

COVID - 19 Challenges

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Introduction

The COVID-19 pandemic caused by the novel severe acute respiratory syndrome Coronavirus-2 (SARS-Cov-2) has wrought havoc on hospitals throughout the world. As of 25th April 2020, the burden of disease in South Africa remains relatively low with just over 4220 confirmed cases and 79 attributable deaths (sacoronavirus.co.za/). Nevertheless, cognisant of the extent of disease which has manifested in many countries around the world, the Department of Critical Care together with various other stakeholders at the Chris Hani Baragwanath Hospital (CHBAH) have set about preparing for the expectant “surge” of serious COVID-19 cases, many of whom will predictably require critical care.

CHBAH is a 3200-bed academic hospital located in Soweto, Johannesburg ([# The Calm Before the Storm](http://chrishani-</p>
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Preparing intensive care capacity for the COVID-19 pandemic at a tertiary hospital in South Africa.

baragwanathhospital.co.za). CHBAH is the fourth largest hospital in the world, serving an immediate population of at least 1.5 million people in surrounding Soweto while simultaneously serving as the tertiary referral centre for much of the Gauteng (11.4 million) and North West (3.7 million) provinces (statssa.gov.za).

The Main Intensive Care Unit (MICU) at CHBAH is a combined Adult and Paediatric unit comprising 9 paediatric beds, 9 adult medical and surgical beds, 9 trauma and 6 adult surgical post-op high care beds. Additionally, neurosurgical and burns patients are managed in dedicated ICUs. Adult ICU beds represent less than one percent of total beds while paediatric ICU beds (excluding neonatal ICU) are closer to two percent. These numbers are considerably lower than the number of acute care beds designated for intensive care in European high-income countries (Rhodes et al. 2012).

Despite the limitation on beds, the ICU offers mechanical ventilation and continuous renal replacement therapies which necessitates a one nurse per patient ratio. The shortage of ICU trained nurses in South Africa has placed further restrictions on the availability of critical care services at hospitals like CHBAH. Given these factors, it is unsurprising that the demand for critical care beds, both adult and paediatric, far exceeds the resources available under usual circumstances. The constant pressure for ICU beds represents a mismatch which has in time led to the development of a set of triage principles designed to optimise the utility of these scarce resources. As such, patients requiring intensive care are denied

access on a daily basis by the attending intensivists with full appreciation of the dire consequences of these decisions. The patients negatively affected include both in-patients at CHBAH as well as referrals received from outside hospitals.

It is against this background that the discussion regarding the need for additional critical care capacity for the COVID-19 pandemic needs to be framed.

COVID-19 ICU Preparation

The team tasked with leading the preparation at CHBAH has been drawn from the departments of Internal Medicine (particularly Infectious Diseases), Critical Care, Anaesthesia, Infection Control, Microbiology and Paediatrics with oversight from the senior management of the hospital. Additional support to initiate testing for COVID-19 was sought from the Infectious Diseases Research Unit located on the CHBAH campus. Given the transmission risk posed by COVID-19 patients and the current R0 in excess of two, the first challenge was identifying the optimal physical flow of these patients into the hospital. Consensus quickly determined the need for rapid separation of respiratory and non-respiratory patients. A triage tent has been set up modelled on the immigration area of an airport to rapidly screen the risk of COVID-19 among new patients entering the hospital. For those requiring admission, dedicated wards have been established within the pre-existing Medical and Paediatric departments to nurse those patients with COVID-19 and thus allow isolated co-habitation.

For those requiring critical care, the first

and most important consideration was the impact that COVID-19 patients would have on existing capacity. Given the pre-existing burden on the ICU, it was determined that additional, physically separate, capacity would have to be created to address this problem. This would allow both for the continuation of routine critical care to non-COVID-19 patients and simultaneously reduce the risk of nosocomial transmission of the virus to this vulnerable group given what was known about mortality risk factors associated with COVID-19 at the time.

To this end, the ward which had been designated for possible Viral Haemorrhagic Fever patients has been re-tasked as the temporary COVID-19 ICU. This area is quite distant from the MICU and has the physical ability to be cordoned off from the general hospital, thus limiting the mixing of general human traffic around the hospital and the staff specifically assigned to the management of critically ill COVID-19 patients. The critically ill present the highest risk of nosocomial transmission given the increased frequency of aerosol inducing procedures routine to the management of these patients. Another significant benefit stems from the presence of a negative pressure ventilation system within the unit. Nineteen separate cubicles have been established within the ward, 15 for adult patients and four dedicated to paediatric patients, excluding neonates. The neonatal patients will be managed within the neonatal department.

A significant drawback in this repurposed ward, however, is the space constraints imposed by an environment not specifically intended for intensive care. The cubicles are approximately five square metres, which allows for a patient bed, basic monitoring, a group of infusion pumps, a mechanical ventilator and very little else. This physical constraint has created an intensive care unit limited primarily to the provision of cardio-respiratory support with limited access to the full gambit of intensive care

interventions including continuous renal replacement therapy. CHBAH currently does not provide extracorporeal support so this is a moot point.

The limitation of space impacts other crucial activities and procedures. In order to transfer intubated patients to this unit, they would have to be carried in on a “scoop stretcher.” Moving of the patient beds requires manipulation at various angles which poses a challenge when trying to optimise the position of medical staff attempting to undertake tasks such as intubation, placement of central lines, echocardiography and CPR.

The physical characteristics of the designated ICU, the limitations of both human and physical resources to service additional ICU capacity and reports of the early experiences from other countries have combined to inform a set of triage criteria which will be utilised specifically at CHBAH during the pandemic. Indeed, the offer of 15 adult and four paediatric intensive care beds may at first glance seem a paltry attempt at addressing the expected tsunami of cases. However this represents an increase in capacity of 83% and 44% respectively, which is considerable given the challenges inherent in public health care in South Africa. At a pragmatic level, the limited availability of critical care trained nurses means that the patients will be nursed by less experienced individuals at a much lower nurse to patient ratio, further limiting the ability to offer multi-organ intensive care support.

Early experience in the use of mechanical ventilation and associated mortality rates has been astonishing. Chinese clinicians reported rates of 86% and 97% (Yang et al. 2020; Zhou et al. 2020), the Intensive Care National Audit and Research Center (UK) reported 66% mortality (icnarc.org) and most recently a preliminary report of 2634 patients from New York found 88% mortality (Richardson et al. 2020). Of particular concern was the clear increase in case fatality rates with advancing age,

notably above the age of 60 years (Grasselli et al. 2020) and the obvious detrimental association of medical co-morbidities (Zhou et al. 2020; Grasselli et al. 2020). These factors clearly informed the COVID-19 triage criteria recently published by the Southern Africa Critical Care Society (criticalcare.org.za) which have been further adapted by the CHBAH critical care team (**Table 1**) in an attempt to navigate the ethical dilemmas inherent to the process of attempting reasonable allocation of life saving measures to only the few.

These triage criteria may seem excessively stringent to many intensivists around the world but are not that different from those applied at CHBAH before the pandemic. The crucial difference has been the inclusion of very specific cut-offs such as an age greater than 65 years. While older patients are not usually viewed favourably in terms of ICU admission, the lack of a cut-off allows for decisions to be made on a case by case basis. The thinking around the pandemic necessitated much clearer criteria to allow for all the various teams involved to sing from the same hymn page per se. Interventions such as inappropriate intubation are not helpful for the patient, utilise additional resources and creates unnecessary risk to the staff. The exclusion of so many categories of critically ill children was aimed at keeping potential ICU stays to a minimum to facilitate rapid turnover times of patients, thus increasing the access to critical care to higher numbers of patients.

Additional preparation has involved the development of local guidelines and protocols to assist various levels of staff to manage these patients. The need to enhance safety around intubation has seen the Department of Anaesthesia create a specific roster for a COVID-19 intubation team. The advantages of video laryngoscopy have been recognised and new equipment has been procured, necessitating additional staff training. Staff to manage the patients within the “COVID-19” ICU has been seconded from Internal Medicine and Paediatrics.

Triage exclusion criteria CHBAH (March 2020)

The following patients should not be considered for ventilation:

1. Patients over the age of 65 years
2. Patients with severe underlying lung disease e.g. COPD, Bronchiectasis, Ca lung
3. Advanced malignancies
4. Multiple co-morbidities e.g. metabolic syndrome
5. Multi-organ failure
6. Neurological devastation (from whatever cause)
7. Significant malnutrition
8. Chronic renal failure
9. Post cardiac arrest
10. HIV positive per se is not an exclusion criteria at this stage, however severely immune-compromised patients will not be considered.
11. Prolonged oxygen therapy

In addition to the above, the following paediatric patients will not be considered for mechanical ventilation:

1. Severe malnutrition and failure to thrive (Weight-for-age score < -2)
2. Chronic respiratory diseases including proven Pneumocystis & Cytomegalovirus pneumonia
3. Congenital heart disease
4. Chronic renal failure
5. Congenital syndromes and metabolic disorders
6. Malignant and haematological disease
7. Predicted "long term PICU patients" e.g.: severe Traumatic Brain Injury

Table 1: Current working triage exclusion criteria at CHBAH for COVID-19 ICU admission

Perhaps the greatest source of ongoing staff anxiety has been the question of the adequacy and ongoing supply of personal protective equipment (PPE). CHBAH has never faced such a demand previously, with current estimates of 1200 packs of PPE required on a daily basis. It seems an amount beyond the realm of our reality. Both departments and individuals have

resorted to sourcing PPE independent of the usual process. The unfortunate shortage created by increased worldwide healthcare demand compounded by public stockpiling of PPE has seen equipment purchased from non-medical suppliers. The visors and suits which may have to be used by the intensivists have come from the local hardware store!

The potential impact of COVID-19 on a population with high rates of both HIV and Tuberculosis remains to be revealed. The influences of higher ambient temperatures, pollution and malaria are probably less relevant in the South African context.

These are unprecedented times and the uncertainty is difficult to bear. Much preparation has been done. The government's response to the pandemic has been lauded and the response from our leaders at a hospital level has been heartening. CHBAH awaits its first COVID-19 ventilated patient with bated breath. ■

Conflict of Interest

The authors declare no conflict of interest.

Key Points

- Chris Hani Baragwanath Hospital (CHBAH) is the fourth largest hospital in the world, located in Soweto, Johannesburg and serving a population of 1.5 million people.
- The demand for critical care beds, both adult and paediatric, far exceed the resources available under usual circumstances.
- A triage tent has been set up modelled on the immigration area of an airport to rapidly screen the risk of COVID-19 among new patients entering the hospital.
- The ward for Viral Haemorrhagic Fever patients has been re-tasked as the temporary COVID-19 ICU.
- The COVID-19 triage criteria recently published by the Southern Africa Critical Care Society has been further adapted by the CHBAH critical care team to navigate the ethical dilemma of reasonable allocation of life saving measures.
- The government's response to the pandemic in South Africa has been lauded and the response from leaders at a hospital level has been heartening.

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