

PERSPECTIVE

COVID-19 preparedness within the surgical, obstetric, and anaesthetic ecosystem in sub-Saharan Africa

Adesoji O. Ademuyiwa¹, Abebe Bekele², Ataklitie Baraki Berhea³, Eric Borgstein⁴, Nina Capo-Chichi⁵, Miliard Derbew⁶, Faye M. Evans⁷, Mekdes Daba Feyssa⁸, Moses Galukande⁹, Atul A. Gawande¹⁰, Serigne Magueye Gueye¹¹, Ewen Harrison¹², Pankaj Jani¹³, Neema Kaseje¹⁴, Louis Litswa¹⁵, Tihitena Negussie Mammo¹⁶, Jannicke Mellin-Olsen¹⁷, Godfrey Muguti¹⁸, Mary T. Nabukenya¹⁹, Eugene Ngoga²⁰, Faustin Ntirenganya²¹, Stephen Rulisa²², Nichole Starr²³, Stephen Tabiri²⁴, Mahelet Tadesse²⁵, Isabeau Walker²⁶, Thomas G. Weiser²⁷, Sherry M. Wren²⁸

1. Professor of Surgery, University of Lagos and Lagos University Teaching Hospital, Lagos, Nigeria; Director, National Institute of Health Research Global Surgery Unit, Lagos Hub, Lagos, Nigeria; Executive Secretary, Pan Africa Paediatric Surgery Association
2. Professor of Surgery and Dean of Health Sciences, University of Global Health Equity, Rwanda; Chair of Examinations – College of Surgeons of Eastern, Central, and Southern Africa
3. Assistant Professor of Surgery, Addis Ababa University, Addis Ababa, Ethiopia; President, Surgical Society of Ethiopia
4. Professor of Surgery, Blantyre, Malawi; Secretary General – College of Surgeons of Eastern, Central, and Southern Africa
5. Program Assistant, Smile Train, Francophone West Africa (Benin, Togo, Burkina Faso); Lifebox Associate Fellow, Lifebox Foundation, Benin
6. Professor of Surgery, Addis Ababa University, Addis Ababa, Ethiopia; Past President – College of Surgeons of Eastern, Central, and Southern Africa; Board Member, Lifebox Foundation
7. Assistant Professor of Anesthesia, Harvard University, Boston, MA, USA; Board Member, Lifebox Foundation; Medical Advisory Board Member, Smile Train
8. Assistant Professor of Obstetrics and Gynecology, St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia; President, Ethiopian Society of Obstetricians and Gynaecologists
9. Professor and Chair, Department of Surgery, Makerere University, Kampala, Uganda; Governing Councillor, Association of Surgeons of Uganda
10. Professor of Surgery, Harvard University, Boston, MA, USA; Chair, Ariadne Labs at Brigham Health and Harvard TH Chan School of Public Health, Boston, MA, USA; CEO, Haven, Boston, MA, USA; Chair of the Board, Lifebox Foundation
11. Professor and Chair of Urology, Université Cheikh Anta Diop, Dakar, Senegal; President, West African College of Surgeons
12. Professor of Surgery, University of Edinburgh, Edinburgh, UK; Informatics Lead, GlobalSurg Collaborative
13. Past President – College of Surgeons of Eastern, Central, and Southern Africa
14. Lead Consultant, World Health Organization Emergency and Essential Surgical Care Programme; Surgeon, Médecins Sans Frontières; Past Secretary, Global Initiative for Children's Surgery, USA
15. Chair, Division of Anaesthesia, Gertrude's Children's Hospital, Kenya; Chair, Kenya Society of Anaesthesiologists, Kenya
16. Associate Professor of Surgery, Addis Ababa University, Addis Ababa, Ethiopia; Ethiopian Clinical Lead, Lifebox Foundation
17. President, World Federation of Societies of Anaesthesiologists
18. Professor of Surgery, University of Zimbabwe, Harare, Zimbabwe; President – College of Surgeons of Eastern, Central, and Southern Africa
19. Consultant Anaesthetist, Makerere University College of Health Sciences, Kampala, Uganda; Chair, Education Committee, Association of Anaesthesiologists of Uganda; Member, Lifebox Pulse Oximeter Clinical Advisory Group, Lifebox Foundation
20. Chief Consultant, Department of Obstetrics and Gynecology, Rwanda Military Hospital (affiliated with University of Rwanda), Kigali, Rwanda; President, Rwanda Society of Obstetricians and Gynecologists; President – East, Central, and Southern Africa College of Obstetrics and Gynecology
21. Associate Professor of Surgery, University of Rwanda, Kigali, Rwanda; Lead, National Institute of Health Research Global Surgery Unit, Rwanda Hub
22. Professor of Obstetrics and Gynaecology, University of Rwanda, Kigali, Rwanda; Chair, Finance Committee – East, Central, and Southern Africa College of Obstetrics and Gynecology
23. Surgical Resident, University of California San Francisco, San Francisco, CA, USA; Safe Surgery Fellow, Lifebox Foundation
24. Professor of Surgery and Vice Dean, University for Development Studies-School of Medicine and Health Sciences, Tamale, Ghana; Director, National Institute of Health Research Global Surgery Unit, Ghana Hub
25. Assistant Professor of Anesthesiology, Addis Ababa University, Addis Ababa, Ethiopia; President, Ethiopian Society of Anesthesiologists
26. Trustee, Association of Anaesthetists of Great Britain and Ireland Foundation; Board Member, Lifebox Foundation
27. Associate Professor of Surgery, Stanford University, Stanford, CA, USA; Consulting Medical Officer, Lifebox Foundation
28. Professor of Surgery, Stanford University, Stanford, CA, USA

Correspondence: Dr Thomas G. Weiser (tweiser@stanford.edu)

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East Cent Afr J Surg. 2020;25(1):1-9
<https://doi.org/10.4314/ecajs.v25i1.1>

Introduction

COVID-19 cases rapidly spread from East Asia through Europe and North America, and the pandemic is now a growing threat in Africa.^{[1]-[3]} Early modelling studies project enormous resource challenges for countries that are already stretched thin, and whose capacities are currently not capable of providing minimum surgical service needs for their populations.^{[4],[5]} While widespread testing and containment are desirable for reducing transmission, they will be difficult to achieve. As this pandemic grows, hospitals must ensure the continued provision of emergency and essential surgical and obstetric care. At the same time, hospitals risk increasingly becoming sources of infection and transmission, both among patients and to healthcare workers; hospitals must take appropriate steps to minimize onward transmission.^{[6],[7]} In sub-Saharan Africa, where the healthcare workforce is already insufficient, human and physical resources will be rapidly overwhelmed, and providers will be at particular risk of infection. Furthermore, as is already happening in well-resourced contexts, consumables and disposables will also be critically inadequate.

Surgical, obstetric, and anaesthetic care are integral components of any health system, and the acuity, skill sets, resources, and supply chains that support such services will be essential for responding to the impending crisis. Operating theatres are potentially high-exposure zones given the frequent airway manipulation and aerosolization of respiratory particles that take place in this context, with anaesthesia providers at particularly high risk. It comes with the additional risk inherent in the presence of multiple staff members—surgeons, anaesthesia providers, nurses, and cleaners—who are all potentially exposed to aerosolization from the gastrointestinal tract and use of high-speed drills or saws. Anaesthesiologists are also frequently responsible for managing intensive care units (ICUs). Thus, there is an extraordinary risk of exposure and subsequent nosocomial and community transmission.

To prepare for the COVID-19 pandemic in low-resource nations in Africa and elsewhere, surgical systems within hospitals should apply lessons learned in other settings while recognizing the realities of current resource constraints (Table). It is necessary to *act immediately* so as to prepare facilities to support ongoing essential surgical care as much as possible while protecting patients and staff and conserving valuable resources.^{[8],[9]}

1. Develop a clear plan for providing essential operations during the pandemic^[9]

While many highly resourced environments have indefinitely postponed elective operations to preserve vital resources, including hospital beds and personal protective equipment,^[10] this approach is not as applicable in many facilities within sub-Saharan Africa. The American College of Surgeons has recently proposed a schema to help with triage decision-making for urgent and elective cases depend-

ing on hospital capabilities in response to the pandemic.^[11] Many operations in the region are for cancer or highly symptomatic patients, and, as such, the current guidance is not to postpone such cases. It is important to recognize that decisions are fluid, and each hospital must make them based on the current availability of resources and good clinical judgement.

Truly elective operations should, however, be postponed immediately, as this will help preserve the health and well-being of surgical, anaesthetic, nursing, and support staff. These providers will all be important resources during a surge response at a hospital. It is essential to note that this may be particularly difficult for surgical and anaesthetic providers, as many of them rely on elective and private work for their financial well-being. Thus, postponing elective surgery may work against their financial incentives. Health ministries must recognize this as they plan for a pivot in health service provision. However, improved health worker and patient safety, through reduced transmission, is a compelling enough argument. To facilitate decision-making and avoid conflicts between patients and providers, a triage algorithm for identifying nonemergent conditions can be used.

While elective lists might be postponed, surgical emergencies still require prioritization; in many settings, this is already challenging. Clear triage algorithms and protocols need to be established and enforced and surgical capacities preserved. This should include funding to support the hospital and staff with critical surgical services that will continue to be required despite the pandemic response. Nonoperative management for certain surgical conditions, such as appendicitis and cholecystitis, should be considered when it is safe for patients. Some of the most challenging decisions will arise from oncology cases: individualized decision-making should involve the most experienced staff and informed patient consent. Furthermore, there must be consideration of, and planning for, how such patients can be kept geographically separate from patients with COVID-19, and how they can be rapidly discharged to prevent nosocomial transmission.^{[12]-[15]} If the case burden is high, hospital teams should consider designating 1 operating theatre for operations on patients with COVID-19 only. Operating theatres for patients with COVID-19 should be kept at neutral or negative pressure rather than the typical positive-pressure environment.^[16]

2. Decrease exposure of healthcare staff as much as practicable

Few staff are adequately trained in the appropriate use and application of personal protective equipment (PPE). However, perioperative personnel are at an advantage, given their familiarity with maintaining sterility. Staff should receive training on the appropriate donning and doffing of PPE, taught through simulation and videos (without using precious resources). The use of 2 providers for PPE donning and doffing procedures should be encouraged, to allow 1 person to observe and coach the other through the steps of the routine.^{[17]-[23]} While the specifics of PPE are beyond

Table. Recommendations for COVID-19 preparedness within the surgical, obstetric, and anaesthetic ecosystem in sub-Saharan Africa

1	Develop a clear plan for essential operations during pandemic	<ul style="list-style-type: none"> • Postpone truly elective operations to preserve PPE, staff, and facility capacity • Adapt and enforce algorithms to categorize cases as elective, urgent, or emergent • Trial nonoperative management when it is safe for patients • Keep COVID-19 patients separate from other surgical patients • Consider dedicating an operating theatre for COVID-19 patients only if case burden is high • Operating theatres used for COVID-19 patients should be kept at neutral or negative pressure
2	Decrease exposure of healthcare staff	<ul style="list-style-type: none"> • Train staff on appropriate donning and doffing of PPE • Encourage simulation and using 2 providers for donning/doffing procedures • Limit unnecessary patient and physician movement through the hospital • Limit visitors • Avoid involving students and trainees in the care of COVID-19 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 PPE appropriate to their job descriptions and trained to don and doff safely • Use surgical masks when caring for patients confirmed or suspected to have COVID-19 • Launder all contaminated linens with detergent regularly and disinfect all hard surface areas regularly with 0.5% chlorine or 70% alcohol solution
3	Prevent transmission of the coronavirus to other patients and personnel	<ul style="list-style-type: none"> • Enforce frequent and proper handwashing practices; medicated soap and alcohol-based hand rub should be easily available to all staff in the hospital • Alcohol-based hand rub can be locally manufactured easily and inexpensively • Develop care protocols and teams specifically for the COVID-19 response • Consider designating an operating theatre for operations on COVID-19 patients only, with nonessential materials removed • Minimize aerosolization during anaesthesia provision: use regional anaesthesia when possible; the most senior provider should attempt intubation; only absolutely essential personnel should be in the operating theatre during intubation; recover patients in the operating theatre rather than in the PACU • Limit case duration and limit aerosolization during laparoscopy • Consider using the COVID-19 checklist for suspected or known COVID-19 patients undergoing surgery • If reprocessing single-use plastic materials, achieve high-level disinfection or sterilization
4	Conserve PPE and consumables	<ul style="list-style-type: none"> • Develop a clear understanding of current stocks and supply chains • Airborne precautions (N95 or PAPR) only required during aerosolizing procedures (intubation, bronchoscopy, NIPPV, high-flow nasal cannula oxygen, nebulized medication administration) • Use droplet and contact precautions (surgical mask, eye protection, gown, gloves) for other patient encounters with suspected or known COVID-19 patients • 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 60 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
5	Plan to expand critical care	<ul style="list-style-type: none"> • Carefully consider if/how many operating theatres or PACUs could be repurposed for critical care needs • Preserve hospital capacity to care for surgical and obstetric emergencies
6	Repurpose staff for managing COVID-19 cases	<ul style="list-style-type: none"> • Prepare providers to work outside their usual scope of practice • Provide refresher training on ventilator management, critical care, and COVID-19-specific care guidelines to providers who may be asked to work in different areas
7	Maintain and support staff wellness	<ul style="list-style-type: none"> • Provide material and psychological resources to staff during this time of crisis • Consider how needs, such as healthcare worker home isolation, childcare, meal preparation, and general stress management can be supported by hospital leadership
8	Prepare for a rapidly evolving situation	<ul style="list-style-type: none"> • Establish communication plans within and between facilities and providers • Prepare the facility for a surge of patients with suspected or known COVID-19 based on available guidance
9	Plan for ethical considerations in resource management	<ul style="list-style-type: none"> • 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

NIPPV, noninvasive positive pressure ventilation; PACU, post-anaesthesia care unit; PAPR, powered air-purifying respirator; PPE, personal protective equipment

the scope of this paper, we refer you to several resources describing appropriate PPE and the procedures for donning and doffing PPE.[18],[24] A repository of healthcare training resources specific to COVID-19 is also available through the National Institutes of Health.[25]

Additional patients or family members moving through the hospital increases human traffic and adds to the exposure risk. Limiting unnecessary patient movement through the hospital decreases the introduction and transmission of disease between infected and uninfected patients, their families, and healthcare staff.

Health workers are being affected in large numbers. Fundamental hygiene practices are essential for everyone: wash your hands frequently, use alcohol-based hand rub, and stop shaking hands; avoid touching your eyes, nose, and mouth; stay home when you are sick; cough or sneeze into your elbow (or a tissue, then throw it away); and disinfect frequently touched objects and surfaces. For usual care routines not involving the airway, the use of surgical masks has been associated with decreased transmission and lower rates of healthcare worker infections, and is recommended.[26],[27] Furthermore, limiting operating theatre staff to essential members will help preserve the surgical workforce. Trainees and students, in particular, should not unnecessarily be involved with known COVID-19 patients.

When they are not vital to the effort, keep surgical and anaesthetic staff out of the hospital and self-isolating at home to preserve human resources. This will also allow personnel to rest before they return to clinical work. Furthermore, ancillary staff, such as cleaners, instrument reprocessing staff, and laundry personnel should take appropriate precautions and wear PPE (goggles or face shield, surgical mask, heavy-duty gloves, long-sleeved gown, boots) to avoid exposure to contaminated materials.[9] No special decontamination methods, other than machine laundering with detergent, are required for laundering linens; all surfaces should be disinfected with 0.5% chlorine or 70% alcohol solutions.

3. Prevent transmission of the SARS-CoV-2 coronavirus to other patients and personnel

Wash your hands! Hand sanitizer should be made widely available; the World Health Organization (WHO) has published guidance on making alcohol-based hand rub that most facilities should be able to perform.[28] Symptomatic workers should self-isolate and not provide patient care.

Develop care pathways and protocols for patients diagnosed with COVID-19, including by identifying dedicated team members to manage COVID-19 patients each day. Many facilities have limited operating theatre space and numbers, but, if it is practicable, hospitals should establish dedicated COVID-19 operating spaces. Such designated operating theatres should be emptied of all nonessential materials and equipment. Clear instructional posters for PPE donning and doffing should be prominently displayed.[18],[24]

In addition, a taped-off area by the operating theatre door should be clearly marked for donning and doffing activities. No unnecessary items should be brought into the operating theatre, 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 if they have been used during the treatment of patients known to have COVID-19. Traffic should be minimized, as should be the opening and closing of theatre doors.[9]

Patients with known or suspected SARS-CoV-2 infection should wear surgical masks when being transported through hospital spaces or in rooms without negative-pressure isolation.[29]-[31] Intubation is an aerosolizing procedure and should be performed by the most skilled provider available. When appropriate and safe, consider regional anaesthesia with intravenous sedation rather than general anaesthesia to reduce aerosols. During intubation, airborne precautions should be taken through the use of N95 masks or powered air-purifying respirators (PAPRs) in addition to contact PPE; *only absolutely essential staff* should be present in the operating theatre. Intravenous rapid sequence induction without bag-mask ventilation is preferred to minimize exposure risk and aerosolization; the use of deeper sedation for extubation to prevent coughing is also preferable as long as the airway is safe. Patients should recover in the operating theatre, and before patients are transported between the operating theatre and ward, the path should be kept clear using an advance runner to clear the way. The World Federation of Societies of Anaesthesiologists have developed guidance for perioperative personnel involved in airway management.[32]

Whenever practicable, minimize operating times and limit aerosolization (such as the release of pneumoperitoneum during laparoscopy), and when possible, use viral filters and appropriate circuit-cleaning measures for all patients with suspected or known SARS-CoV-2 infection requiring mechanical ventilation.[12],[33] Each centre should prepare its own airway management protocol with available resources in mind.

If single-use plastic anaesthetic 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.[14],[30],[34] This includes immersing instruments in appropriately concentrated glutaraldehyde, phenol, or hydrogen peroxide solution for the recommended duration.[34] Surfaces in the operating theatre should be thoroughly cleaned between cases; this includes pulse oximeter probes, thermometers, blood pressure cuffs, and other reusable materials. SARS-CoV-2, the virus that causes COVID-19, is rapidly killed on surfaces with 70% alcohol solution or 0.5% chlorine solution.[9],[35] As part of minimizing contamination in the operating theatre, in addition to surface cleaning, clear plastic sheets (to be changed between patients) should be used to cover the anaesthesia machine, the monitors, and the patient’s face, especially during aerosol-producing airway manoeuvres, like intubation and extubation.

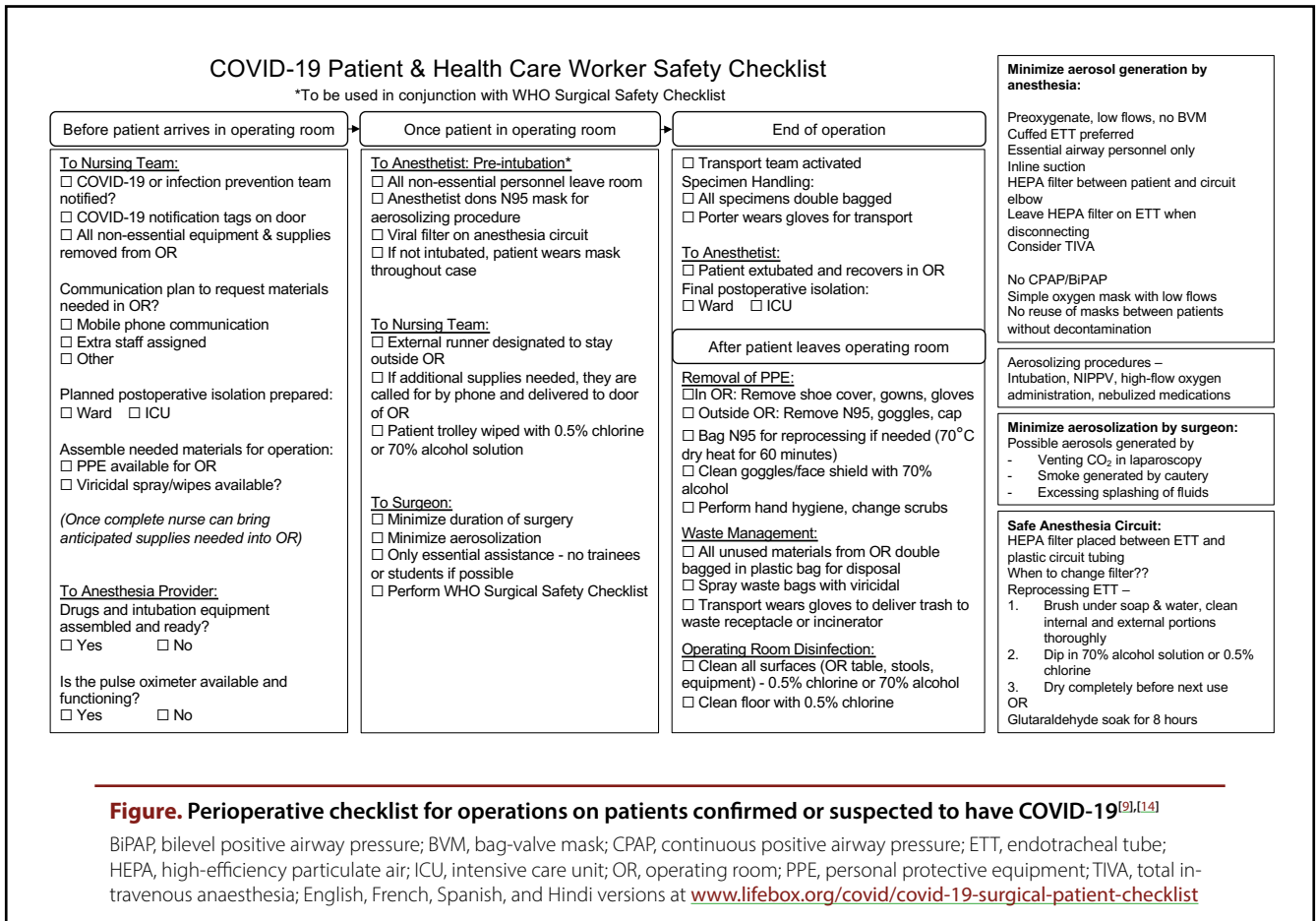


Figure. Perioperative checklist for operations on patients confirmed or suspected to have COVID-19^{[9],[14]}

BiPAP, bilevel positive airway pressure; BVM, bag-valve mask; CPAP, continuous positive airway pressure; ETT, endotracheal tube; HEPA, high-efficiency particulate air; ICU, intensive care unit; OR, operating room; PPE, personal protective equipment; TIVA, total intravenous anaesthesia; English, French, Spanish, and Hindi versions at www.lifebox.org/covid/covid-19-surgical-patient-checklist

Consider using a checklist to ensure that appropriate precautions are taken for operations on patients with suspected or known SARS-CoV-2 infection (Figure).^{[9],[14]} Simulation exercises have been helpful for establishing new routines in the operating theatre.^[15]

4. Prepare for shortages and conserve personal protective equipment (PPE) and consumables

Many well-resourced countries are already experiencing shortages of PPE; this will further stress supply chains to Africa, as manufacturers will be working to fill backorders from countries that have been affected earlier in the pandemic timeline. Many facilities are familiar with severe resource shortages, so this experience may guide creative and innovative ways to conserve and extend necessary resources.

In resource-limited situations, extended use of N95 masks (continuous wearing while seeing multiple patients) is preferred to limited reuse of N95 masks (doffing and redonning between patients).^[36] Furthermore, N95 mask life may be lengthened and surface contamination reduced by wearing a plastic face shield or a surgical mask over the N95.^[37] The use of chlorine or alcohol solution to sanitize N95 masks is not recommended, as it damages mask integrity. Heating N95 masks to 70°C (160°F) in a dry oven for 60 minutes seems a promising solution to disrupt viral particles and maintain mask integrity for reuse^{[38],[39]}—note that this is

a correction from a previous version of this article. Further guidance from the United States Centers for Disease Control (CDC) and Partners In Health on the reuse of N95 masks and best practices when no respirators are available (such as wearing 2 surgical masks) are available.^{[9],[18],[37],[40]} Other innovative solutions are being proposed; for example, a team at Boston Children’s Hospital has demonstrated how to put together a reusable elastomeric respirator using an anaesthesia facemask, ventilator inline bacterial/viral filter, and elastic straps (such as those used for nebulizer masks).^[41]

In the routine clinical care of patients with suspected or confirmed SARS-CoV-2 infection, surgical masks are acceptable PPE, except in the contexts of aerosol-generating procedures (for example, intubation, high-flow nasal cannulation, noninvasive ventilation, bronchoscopy, administration of nebulized medications).^[42] While N95 masks are superior to surgical masks for protecting healthcare workers against aerosolized viral particles, surgical masks still afford significant protection.^{[37],[43],[44]} It should be noted that aerosol-generating procedures that can be replaced by other mechanisms should be avoided if at all possible; for example, metered-dose inhalers can be used instead of nebulizer treatment.

Recognizing that many providers and facilities do not have disposable surgical attire, theatre garb in the form of cloth scrub hats or bonnets should be washed between each use, if possible, and no less than daily. Theatre gowns and drapes should be washed and sterilized between each

patient as is currently expected. If theatre gowns are repurposed for isolation units, they should be washed after each prolonged care routine. If surgical PPE is not impermeable, consider wearing rubber aprons under linen gowns, and always perform handwashing after doffing surgical PPE and before touching clean items or oneself. Of note, *the protection afforded by cloth masks for droplet and airborne particles is not well studied but may be significantly less than that provided by surgical masks and is not protective to the same extent as N95 respirators; cloth masks should be used as a last option only.*[9],[37],[45]-[49]

5. Plan for strategic repurposing of operating theatres and recovery areas for managing COVID-19 cases

Surgical services are already underfunded and poorly prioritized in many health systems, so the commandeering of operating theatres for use as ICUs—which has been proposed in many high-resource settings—must be done with extreme caution. Emergency surgery will still be necessary for obstetrics and to save life and limb, and these capacities should not be compromised by taking up all available operating theatre space and ventilators for patients with COVID-19. As the average reported time spent on mechanical ventilation has been up to 13 days,[6],[50] critical resources and space will be occupied for many weeks and will be difficult to reclaim once repurposed. Another option would be to convert recovery areas into ICUs, as the feasibility of repurposing operating theatres is low due to the inadequacies already mentioned. Patients could recover in the operating theatre under appropriate supervision.

6. Repurpose staff for managing COVID-19 cases

When healthcare workers fall ill, or capacity is exceeded, other healthcare professionals will be required to provide clinical services outside their normal scope of practice. Guidance and training should be provided *immediately* to make best use of the technical and clinical skills of all perioperative personnel while protecting them from exposure. Waiting until caseloads increase will unduly delay necessary preparations. As screening and treatment guidance are in flux, these specifics are beyond the scope of this paper, but guidance is available on an ongoing basis from the WHO.[51] Hospitals, professional societies, and ministries of health could also provide physician and nursing staff with basic ICU and ventilator management refresher education to improve their capacity to care for COVID-19 patients; the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) has recently provided such a resource.[52] The ICM Anaesthesia COVID-19 website was recently developed to provide guidance on critical care for COVID-19 patients.[53] Up-to-date guidelines on COVID-19 management should be provided as knowledge and evidence around best management evolves.[16],[50],[54]-[59] Partners In Health have provided an excellent guide.[60] Additionally, the WHO has compiled a repository of the latest COVID-related research.[61]

7. Maintain and support staff wellness

It is important to recognize that doctors, nurses, cleaners, and other hospital support staff have significant fears and concerns 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. Providers may also be understandably nervous about providing care outside of their normal scope of practice or working beyond their area of competence. Leadership can help manage these concerns by providing information in a transparent way, expressing gratitude for the commitment to patients and colleagues, and reassurances that the system will help protect and support staff members and their families. This is a time for visible leadership to listen to staff as they have ideas and concerns.

8. Prepare for a rapidly evolving situation

The severity of the situation and the availability of resources may change on a daily basis. Thus, communication is critical, and *effective communication plans*—within and between facilities and health system planners, between providers across the health system, and even between countries—are essential and should be *established immediately*. The preparation of healthcare facilities at large for the safe triaging, testing, and management of patients with confirmed or suspected COVID-19, as well as for managing surge conditions, is outside the scope of this document but *must begin immediately*; multiple guidelines are available to assist in decision-making.[9],[35] Establishing task forces that can oversee this dynamic situation and provide additional guidance and interpretations of directives (from ministries or multinational organizations such as the WHO) 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 by government and agencies to organize and coordinate activities; an online ICS course is available at no charge.[62]

9. Ethical considerations in resource management are vital

Shortages of healthcare resources, including PPE, ventilators, hospital beds, and medications for ill patients, are to be expected in many nations worldwide, with worse shortages likely to occur in low-income countries with less purchasing power over supply chains of medical resources and less excess healthcare systems capacity at baseline. In many places, the number of ventilators available for persons requiring ventilatory support will be inadequate. In some settings, it is common to reallocate resources from terminal patients or patients with brain death or very low likelihood of recovery (for example, patients with severe traumatic brain injury) to those with a higher likelihood of recovery. In some contexts, family or community members have provided manual bag ventilation for patients requiring respiratory support when ventilators are not available. However, given the risk of disease spread during the COVID-19 pandemic, this is an unacceptable strategy when isolation units and PPE are in short

supply. In settings where resources are severely limited and must be rationed, consider creating a committee or utilizing standardized risk assessments to determine allocation decisions in advance. This avoids placing the burden of decision-making on the front-line healthcare workers, as these decisions should be not be made ad hoc by the bedside clinician but through careful deliberations by the institution.[9] Each country should consider its cultural and medicolegal context to *determine the most appropriate allocation and potential protocols for rationing medical resources and care in advance*. There are multiple resources for guiding the complex decision-making involved with resource allocation and rationing in pandemic situations.[63]-[68] A recent ethical framework from the *New England Journal of Medicine* made the following priority recommendations,[69],[70] among 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 with reasonable life expectancy and maximizing improvements in length of life as a subordinate aim (maximizing benefit).
2. Critical testing, PPE, ICU beds, therapeutics, and vaccines should go first to front-line healthcare workers and others who keep critical infrastructure functioning; these workers should be given priority not because they are more worthy but due to their instrumental value in the pandemic response and difficulty of replacing (instrumental value).
3. For patients with similar prognoses, *avoid first-come, first-serve approaches* and use random allocation such as a lottery (equality). The Hastings Center has provided a freely available online resource that is a helpful guide to ethical considerations.[71]

The COVID-19 pandemic will be a tremendous challenge for health systems and providers in Africa. 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. Our duty to our patients, our communities, and our families must be paramount. We will be remembered for our actions and how we comported ourselves in the midst of this pandemic. Most importantly, our most valuable skills—our compassion, empathy, and words of comfort—must be dispensed liberally, as they are both free and priceless.

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Keywords: COVID-19, guidance

Competing Interests: None declared. NS is supported by the NIHT32 training grant DK007573.

Received: 27 Mar 2020 • **Accepted:** 31 Mar 2020 • **Published:** 31 Mar 2020

Cite this article as: Ademuyiwa AO, Bekele A, Baraki Berhea A, et al. COVID-19 preparedness within the surgical, obstetric, and anaesthetic ecosystem in sub-Saharan Africa. *East Cent Afr J Surg.* 2020;25(1):1-9. doi:10.4314/ecajs.v25i1.1

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