Critical Care Society of Southern Africa

CRITICAL CARE SOCIETY OF SOUTHERN AFRICA GUIDELINES FOR THE PROVISION OF CRITICAL CARE SERVICES IN SOUTH AFRICA

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Conflicts of Interest

K de Vasconcellos has no conflicts of interest to declare.

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Introduction

The guideline aims to provide minimum standards for the provision of critical care services in South Africa. The intention is to ensure high quality critical care that focuses on patient safety and improving the outcome of critically ill patients, and that is appropriate to the South African context. The differences between the public and private sector are acknowledged, as are the uncertainties associated with the proposed National Health Insurance. Given the baseline variability between critical care units in South Africa and differences in access to resources, this first iteration of the guidelines should be read as best practice guidelines. The intention is for this first iteration to be used as a basis to uplift the standards of critical care units in the interval prior to the second edition of the guidelines. It is envisaged that the guidelines will be revised within five years of the publication of the current document with earlier revisions if required.

Scope and purpose

The guidelines are intended for use at all healthcare facilities in South Africa that provide care to critically ill patients. They are intended for use by healthcare personnel involved in the provision of care to critically ill patients, including, but not limited to, nurses, doctors, dieticians, physiotherapists, occupational therapists, speech therapists, pharmacists, psychologists, and clinical technologists. They are also intended for use by administrative personnel and management at the level of healthcare institutions and by funders.

Guideline development

The guidelines were developed by a working group of the Critical Care Society of Southern Africa (CCSSA). The working group comprised K de Vasconcellos, PD Gopalan and F Paruk. Draft guidelines were developed after reviewing current local guidelines and regulations relevant to critical care, international guidelines on the provision of critical care services and current data on the provision of critical care services in South Africa. The initial draft guideline was reviewed by the CCSSA council and modified accordingly. The amended draft was emailed to members of the CCSSA and was published on the CCSSA website with a call for public comment. Comments received were considered and the guidelines revised by the working group. Specific further input was requested from the CCSSA private practice critical care physicians' group and the CCSSA critical care nurses committee. All input was considered, and a final draft

guideline was presented to the CCSSA council which was accepted for final approval at a CCSSA council meeting on 10 June 2022.

Section 1: General principles

Background

There are significant global differences in the availability and structure of critical care services. Due to different definitions of critical care beds and differences in the quality of statistics available, it is difficult to directly compare the availability of critical care resources between countries. Available data suggests that the number of intensive care unit (ICU) beds per 100 hospital beds varies from 9.0 in the United States of America (USA), to 4.4 in Belgium, 4.1 in Germany, 3.5 in Columbia, 0.9 in New Zealand and 0.2 in Zambia[1]. The number of ICU beds per 100 000 population in turn varies from 24.6 in Germany to 21.9 in Belgium, 20.0 in the USA, 8.0 in Australia, 4.8 in New Zealand, 3.5 in the United Kingdom and 1.6 in Sri Lanka[1]. Data from South Africa is limited and is complicated by the coexistence of the public and private healthcare systems. An audit conducted in 2008-2009 determined that there were 4 719 ICU and high care beds in South Africa, of which 1186 were in the public sector and 3 533 in the private sector[2]. The ICU/high care bed to hospital bed ratio varied from 1.7 per 100 in the public sector to 8.9 per 100 in the private sector[3]. The total ICU/high care bed to population ratio for South Africa is thus in the range of 8.9 to 9.57 per 100 000 (depending on methodology), however the ratio for public sector ICU beds is 2.4 to 3.8 per 100 000[1, 2]. There are significant regional differences in ICU/high care bed availability in South Africa, with the ICU/high care bed to population ratio being as low as 0.7 per 100 000 in Limpopo, and as high as 5.0 per 100 000 in the Western Cape[2].

Global differences in critical care bed availability and utilisation are undoubtedly influenced by differences in financial resource availability. The appropriate number of critical care beds for a given population should, however, also vary depending on the burden of critical illness in the population[1]. Other factors, such as differences in healthcare structure, philosophy and ethics also play a role. As an example, 47.1% of in-hospital deaths in the USA occur in ICU versus only 10.1% in the UK[4]. This suggests significant social differences in concepts of appropriate use of critical care resources and end-of-life care. These local differences need to be considered when determining appropriate critical care bed numbers and utilisation.

The provision of critical care is costly. Critical care outcomes appear to be influenced by a country's gross national income, with ICU mortality being higher in upper-middle income countries when compared to high income countries, despite similar illness severity scores[5]. This suggests that resource limitations need to be considered in determining appropriate critical care norms and goals of critical care.

The aim of this guideline is to promote the appropriate development of in-hospital critical care services in South Africa. These services should provide high-quality multidisciplinary care that is appropriate to the specific financial, ethical, and social circumstances of South Africa.

Definitions of critical illness and critical care

A critically ill patient is one that has, or is at high risk of developing, acute life-threatening organ dysfunction. Such patients require constant, intensive monitoring and comprehensive care including multiple modalities of vital physiologic organ support to sustain life during a period of life-threatening organ system insufficiency, intensive resuscitation, and appropriate end-of-life care.

Critical care is a specialised multidisciplinary field that is dedicated to the care of the critically ill patient. Critical care is not limited to a specific geographic location in a hospital. Critical care is a continuum of care that includes prehospital management, in-hospital management in non-ICU settings, management in the ICU, and management of the recovery phase of critical illness.

An intensive care unit is a clearly defined geographic area in a hospital, dedicated to the management of critically ill patients. It is characterised by the presence of a multidisciplinary team with specific expertise in the management of critically ill patients, and by the presence of advanced monitoring and organ support equipment and may require specific infrastructure. The level of monitoring and medical care offered in an ICU is greater than that which can be provided safely in a general hospital ward.

Critical care models

Intensive care units may be managed as "open" or "closed" units.

In an *"open"* unit, the patient's primary medical practitioner (e.g. surgeon, physician, obstetrician) is primarily responsible for the decision to admit the patient to ICU and for the patient's ongoing management in the ICU.

In a *"closed"* unit, the ICU is run by an intensive care doctor (or team of doctors) who makes the decision on which patients to admit to ICU and is primarily responsible for the patient's care while in ICU. Input may be sought from other doctors (including the primary referring physician) but the ICU doctor remains primarily responsible for treatment decisions relevant to ICU care and ensures that decisions made by members of the multidisciplinary team are consistent with the overall goals of care for the particular patient.

Intensive care doctors may be "intensivists" or "non-intensivists".

An *intensivist* is a medical practitioner with a recognised specialist qualification in critical care medicine. In South Africa, an intensivist is a specialist who has completed subspecialist training in critical care in the form of a certificate in critical care and is registered as a subspecialist in critical care with the Health Professions Council of South Africa (HPCSA).

Non-intensivists refer to other medical practitioners who do not have a formal specialist qualification in critical care medicine. This may include specialists from other disciplines who have received formal critical care training as part of their specialist training but may also include practitioners with no formal intensive care training.

Hybrid models also exist. There are numerous possible permutations. These include open models with optional intensivist consultation and open models with mandatory intensivist consultation. They also include "semi-closed" models where some beds in an ICU are "closed" beds and some beds are "open" beds or where the ICU operates as a closed unit during certain hours but (usually due to staffing constraints) functions as an open unit at other times.

As intensive care has become increasingly specialised, the limitations of open ICUs and part-time intensive care doctors have become apparent. Evidence suggests that closed ICUs and treatment directed by intensivists leads to improved clinical outcomes, administrative functioning, and resource utilisation.

A closed, intensivist-managed ICU is thus optimal. In addition, this ICU should have 24-hour on-site non-intensivist medical staff whose only clinical duties are to ICU. Intensivists whose only clinical duties are to ICU should be on site during the day and should provide after-hours offsite support to the resident doctors telephonically and be available to attend on site if required. This optimal model is often not possible due to inadequate numbers of trained intensivists, lack of career-pathing or administrative support for non-intensivist doctors dedicated to ICU, and concerns about funding models and the

perceived cost of this model. Cost savings from this model may be significant though, and include reduced inappropriate resource utilisation, reduced costs from consultation from other specialties, reduced costs from a lower incidence of nosocomial infections, among others[6-17].

Intensive care units may also be "multidisciplinary" or "specialised" units. Specialised units may include trauma, coronary care, cardiothoracic, neurosurgical, surgical, burns, pulmonary, transplant and numerous other units. In general, there is little evidence to support the use of specialised over multidisciplinary units or vice versa. Paediatric intensive care units are the exception, and dedicated paediatric units are preferable to multidisciplinary combined paediatric and adult units.

Categorisation of intensive care units

There is no universally accepted method of classifying intensive care units. For the purposes of classifying the services offered, and resources required by different levels of ICUs, a system proposed by the (then) World Federation of Societies of Intensive and Critical Care Medicine has been modified for local circumstances[6]:

Level 1 ICU (High Care)

A Level 1 ICU has traditionally been described as a high care but classifying it as an ICU highlights the importance of these units in providing critical care in our healthcare system. Level 1 ICUs may be run as an open or closed model and by critical-care trained or non-critical-care trained medical personnel.

Level 1 ICUs include coronary care units. A Level 1 ICU is ideally located in a geographically distinct ward, infrastructure constraints may however require a Level 1 ICU to be located within a general ward. Irrespective of the geographical location the following are required for a Level 1 ICU:

Monitoring: A Level 1 ICU must have the ability to provide intensive non-invasive monitoring. This includes continuous ECG, respiratory rate and SpO_2 monitoring and hourly NIBP, urine output, glucose, temperature, airway, and neurological monitoring, including Glasgow Coma Scale (GCS) monitoring. Level 1 ICUs should be able to offer invasive blood pressure monitoring. Certain level 1 ICUs will offer additional specialised monitoring.

Organ support: A Level 1 ICU should be able to provide single-organ support, other than mechanical ventilation. This includes supplemental oxygen therapy, inotrope/vasopressor support, parenteral antihypertensives, renal replacement therapy (RRT) (usually intermittent haemodialysis (IHD) but may

include continuous renal replacement therapy (CRRT) where expertise exists), plasma exchange, airway support (including care of intubated patients and those with tracheostomies who do not require invasive ventilation) and external ventricular drain monitoring and drainage. Non-invasive ventilation (NIV) or high-flow nasal cannula oxygen (HFNCO) therapy may be offered where the facilities are available. Invasive mechanical ventilation in a Level 1 ICU is not recommended except as a bridge to referral to an appropriate setting, during stabilisation, or during evaluation for admission by a higher-level unit.

Staffing: Level 1 ICUs should have a designated doctor and nurse in charge of the unit. These personnel should have appropriate experience to run the unit and should ideally have critical care experience, not necessarily at the level of a specialist. Each patient must have a designated doctor responsible for responding to emergencies. The doctor responsible for each patient must be readily contactable, but a dedicated medical practitioner does not need to be available on site in the unit. A medical practitioner (or equivalently trained personnel: see below) must be immediately available in the hospital to attend to life-threatening emergencies (e.g. accidental extubations, cardiac arrest) until the patient's physician arrives, if required. In hospitals without a doctor on site (including many private hospitals), an alternative would be to have an appropriately trained emergency care practitioner (or equivalent) on site who could provide the above-mentioned emergency management in the ICU. A registered nurse with appropriate training for the functioning of that unit should be rostered for each shift. The ratio of nursing staff to patients rostered for each shift should not be less than less than 1:2.

Level 2 ICU

A Level 2 ICU, in general, refers to an ICU at a regional public hospital or equivalent level private hospital. Level 2 ICUs may be run as open or closed units. Level 2 ICUs must be located in a geographically distinct ward. The following are the minimum required for a Level 2 ICU:

Monitoring: A Level 2 ICU must be able to provide the monitoring offered in a Level 1 ICU, and in addition must be able to provide continuous invasive arterial pressure monitoring (and if required central venous pressure monitoring). Intraabdominal pressure must be able to be monitored, either intermittently or continuously. A blood gas machine must be immediately available.

Organ support: A Level 2 ICU must be able to offer invasive and non-invasive mechanical ventilation, and inotropic/vasopressor support. A Level 2 ICU must be able to offer RRT in the form of either IHD or CRRT.

Medical personnel: Each unit must have a responsible medical director who should be an intensivist. Given the shortage of intensivists in South Africa the medical director may be a specialist with intensive care experience. Intensive care experience is defined as two years full-time experience (or equivalent part-time experience) working as a specialist in an academic ICU or working with an intensivist. The aforementioned recommendation will be reviewed in the next version of these guidelines in the context of availability of intensivists at the time of drafting the new guidelines. Patients remaining in a level 2 ICU for more than 72 hours should be reviewed by an intensivist every 3-5 days if one is available. The medical personnel responsible for the care of each patient may be an intensivist or a non-intensivist specialist who has received formal critical care training as part of their specialist training. The doctor responsible for each patient must be readily contactable, but a dedicated medical practitioner does not need to be available on site in the unit. A medical practitioner (or equivalently trained personnel: see below) must be immediately available in the hospital to attend to life-threatening emergencies (e.g. accidental extubations, cardiac arrest) until the patient's physician arrives, if required. In hospitals without a doctor on site (including many private hospitals), an alternative would be to have an appropriately trained emergency care practitioner (or equivalent) on site who could provide the above-mentioned emergency management in the ICU.

Nursing personnel: Level 2 ICUs must have a critical care-trained nursing director. A registered nurse with critical care experience should be rostered for each shift. The ratio of nursing staff to patients rostered for each shift should not be less than 1:1 for ventilated patients or less than 1:2 for non-ventilated patients. Alternatively nursing ratios may be determined by established tools such as the Nursing Activities Score or Therapeutic Intervention Scoring System (TISS-76) using evidence-based cutoffs as long as the ratios are not less than the abovementioned ratios[18, 19]. Enrolled nurses may nurse patients in Level 2 ICUs but there must be at least one registered nurse per enrolled nurse rostered per shift.

Multidisciplinary team: A Level 2 ICU must have regular input from relevant members of a multidisciplinary team, including dieticians, microbiologists, pharmacists, physiotherapists, occupational therapists and speech therapists. A clinical microbiologist or infectious disease specialist should provide regular alerts on drug-resistant organisms and reports on antimicrobial susceptibility profiles that are relevant to the unit. A clinical technologist should be available assist in the ICU when required. A psychologist should be available to provide psychological support to patients, family, or staff members as required.

Administration: A Level 2 ICU must have established administrative and clinical protocols and must engage in quality improvement projects.

Education: A Level 2 ICU must ensure staff receive appropriate continuous professional development (CPD) training

Referral: A Level 2 ICU should act as a referral centre for referring hospitals that do not have an ICU on site

Level 3 ICU

A Level 3 ICU, in general, refers to an ICU at a tertiary public hospital or equivalent level private hospital but may be established at other hospitals depending on specific local requirements. Level 3 ICUs offer modern, specialised critical care to complex critically ill patients. Level 3 ICUs must be located in a geographically distinct ward, with appropriate links to support services. The following are the minimum requirements for a Level 3 ICU:

Monitoring: A Level 3 ICU must be able to provide the monitoring offered in a Level 2 ICU, but in addition must be able to provide advanced cardiac output monitoring, continuous capnography and echocardiography. A Level 3 ICU may also offer advanced neuromonitoring. A blood gas machine must be available in the ICU complex.

Organ support: A Level 3 ICU must be able to offer invasive and non-invasive mechanical ventilation, including advanced ventilatory modes. A Level 3 ICU must be able to offer inotropic/vasopressor support, including therapies that may not be available in Level 2 hospitals (e.g., vasopressin or noradrenaline). A Level 3 ICU must be able to offer RRT in the form of IHD and CRRT. Level 3 ICUs may also offer additional therapies such as extracorporeal membrane oxygenation (ECMO).

Medical personnel: Level 3 ICUs must be managed as closed units. Each unit must have an intensivist as the medical director. An intensivist (or a specialist intensive care trainee under the supervision of an intensivist) must be responsible for the care of every patient in the ICU. The responsible intensivist must be readily contactable by ICU staff and must not be assigned other clinical duties when on duty for the ICU. A medical practitioner (medical officer, registrar, specialist trainee) with no other clinical duties must be immediately available to attend to emergencies in the ICU at all times. At least a core of these medical staff should be permanent staff members in the ICU.

In hospitals without a doctor on site (including many private hospitals), an alternative would be to have an appropriately trained emergency care practitioner (or equivalent) on site who could provide the above-mentioned emergency management in the ICU.

While formal doctor-patient ratios are difficult to mandate, excessive doctor-patient ratios should be avoided to prevent risks to patients and medical personnel themselves. The minimum doctor-patient ratio needs to be determined for each unit and will depend on caseload, patient complexity, patient acuity and the experience of the medical personnel. The doctor to patient ratio should allow for adequate time away from the ICU and prevent excessively frequent night calls and should allow for the performance of the other non-clinical tasks required of medical personnel. The Critical Care Society of Southern Africa (CCSSA) may be approached to provide a recommendation on doctor-patient ratios for specific units. In general, one doctor should not be primarily responsible for > 6-8 Level 3 ICU patients at any one time, however, a doctor may supervise the management of up to 12-16 patients who are also being cared for by other practitioners. In the public sector/an academic unit a ratio of 1 medical officer or registrar to 8 patients is the maximum recommended ratio per shift. This may be reduced to 1:6 depending on patient complexity/acuity of illness. A ratio of one consultant to 12-16 patients (depending on complexity and acuity) per shift should not be exceeded. All non-intensivist consultants require a supervising intensivist. Junior and senior rosters should ensure adequate rest periods/off call periods and cater for annual leave, sickness and maternity leave and all administrative and academic duties.

Nursing personnel: Level 3 ICUs must have a registered nurse with formal critical care training as the nursing director. A registered nurse with formal critical care training must be rostered for each shift. The ratio of nursing staff to patients rostered for each shift should not be less than 1:1 for ventilated patients or less than 1:2 for non-ventilated patients. More intensive nurse to patient ratios may be required in patients with high nursing workloads e.g., patients undergoing CRRT or ECMO. Alternatively nursing ratios may be determined by established tools such as the Nursing Activities Score or Therapeutic Intervention Scoring System (TISS-76) using evidence-based cutoffs as long as the ratios are not less than the abovementioned ratios[18, 19]. All nurses in a Level 3 ICU must be registered nurses with ICU experience.

Multidisciplinary team: A Level 3 ICU must have regular input from relevant members of a multidisciplinary team, including dieticians, microbiologists, pharmacists, physiotherapists, occupational therapists and speech therapists. Physiotherapists should be available seven days a week to provide urgent physiotherapy. Daily input from a clinical microbiologist and dietician is strongly recommended.

A clinical microbiologist or infectious disease specialist should provide regular alerts on drug-resistant organisms and reports on antimicrobial susceptibility profiles that are relevant to the unit. A dedicated clinical technologist should be assigned to the ICU. A psychologist should be available to provide psychological support to patients, family, or staff members as required.

Administration: A Level 3 ICU must have established administrative and clinical protocols and engage in quality improvement projects.

Research: A Level 3 ICU should be engaged in critical care research.

Education: A Level 3 ICU must ensure staff receive appropriate CPD training and should provide in-service training to other areas of the hospital as required. In addition, a Level 3 ICU must serve as a training centre and offer critical care training to nursing staff, specialist registrars and subspeciality trainees.

Referral: A Level 3 ICU acts as a regional referral centre for complex critically ill patients.

Outreach/Integration: A Level 3 ICU should offer assessment and support services for critically ill patients in the hospital and should offer post-ICU follow-up and support.

Surge capacity: A Level 3 ICU should have contingency plans in place to provide or coordinate expanded critical care services in the event of a natural disaster or pandemic.

Access to critical care and triage

All patients in South Africa should have access to critical care. Critical care should not be denied to anyone based on their race, gender, religion, nationality, sexuality, and socioeconomic status. Critical care resources are, however, finite and rationing of critical care resources is expected and appropriate. This not only prevents wasteful health expenditure but prevents unnecessary non-beneficial therapies, which may prolong pain and suffering in a patient in whom critical care is not appropriate. Patients who are unlikely to enjoy the long-term benefits of critical care due to severe neurological or other organ impairment or who are unlikely to survive critical care admission due to acute or chronic organ dysfunction should not be admitted to critical care units. These decisions should be made by senior medical practitioners and be supported by clear triage policies for each unit. The Critical Care Society of Southern Africa Consensus Guideline on ICU Triage and Rationing (ConICTri) and the document

"Allocation of Scarce Critical Care Resources During the COVID-19 Public Health Emergency in South Africa", offer further guidance in this regard[20, 21].

Goals of critical care

The goals of critical care must be viewed in conjunction with the long-term care goals for individual patients, societal views and resource constraints. ICU survival is no longer an ethically or financially appropriate sole goal. It is well established that many patients who survive ICU die in hospital or have long-term functional impairment. When determining appropriate goals of care, more holistic concepts such as long-term functional outcome or quality-adjusted life years should be considered, and these should be integrated with the wishes of patients and their families, as well as the belief systems in the location of the ICU.

Section 2: Infrastructure requirements

Physical facilities

Bed numbers

The number of critical care beds required in a hospital or per capita is not clearly defined and is influenced by many factors. The recommended number of ICU beds per hospital varies according to the level of hospital and the services offered at the hospital. In general, the following targets for critical care beds are recommended:

- District hospitals: 1% of beds
- Regional hospitals or equivalent: 3-5% of beds
- Tertiary hospitals or equivalent: 8-12% of beds

The distribution of these beds will vary by hospital, but the following general principles should apply:

- District hospitals: all beds are Level 1 ICU beds
- Regional hospitals: 2/3 of beds are Level 1 ICU beds and 1/3 are Level 2 beds
- Tertiary and Central hospitals: 2/3 of beds are Level 1 ICU beds and 1/3 are Level 2 and 3 beds

With respect to ICU beds per capita, the number of ICU beds in the public sector needs to increase. A reasonable target would be 5-8 beds per 100 000.

An ICU of less than six beds is unlikely to be resource effective and it may be worth consolidating smaller units into larger referral units.

It must be noted that optimising ICU bed utilisation is as important as increasing ICU bed capacity in terms of delivering quality critical care services to a patient population. In this regard, intensivist run ICUs and equitable admission and discharge criteria will improve utilisation of current ICU beds. An ICU bed occupancy of >80% in an intensivist-run unit suggests that ICU bed capacity for that institution is inadequate and should be increased. A recommended bed occupancy in ICU is 70-80%. This allows for effective surge capacity. An increase in ICU bed capacity may be warranted even in settings with apparently optimal bed occupancy. In these settings' optimal occupancy may be due to strict triage decisions, and thus, the ICU director must periodically be consulted regarding increasing ICU bed capacity as this may allow the director to relax stringent triage criteria and expand critical care services.

ICU design

General

Details of ICU design are available in documents such as the Infrastructure Unit Support Systems (IUSS) Health Facility Guide for Adult Critical Care of 30 June 2014. Specific issues and requirements are highlighted below.

When developing new critical care areas or renovating existing critical care areas, an intensivist must be included in the design team.

New critical care areas should meet current IUSS standards. When renovating existing critical care areas, attempts should be made to meet IUSS standards, and where not feasible, this must be justified and approved by the intensivist on the design team.

New ICUs should ensure that provision is made for natural lighting in the unit during the day. Daylight is important for both patient and staff wellbeing.

All appropriate fire and other safety regulations should be adhered to. Furthermore, an evacuation route able to accommodate the patient's bed, accompanying staff and life support systems must be incorporated into the development of an ICU.

Non-clinical areas

The entrance to the ICU should be accessed controlled. There should ideally be separate visitors and patient/staff entrances and separate clinical and supply entrances. Access control systems should utilise proximity sensors rather than systems that require physical contact.

A visitor waiting area should be provided either before or after the access control. This should include 1.5 seats per ICU bed. Visitors should have access to restroom facilities.

A counselling room should be available within or in close proximity to the ICU. This must be private and provide a conducive environment for counselling of family members.

Adequate rest facilities should be available to staff members in close proximity to the ICU. These include "tearooms" for breaks and doctors call rooms where the ICU model requires a full-time on-site doctor.

Designated areas with adequate privacy should be available for staff to complete administrative tasks.

Office space should be available in proximity to the unit for senior staff e.g. nursing manager, medical director, permanent consultant staff.

Clinical care areas

The clinical care area may be "open plan" where beds are separated by curtains or may consist of individual cubicles separated by permanent partitions. Whichever design is chosen, provision needs to be made for both patient privacy and to allow for clear visibility of the patient and monitors from the nursing station when privacy is not required. One nursing station is required per "pod" of 8 beds (as a minimum).

Bed space

A Level 1 ICU requires a minimum bed space of 3.5 x 4.5m, a Level 2 ICU 4 x 5m, and a Level 3 ICU 5 x 5m per bed. The space should allow for all necessary equipment to be placed at the patient's bedside; for clinical staff to be able to access the patient from all sides (including the head end of the bed); for diagnostic radiology procedures to be performed, for five staff members to be able to access the patient during an emergency; and to allow for adequate infection prevention and control practices. The floor to ceiling height should be at least 3m. The ceiling must be adequate to support the weight of devices/pendants that are to be mounted to the ceiling.

Single bed areas or so-called "isolation cubicles": A Level 1 ICU should have at least 1 single bed area per 12 beds and Level 2 and 3 ICUs should have at least 1 single bed area per 6 beds. These cubicles should have a dedicated hand basin within the cubicle. In general, these single rooms will be used to separate patients with potential or confirmed infectious diseases from the rest of the ICU. In this case, these single rooms should have negative pressure ventilation. If the rooms are being used to isolate patients from potential infectious diseases (e.g. immunocompromised or burns patients), the single rooms should have positive pressure ventilation at a higher pressure than the exterior of the room. The single rooms should have "no-touch" sliding glass doors. As with all single rooms in the ICU, ensure that there is adequate visibility into the room and provision is made for patient privacy when required. A true "isolation" room will require an anteroom with one door between the exterior and the anteroom and a second door between the anteroom and the isolation room. The anteroom should have a sluice.

Ventilation

The main patient care area should have positive pressure ventilation in the range of 40 to 100kPa. Single bed areas should have negative pressure ventilation in Level 3 ICUs and where feasible, in Level 1 and Level 2 ICUs. General critical care areas should have at least six air changes per hour, while airborne infection isolation areas should have at least twelve air changes per hour. Airconditioning should be adequate to maintain a unit temperature between 24°C and 26°C independent of the external ambient temperature.

Toilets and disposal of bodily waste

Patients who are able to mobilise should have ready access to an enclosed toilet. All patient clinical areas should have ready access to a soiled utility room with a flushing rim sink for the disposal of bodily waste.

Hand basins

Hand basins must be readily accessible from every bed in the ICU to ensure adequate infection prevention and control practices. In an open-plan ICU there should be a minimum of 1 hand basin per 4 beds. In units with enclosed cubicles, each cubicle should have a hand basin. The hand basin should have elbow taps or no-touch electronic sensors controlling water flow. The tap must be high enough above the basin to allow for hand washing without accidentally touching the tap and without water

splashing from the basin onto the person's hands. The tap should not discharge directly over the drain outlet. Each basin should have a soap dispenser and a paper towel dispenser.

Lighting

Lighting must be bright enough to allow for adequate clinical assessment and management of patients. A minimum of 400 lux is required for clinical areas. Additional lighting of at least 10 000 lux must be available for procedures. Lighting in patient care areas must be dimmable to allow for patient rest/sleep periods. Adequate daylight should be available in all patient care areas and staff restrooms.

Services

A Level 1 ICU should have the following services for each bed:

- 2 oxygen outlets
- 1 medical air outlet
- 1 vacuum outlet
- 8 unswitched 15-amp socket outlets
- An emergency nurse call system

The above may be mounted on the wall at the head end of the bed or on ceiling- or floor-mounted pendants. Strong consideration should be given to providing adequate data points at each bed to allow for connection to hospital information systems, even if these are not currently utilised in the institution. One water outlet and one drainage point for dialysis should be available for every 8 beds.

Level 2 and 3 ICUs should have the following services for each bed:

- 4 oxygen outlets
- 2 medical air outlets
- 2 vacuum outlets
- 14 unswitched 15-amp socket outlets
- An emergency nurse call system

The above may be mounted on the wall at the head end of the bed or on ceiling- or floor-mounted pendants. Strong consideration should be given to providing adequate data points at each bed to allow for connection to hospital information systems, even if these are not currently utilised in the institution. One water outlet and one drainage point for dialysis should be available for every four beds.

Electrical supply: All patient care areas, clinical areas, and areas where vital equipment (blood fridges, blood gas analysers) is stored should be fully covered by an uninterruptable power supply (UPS) with a minimum backup period of one hour. Furthermore, all the above areas should have generator backup to provide backup power for longer power outages.

Equipment

The following minimum equipment should be available:

	Level 1 ICU	Level 2 ICU	Level 3 ICU
Multiparameter monitor	1.33/bed. Minimum requirements: 3-lead ECG, NIPB, SpO_2, 2x invasive pressure	1.33/bed. Minimum requirements: 3-lead ECG, NIPB, SpO_2, 3x invasive pressure	1.33/bed. Minimum requirements: 3-lead ECG, NIPB, SpO_2, 4x invasive pressure
Mechanical ventilator	1 transport ventilator or equivalent per 12 beds.	1.33/bed. Must include at least the following ventilation modes (or equivalent): VC-CMV, PC-CMV, SIMV-VC, SIMV-PC, PS, APRV, NIV. At least 50% of ventilators must include capnography.	1.33/bed. Must include at least the following ventilation modes (or equivalent): VC-CMV, PC-CMV, SIMV-VC, SIMV-PC, PS, APRV, NIV. At least 80% of ventilators must include capnography.
Transport ventilator	1 per 12 beds	1 per 6 beds	1 per 6 beds
MRI-compatible ventilator		1 per unit if MRI facilities available in the hospital	1 per unit if MRI facilities available in the hospital
Capnograph	1 per 12 beds	Optional	Optional
High flow nasal cannula oxygen devices	1 per 6 beds in general/surgical high care. 1 per 4 beds in medical high care.	1 per 6 beds or 16.7% of mechanical ventilators capable of delivering this modality.	1 per 6 beds or 16.7% of mechanical ventilators capable of delivering this modality.
12-lead ECG machine	1 per 12 beds	1 per 12 beds	1 per 12 beds
Defibrillator	1 per 12 beds	1 per 12 beds	1 per 12 beds
Emergency trolley	1 per 12 beds	1 per 12 beds	1 per 12 beds
Airway trolley with difficult airway equipment (may be incorporated into emergency trolley)	1 per 12 beds	1 per 12 beds	1 per 12 beds
Bag valve mask	1 per 6 beds	1 per bed	1 per bed
Volumetric infusion pump/syringe driver	4 per bed	10 per bed	12 per bed
Glucometer	1 per bed	1 per bed	1 per bed
Thermometer	1 per bed	1 per bed	1 per bed
Ultrasound machine	Optional	1 per 12 beds (with vascular and cardiac probes)	1 per 12 beds (with vascular and cardiac probes)
Advanced cardiac output monitor	Optional	Optional	1 per 6 beds
EEG	Optional	Optional	1 per 12 beds
Flexible bronchoscope	Optional	1 per 12 beds	1 per 12 beds

Intermittent haemodialysis machine (IHD)	1 per 12 beds	1 per 12 beds (either IHD or CRRT required but both preferable)	1 per 6 beds (both IHD and CRRT required)
Continuous renal replacement therapy machine (IHD)	Optional	1 per 12 beds (either IHD or CRRT required but both preferable)	1 per 6 beds (both IHD and CRRT required)
Extracorporeal membrane oxygenation	No	No	Optional
Arterial blood gas machine (at a minimum must include pH, PO2, PCO2, HCO3/BE, Hb, lactate)	1 easily accessible	1 in unit (and easy access to another blood gas machine if required)	1 in unit (and easy access to another blood gas machine if required)
Point of care viscoelastic testing	Optional	1 easily accessible	1 in unit (with advanced coagulation monitoring capacity)
Emergency transport bag/box (a portable collection of resuscitation drugs and equipment that may be required during transport of critically ill patients). To accompany all critically ill patients during transport.	1 per 12 beds	1 per 12 beds	1 per 12 beds

*Ratios are a minimum. Higher ratios may be required depending on individual unit's experience with equipment repair/replacement turnaround times.

**ECG: electrocardiogram, NIBP: non-invasive blood pressure, SpO_2: pulse oximetry, VC: volume control, PC: pressure control, CMC: continuous mandatory ventilation, SIMV: synchronised intermittent mandatory ventilation, PS: pressure support, APRV: airway pressure release ventilation, MRI: magnetic resonance imaging, EEG: electroencephalogram

Equipment should have a preventative maintenance plan and service certificates. Equipment manuals should be available for all equipment and training should be conducted by the supplier or appointed third party, with proof of training available on record. All equipment should be regularly checked as per a written unit protocol and the records of these checks should be maintained for at least five years.

Section 3: Governance requirements

Admission and refusal criteria

The ICU should have written admission and refusal criteria. These should include guidelines specifying when patients are too well or too sick for ICU and are thus unlikely to benefit from ICU admission. There should be a documented process for dispute resolution regarding admission or refusal decisions.

Handover

Nursing and medical handover should follow a prescribed format. This should include a minimum dataset to be included in the handover.

Discharge criteria

The ICU should have written discharge criteria and step-down pathways.

Transport

The ICU should have a written transport protocol for both transfers into the ICU and for ICU patients that require transport for investigations or interventions. This protocol should include minimum vital parameters/maximum support levels for safe transfer and minimum equipment, monitoring, and personnel required for safe transport.

Infection prevention and control

The ICU should be represented on the institutional infection prevention and control (IPC) committee. Furthermore, the ICU should have written IPC protocols including, inter alia, ventilator-associated pneumonia and catheter-related blood stream infection prevention protocols. Hospital-associated infection rates in the ICU should be monitored, and appropriate audits and interventions performed where required.

Antibiotic stewardship

The ICU should be represented on the institutional antibiotic stewardship committee. The prevalence of drug-resistant organisms and the antibiotic resistance profile of the unit should be known and updated regularly (at least every six months). The ICU must have an antibiotic prescribing protocol that incorporates current antibiotic stewardship principles.

Patient blood management

The ICU should be represented on the institutional patient blood management committee. There should be a written ICU protocol for the use of blood and blood products that incorporates current patient blood management principles, especially restrictive transfusion strategies. This protocol should align with relevant national guidelines (notably the CCSSA patient blood management guidelines)[22].

Morbidity and mortality

The ICU should hold regular morbidity and mortality meetings (quarterly at a minimum). These meetings should be multidisciplinary and should focus on identifying and correcting potentially preventable factors that led to morbidity or mortality. The meetings should be non-punitive to allow for frank and open discussion. Minutes should be kept of these meetings, which should record a summary of the discussion, the consensus points reached and the action plan. Participants in these meetings should abide by a clear code of conduct adopted by the unit or institution.

Section 4: Contextual critical care

Multidisciplinary team

Critically ill patients should be cared for by a multidisciplinary team including medical practitioners, nursing staff, dieticians, microbiologists, pharmacists, physiotherapists, psychologists, social workers, occupational therapists and speech therapists. Each patient should have a clearly designated primary physician whose responsibility it is to coordinate the multidisciplinary team. In level 2 ICUs, the primary physician should be the ICU physician. In level 3 ICUs, the primary physician must be the intensivist. Where an intensivist is the primary physician, the need for other consulting physicians needs to be justified in order to limit over-servicing of patients.

Outreach

Level 2 and level 3 ICUs should have a clear ICU outreach plan. This outreach plan will differ depending on the structure of the healthcare system in which the ICU functions. In a tiered healthcare system where the ICU functions as a referral centre, the outreach should provide support for referring level 1 and 2 ICUs. Outreach may also take the form of "in-reach" where programmes are conducted in the same healthcare facility as the ICU. These may include initiatives aimed at, inter alia, improving patient stabilisation prior to ICU and transfer to ICU or improving post-ICU care. The programmes may also include training programmes in the ICU for non-ICU staff.

Non-ICU critical care

Given the lack of critical care beds in South Africa, it is a reality that critically ill patients are managed in non-critical care beds. This may include patients that are deemed "too well" for ICU but require intensive monitoring or lesser degrees of organ support, patients who require ICU but are waiting for an ICU bed, and patients where ICU admission is deemed non-beneficial due to the severity of their acute or chronic medical conditions. Furthermore, even in well-resourced environments, there is a growing appreciation that it is no longer feasible or desirable to limit critical care practices to one geographically distinct location in a hospital. The nature and duration of "critical care" provided in these non-ICU areas needs to be decided upon by all relevant stakeholders. Similarly, provision of equipment and training needs to be decided upon by the relevant stakeholders, as must the level of involvement/oversight by ICU staff. Creating and capacitating non-ICU critical care practices is a potential outreach project.

Rehabilitation

Many critically ill patients require rehabilitation after surviving critical illness. Adequate rehabilitation facilities and programmes are essential to allow patients to experience the full benefit of the lifesaving therapies provided in ICU. These should be fully funded by healthcare providers. In the absence of adequate rehabilitation services, it may be appropriate to limit access to critical care services for patients with conditions that are likely to have a poor functional prognosis without rehabilitation.

Critical care and society

Critical care practitioners should be cognisant of the needs and wishes of society. Critical care services should be managed with this in mind and should actively seek to balance the ethical principles of beneficence, non-maleficence, social justice and autonomy. Hospitals with critical care services should have functioning ethics committees. These should include members of the community. The critical care services should be actively represented on these committees.

Communication with family/surrogate decision makers

Open and compassionate communication with the patient and/or their surrogate (as appropriate) is encouraged. A family/surrogate liaison should be determined for all patients with diminished capacity. This liaison will default to the surrogate decision-maker as laid out in the National Health Act (Act 6 of 2003) unless the surrogate decision-maker specifically allocates this responsibility to another individual. The patient should be provided with daily updates on their condition. If the patient has diminished capacity, the liaison should be allowed the opportunity to receive daily updates on the patient's condition. Informedconsent for procedures/therapy should be obtained by the responsible physician (or their designated representative) from the patient, or from the legally appropriate surrogate decision maker if the patient lacks capacity to provide informed consent. In the event of conflict between the patient (or their surrogate decision-maker) and the treating physician, the patient/surrogate should be offered the option of obtaining a second opinion. This second opinion should be from a medical practitioner with appropriate training and expertise in the relevant field and should be obtained within 48 hours.

Each ICU should have an information leaflet available to family members/surrogates.

An open visitation policy is ideal but may not be feasible in all settings. Each ICU should have a minimum of two one-hour visiting times per day. A maximum of two visitors should be allowed in the ICU per patient at any time. A maximum of six visitors should be allowed for any specific visiting time. These visiting times and numbers should only be reduced under exceptional circumstances.

Data collection

All critical care services need to have data collection policies. While adhering to Protection of Personal Information Act (Act 4 of 2013) and relevant local and national administrative and ethical requirements,

critical care services should actively seek to routinely collect relevant clinical and laboratory data for all patients. This will allow for locally relevant audit and research that will guide and improve patient care.

Research

Locally relevant critical care research is crucial to improving critical care in South Africa. All level 2 and 3 ICUs should have active research programmes. Collaborative research is highly encouraged.

Audit

All ICUs should conduct frequent audits (at least quarterly). Suggested areas amenable to audit include, but are not limited to, glycaemic control, thromboprophylaxis, antimicrobial prescribing, healthcare-associated infections, and nutritional support. Regular clinical record audits should also be conducted to ensure good record keeping. Audit should be followed by appropriate analysis and implementation plans and ongoing audit of the effect of any interventions.

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