COVID-19 Preparedness within the Surgical, Obstetric and Anesthetic Ecosystem in Sub Saharan Africa

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Community transmission of COVID-19 is already being reported in Africa (1). Most countries on the continent will have 10,000+ confirmed cases within the month (2). The population, while generally younger than in Europe and North America, has much higher rates of poverty, malnutrition, HIV, and TB, which could shift the demographics of lethality. For surgeons, obstetricians, and anesthesiologists, the major challenge will be maintaining provision of emergency and essential surgery and obstetric care while preserving precious resources, minimizing exposure of health care workers, and preventing onward transmission (Table) (3). The human skill sets, resources, and supply chains supporting surgical services are also those needed for responding to the crisis (4)(5).

1. Develop a clear plan for providing essential operations during the pandemic.

The capacity to care for surgical and obstetric emergencies must be preserved. Many facilities have already postponed elective operations to conserve vital resources, but this approach is not as applicable as in high-income countries. Operations in the region are frequently for high-risk cancers or highly symptomatic patients, for which current guidance is not to postpone. The surgical burden is already high, and limitations on services will exacerbate waiting lists and sacrifice essential care.

Truly elective operations should, however, be postponed immediately to preserve the health and wellbeing of surgical, anesthetic, nursing, and cleaning staff. These providers will be important resources during a surge response. Many providers rely on elective and private work for their financial well-being, thus postponing elective surgery may work against their financial incentives. However, improved health worker and patient safety through reduced transmission is a compelling enough argument. To facilitate decision making and avoid conflicts, a triage

algorithm needs to be established and enforced, such as that proposed by the American College of Surgeons: https://www.facs.org/about-acs/covid-19/information-for-surgeons/triage.

Patients should be kept geographically separate from COVID+ patients and discharged expeditiously to minimize nosocomial transmission (6)(7)(8). If case burden is high, consider dedicating one OR to COVID+ operations only (ideally with neutral or negative pressure) (9). This should be emptied of all non-essential materials and equipment. No unnecessary items should be brought into the operating room, including personal items such as mobile phones and pens. Personal linens and coverings such as cloth masks and bonnets should be washed at least daily, and probably more often when treating COVID+ patients.

2. **Decrease exposure of health care staff as much as practicable and prevent nosocomial transmission to other patients and personnel.**

While few staff are adequately trained in the appropriate use and application of personal protective equipment (PPE), perioperative personnel are at an advantage given their familiarity with maintaining sterility. Staff should receive training in appropriate donning and doffing techniques through simulation and videos (without using precious resources). Clear instructional posters for PPE donning/doffing should be prominently displayed, and the use of two providers should be encouraged to allow one person to observe and coach the other through the steps of the routine: www.cdc.gov/hai/pdfs/ppe/ppe-sequence.pdf (10)(11)(12)(13)(14)(15). Hand hygiene is critical, and 70% alcohol-based hand rub should be made widely available: https://www.who.int/gpsc/5may/Guide_to_Local_Production.pdf. Symptomatic workers should not provide patient care but rather self-isolate, and testing of these workers should be prioritized.

Limiting unnecessary patient, family, and health worker movement through the hospital decreases the introduction and transmission of disease. When not essential, keep surgical and anesthetic staff out of hospital to preserve human resources. Trainees and students, in particular, should not be involved with known COVID+ cases unnecessarily. For usual care routines, including patient encounters, plain surgical masks can lower rates of health care worker infections and are recommended (16)(17)(18). Ancillary staff such as OR cleaners, instrument reprocessing staff and laundry personnel should take appropriate precautions and wear full PPE (goggles or face shield, surgical mask, heavy duty gloves, long sleeved gown, boots) (5). No special decontamination methods other than machine laundering with detergent are required for laundering linens; all surface areas should be disinfected with 0.5% chlorine or 70% alcohol solutions.

Patients with known or suspected COVID-19 should wear surgical masks when being transported through hospital spaces or in rooms without negative pressure isolation (19)(20)(21). Intubation is an aerosolizing procedure and should be performed by the most skilled provider available wearing an N95 or KN95 mask. *Only absolutely essential staff* should be present during intubation, and IV rapid sequence induction without bag mask ventilation is preferred (22). When appropriate and safe, consider regional anesthesia with IV sedation to reduce aerosols. Whenever practicable, decrease case duration and limit aerosol-generating maneuvers (such as the free release of pneumoperitoneum during laparoscopy). Patients should be recovered in the OR, and prior to transport an advance runner sent to clear the path. Consider using a Checklist to ensure appropriate precautions are taken for operations with suspected or known COVID-19 patients (Figure)(7).

Viral filters and appropriate circuit cleaning measures are essential and should be reviewed (6)(23), otherwise ventilation mechanics may disseminate aerosols throughout an ICU. If single-use plastic anesthesia or surgical equipment (endotracheal tubes, ventilator circuit tubing, plastic suction tubing, electrocautery handpieces) must be reused, ensure that disinfection aiming for "high-level disinfection" or "sterility" is employed, including immersion in appropriate concentration glutaraldehyde, phenol, or hydrogen peroxide solution (7)(20)(24).

Surfaces in the OR should be thoroughly cleaned between cases, including pulse oximeter probes, thermometers, blood pressure cuffs and other reusable materials; SARS-CoV-19 is rapidly killed with 70% alcohol solution or 0.5% chlorine solution (5)(25). Using clear plastic sheets (cleaned or changed in between patients) to cover the anesthesia machine, the monitors, and the patient's face during aerosol-producing maneuvers like intubation and extubation, could provide additional protection.

3. Conserve PPE and consumables.

Manufacturers are already filling backorders from high-income countries; this will additionally stress supply chains to Africa. Familiarity with severe resource shortages may guide creative and innovative strategies to conserve and extend resources. Extended use of N95 masks (continuous wearing while seeing multiple patients) is preferred to limited reuse of N95 masks (doffing and redonning between patients) (26). N95 mask life may be lengthened by wearing a plastic face shield or a surgical mask over it. Use of chlorine or alcohol solution to sanitize N95 masks damages mask integrity; however heating to 70°C (160°F) in a dry oven for 30 minutes seems a promising solution to disrupt viral particles and maintain mask integrity for reuse (27)(28). Other

innovative solutions are being proposed, as in this example from Boston Children's Hospital: https://www.youtube.com/watch?v=Es_iY5WJdmI. While N95 masks are superior to surgical masks in protecting against aerosolized viral particles, surgical masks still afford significant protection over no mask (29)(30)(31).

Cloth attire in the form of scrub hats or bonnets should be washed between each use if possible, and no less than daily. If gowns are repurposed for isolation units, they should be washed after each prolonged care routine; consider wearing rubber aprons under such gowns. The protection afforded by cloth masks is not well studied but may be significantly less than surgical masks and is not protective to the same extent as N95 respirators; it should be used as a last option only (5)(29)(32)(33)(34)(35)(36).

4. Plan for strategic repurposing of ORs, recovery areas, and staff for managing COVID-19 cases.

The commandeering of ORs for use as ICUs, which has been proposed in many high-resource settings, must be done with extreme caution. Emergency surgery capacities should not be compromised by taking up all available OR space and anesthetic machines with COVID+ patients. As the average reported time spent on mechanical ventilation has been up to 13 days (37)(38), critical resources and space will be occupied for weeks to months and will be difficult to reclaim once repurposed.

Guidance and training should be provided *immediately* to make best use of the technical and clinical skills of all perioperative personnel – waiting until caseloads increase will unduly delay preparations. Hospitals, professional societies, and ministries of health should provide physician

and nursing staff with basic ICU and ventilator management refresher education to improve their skill sets; SAGES and the Faculty of Intensive Care Medicine have recently provided such resources: https://www.sages.org/basics-of-mechanical-ventilation-for-non-critical-care-mds/ and https://icmanaesthesiacovid-19.org/clinical-guidance.

5. **Maintain and support staff wellness while assisting with difficult ethical considerations in resource management.**

Doctors, nurses, cleaners, and other hospital support staff have significant anxieties that must be acknowledged and managed. The fears of transmitting to family or becoming infected oneself, the increase in work hours, and the need for childcare coverage are real. Furthermore, providers may be understandably nervous about providing care outside of their normal scope of practice or working beyond their area of competence. Leadership can help by providing information in a transparent way, expressing gratitude for the commitment to patients and colleagues, and offering reassurance that the system will help protect them and support them and their family.

As ventilators will be critically inadequate, there will be additional emotional distress when allocating resources and denying care to patients. Facilities should create a committee and utilize standardized risk assessments to determine allocation decisions in advance. The burden of decision making should not be placed on the frontline health care workers, nor made ad hoc at the bedside. There are multiple resources for guiding the complex decision making in resource allocation and rationing in pandemic situations (39)(40)(41)(42)(43)(44). A recent ethical framework made the following priority recommendations(45)(46), amongst others: 1. Aim to both save the most lives and most years of life, giving priority to maximizing the number of patients that survive treatment (maximizing benefit); 2. Critical testing, PPE, ICU beds, therapeutics, and vaccines should go first to front line health care workers and others who keep

critical infrastructure functioning due to their instrumental value in the pandemic response and difficulty of replacing (instrumental value); and 3. Avoid first-come first serve approaches and use random allocation such as a lottery instead (equality). The Hastings Center has provided a freely available online resource that is helpful to guide an ethics process: https://www.thehastingscenter.org/ethicalframeworkcovid19/.

Communication will be critical, and an effective communication plan within and between facilities, as well as between providers across the health system and even between countries, is essential and should be established immediately. A task force that can oversee this dynamic situation and provide additional guidance and interpretation of directives (from ministries or multinational organizations such as the World Health Organization) can be extremely valuable. A useful tool for health system organization is the Incident Command System (ICS), a standardized hierarchical structure that enables a cooperative response and organizes and coordinates activities; online ICS training is available for free: https://emilms.fema.gov/IS0700b/curriculum/1.html.

Much will be asked of us all in the coming weeks and months, and we may well find ourselves stretched and beyond our comfort zones. We will be remembered for our actions, and how we comported ourselves in the midst of this pandemic. Our most valuable talents – our compassion, our empathy, and our words of comfort – must be dispensed liberally, as they are both free and priceless.

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Figure: Perioperative Checklist for operations on confirmed or suspected patients with COVID-19

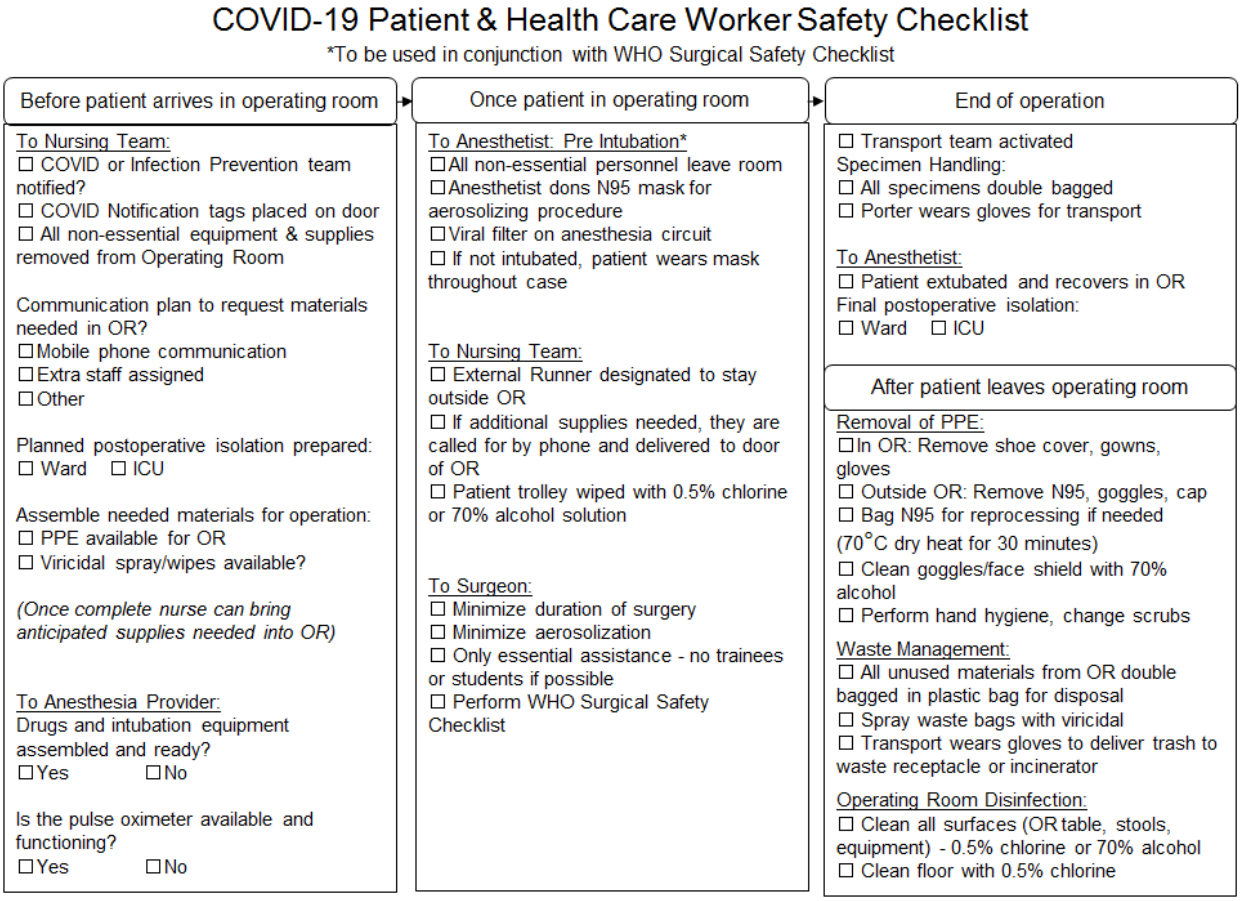

Table: Recommendations for COVID-19 preparedness within the surgical, obstetric, and anesthetic ecosystem in Sub-Saharan Africa

1	Develop a clear plan for essential operations during pandemic	○ Preserve hospital capacity to care for surgical and obstetric emergencies ○ Postpone truly elective operations to preserve PPE, staff and facility capacity ○ Adapting algorithms to categorize cases as elective, urgent or emergent, and enforce them ○ Trial nonoperative management of patient conditions when safe for patients ○ Keep COVID+ patients geographically separate from other surgical patients ○ Consider dedicating one operating room for COVID+ patient use only if case burden is high ○ Operating rooms used for COVID+ patients should be kept at neutral or negative pressure
2	Limit exposure of health care staff and prevent hospital transmission of SARS-CoV-19	○ Train staff on appropriate donning and doffing of PPE ○ Encourage simulation and using two providers for donning/doffing procedures ○ Limit unnecessary patient and physician movement through the hospital, limit visitors ○ Avoid involving students and trainees in patient care of COVID+ patients when possible ○ Minimize the staff required in the hospital to preserve human resources ○ All staff including cleaners, laundry personnel and others should be provided with appropriate PPE ○ Use surgical masks when caring for COVID-19 suspected or infected patients ○ Launder all contaminated linens with detergent regularly ○ Disinfect all hard surface areas regularly with 0.5% chlorine or 70% alcohol solution ○ Enforce frequent and proper handwashing practices - Alcohol-based hand rub can be locally manufactured easily and inexpensively ○ Develop care protocols and teams specifically for COVID response ○ Consider establishing a COVID+ only operating room to be cleared of all materials ○ Minimize aerosols during anesthesia: use regional anesthesia when possible, most senior provider should attempt intubation, only absolutely essential personnel in OR during intubation, recover patients in OR ○ Limit case duration, limit aerosolization during laparoscopy ○ Consider use of COVID checklist for suspected/known COVID patients undergoing surgery ○ If reprocessing single use plastic materials, achieve high-level disinfection or sterilization
3	Conserve PPE	○ Develop a clear understanding of current stocks and supply

	and consumables	chains ○ Airborne precautions (N95 or PAPR) only required during aerosolizing procedures (intubation, bronchoscopy, NIPPV, high flow nasal cannula oxygen, nebulized medication administration) ○ Use droplet & contact precautions (surgical mask, eye protection, gown, gloves) for other patient encounters with suspected or known COVID patient. ○ Extended use of N95 masks is preferred to reuse of the same mask ○ N95 mask contamination may be reduced by covering with plastic face shield or surgical mask ○ Do not decontaminate N95 respirators with chlorine or alcohol solution ○ If severe shortage, consider reprocessing N95 masks in 70°C oven for 30 minutes ○ Wash reusable PPE (cloth hats, gowns, etc) between each use Cloth masks should be used as a last option only and provide little protection against droplet or airborne particles
4	Plan to expand critical care and repurpose staff	○ Carefully consider if/how many ORs or PACUs could be repurposed for critical care needs ○ Prepare providers to work outside their usual scope of practice ○ Provide refresher trainings on ventilator management, critical care, and COVID-specific care guidelines to providers who may be asked to work in different areas
5	Support staff wellness while assisting with difficult ethical considerations	○ Provide material and psychological resources to staff during this time of crisis ○ Consider how needs such as HCW home isolation, child care, meal preparation, or general stress management can be supported by hospital leadership ○ Develop a plan in advance for managing resource shortages and determining scarce resource allocation ○ Frontline healthcare workers should not have to make resource allocation decisions alone ○ Provide compassion, empathy and respect for patients, family members, and healthcare workers in this time of crisis