

Design, organization and staffing of the intensive care unit

Christopher Johnson

Abstract

The intensive care unit is at the heart of a hospital's acute services. It brings together almost all of the medical specialties alongside allied health professionals and support services. The design of intensive care units is complex and needs to be carefully thought out to provide the best environment for both patients and staff in order to maximize therapies and minimize risks. The level of organ support required dictates the level of support and staff needed to care for each individual patient. Critical care units need to be flexible to the demands of a hospital and provide capacity when it is required.

Keywords Critical care; intensive care design; organization; staffing

Introduction

Critical care medicine has grown almost exponentially over the last 20 years and is now an established specialty in its own rights. It is now possible to have a General Medical Council approved single CCT (Certificate of Completion of Training) in intensive care medicine as well as dual (as opposed to the previous joint) CCTs alongside not only anaesthetics, but also acute medicine, renal medicine, respiratory medicine and emergency medicine. There is a faculty based out of the Royal College of Anaesthetists as well as its own society that helps to form frameworks and guidelines.

The expansion of critical care medicine has brought the specialty to the forefront of the acute specialties providing advice and support outside the physical walls of the intensive care and high dependency units. The units themselves have changed over the last 20 years. Where previously they may have been placed in generic ward like spaces, there are now numerous purpose-built intensive care units in the newer hospitals around the country offering advantages to both the patients and staff who occupy them.

Intensive care unit design

If one were to design a hospital from scratch the physical location of the intensive care unit would form a central part of the hospital. The location and provision of services adjacent to the intensive care unit as well as the provision of the unit itself is set out in the Department of Health Building Note.¹

A critical care unit requires easy access to and from many other departments including (but not limited to):

- emergency and elective operating theatres – ideally situated adjacently
- diagnostic radiology – both plain film, ultrasound, CT (computerized tomography) and MRI (magnetic resonance imaging)
- interventional radiology – especially specialist critical care units such as neurosurgical units
- the emergency department and acute medical admissions unit
- the haematology and biochemistry laboratory for both diagnostic purposes and the provision of blood products
- a pathology lab – primarily for microbiological support. This does not necessarily need to be on the same site as the critical care unit but there needs to be easy access to this service to submit specimens
- sterile services – for equipment cleaning and sterilization, including fibre optic bronchoscopes and airway equipment
- a pharmacy that is able to provide the common medicines required in a critical care setting quickly as well as having access to specialist poisons services.

Figure 1 shows the schematic design as suggested by the Department of Health.¹

The Critical Care unit itself can be considered as an entity split into three distinct areas providing for separate groups of people.

Clinical/patient areas

The size of the clinical area is very much determined by the number of bed spaces each unit has which in turn is regulated by the population which it serves. It is recommended² that larger units split down the care areas into 'pods' of between 8 and 15 bed areas with its own smaller team of healthcare professionals looking after patients here to improve oversight of these patients by the team. This split can be arbitrary or can follow specialist lines; for example, one 'pod' may be primarily allocated for the care of cardiothoracic surgical patients, whereas another may be for neurosurgical patients. This then allows specialization of nursing and physiotherapy teams looking after this patient population as well as streamlining the review of patients by the parent teams.

In 2010, the Department of Health produced guidance³ on the provision of mixed-sex accommodation in hospitals for England and Wales with a view to providing more single rooms and same sex only bays on wards. Critical care areas with virtue of their increased level of staffing are mostly excused from this guidance but it remains important to preserve patient dignity and privacy. The conundrum facing newly built hospitals is the proportion of single patient cubicles versus multi-patient bays on the intensive care unit – each having their own advantages and disadvantages.

Single patient cubicles offer an increased level of privacy helping to maintain patient dignity. They also reduce the risk of the transmission of infectious pathogens between patients. The potential downside of single patient cubicles is reduced visibility of the patient, which can cause significant issue in the critically ill especially if they are being looked after by a member of staff who has responsibility for another patient as well, e.g. on the high dependency unit.

Cubicles that are incorporated into the critical care unit must be able to provide both source (i.e. negative pressure) and protective (i.e. positive pressure) isolation to protect the patient

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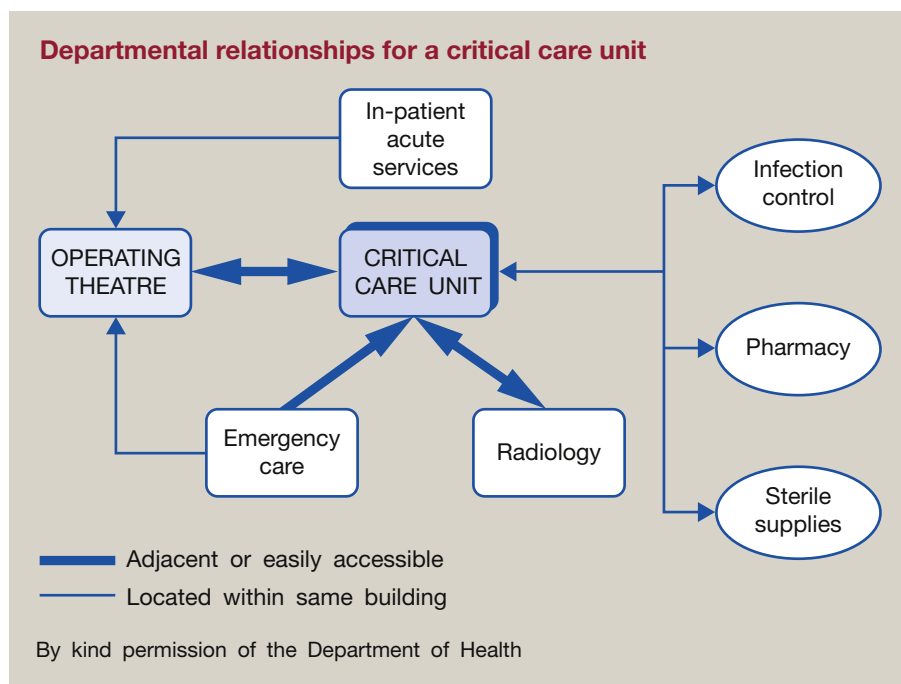


Figure 1

within the cubical or the other patients, staff and visitors to the unit. This will incorporate the use of a lobby airlock where personal protective equipment can also be donned as well as airflow filtration systems to remove pathogens. An example of a single patient cubicle schematic is shown in [Figure 2](#) from the Department of Health.¹

Multi-patient bays allow for greater flexibility for unit staffing with the disadvantages of potentially increased pathogen transmission and disturbance when critical care interventions are being administered to a patient within the same bay.

An example of a multi-patient bay schematic is shown in [Figure 3](#) from the Department of Health.¹

The number of single patient cubicles required varies by the case mix of the unit. For example, a unit serving a specialist haematology/oncology population is likely to require 50% or more of its beds to be cubicles to aid in the isolation of these patient groups, whereas a general critical care unit will require fewer isolation facilities. It is recommended that no less than 20% of critical care beds are located within single patient isolation cubicles.¹

Regardless of the mix the same standards apply to critical care bed spaces and are outlined below:¹

- Must have a minimum of 25.5 m² allocated for each bed space with a ceiling height of 3 m to allow for the provision of hoists and other equipment to be built into the ceiling.
- Multi-bed areas must have an additional 2.5-m wide circulation space at the foot of each bed.
- Each bed space must have its own handwashing sink ideally located at the entrance/exit to the bed area to allow for pre- and post-patient contact hand hygiene.
- Regardless of whether the bed space is a cubicle or in a multi-bed bay there must be adequate provision for privacy be that curtains, screens or glass walls that can be rendered opaque by passing a current through them. The

latter allow for privacy when required but help to mitigate against the lack of constant patient visualization by staff who may be involved in the care of other patients.

- Each single room or bay should have isolated temperature and humidity controls integrated within its ventilation system.
- Each bed space must contain:
 - at least 28 un-switched single electricity socket outlets on an isolated pendant. A proportion of these should be on the hospital's uninterruptable power supply (UPS) so that power is not lost to vital equipment in the event of a mains power cut, e.g. ventilators, renal replacement machines
 - three to four piped oxygen outlets
 - two 4-bar air outlets
 - one 7-bar air outlet for surgical equipment
 - two to four medical vacuum outlets for suction devices
 - a patient call buzzer and an emergency call buzzer linked to the rest of the critical care unit including the non-clinical/staff rest areas
 - a telephone outlet
 - a TV outlet
 - four data outlets to allow a computer to be connected to the hospital network for patient results/investigations etc.
 - a multi-position bed with a pressure relieving mattress
 - appropriate critical care equipment including a ventilator, infusion pumps, feed pumps and monitoring.
- Ideally each bed space should be exposed to natural light but also needs overhead lighting controlled by dimmer switches to alter the light levels as required.

Outwith the bed spaces, the rest of the clinical area requires a staff base ideally from which staff can see all of the patient bed spaces. If possible it should be partially shielded to reduce noise and light pollution of the clinical areas disturbing patient sleep.

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