family members and visitors should limit the time they spend within the hospital. Some institutions may ban the entry of family members and visitors to the hospital.

- The surgeon and surgical team should avoid direct contact with family members and update the families via phone or video conferencing.
- Family members of pediatric patients should be screened for SARS-CoV-2 virus before pediatric surgery.
- Patients should be housed in single rooms, if possible. When patients are housed in the same room, the beds should be distanced at least 2 meters (6 feet) from each other and all patients should wear a surgical mask.
- Commonly touched surfaces should be wiped down and cleaned with an effective disinfectant solution (e.g. 70% alcohol) at least twice a day.
- Any close contact with the patient should be done using appropriate PPE, as directed by the institutional policy and in conjunction with national and local guidelines.
- In the early weeks following the return to elective surgery each patient should be placed in a single room or cubicle where check-in, registration and other administrative tasks can be performed.
- Consideration should be given to having a screening ward to house patients, especially those who may not have been tested for SARS-CoV-2 preoperatively
- Large surgical bays with multiple patients sharing one room should be avoided
- Consideration should be given to the use of portable High Efficiency Particulate Air (HEPA) filtration systems in relatively crowded areas/rooms
- Presently in most parts of China, even low prevalence areas, the patients are required to have a green digital health code and one negative RT-PCR test prior to undergoing their planned procedure. This signifies that the patient has not been infected with COVID-19 and can undergo procedures and partake in daily activities with general precautions. In the absence of the latter the patients are quarantined for 2 weeks.

Grade of Recommendation: Moderate

Delegate vote: Agree (97.5%), Abstain (2.5%)

Rationale: Contact and droplet precautions are recommended during the routine care of patients.²² There is controversy if patients without symptoms and a negative screening-questionnaire should wear masks²³⁻²⁶.

Social distancing must be practiced throughout the journey of the patients in the hospital.¹⁸ This means that patients should be distanced at least 2 meters (6 feet) from each other. Accordingly, surgical waiting rooms should not be used, or the number of people in one room should be limited. Patient beds should be distanced at least 2 meters (6 feet) from each other. Medical staff should wear masks and, preferably, gloves when interacting with patients.^{18,22,23,27} Commonly used areas such as desks, computers and phones should be frequently wiped down and cleaned with an effective disinfectant solution (e.g. 70% alcohol).²⁸

Question II.2: Should asymptomatic patients undergoing elective surgery wear protective masks during the SARS-CoV-2 pandemic?

Response/Recommendation: It is the opinion of this group that all patients entering hospital to undergo elective surgery should wear a mask.

Grade of Recommendation: Weak**Delegate vote: Agree (97.5%), Disagree (1.25%), Abstain (1.25%)**

Rationale: It remains controversial as to whether asymptomatic patients with a negative screening-questionnaire should wear masks²³⁻²⁶. The World Health Organization recommends that symptomatic individuals visiting a healthcare setting should wear a medical mask while waiting in triage or other areas and during transportation within the facility. However, they should not wear a medical mask when isolated in a single room, and instead cover their mouth and nose when coughing or sneezing with disposable paper tissues. Tissues must be disposed of appropriately, and hand hygiene should be performed immediately afterwards.

The CDC recommends face coverings to limit the transmission of virus from those who may be pre-symptomatic or asymptomatic. Everyone, including patients entering the hospital should wear a mask or face-covering during the pandemic, to avoid asymptomatic patients from spreading the virus by talking, coughing, sneezing or otherwise spreading the respiratory droplets.²⁶ N95 and Filtering Facepiece Particles (FFP2 or FFP3) masks should be reserved for healthcare workers, especially as the supplies are currently limited in many countries.

Question II.3: Should patients undergoing elective surgery be screened for symptoms of COVID-19 during the pandemic?

Response/Recommendation: Yes. All patients undergoing surgery during the pandemic should have their temperature and pulse oximetry measured and be screened with a series of questions that will stratify them into various risk groups. The questions should aim to ask the patients about COVID-19 symptoms (fever, shortness of breathing, cough, loss of smell and taste, diarrhea, headache, sore throat) as well as TOCC information (Travel to regions with high prevalence of COVID-19, Occupation with high risk of COVID-19 infection, Contact with people known to be infected with COVID-19, or Close proximity with a COVID-19 positive cases). Those with a high risk for being infected should have surgery deferred, and be quarantined as per local guidelines, unless adequate testing can be performed to rule out COVID-19.

Grade of Recommendation: Moderate**Delegate vote: Agree (98.75%), Disagree (1.25%)**

Rationale: In regions where there is a limited capacity for SARS-CoV-2 RT-PCR testing, patients should be selected for RT-PCR based on a comprehensive screening history and physical examination. The history should focus on the symptoms of COVID-19 (Table 1). Patients reporting a history of travel or stay in areas with a high prevalence of SARS-CoV-2 and/or contact with a patient who is known to have tested positive with COVID-19 should be considered for RT-PCR testing^{29,30}.

Patients deemed to be infected or at high-risk of COVID-19 infection should have elective surgery deferred and receive RT-PCR testing as per local guidelines. Those with confirmed infection should be quarantined for at least 7 days and for 72 hours after resolution of symptoms⁵. Those with a high-risk of exposure without symptoms should quarantine for 14 days. The duration of domestic quarantine comprises the maximum time interval from potential initial virus infection to clinical

symptom occurrence (Incubation Period [ICP], 14 days). Therefore, it is helpful to identify the index-patient with verified COVID-19 infection and the point of time of potential contagion³¹⁻³³.

Question II.4: Should patients undergoing elective surgery be tested for SARS-CoV-2? If so, should the testing be done on all patients or a select group?

Response/Recommendation: RT-PCR testing for SARS-CoV-2 is becoming more accessible. Testing of patients should be mandatory in high prevalence areas, given the risk of disease transmission by asymptomatic patients. Routine testing is not feasible in all locations due to limitations in testing capacity and therefore local guidelines should be followed in these areas.

Grade of Recommendation: Strong

Delegate vote: Agree (96.25%), Disagree (1.25%), Abstain (2.5%)

Rationale: As described above, patients with a history of travel or stay in areas with a high prevalence of SARS-CoV-2 or direct contact with people who have tested positive for COVID-19 should be tested [10]. Furthermore, there are other clinical characteristics that can indicate a potential COVID-19 infection³⁴⁻³⁷ (Table 1). A symptom which has been increasingly discussed is the loss of the smell and taste³⁸, particularly in the absence of nasal congestion and rhinorrhea³⁹. The main clinical findings in the scenario of a screening environment are likely to be the presence of a fever, cough, shortness of breath, cough and anorexia. Concurrent infection with other respiratory, mainly viral, pathogens has been reported in up to 21% of patients with SARS-Cov-2 infection, and a high degree for suspicion for co-infection should exist⁴⁰.

Symptom	Frequency (%)
Fever	83 – 99%
Cough	59 – 82%
Fatigue	44 – 70%
Anorexia	40 – 84%
Shortness of breath	31 – 40%
Sputum production	28 – 33%
Loss of taste and smell	18.6 – 33.9%
Sore throat	5 – 17.4%
Diarrhea	2 – 12.5%
Nasal congestion	4 – 4.8%

Table 1: Frequency of clinical symptoms in COVID-19 infection.

Question II.5: For patients being considered for molecular testing of SARS-CoV-2, what type of test should be used?

Response/Recommendation: We recommend a RT-PCR test for SARS-CoV-2 that is known to have high sensitivity and negative predictive value. Currently, a nasopharyngeal swab appears to have a reasonable yield, although RT-PCR of a combination of saliva, sputum and even the use of oropharyngeal swab are also effective. These may replace the more painful and invasive nasopharyngeal tests in the future. Next generation sequencing (NGS), CRISPR/Cas, and other molecular technique can be used as an adjunct, when available. Emerging data suggests specimens should be transported in media (Virus Transport Medium, Universal Transport Medium, or saline) approved for use with each respective testing platform.

Grade of Recommendation: Strong

Delegate vote: Agree (100%)

Rationale: Nasopharyngeal swabs have shown good detection of SARS-CoV-2^{5,40,41,42 [40]5}. As false negative results may occur, repeat testing in high-risk patients should be considered. However, nasopharyngeal tests are uncomfortable for some patients and may be replaced by a combination of saliva, oropharyngeal and/or sputum tests⁵. Although a few point of care (POC), rapid turnaround tests are available, their sensitivity is currently limited and most institutions do not have access to the POC test. Patients should consider self-isolating themselves during the preoperative period and after the RT-PCR test is done.

Question II.6: Should antibody testing for SARS-CoV-2 be performed? If so, in whom should this test be carried out?

Response/Recommendation: At this time, there is no data to support routine antibody testing of patients undergoing elective surgery. There are a number of serum antibody tests available which include point of care (POC) lateral flow tests. The accuracy of these kits in detecting the relevant antibody against SARS-CoV-2 is variable. There is also genetic variability in SARS-CoV-2 strains being isolated in different parts of the world which may limit the accuracy of current antibody tests. The degree of immunity conferred with detectable antibodies and the significance of antibody quantification are unknown at this time.

Grade of Recommendation: Strong

Delegate vote: Agree (96.25%), Disagree (1.25%), Abstain (2.5%)

Rationale: There is currently no evidence supporting routine serum antibody (IgG) testing for all patients. When/if a vaccine becomes available, antibody testing will be crucial to differentiate the at-risk populations. At the time of writing this, among 115 vaccine candidates, only 5 have moved into clinical development phase⁴⁴. The global vaccine R&D effort in response to the COVID-19 pandemic is unprecedented in terms of scale and speed. Still, it does not appear that a vaccine will be available against COVID-19 before first part of 2021 at the earliest.⁴⁴ Antibody testing of the general population will be critical in monitoring the status of the pandemic locally and globally, and determining when it is over. Thus, there is epidemiologic value in testing elective surgery patients for antibodies against COVID-19. If antibody testing with high specificity becomes available, all patients undergoing elective surgery should undergo such tests, in addition to RT-PCR testing for the virus.

Question II.7: What additional tests other than molecular and serology tests are available to detect SARS-CoV-2 and when should they be done?

Response/Recommendation: For patients with symptoms suggestive of COVID-19, but a negative SARS-CoV-2 RT-PCR test, repeat testing should be considered. If still negative, and without any alternative explanation for the patient's symptoms, a chest radiograph and a low-dose CT chest should be performed to determine if COVID-19 specific lung abnormalities are present. Elective surgery should be deferred in this patient population.

Grade of Recommendation: Strong

Delegate vote: Agree (95%), Disagree (3.75%), Abstain (1.25%)

Rationale: Every patient with symptoms suggestive of COVID-19 should receive a chest radiograph. In addition, a low-dose chest CT has shown good diagnostic performance in detecting COVID-19⁴⁵. Specific lung imaging findings include multifocal, bilateral, peripheral, ground-glass opacities with nodular configurations and a slight predominance in the lower lungs^{46,47}. However, the utility of performing a chest CT for preoperative screening is largely debated. It is known that COVID-19 specific lung abnormalities can be found on CT imaging in a relatively large proportion of symptomatic patients tested negative with RT-PCR⁴⁸⁻⁵¹. For example, Tao et al. evaluated 1,014 patients in whom 147 out of 308 patients (48%) with a negative throat swab test showed lung abnormalities on CT that were highly suspicious of COVID-19⁴⁹. However, at the time of writing, it is unknown how many asymptomatic patients have COVID-19 specific lung abnormalities on CT. For this reason, we argue that for asymptomatic patients with a high risk of having COVID-19 (i.e. having an epidemiological link and/or living in a high endemic area), a nasopharyngeal swab for SARS-CoV-2 RT-PCR should be strongly considered, but that no additional imaging is needed in this patient group. However, in patients with symptoms suggestive of COVID-19 but with a (repeated) negative nasopharyngeal swab, a chest x-ray and possibly a low-dose CT chest should be performed to search for COVID-19 specific lung abnormalities.

III. Intra-operative

Question III.1: What considerations should be given to the operating room ventilation systems while SARS-CoV-2 is still highly prevalent and elective cases are resumed?

Response/Recommendation: The operating room ventilation system should reduce the presence of airborne pathogens to a minimum. We recommend to:

- i. Have a ventilation system in the operating room with a minimum of 20 air changes per hour.
- ii. Reduce the number of equipment in the operating room and limit it to those essential for the surgical procedure
- iii. Install filters that are able to remove aerosol and droplets such as HEPA filters
- iv. Have normal positive pressure rooms for elective cases. There is no need to convert to negative pressure rooms, but modalities to decrease efflux of contaminated air into the hallways, such as in-room air filters and negative pressure antechambers, can be considered

- v. Minimize the number of people in the operating room at all times, particularly during intubation or extubation of a patient

Grade of Recommendation: Strong**Delegate vote: Agree (98.75%), Abstain (1.25%)**

Rationale: There are several steps during surgery that are thought to produce aerosols including electrocautery, saws, drills, reamers and impaction of broaches and other components. It is not known if SARS-COV-2 virus particles are present in blood, bone and fat in significant numbers in infected patients. One study demonstrated that in up to 1% of patients, SARS-CoV-2 could be detected in the blood⁵². However, it is safe to assume that there must be some risk of orthopedic procedures producing aerosols that can contain virus particle.^{52,53} Intubation and extubation are aerosol generating procedures as virus is known to be present in the nasopharynx of infected patients.²⁷

Ventilation systems may vary between operating rooms in a single hospital and even more broadly between operating rooms in hospitals within different countries. However, almost all operating rooms are fitted with HEPA (high efficiency particulate air) filters which remove viral particles in aerosol form. Typical standards require the ventilation system to produce a minimum of 20 air exchanges per hour. At this rate, 99.9% of viral particles will be removed in 21 minutes (7 cycles)⁵⁴⁻⁵⁷. The ventilation systems in operating rooms are generally set to maintain positive room pressure to minimize the ingress of contaminated air into the operating room from corridors and other adjacent spaces. Airborne infection isolation rooms (AIIR) are generally negative pressure to prevent the egress of contaminated air from the isolation room to surrounding spaces. The engineering modifications required to convert a positive pressure operating room environment into a negative pressure (isolation) environment may be complex, time consuming and expensive.⁵⁸ Consideration should be given to the use of portable HEPA filter systems that can remove viral particles from the operating room air without converting to a negative pressure environment.

In facilities implementing vertical laminar flow; aerosols produced at the surgical site will theoretically flow down to the floor level and exit through vents without circulating widely in the operating room. This in turn minimizes the exposure of individuals and equipment in the room to aerosolized particles. Of note however, laminar flow may be distorted by additional equipment and personnel in the room. Minimizing the operating room traffic and streamlining equipment will facilitate the intended laminar airflow and mitigate the risk to personnel and essential equipment.

The strict incorporation of the above-mentioned recommendations highly depends upon the prevalence of COVID-19 in the affected area and the ability to fully implement the recommended diagnostic tests to properly rule out COVID-19 prior to elective surgery.

Question III.2: Should standard surgical helmets and protection suits be utilized when performing elective surgery during the SARS-CoV-2 pandemic?

Response/Recommendation: We recommend that surgical helmets should not be used as the primary protection against aerosol and airborne diseases, including COVID-19. Fans within the helmets and the helmets themselves can harbor viruses and these devices cannot be sterilized between cases, increasing the potential spread of infection from patients to surgeons, or surgeons to the next patient. If, however, surgical helmet use is mandated by the hospital standard protocols for

total joint arthroplasty, this should be continued with appropriate disinfection protocols in place and an N-95 (or equivalent) mask should also be worn when using the helmet.

Grade of Recommendation: Strong

Delegate vote: Agree (93.75%), Disagree (1.25%), Abstain (5.0%)

Rationale: Surgical helmets are designed to protect surgeons from being contaminated by patients' bodily fluids and particulate that may become airborne during surgery. They are not designed to be air filtration devices capable of removing small aerosolised particles. Previous studies regarding the air filtration abilities of standard surgical helmets during the SARS-CoV-1 pandemic in 2003 found that N100 masks were 20-25 times better at filtering out submicron air particles than surgical hoods¹. In fact, these helmets may actually concentrate the virus within the front of the helmet, increasing the viral exposure to the oropharynx and ocular mucosal membranes- further increasing the risk of disease transmission during the COVID-19 pandemic. In addition, there are no standardized protocols in place for the sterilization of surgical helmets between cases which can allow SARS-CoV-2 to remain on the helmet during, between and after cases. Thus, the use of helmets, at least during the early period of resuming elective orthopaedic procedures, should be questioned. Especially given the lack of convincing data to support the use of surgical hoods in order to decrease the risk of periprosthetic joint infection⁵⁹.

Powered air-purifying respirators (PAPR) filter air through a HEPA filter and create a high-flow, positive-pressure environment within a mask in order to decrease the risk of disease transmission. While some modifications to the standard surgical helmet have been made in an effort to turn them into a PAPR device⁶⁰, these modifications are still under evaluation for effectiveness and safety. The build-up of carbon dioxide inside the helmet is a real concern when using these modified helmets.

Question III.3: What type of protective equipment should the surgeons, and assistants, utilize during elective surgery performed at the time of SARS-CoV-2 pandemic?

Response/Recommendation: In areas of high prevalence of COVID-19, and during surgery on patients who have not been RT-PCR-tested for SARS-CoV-2, we recommend that surgeons and the entire surgical team that scrub during the case wear a mask (preferably N95, FFP2 or P3) and a face shield with a neck cover that wraps around the face and has an extension that can be placed inside the gown. In the absence of a face shield, protective eye wear that provides a seal around the eyes (i.e. goggles) should be worn. In patients who have been tested for SARS-CoV-2 by RT-PCR within 3 days of surgery and quarantined for 14 days prior to elective surgery, regular protective equipment (surgical mask, etc.) may be worn. These measures should be implemented until the pandemic ends. Global variation in access to the aforementioned PPE is currently reported and will influence the implementation of some of these guidelines.

Grade of Recommendation: Strong

Delegate vote: Agree (98.75%), Disagree (1.25%)

Rationale: Considering that the SARS-CoV-2 appears to be mainly transmitted via respiratory droplets²⁷, it is reasoned that N95, FFP2 or FFP3 masks provide improved protection against transmission of aerosol droplet nuclei⁶¹. Regular surgical masks are effective against the transmission of droplets. As it is possible that a patient may need to be intubated during surgery,

patients and staff may be unable to properly protect themselves or others during coughs and other situations in which aerosolization of particles may occur. Thus, wearing a N95 (FFP2 or P3) mask during these procedures appears to provide the best protection against transmission of any potential disease⁶².

While it appears possible that the cleaning and disinfection of N95(FFP2 or P3) masks could be performed by using ionized hydrogen peroxide or ultraviolet light⁶³, this practice has not been studied enough to be widely recommended. Furthermore, there are many unknowns of how many times a N95(FFP2 or P3) mask can be disinfected or if wearing a previously cleansed N95(FFP2 or P3) mask may pose new risks to the healthcare provider (i.e. the inhalation of hydrogen peroxide, etc.)⁶³.

Face shields can be used in order to decrease the potential contamination of the surgeon and staff from patient's bodily fluids and particulate during the procedure⁶¹. The neck wrap tucked into the surgical gown provides further protection in this regard. It is also important for staff to remember that hand washing should be performed both before and after the donning or doffing of PPE⁶¹. However, it is imperative that staff members understand that hand hygiene alone, regardless of the use of PPE, is also effective in limiting transmission of SARS-CoV-2²⁷.

Question III.4: Does the type of anesthesia influence the potential spread of COVID 19?

Response/Recommendation: Yes. General anesthesia that requires airway manipulation, endotracheal intubation, and positive ventilation is more likely to predispose the anesthesia and surgical team to transmission of SARS-CoV-2. The use of regional anesthesia, whenever possible, should be strongly considered for patients undergoing elective surgery during the pandemic.

Grade of Recommendation: Moderate

Delegate vote: Agree (97.5%), Disagree (1.25%), Abstain (1.25%)

Rationale: Performing surgical procedures during a global pandemic carries immense risks for disease transmission. Thus, reducing the risk of aerosolization and spread of infectious viral particles through the air to others should be a priority. The risk of aerosolization increases with the manipulation of the airway to perform direct or indirect laryngoscopy during endotracheal intubation^{64,65}. However, the risk of viral transmission is not eliminated with regional anesthesia. Aerosolization of viral particles can occur when simply providing supplemental oxygen with a nasal cannula with a high-flow rate of oxygen increasing the risk for dispersion and viral spread⁶⁶. It is important to take appropriate precautions and assume that viral aerosolization will occur with regional anesthesia. Anesthesia team in charge of patient's airway should use proper PPE throughout the procedure. At a minimum, a surgical mask should be fitted to cover the patient's face throughout the procedure and, if possible, an enclosed oxygen mask with a proper seal used to deliver oxygen, especially if high-flow rates are required. A HEPA filter may be necessary, especially for patients at high risk. If general anesthesia is required for the procedure, certain techniques can help reduce the risk for exposure to healthcare workers. Patients should be adequately pre-oxygenated to avoid multiple attempts at endotracheal intubation, and rapid sequence intubation is appropriate for all patients. Anesthesia team should use appropriate PPE during aerosol generating procedures. This includes both intubation and extubation, as well as airway suction. A good seal is required for an endotracheal tube to avoid additional exposure to

aerosols. A laryngeal mask airway may be appropriate, in particular after a failed attempt at endotracheal intubation and to avoid multiple attempts, but a good seal is absolutely necessary to avoid exposure. Again, a HEPA filter should be used, especially with high risk patients even with a previous negative test. During intubation and extubation the number of personnel in the room should be minimized as much as possible.

Question III.5: What precautions should be taken by the operative staff during elective surgery performed at the time of the SARS-CoV-2 pandemic ?

Response/Recommendation: A number of precautions should be taken by the operative staff that includes:

- a. Limiting the number of people in the operating room
- b. Reducing door opening in the operating room
- c. Cautious use of the electrocautery and judicious use of suction to remove smoke
- d. Keeping the power setting to as low as possible, when high power tools are being used or consider using Gigli saw, sharp osteotomes, and manual reaming, whenever possible
- e. Keeping equipment in the room to a minimum. This includes navigation consoles, X-ray machines and robots, which all represent surfaces for contamination by the virus.

Grade of Recommendation: Strong

Delegate vote: Agree (97.5%), Disagree (1.25%), Abstain (1.25%)

Rationale: During any surgical procedures, and particularly those performed during a pandemic, there should be a strict adherence to universal precautions at all times²⁰. There is strong evidence showing that decreasing the number of people within the operating room can decrease the risk of contamination of surgical wounds and reduce the risk of infection in patients undergoing total joint arthroplasty⁶⁷. There is also ample evidence to show that increased flow of particulate matter and disruption of the ventilation system in the operating room does occur by door opening and entry of people to the operative theater^{67,68}. As such, staff members should limit the operating room traffic to essential personnel⁶¹. SARS-CoV-2 is mainly transmitted via aerosolized droplets, therefore decreasing the air turbulence and the number of air particles should help decrease disease transmission. Reducing the number of door openings during an operative case also helps the efficiency of air management systems within the operating room and decreases the spread of particles from within the operating room to the outside environment. Likewise, decreasing the number of people in each operating room will help implement the social distancing concept within the operating room as much as possible¹⁸ while also decreasing the demand for PPE²⁷.

The electrocautery device has been previously shown to create a number of aerosolized particulates which can be inhaled⁵⁷. While it is unknown if the SARS-CoV-2 particles are able to survive electrocautery, minimizing the amount of smoke that enters the operating room will help decrease the potential transmission of disease. Furthermore, these suction devices should be attached to a HEPA filter, whenever possible⁶⁹. Similarly, it is possible for any power tools used during the surgical case to generate aerosolized particles. While it is unknown if SARS-CoV-2 can be spread

through bodily fluids, soft tissue or bone particulate, putting the power settings as low as possible to accomplish the task will decrease the formation of any aerosolized particles.

As SARS-CoV-2 has been shown to survive on inanimate surfaces for a relatively long time⁷⁰, all non-essential equipment should be kept outside of the operating room, whenever possible. It is also paramount that gowns, and other material are not unnecessarily stored in the locker rooms and other areas that could potentially be contaminated and come into contact with individuals.

Question III.6: Should additional cleaning or sterilization of instruments be performed for elective surgical procedures during the SARS-CoV-2 pandemic?

Response/Recommendation: The standard recommendations for cleaning and sterilizing of instruments are still adequate and need to be followed vigilantly. We refer to the standards posited by the Association for the Advancement of Medical Instrumentation (AAMI) and the Association of periOperative Registered Nurses (AORN).

Grade of Recommendation: Moderate

Delegate vote: Agree (98.75%), Abstain (1.25%)

Rationale: During any outbreak, and especially the current COVID-19 pandemic, it is critical to treat reusable medical devices as potential sources of pathogen transmission. At the time of writing, there were no studies that suggested using different cleaning, washing and sterilization techniques for surgical instruments. In addition to standard infection prevention measures, the CDC notes that task-specific training is essential during an outbreak, including implementing refresher training to reinforce procedures and manufacturers' instructions for use.⁷¹ Equipment decontamination should be ensured after each use. Reusable surgical instruments require steam sterilization. Heat resistant or sensitive items may be sterilized with ethylene oxide gas, hydrogen peroxide gas plasma, ozone or liquid chemical sterilant.⁷²

When evaluating the existing literature of the closely related SARS-CoV-1 (SARS), of which there was an outbreak in 2003, there was one study that reported detecting SARS-CoV-1 systemically in tissues from patients who died of SARS. SARS-CoV-1 was found in lung, trachea/bronchus, stomach, small intestine, distal convoluted renal tubule, sweat gland, parathyroid, pituitary, pancreas, adrenal gland, liver and cerebrum, but was not detected in oesophagus, spleen, lymph node, bone marrow, heart, aorta, cerebellum, thyroid, testis, ovary, uterus or muscle.⁵³ Another study evaluating the detection of SARS-CoV-2 in different types of clinical specimens has shown that a small percentage of blood samples had positive RT-PCR for SARS-COV-2, suggesting that infection sometimes may be systemic.⁵² Nevertheless, SARS-CoV-1, SARS-CoV-2, Middle East respiratory syndrome (MERS) coronavirus and endemic human coronaviruses (HCoV) can persist on inanimate surfaces, such as metal, glass or plastic, for up to 9 days^{70,73,74}. However, these can be efficiently inactivated by surface disinfection procedures with dilute povidine-iodine, 62–71% ethanol, 0.5% hydrogen peroxide or 0.1% sodium hypochlorite within 1 min.⁷⁵

Other biocidal agents often used include 0.05–0.2% benzalkonium chloride (Clinell™) or 0.02% chlorhexidine digluconate. Since information about COVID-19 is incomplete, additional use of high-level disinfectants is recommended. High-level disinfectants include ethanol 80-95% (exposure time 30 sec), 2-propanol 75-100% (exposure time 30 sec), 2-propanol and 1-propanol

45% and 30% (exposure time 30 sec), sodium hypochlorite 0.21% (Antisapril Blu 2%, exposure time 30 sec), glutaraldehyde 2.5% (exposure time 5 min) and 0.5% (CIDEX OPA, exposure time 2 min), hydrogen peroxide 0.5% (REVITAL-OX RESERT, exposure time 1 min). Protective eyewear and gloves should be used when cleaning, disinfecting or sterilizing any equipment.⁷⁵ Standard guidelines for cleaning and sterilization are developed by different organizations. The Association for the Advancement of Medical Instrumentation (AAMI) has supplied information about this process on their website. Summarized, they recommend^{76,77}:

- Ideally, soiled items (especially surgical instrumentation) should be transported immediately to the decontamination area for processing to prevent blood, body fluids, and other contaminants from drying on the surfaces. Pick-up schedules should be designed to facilitate transport as soon as possible after use and to avoid high-traffic areas
- Gross soiling should be removed at the point of use with a disposable gauze pad or a cloth moistened with water. Saline should not be used for this purpose because it can be corrosive to surgical instruments.
- Instrumentation should be placed into containers, instrument pans, or other transportation pans so as to prevent damage to the instrumentation. In addition, all instrumentation should be placed in its original container or basket and should be protected from damage. To prevent sharps injuries, separate all reusable sharp instruments from non-sharps inside the container or basket.
- Soaking contaminated items in an enzyme solution at the point of use is discouraged because the solution must be discarded before transport. As each item is introduced into the solution, the contamination level increases, as does the potential for cross-contamination of staff and the environment.

There is also concern about formation of biofilm, so cleaning should occur as soon as possible after use. Some manufacturers are now specifying a time frame from use of the instruments to implementation of cleaning. One way to prevent formation of biofilm is to prevent organic soils from drying. Once biofilm forms, direct friction and/or oxidizing chemicals are needed to remove it. Prompt cleaning reduces or eliminates the population of biofilm-forming microorganisms and thus prevents the formation of biofilm.

Question III.7: How should each operating room be cleaned in between cases during the SARS-CoV-2 pandemic?

Response/Recommendation: Consideration should be given to performing a thorough cleaning of the room at the end of each case. The surfaces of all equipment in the operating room (including computers, lead gowns, robots, case carts and so on) should be wiped down after each case. Manufacturer's instructions on the surface contact time requirements of the disinfectant, which can range from 4 to >10 min, must be followed. Random testing of surfaces may need to be carried out to ensure that contamination with SARS-CoV-2 has not occurred. At the end of the day ultraviolet (UV) lights should be left on in the operating room or UV machines should be used for further sanitization when available and feasible. It is also determined that 21 minutes of air cycle, in operating rooms fitted with efficient ventilation system, can remove aerosolized viral particles and may be used in lieu of terminal cleaning^{54-57,78}.

Grade of Recommendation: Strong

Delegate vote: Agree (93.75%), Abstain (6.25%)

Rationale: It seems that SARS-CoV-2 is capable of surviving on the surfaces of metal and plastic for up to a few days^{70,79,80}. While the current recommendation should reduce the risk of viral load on surfaces, especially in the operating room, the current SARS-CoV-2 pandemic can act as a triggering event to implement further protocols for the cleaning and sanitation of operating room surfaces. One agent that has been demonstrated to be viricidal, including activity against coronaviruses, is dilute povidone iodine⁸¹⁻⁸³. Dilute povidone iodine was tested against SARS, MERS and Ebola and found to have absolute efficacy. Other agents with potential activity against viruses, as well as bacterial and fungal pathogens, includes hypochlorite and high-concentration alcohol (>70%). Thus, it is crucial that all reusable material in the OR, including lead aprons, tourniquets and so on, be sanitized and decontaminated routinely. The current sterilization systems in the hospitals for instruments and trays are effective in eliminating viruses and may not need to be altered.

Question III.8: How should the surgeon and the surgical team clean themselves following the conclusion of each procedure during the SARS-CoV-2 pandemic?

Response/Recommendation: The surgeon and the surgical team should change scrubs frequently during a surgical day. If respirators (N95, FFP2, P3) are being worn, they can be used for 6-8 hours and need not be discarded after each use, unless soiled. A new respirator is required each day.

Grade of Recommendation: Strong

Delegate vote: Agree (97.5%), Disagree (1.25%), Abstain (1.25%)

Rationale: There is limited evidence to support specific protocols⁶³. However, in terms of reasonable asepsis, we suggest that each member of the operating room staff consider changing scrubs, head gear and other PPE frequently, and possibly after each case. This applies to surgeons, scrub technicians, nurses, assistants, residents, anesthesiologist, and tech representatives.

Question III.9: Are there any considerations to give towards, or concerns regarding, surgeons utilizing multiple operating rooms during the operative day?

Response/Recommendation: Because of the implementation of extra steps aimed at reducing the transmission of COVID-19, and an expected decline in operating room efficiency, the use of multiple operating rooms is preferred, whenever possible. This would allow one of the surgeon's room to be cleaned while another room is being used for surgery. However, the surgeon and surgical team should follow strictly the personal cleansing procedures between cases.

Grade of Recommendation: Strong

Delegate vote: Agree (97.5%), Abstain (2.5%)

Rationale: The optimal strategy is to do a case and then have the room thoroughly cleaned before the next case starts. This process can be time consuming and depends on the number of people carrying out this task and whether UV-C light is utilized between cases. Thus, having access to

multiple rooms allows for proper cleaning of the room between the cases without disrupting the flow of the procedures in a given day.²⁷

Question III.10: Should wound closure be altered in patients undergoing elective surgery?

Response/Recommendation: The use of suture material (such as staples and non-absorbable sutures) that requires the patient to return to the office, or a visit by a nurse, for suture removal should be minimized. The wound should also be covered in an occlusive dressing.

Grade of Recommendation: Strong

Delegate vote: Agree (96.25%), Disagree (1.25%), Abstain (2.5%)

Rationale: The use of an occlusive dressing (that requires minimal maintenance) and absorbable sutures would eliminate the need for the patient to visit the office or for a nurse to visit the patient in the house to perform wound management tasks. While offices are likely to be designed to minimize personal contact and implement the rule associated with social distancing, using surgical techniques that decrease the need for patients to enter the community appears likely to decrease the possible transmission of SARS-CoV-2^{19,20}.

IV. Post-operative

Question IV.1: What steps should be taken if a patient who underwent elective surgery tests positive for SARS-CoV-2 in the postoperative period?

Response/Recommendation: If a patient is positive for SARS-CoV-2 by RT-PCR test after a surgical procedure, all healthcare workers who came into contact with the patient without using PPE, and are not known to have antibody against SARS-CoV-2, should be tested and quarantined until test results become available. Decisions regarding the need to quarantine staff should be made in tandem with the hospital infection control team and employee health department. The patient should also be isolated and any contact with the patient should occur using full PPE.

Grade of Recommendation: Strong

Delegate vote: Agree (96.25%), Disagree (2.5%), Abstain (1.25%)

Rationale: The development of a policy to manage identified COVID-19 positive patients and healthcare workers is required to resume elective surgeries during the COVID-19 pandemic²⁻⁴. The most common source of exposure for infected medical staff with SARS-CoV-2, including surgeons, were the general wards rather than emergency departments^{26,84,85}. Further disease transmission to family members can also occur²⁶. However, following strict perioperative measures, especially for suspected cases, both patients and healthcare workers can be protected¹³. Inappropriate screening of patients undergoing elective surgery during the COVID-19 pandemic could deplete the resources necessary to correctly identify SARS-CoV-2 positive cases in high-risk patients. Postoperative detection of SARS-CoV-2 infection can result from missed identification of a preoperative exposure or by disease transmission during, or after, hospitalization. Healthcare workers can be asymptomatic carriers and spread SARS-CoV-2 to patients, as some cases have been infected from

asymptomatic contacts or during the incubation period⁸⁶⁻⁸⁸. The mean incubation time of SARS-CoV-2 varies widely between 2 and 14 days²³. Regardless of the timing of the results, all healthcare workers who had contact with the COVID-19 positive patient need to be tested and quarantined at home until the negative result is available. Additional steps may also need to be taken that includes:

- a. Public health authorities should be notified of positive testing
- b. Patient, and those who came into contact with the patient, should be closely monitored for signs of respiratory illness
- c. Adequate oxygen therapy and nutritional support should be administered to the patient during recovery
- d. If the patient is still admitted, clinical and laboratory tests (including CRP, LDH, and D-dimer) should be performed to monitor the patient
- e. Patients may be allowed to go home and self-isolate
- f. The use of stronger anticoagulants should be considered

Question IV.2: What changes should be implemented in the recovery room and in the postoperative care of patients?

Response/Recommendation: In the post-anesthesia care unit (PACU):

- a. Patients should be separated from each other by a minimum distance of 2 meters (6-feet)
- b. Personnel taking care of the patient should be wearing an appropriate mask at all times
- c. Patient stay in the recovery area should be minimized while maintaining perioperative safety
- d. Over-crowding and non-essential personnel traffic should be avoided
- e. Patients who could not be extubated in the operating room, should be transferred to ICU directly, bypassing the PACU
- f. Surfaces around the bed of each patient in the PACU should be wiped down after transfer of the patient and prior to arrival of the next patient
- g. Consideration should be given to recovering patients in the operating room and bypassing PACU, if possible
- h. Consideration should be given to the use of a separate PACU or recovery space for non-COVID cases and short-stay cases, to avoid admission to hospital floors where exposure to SARS-CoV-2 may be higher.

Grade of Recommendation: Moderate

Delegate vote: Agree (100%)

Rationale: Post-anesthesia care units (PACUs) are a standard and integral part of daily anesthesia care in most developed countries. Their main purpose is to safely recover patients from surgical and interventional procedures. Through structured and tight clinical observation combined with continuous patient monitoring, patient discomfort and complications can be identified and treated early, thereby reducing adverse outcomes and increasing efficacy.⁸⁹ Several practice guidelines for post-anesthesia care are available and have been recently updated, such as those from the European Board of Anesthesiology and the American Society of Anesthesiologists.^{90,91}

Currently, there is no evidence available that the PACU should be redesigned or altered in order to facilitate safety. A PACU should be designed to limit the flow of patients/staff to only those necessary and to create a safe and quiet environment for the patients to wake up. Besides the

inherent design specifics, the standard measurements regarding hand hygiene and patient safety remain in place.

During a pandemic it is recommended not to have patients go into a large, pooled, phase-1 PACU, because of the risk of contaminating the facility and the staff members. Instead of bringing patients to a the PACU, they could be recovered in the operating room. This is a routine practice in certain countries.⁹² When the time of patient recovery was compared between a hospital where anesthesia recovery occurred in the operating room versus a center where phase-1 PACU was utilized with dedicated nursing staff, the longest recovery time in the OR was shorter than the shortest recovery time in PACU.^{27,92}

We also advocate an increased frequency and quality of cleaning of the PACU. This approach will reduce the overall potential contamination of the work area. Spraying all surfaces and the workspaces, including but not limited to keyboards and mice, with an antiseptic agent is believed to be effective in minimizing disease transfer.²⁷

There is ample evidence showing that UV-C is also effective against viruses.^{27,93,94} Treatment with UV-C is, however, logistically difficult. It requires UV-C light to be applied over a period of time (some minutes), requires wearing eye-protection glasses for those in the vicinity and so on. Thus, UV-C should be reserved for the high-risk anesthesia work area and should also include the circulating nurse desk area that is likely to be contaminated and often excluded from cleaning procedures. The removal of residual environmental contamination involves a combination of deep cleaning with surface disinfectants and UV-C. This combination is necessary as UV-C alone may be limited by shadowing. If UV-C is not available or feasible, use the above mentioned cleaning process for at risk environments (enhanced terminal cleaning).²⁷

Question IV.3: Should patients wear a mask in the postoperative period during the SARS-CoV-2 pandemic? If so, what type?

Response/Recommendation: All patients should wear a surgical mask post-operatively. This will decrease the spread of droplets during coughing, sneezing and talking while patients are mildly incapacitated and may not be able to control these functions as they would without anesthesia.

Grade of Recommendation: Moderate

Delegate vote: Agree (97.5%), Disagree (1.25%), Abstain (1.25%)

Rationale: If there is a sufficient supply of standard surgical masks, despite the absence of evidence, all patients should wear a mask during the pandemic, to avoid asymptomatic patients from spreading the virus.²⁶ N95, FFP2 or FFP3 masks should be reserved for health care workers who are working with COVID-19 infected patients, especially as the supplies are currently limited in many countries.

Question IV.4: Should routinely performed postoperative radiographs be taken in the post-anesthesia care unit (PACU) or somewhere else?

Response/Recommendation: It is preferable that postoperative radiographs are taken in the operating room. If radiographs need to be taken in the PACU, the x-ray plate and other equipment coming into contact with the patient should be thoroughly cleaned after use.

Grade of Recommendation: Weak

Delegate vote: Agree (93.75%), Disagree (2.5%), Abstain (3.75%)

Rationale: Radiographs taken in the PACU require additional equipment and personnel. Each additional person increases the risk of transmission of SARS-CoV-2. Each additional piece of equipment provides another surface that may harbor and transmit virus particles. With X-ray machines this would include keyboards, handles and buttons. If they are to be used, all components related to the radiograph should be thoroughly cleaned after use. In addition, the radiology technicians should be cognizant of social distancing principals and implement these during the procedures.

Question IV.5: Should the antibiotic or venous thromboembolism (VTE) prophylaxis be altered in patients undergoing elective surgery during the SARS-CoV-2 pandemic?

Response/Recommendation: No. The available data on thrombotic risk in COVID-19 patients is limited, although an increased risk of thromboembolic disease has been reported. VTE prophylaxis needs to be administered to patients with COVID-19, unless there is a contraindication (bleeding risk and so on). The type of VTE prophylaxis for patients undergoing elective surgery needs to be determined by the treating surgeon and does not need to differ from the protocols used prior to the pandemic. Bacterial coinfection in patients with COVID-19 is low and there is no need to alter the antibiotic prophylaxis.

Grade of Recommendation: Strong

Delegate vote: Agree (98.75%), Abstain (1.25%)

Rationale: Advanced SARS-CoV-2 infection has been associated with an increased risk of disseminated intravascular coagulation and hypercoagulable states⁹⁵. Case series from China, The Netherlands and France suggest a potential increased risk of thrombotic event⁹⁶⁻⁹⁸. Bacterial coinfection in patients with COVID-19 is low.

Question IV.6: Should any changes be made in post-operative care protocols for patients undergoing elective surgery during the SARS-Cov-2 pandemic?

Response/Recommendation: This workgroup recommends that the following changes be made in the postoperative care of patients during the pandemic:

- a. The length of hospital stay for patients should be minimized
- b. Postoperative rounds by the surgeon may be done by using telemedicine, whenever possible

- c. Patients should be discharged home and transfer to inpatient rehabilitation minimized
- d. The patient should be instructed how to perform self-directed physical therapy at home
- e. Post-discharge visits to office should be minimized with the majority of the follow-up being done by tele-medicine
- f. Office visit should be limited to those who are having issues/complications such as wound healing problems, suspected fracture, stiffness and so on.
- g. Digital health programs and wearable sensor technologies that allow monitoring of patients will play a larger role in management of patients in the future
- h. Social distancing should be resumed and at-home visits avoided, unless absolutely essential

Grade of Recommendation: Moderate

Delegate vote: Agree (100%)

Rationale: Using the general principles of social distancing and minimizing contact between individuals, we resorted to make the above recommendations. Although no specific studies have been completed relating to the postoperative care of orthopaedic patients, logically one would expect that minimizing hospital stay, minimizing transfer to rehabilitation facilities, and other measures are likely to reduce risk for transmission of disease.

Question IV.7: What considerations, if any, should be given to the use of non-steroidal anti-inflammatory drugs (NSAIDs) to patients undergoing elective surgery during the SARS-CoV-2 pandemic?

Response/Recommendation: This workgroup recommends that NSAIDs can be used, as part of multimodal analgesia regimen, in patients who do not have COVID-19 infection and have undergone elective surgery.

Grade of Recommendation: Moderate

Delegate vote: Agree (97.5%), Disagree (1.25%), Abstain (1.25%)

Rationale: Numerous reports have suggested that non-steroidal anti-inflammatory drugs (NSAIDs) may exacerbate or mask the early symptoms in patients with SARS-CoV-2, potentially leading to worsening of symptoms or a delay in diagnosis. However, currently there is no scientific evidence for or against the use of NSAIDs in this patient population⁹⁹⁻¹⁰¹. Additionally, patients taking NSAIDs for other reasons should not stop its use for the fear of increasing their risk of contracting SARS-CoV-2¹⁰⁰. SARS-CoV-2 *negative* patients may take NSAIDs in the post-operative period as normally prescribed in a multimodal protocol, by their operative team. Should symptoms or a positive test of SARS-CoV-2 develop after surgery, the current literature should be reviewed to determine if discontinuing NSAIDs should be considered.

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