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The Role of Anaesthesiologists in the COVID-19 Pandemic: Practical lessons from Groote Schuur Experience

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Abstract

Clinicians worldwide have been called to action against COVID-19, requiring development of effective systems to respond to the surge of pandemic cases. Anaesthesiologists are equipped to fulfil many roles in the operating room, critical care and retrieval settings. However, it was anticipated that the case load could overwhelm our existing referral structures, and put staff and patients at increased risk. We describe, using the "4S" components of surge capacity development, how systems, staff, space and stuff were utilised to create a COVID Anaesthesia, Intubation and Retrieval (CAIR) Team at Groote Schuur Hospital, Cape Town, South Africa. The primary aims of the team are to provide safe anaesthesia for patients with known or suspected COVID-19, and perform intubation and transfer in COVID wards or high care areas to intensive care units. Concurrently, promotion of strict infection control practices and risk mitigation through the use of a dedicated group of low-risk, highly trained individuals was achieved. Staff support systems, protocols for streamlined patient management, reallocation of spaces within the hospital, the capital and disposable equipment required for the service, and use of continual audit and iterative improvement are discussed in this article.

Key words: airway management, anaesthesia, COVID-19, critical care, intubation, health systems, personal protective equipment

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INTRODUCTION

The first case of SARS-CoV-2 infection in South Africa was confirmed on 5 March 2020. By October, when the wave of infections was waning, there had been over 700 000 cases and 17 000 deaths, and the healthcare system within the country was under severe pressure[1,2]. As the country suffers from a second wave, this has doubled to 1.4 million cases, 40 000 fatalities, and an overburdened medical community which is showing increasing signs of operating under severe strain[3]. While the COVID-19 pandemic has had a dramatic short-term impact on the entire world, there will continue to be devastating consequences for low- to middle-income countries (LMIC) well into the foreseeable future. Global inequality has been highlighted by the fact that, while developed nations are already embarking on widespread vaccination programs to slow or halt the pandemic, access to vaccines may be greatly delayed in LMICs. Long-lasting effects will include negative health and economic influences over individual lives and livelihoods that will spread far more widely than the virus itself. The unique challenges facing developing countries - stress on health systems and resources, baseline poor health care access, and suboptimal health status of the population - leaves LMICs in a vulnerable state[4]. It is thus incumbent upon us to create, test, share and collaborate on solutions to mitigate the impacts in less-resourced regions.

Clinicians worldwide have been called to action against COVID-19. There has been a need to develop effective systems to distribute and organise staff and equipment in spaces that promote the best possible outcomes. Central to this is the need for dynamic integration of multiple aspects: changing risks, shifting workloads and evolving needs; and to foster collaboration between disciplines and clinicians who may not traditionally work together[5]. Anaesthesiologists can fulfil niche roles that help other areas of the hospital function optimally. As perioperative medicine practitioners, anaesthesiologists are trained in acute-phase critical care cross-over skills such as advanced airway management, ventilation of the critically ill, haemodynamic monitoring and control, point-of-

care imaging and bedside interventions. The specialty is therefore well equipped to contribute outside of the operating room during a pandemic. Furthermore, in many LMICs, anaesthesiologists also function as the primary clinicians for patients in the intensive care unit (ICU).

Based on reports from China and Europe emerging early in the pandemic, it was anticipated that there would be a rapid surge of patients who would require intubation, ventilation and transfer from emergency departments and COVID ward areas. This would rapidly overwhelm our traditional referral systems. There were established concerns over the increased exposure to transmission of SARS-CoV-2 during critical interventions such as intubation, cardiopulmonary resuscitation, suctioning, bronchoscopy and tracheostomy[6]. Historical data from the earlier SARS epidemic suggest that airway management is amongst the highest-risk procedures[7]. In order to address the surge requirements and mitigate the increased risks to staff, a new structure was created within the University of Cape Town (UCT) Department of Anaesthesia and Perioperative Medicine to address the previously described "4S" components of surge capacity: Staff, Systems, Space, and Stuff. These concepts evolved from the proceedings of a 2006 Academic Emergency Medicine Consensus Conference on the science of surge capacity[8]. In addition to this, daily review and debriefing took place to allow timely troubleshooting and integration of lessons learnt through trial and error back into service improvement. Core to this iterative improvement process was a fifth "S": collecting qualitative data and statistics on performance.

We describe below the processes, successes and failures of the COVID-19 Anaesthesia, Intubation and Retrieval (CAIR) Team at Groote Schuur Hospital (GSH), Cape Town, South Africa. Groote Schuur is a 991 bed tertiary/quaternary academic hospital. During the peak of the first wave, approximately a third of this capacity was dedicated solely to COVID patients, and ICU capacity trebled over baseline levels. At the time of submission, the GSH had treated 6399 COVID admissions. The UCT Department of Anaesthesia and Perioperative Medicine spreads its team of approximately 150 clinicians and support staff for anaesthesia, critical care and pain management between Groote Schuur and several smaller hospitals (Red Cross Children's, New Somerset, Mowbray Maternity Hospital and other specialised units).

The primary aims of the CAIR Team are to provide safe anaesthesia services for patients with known or suspected COVID-19, and

Figure 1: CAIR Team members in PPE performing a COVID-19 intubation. (Photo: Barry Christianson, @thestreetsza)

to perform safe intubation and transfer of patients with severe COVID pneumonia from the wards and high care areas to an ICU. Concurrently, we aim to promote and maintain strict infection prevention and control (IPC) through unwavering use of correct personal protective equipment (PPE) and decontamination practices, while shifting the overall risk of transmission of the disease from higher risk colleagues within the Department to a dedicated group of low-risk, highly trained individuals.

STAFF

When the Department embarked on developing a COVID-19 strategy, the first priority was to optimise the use of its staff members' expertise to maximise surge care capacity while minimising risk to both hospital staff, and patients themselves. Three important areas were identified in which the anaesthesiology skillset could be optimally beneficial during the pandemic surge: Ongoing anaesthetic support of a reduced but crucial emergency and urgent theatre service, increasing the capacity in the intensive care units, and bridging the gap between COVID units and intensive care by providing expedient airway management and safe transfer of critically ill patients. Integrated with this strategy was the timely identification of staff members at increased risk of poor outcome should they contract COVID-19, who could be diverted either to the non-COVID theatre service or into administrative or other non-clinical services.

The COVID-19 Anaesthesia, Intubation and Retrieval (CAIR) Team was established in March 2020 on a voluntary basis, and comprised anaesthesia medical officers, registrars and specialists within the GSH Department of Anaesthesia and Perioperative Medicine. Approximately 16 team members at a time (on a rotational basis, divided evenly between trainee and consultant levels) were redeployed from their routine and emergency anaesthesia duties to provide 24-hour emergency COVID intubation and retrieval services. This team also provided anaesthetic services for known COVID-19 patients and suspected cases (Persons Under Investigation; PUIs) in a dedicated theatre area. A similar number of staff were redeployed to increase ICU capacity. The reallocation of such a significant proportion of the Department left the remaining personnel to maintain urgent and emergency theatre duties, as well as covering the numerous regular on-call rosters. This placed additional workload and strain on all members of the Department. However, a camaraderie in dealing with "...the mutual conquest of difficulties…"[9] did improve morale, and colleagues were motivated to step up into new roles. The greatest challenge was to prevent burnout due to the greatly increased frequency and intensity of the triple on-call duties. One strategy which brought fresh enthusiasm and helped to reduce emotional and physical burnout over the following six months was rotation between the theatre pool, CAIR Team and ICU on a 6-8 weekly rotation. In addition, daily rosters were dynamically adjusted to optimise rest during less busy periods.

The first objective of the CAIR Team was to ensure staff safety. This was initiated with the development of training tools and educational resources to upskill COVID-19 frontline workers in the correct use of PPE and IPC procedures, and is described further below.

During the initial national lockdown period in March 2020, PPE training, theatre simulations, and intubation/retrieval training was provided for GSH anaesthesiologists, surgeons, physicians and nurses, as well as other hospital and clinic doctors from around the City of Cape Town before they embarked on care of COVID-19 patients.

The high COVID-19 clinical workload required that team members felt valued, morale remained high, and that difficult clinical situations were addressed promptly to reduce burnout. An important strategy was daily morning "huddles," in which CAIR Team members were encouraged to openly voice feelings, concerns, and suggestions for improvement in operational procedures. This was supplemented by regular formal group debriefing sessions with hospital-provided clinical psychiatrists and psychologists (particularly after difficult cases or poor patient outcomes), and provision was made for individual sessions where needed. Rapid and effective communication within the team was crucial, as the members could at any time be spread across distant areas of the hospital, managing "activations" as they occurred. Open communication, regular rotation and optimal flexible daily role allocation were facilitated by the use of a Google Drive spreadsheet accessible to all members, and a dedicated WhatsApp messaging group.

SYSTEMS

Systems were established on both national and provincial levels to address the COVID-19 pandemic in South Africa. This included an early and strict national lock-down which afforded valuable preparation time, and local provision of additional field hospital capacity. These efforts at a managerial level should be recognised as necessary and complementary to changes in our clinical practice. On a hospital level, multidisciplinary leadership coordinated downscaling of non-essential clinical services in order to support the expansion of COVID-19 testing, triage, wards and ICU capacity. There was timely reallocation of staff and resources to newly established COVID areas[5]. As described above, while supporting this expansion by deploying additional staff to critical care, the Department of Anaesthesia also recognised the need for a framework to cope with the surge of patients needing intubation and transfer to ICU. De-escalation of elective surgical services created staff capacity to form the CAIR Team.

Prior to the initial pandemic wave, the focus fell upon upskilling staff to respond safely. Training included safe donning and doffing of PPE with minimal contamination, anaesthesia of COVID-19 patients with good IPC practices (particularly managing aerosol-generating procedures such as intubation and extubation), and an approach to emergency intubations using a 'Hot' (contaminated) and 'Not-Hot' (non-contaminated) area approach. A number of protocols and instructional videos were developed by our team, and endorsed by the South Africa Society of Anaesthesiologists (SASA) for distribution on the Society's dedicated COVID-19 website (https://sasaCOVID19.com/), smartphone app, and via YouTube[10]. These resources have been published as an open-access online resource. They provide far-reaching assistance to anaesthesiologists and other medical colleagues in both the public and private sectors throughout South Africa and further abroad.

The anaesthesia and intubation team model developed for our setting drew on early reports from the first wave in China and Europe, as well as expert opinion within the international anaesthesia and airway community. A contemporaneous collection of resources collated at that time is available online[11]. Emphasis was placed on a team approach that balanced resource constraints (including staff) with patient and staff safety. Based on a standard theatre team (anaesthesiologist, anaesthetic nurse, surgeon, scrub and floor nurses) or a retrieval team of three supplemented by two ward staff, our approach has five interdisciplinary roles: "HOT-1": Airway management, "HOT-2": Airway assistant, "HOT-3": Overall team leader, reads checklist, ensures situational awareness and administers drugs, "NOT-HOT-1": Gatekeeper; transitions between the 'hot' (contaminated) area and the 'not-hot' (non-contaminated) area by passing any additional equipment to the hot team, and "NOT-HOT-2": Runner who stays non-contaminated and facilitates additional equipment/drug provision, outside communication, note-keeping and transport. (Figure 2) This workflow can be adapted to either theatre or ward environment[12].

We deliberately leveraged in situ simulation training to include practitioners of all disciplines in all roles (physicians and nurses in the wards, nurses and surgeons in theatre) to emphasise the importance of role allocation and strengthen the performance of ad hoc teams that could form anywhere in the hospital using the same model. Thereby, a collaborative environment was fostered and interdisciplinary relationships grew as the pandemic progressed[5]. Furthermore, while in this training and iterative performance improvement phase, we tested through simulation a variety of proposed mechanisms to address SARS-CoV-2 transmission, and were able to integrate these results with other teams and experts worldwide[13-15].

A standardized system/checklist was designed to ensure smooth and safe performance from the point of team activation until either extubation (for a theatre case) or hand-over in ICU (for an intubation and transfer)[12]. This included buddy checks and a challenge-response phase immediately preceding and during the intubation, to ensure all steps were followed. Training was undertaken using this checklist from the outset, including CAIR Team members and all other staff, with interactive improvements made to the system from feedback, clinical experience, critical events and debriefing. These systems developed in the early phase of the pandemic ensured protocolised airway expertise and support to our non-anaesthetic colleagues, established a high standard of care, minimised transmission rates during high-risk intubation and other aerosol generating procedures, and provided safe transfer of the most critically ill patients at the most precarious period in their journey[16]. They have also mitigated risk for our own staff: through uncompromising use of PPE and IPC practices, no CAIR Team member contracted COVID-19 during the first wave[15]. Anecdotally, this focus on good IPC systems seems to have had a legacy. With shifting workload though the second pandemic wave, staffing a dedicated CAIR Team was not possible, but the ingrained practices appear to have provided protection: only one former member of the team was diagnosed with COVID in the time between the second wave and commencement of vaccination programs.

SPACE

Essential to our service was the repurposing of existing working space to prepare, store, clean, process and sterilise equipment, decontaminate personnel, provide theoretical, part-task and simulation training, hold team meetings and debriefings, perform

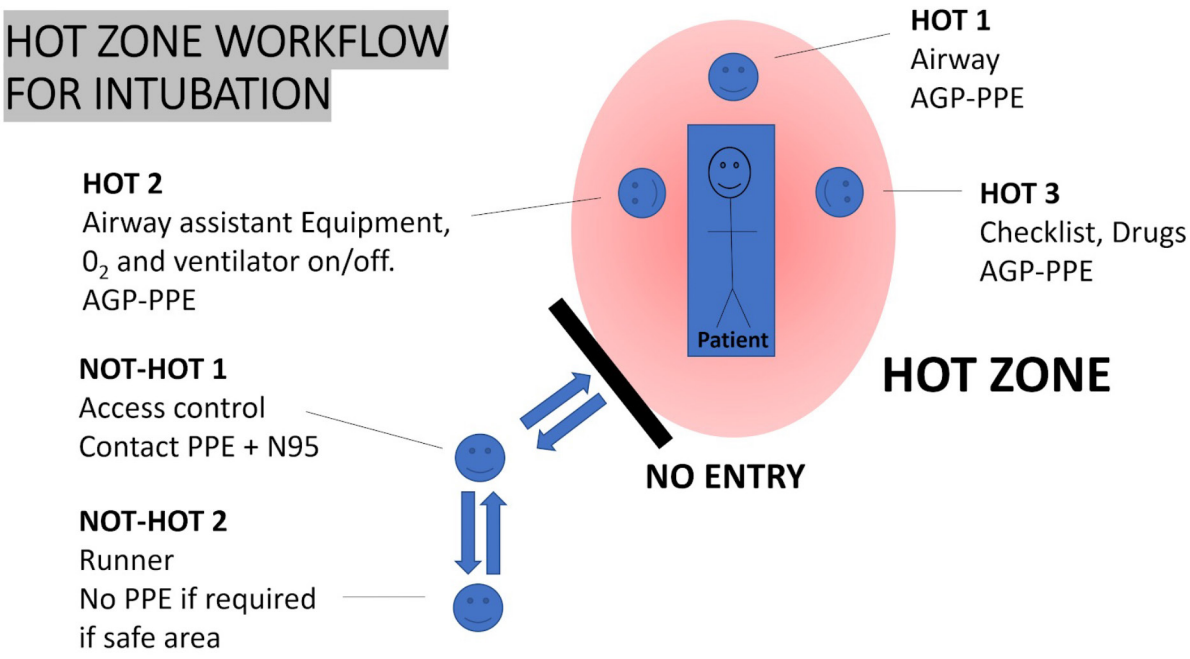

Figure 2: Workflow for COVID-19 Intubation

data capture, and rest. Fortunately, the layout of our Department and theatre areas could be adapted to meet these needs. Various areas were reallocated, whilst being mindful of the potential for transmission through interaction of the staff. An access-controlled airway skills laboratory with multiple power points for charging equipment was converted into the CAIR Team equipment hub, where disposables and cleaned equipment could be securely stored. Access control is important during the pandemic due to widespread PPE shortages and theft. The thromboelastogram (TEG) laboratory with an existing basin and tap, was adapted to create an area where contaminated equipment could be processed before returning it to the hub. Theatre de-escalation allowed one of the existing on-call rooms to be allocated to the CAIR Team, and a second room was converted from a research office to provide sleeping space to on-call staff. The Department fortunately has pre-existing shower facilities, with regular provision of fresh scrubs and laundry.

Initial training and simulation took place within our existing teaching venues. Project Team Care, a resuscitation training unit within the Department, pivoted their activities to COVID and in coordination with the CAIR Team, provided training for all staff in safe PPE use on a ward-by-ward basis. At the later stages of the first wave, this training was also rolled out to medical students before they returned to the clinical platform. With the rapidly increasing need for operating theatre capacity for COVID-19 patients and PUIs, combined with a dramatic decrease in trauma admissions during the initial hard lockdown in March, the underutilised Trauma Theatre Complex was repurposed as a dedicated COVID-19 area. Initially, this was used as a theatre simulation environment with donning and doffing areas, and a clean theatre area equipped with a high-fidelity mannequin. While the Department's own anaesthesia and theatre nursing staff were trained first, this soon expanded to include a wide spectrum of practitioners from the trauma unit, physicians, surgeons and even staff from surrounding public and private hospitals.

As the pandemic progressed, all confirmed SARS-CoV-2 positive and PUI cases were operated on exclusively in the Trauma (now COVID) Theatres, limiting exposure to staff in the main theatre complex. In order to further protect the main theatre staff, screening questionnaire documents developed by SASA were used for every patient being prepared for surgery. The dedicated COVID-19 Theatres became integral to meeting the increasing need for open tracheostomies resulting from prolonged ventilation of COVID-19 patients in ICU. In addition, some of the logistical burden was reduced by performing as many tracheostomies as possible percutaneously in the ICUs, in collaboration with surgeons from the UCT/GSH Division of Otolaryngology.

STUFF

Particularly in resource-constrained settings, provision of a high-quality and safe COVID anaesthesia, intubation and critical care retrieval service is not possible without adequate consumable and capital equipment. The CAIR Team was fortunate to have excellent existing relationships with outside medical equipment companies, our own clinical technologists, medical and hospital management, IPC and laundry teams. This was supplemented by emergency COVID-19 funding from the government healthcare system and through donations by private individuals and companies.

In keeping with the primary goal of staff safety, the first "stuff" supply lines secured were for PPE. Guidelines formulated by members of our team based on the WHO and CDC publications and international experience were adopted by SASA and promulgated to the rest of the country, where they were adapted or adopted by other institutions. A list of appropriate PPE for different clinical situations is shown in Table 1. Recognizing the risk of global shortages at an early stage, the use of reusable PPE was incorporated. This included elastomeric respirators and non-sterile surgical gowns in the place of disposable gowns. Reducing the reliance on single-use items and using scrubs and gowns which could be washed in the hospital laundry averted an acute shortage for the team. This strategy has proven effective; ongoing work in the field suggests that higher levels of PPE are associated with reduced rates of healthcare worker infection[15]. Even with the use of reusable PPE, the complete lack of infections within the CAIR Team is somewhat of an outlier, which may be a reflection on our rigorous training and integration of PPE into a global IPC strategy.

A list of non-consumable capital equipment assembled for the team is presented in Table 2. Consumables as listed in Table 3 were regularly acquired through theatre management and supply chain, which required a weekly (or more frequent) stock-taking to be performed by team members. This was especially important at the peak of the pandemic, when availability of consumables and PPE were at critically low levels due to national and global demand. Up-to-date caseload statistics were used to anticipate future stock needs, and to moderate against unnecessary hoarding.

Equipment was pre-packaged (using standardized checklists) into clear plastic bags that were easy to transport to intubation sites such as the wards, especially where High Flow Nasal Oxygen (HFNO) was used. These wards were the most frequent locations of emergency intubation for the CAIR team. Our centre adopted use of HFNO relatively early (7 May 2020) due to the severe limitation on ICU beds, although its utility in severe COVID hypoxic respiratory failure was

Table 1: Personal Protective Equipment

For Intubation (Hot 1, 2, 3)	For Transport ("Not-Hot" , Porters)
N95/FFP2 respirator or equivalent	Surgical mask (or N95 or equivalent if COVID area)
Plastic Apron	Plastic Apron
Non-sterile gloves (one or two sets)	Non-sterile gloves
Eye protection (Face shield or goggles)	Recommended: Eye protection
Disposable or Linen full-sleeve gown	
Head Cover	Optional: Head cover
Shoe covers	Optional: Shoe covers

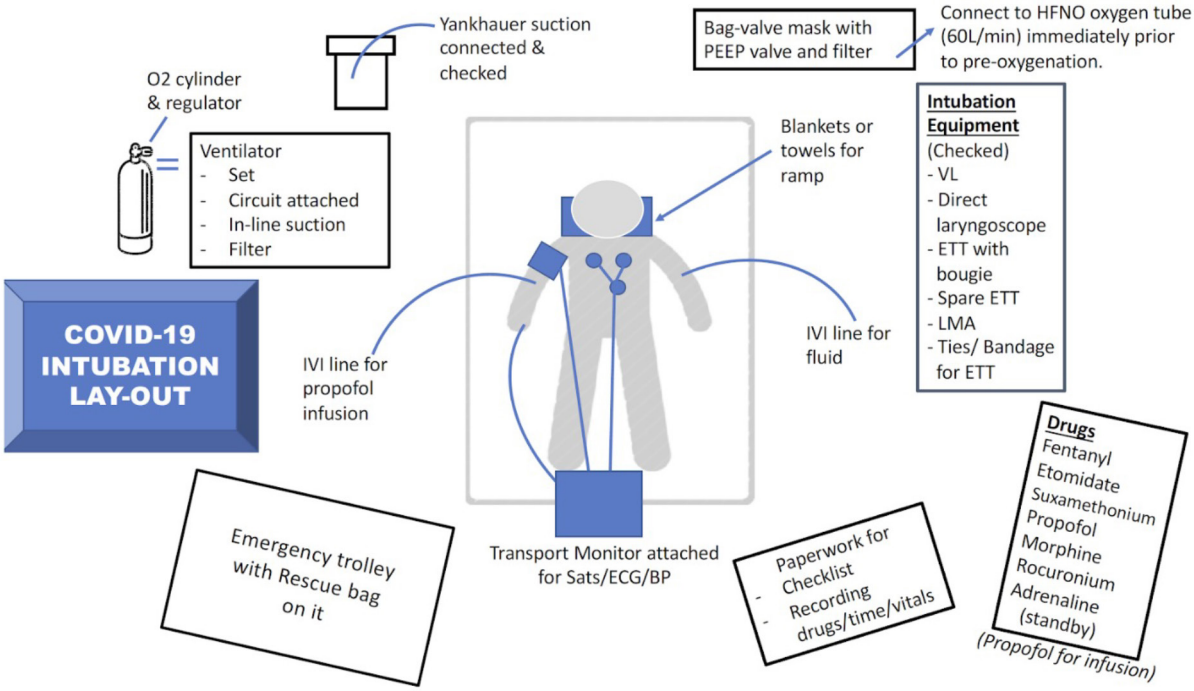

Figure 2: Figure 3. Equipment layout for COVID-19 ward or High Care Unit intubation. (Illustration: Prof Graeme Meintjies)

unproven at the time[5,16,17]. The pre-packaged equipment ensured that all essential equipment required for an intubation was immediately available when needed and no items needed to be sought during an activation. Three types of bags were packed: a PPE Bag, with sufficient PPE for one intubation team; an Intubation Bag, with the standard disposables for a case; and a Rescue Bag designed to be kept sealed but opened immediately in the event of a failed intubation. Spare items, a drug box, syringes, labels and other backup equipment were stored on a secure mobile cart. When the CAIR Team is activated for a case, the three bags, transport monitor, transport ventilator and an oxygen cylinder with reservoir are transported to the area on a steel trolley which is easy to decontaminate. The second cart with backup items is kept in a clean area in close proximity. The team then uses the standard intubation protocol/checklist to undertake the intubation and transfer. Checklists and case report forms are included in the intubation bags; spare paperwork and stationery including stock records are kept in a designated file.

Meticulous cleaning and decontamination of equipment form a critical part of IPC strategies during a pandemic. Stringent precautions must be followed in order to prevent unnecessary exposure not only to the CAIR Team, but also to other clinicians and support staff who are using common spaces. The intubation bag system was designed so that only the required consumables entered into the "hot zone", and as much contaminated material could be disposed of in medical waste bins at the point of care as possible. This includes items such as used filters, oxygen piping, disposable gowns, aprons, gloves, foot and head covers, and ventilator circuits. Reusable items (bag-valve-mask resuscitators, bougies and capital equipment such as ventilators) are sprayed and wiped down with 70% alcohol surface disinfectant in ICU or the operating theatre before being brought back to the wet lab for processing. In the wet lab all equipment that can be submerged is first washed with soap and water, then soaked in a 0.1% hypochlorite solution for 15 minutes. This includes face shields, respirators, goggles, bougies, Magill's Forceps and video laryngoscopy blades. Thereafter the submerged equipment is rinsed with clean water and left to dry in a designated area. Electronic equipment such as transport monitors, monitoring cables, video laryngoscope screens and batteries, portable ventilators and the steel transport trolley are thoroughly sprayed and wiped down with alcohol surface disinfectant, allowed to dry and returned to be charged where appropriate.

STATISTICS

Although not traditionally part of the 4S model of surge planning, the final component to the CAIR Team framework is to audit the team's educational and clinical activities. This includes documenting the services provided, caseload and patterns of activity, formative debriefing notes on individual cases, and de-identified aggregate patient data. We began by collecting logistical data on team activations and equipment requirements, but rapidly added capture of patient, procedure and outcome data into a registry (with expedited research ethics approval). These resources provided a feedback loop which allowed iterative improvement of the service, as well as detecting trends which could be used to improve patient safety.

The CAIR Team developed a single-page case report form (CRF) to document individual cases and act as critical patient notes for intubations and transfers.(18) The CRF data includes concise patient history, pre- and post-intubation vital signs, medications administered, critical events and any difficulties experienced. Paper CRFs are delivered to the ICU as part of the patient's notes, but

Table 2: CAIR Team capital and non-disposable equipment

Capital Equipment:		
Ideal quantity	***Item***	***Description***
2	Transport monitor	Portable, rechargeable vitals monitors and cables (minimum non-invasive blood pressure, three lead ECG, peripheral oxygen saturation)
2	Transport ventilator	Portable with oxygen piping (eg. Oxylog 3000, Hamilton T1)
4	Oxygen regulator	To fit oxygen cylinder forwith adaptor for ventilator
10	Self-inflating bag-valve-mask (BVMR) devices	With reservoir and peep valve
10	Nipple-and-nut oxygen connector	"Christmas Tree" adaptors to connect oxygen tubing to wall flow regulators
2	Video laryngoscope	Portable, with size 3 and 4 Mackintosh blades, rechargable batteries and charging system
5	Direct laryngoscopes	Backup sets of manual laryngoscopes with various blades
5	Disposable video laryngoscopes	Backup single use video laryngoscopes if available
5	Magill's Forceps	For assistance with nasogastric tube placement
1	Transport/Storage Cart	Lockable with drawers
2	Steel preparation trolley	Steel with caster wheels
1	Drug box	Lockable for scheduled drugs

Table 3: CAIR Team consumable equipment

Capital Equipment:	
Item	***Description***
Bougies	Coude-tipped introducers for atraumatic intubation
Anaesthetic masks	Sizes 3,4,5
Oropharyngeal airways	Sizes
Supraglottic airways	Sizes 4, 5
Endotracheal Tubes	Sizes 6-8
Strapping	Ribbon tie for securing endotracheal tube
Tape	Backup sets of manual laryngoscopes with various blades
Suction tubing	Adherent for securing endotracheal tube
Magill's Forceps	
Yankauer suction catheters	
Closed In-line suction devices	
Breathing system filters	HMEF viral/bacteriological and HEPA filters
Clear plastic bags	For packing PPE, intubation and rescue bags
Emergency surgical cricothyroidotomy sets	Front of neck access
Lubricating gel	
Oxygen tubing	From "Christmas tree" nozzle to BVMR, disposable
Ventilator circuits	Disposable for portable ventilator
Oxygen cylinders	Acquisition of full cylinders as needed
Nasogastric tubes	
Syringes	5ml, 10ml, 20ml
Labels or markers	To label drugs syringes
Needles	For drawing up drugs

Table 3: CAIR Team consumable equipment - continued

Capital Equipment:	
Item	***Description***
ECG stickers	
IV medications - refrigeration required	Suxamethonium, rocuronium, cisatracurium
IV medications - no refrigeration required	Propofol, etomidate, midazolam, morphine, fentanyl, adrenaline, atropine
Saline flush	
Tracheal aspirate sample tubes	
Intravenous (IV) cannulas	16G, 18G, 20G, 22G
Transparent dressing	Non-occlusive for securing IV lines
Fluid giving sets	20 drops/ml and blood-giving set with filter
Intravenous fluids	Colloid: Volulyte, Crystalloid: Ringers Lactate, Plasmalyte
Central Venous Catheters	3 lumen
Arterial line and transducer sets	
Cleaning consumables	Hypochlorite granule sachets, 70% alcohol surface disinfectant, hand soap, soft sponges, wash cloths
Large plastic wash tubs	For soaking and decontaminating equipment
Stationery	Pens, markers, scissors, files
Laundry	Full sleeve gowns, towels, scrubs

a digitized copy is entered into the CAIR Registry (on a secure REDCap server).

The CAIR Team was formally constituted in the March 2020 lockdown period, allowing development of protocols and extensive training before the first surge in the region occurred. The team was thus well prepared by time the first cases presented to our institution. However, the value of in situ training and systems testing cannot be overstated. In a noteworthy example, the team performed an in situ simulation of a COVID/PUI intubation in the newly designated PUI unit one afternoon, discovering that the newly installed oxygen flow regulators had not been supplied to the ward with the nipple-and-nut connectors to allow oxygen tubing to be connected. After a debriefing, the protocol was thus modified to include these supplies in our Intubation Bags. The team's first real activation for a patient admitted in extremis with severe viral pneumonia occurred in the same area later that night, by which time the missing connectors had been added.

During the first wave of the pandemic in the Western Cape, the CAIR Team provided support to over 500 cases in COVID-19 and PUI wards, COVID-19 Theatre Complex, obstetric wards and designated COVID-19 obstetric theatres, as well as the emergency and trauma units. This includes more than 250 intubations and ICU transfers of patients with presumed or proven COVID-19 pneumonia, approximately 70 tracheostomies, nearly 200 other COVID-19 anaesthetics for surgery, multiple controlled extubations, tube exchanges, emergency department and trauma intubations, and patient transfers. While details of the patient characteristics and outcomes are reported elsewhere, our findings echo those of other similar clinical settings. Patients with COVID-19 epitomise the "physiologically difficult airway," presenting with profound hypoxaemia, desaturating exceptionally rapidly during airway manipulation, and suffering a disproportionately high rate of haemodynamic compromise, including peri-intubation cardiac arrest.

PREPARING FOR THE NEXT PHASE

The COVID-19 pandemic has unquestionably had a major effect on all members of the healthcare team, the collective healthcare system, all of South Africa and the world as a whole. Whilst the negative consequences on the economic and health sectors are devastating, it is also a time that has confirmed the depth in resilience of health care workers, particularly with regards to the many challenges facing healthcare service delivery in LMICs.

Our experience has proven the value of a dedicated CAIR Team, not only for improved patient safety and efficiency, but particularly for its role in promoting interdisciplinary relationships through mutual support, training and collaboration. Vast experience has been gained and a multitude of lessons continue to be learned. The importance of collaboration, adaptation and preparedness cannot be overstated. In the face of enormous challenge and change, a group of dedicated team members can fill an important role and provide a bridge within the system. The CAIR Team has risen to this challenge, founded on the spirit of reflective and iterative improvement, while highlighting the importance of anaesthesiologists as healthcare leaders beyond the operating room.

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