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# Upgrading intensive care units--getting the design right prevents infection.

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## Upgrading Intensive Care Units - Getting the Design Right Prevents Infection

H Humphreys, J Moriarty

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There is a severe, ongoing shortage of intensive care (ICU) unit beds in Ireland, as recently outlined.<sup>1</sup> This needs to be addressed to ensure that patients who need admission to ICU can be admitted as the need arises and are not prematurely discharged due to pressure on beds. Adequate bed numbers and appropriate staffing will also help to ensure that ICU-acquired infection is minimised.

Determining the number of ICU beds is not an exact science, but is influenced by the total number of beds in the hospital, the case mix of patients usually found in that particular hospital and whether or not the hospital is a tertiary or national referral centre. The number of patients who will require isolation, either because they have a highly transmissible infection or are vulnerable themselves to infection, will vary.

However, irrespective of the number of overall beds, it is important that adequate space is allocated during the refurbishment or construction of a new facility to optimise the care of the ICU patient, which will also help prevent infection. Current standards suggest that a minimum of 20m<sup>2</sup> floor area for each bed is required but this should be at least 32.5m<sup>2</sup> for ICU cubicles.<sup>2,3</sup> However, when considering the design, allocation needs to be made for additional equipment and for likely changes in practice in the near future. Too often, insufficient space is allocated during planning due to a lack of vision or detailed attention to patient care, or due to inadequate consultation with ICU staff.

Recent years has seen an increase in the number of vulnerable immunocompromised patients requiring care in the ICU. Such patients include patients with AIDS and pulmonary infection, severely neutropenic patients with sepsis, patients following organ transplantation who are haemodynamically unstable, patients with extensive burns and patients with infection on immunosuppressive therapy for medical conditions such as severe rheumatoid disease. Patients in ICU with multi-antibiotic resistant bacteria, e.g. methicillin-resistant *Staphylococcus aureus* (MRSA) and patients with potentially highly transmissible infections, such as open tuberculosis, require isolation. In the case of the former, this is referred to as source isolation, preferably with positive pressure ventilation that ensures relatively clean air around the patient, and in the case of the latter, this is referred to as source isolation when negative pressure ventilation helps minimise possible airborne dispersal.

The number of isolation beds, and whether these have negative or positive pressure ventilation, should be decided locally as this will largely be governed by the case mix of patients admitted to the ICU. Future changes in the epidemiology of infection, including the re-emergence of SARS, the likelihood of a pandemic outbreak of influenza and the possibility of multi-drug resistant tuberculosis becoming a significant problem in Ireland, should also be considered. It has been suggested that one cubicle for every six to ten beds is sufficient,<sup>2,3</sup> but this may be inadequate in larger hospitals or national referral centres, or where the proportion of patients with severe infection is high, e.g. MRSA bloodstream infection. Countries where there is a high proportion of single rooms, such as Holland have a negligible incidence of MRSA. Regardless, availability of cubicles with negative or positive pressure ventilation or the facility for both needs to be regularly monitored and reviewed.<sup>4</sup>

When upgrading or designing a new ICU, facilities for hand hygiene, adequate storage and the finish on the floors and ceilings should also be addressed.<sup>5,6</sup> Therefore planners need to consult early with all personnel, especially those working in the ICU, the infection control team, and others with relevant expertise. Many bacteria have evolved to enable them to persist and survive for prolonged periods in the ICU. For example, *Acinetobacter baumannii* has been shown in laboratory experiments, to be capable of surviving on environmental surfaces for three weeks or longer and this partly explains its capacity to cause recurring outbreaks of infection.<sup>7</sup> Previously, it was thought that only Gram positive bacteria, such as *Staph. aureus* were capable of surviving for such long periods in the environment. The type of materials used in fittings and furnishings is an important aspect of infection

control. It is important that cleaning regimens in the ICU are specific to the area and are agreed with the Infection Control team and senior ICU nursing officers. A specialised group of cleaning personnel, trained to a high level in infection prevention in the ICU environment, should be assigned permanently to the area.<sup>3</sup>

There is also a greater need for a more vigorous and scientific approach to hospital cleaning and the assessment of its effectiveness. It has been suggested that this should be based upon a variety of indices including visual appearance, the presence of organic material and the presence or absence of indicator organisms.<sup>8</sup> However, the design and especially the allocation of sufficient space will greatly facilitate all cleaning regimens.

Major capital investment in the provision of ICU beds in public hospitals in Ireland over the coming years is urgently required. It is imperative that in the design of these new facilities, a wide range of disciplines and individuals with appropriate expertise, are involved to ensure that current needs are met. Whilst due consideration has to be given to the cost of any such project, those involved need also to ensure that there is sufficient vision to address likely and anticipated future needs. Adequate capital investment in ICU facilities now will significantly improve patient care and help contain or reduce ICU infections, thus reducing patient mortality, hospital stay and costs well into the future.

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