

The Future ICU

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Future ICU Design: Return to High Visibility

Future ICU designs must feature high visibility to ensure safety.

serious cases could be simultaneously observed and treated by limited numbers of clinicians were the model for ICUs springing up after WWII. The transition from recovery-like open wards to open bay suites, then multi-bed rooms occurred in the decades of 1950s through the 1980s (Kisacky 2017). Ultimately, North American ICUs and many others around the world have today largely transitioned to private rooms with glass walls and doors (Hamilton and Shepley 2010).

The history of ICU design has been powerfully influenced by the importance of the ability for nurses and other staff members to see the patients and their colleagues. Seeing the patients allows for rapid response to changing situations and seeing each other allows for staff to rush to help colleagues faced with a crisis. Also contributing to the need for greater visibility and coverage is the growing number of ICU patients and the declining number of highly skilled physicians and nurses

The ability for critical care nurses, physician intensivists, and other caregivers to visualise their patients has always been a high priority as it plays a major role in patient and staff safety. Architects and designers have responded with configurations for intensive care units (ICUs) to support the ability for staff to see their patients and each other. The focus on patient and family centred care and the shift from paper charting to electronic medical records enabled the overall design of an ICU to change from a centralised nursing station design to decentralised stations closer to the patient. A nurse, architect, and researcher offer their insights into how visibility will be considered in future designs for critical care units.

A Brief History of ICU Visibility

With a few notable early exceptions, wartime open bay recovery rooms in which multiple

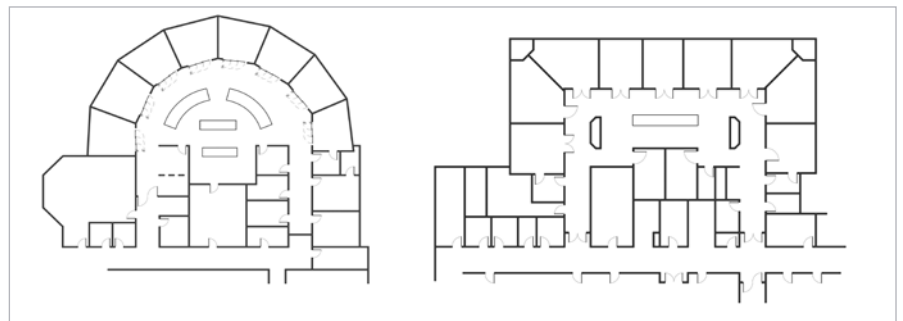


Figure 1: Typical high visibility unit configurations. Illustrations credit: Behzad Yaghmaei

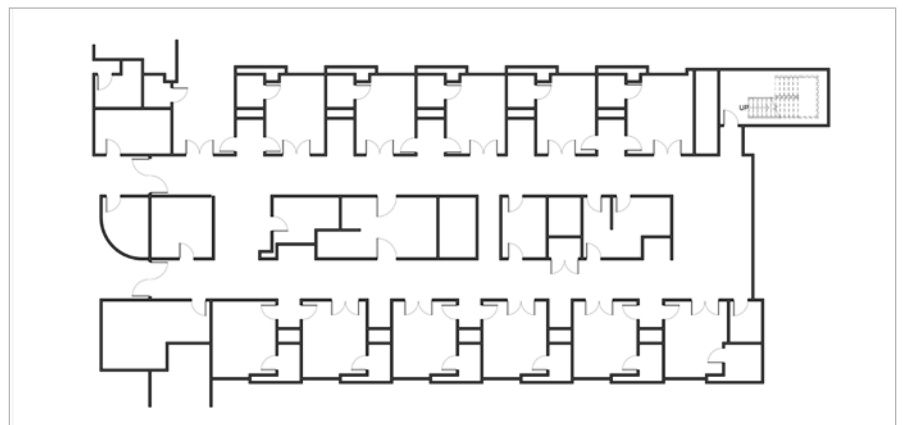


Figure 2: Linear, rectangular unit configuration. Illustrations credit: Behzad Yaghmaei

that care for them. ICU configurations have therefore usually been concentric, or shapes that promoted high visibility (**Figure 1**). Recent rectangular designs that fit in the footprint of acute care patient towers have begun to offer less visibility of patients and staff members as result of reliance on decentralised nursing positions (Hamilton 2017b). Nurses have expressed concern about isolation from colleagues and backup in linear designs (**Figure 2**).

Visibility of Patients

Critical care nurses are responsible for routine assessments (minutes to hourly) depending on the acuity of the patient. Frequent documentation of vital signs and physiologic parameters allow for projection of trends and anticipation of interventions. Additionally, telemedicine technology and “machine learning” or artificial intelligence algorithms can support nurses work and predict trends or changes in patient status. Despite technological advances, nurses are expected to demonstrate awareness of the clinical situation (Abbey et al. 2012; Chulay et al. 2010) and interpret based on patient clinical presentation (Kwon et al. 2019). Situation awareness (Endsley and Jones 2012; Sitterding et al. 2012) allows anticipation of the lessening or improving of the patient’s condition, and permits timely interventions. To maintain this awareness, patients must be easily visible to the nurses and other clinical staff.

The proximity of charting to caregiving influences the accuracy and completeness of the documentation. This suggests that decentralised charting, close to the bedside, is a desirable configuration for critical care units in which information can be recorded sooner than in centralised designs (Bayramzadeh and Alkazemi 2014; Fay et al. 2018).

Accessibility, like visibility, is important to the caregivers. The most common life support configuration is the headwall design in which the bed is arranged like a peninsula with the head of the bed against the wall and served by adjacent wall-mounted utilities, not

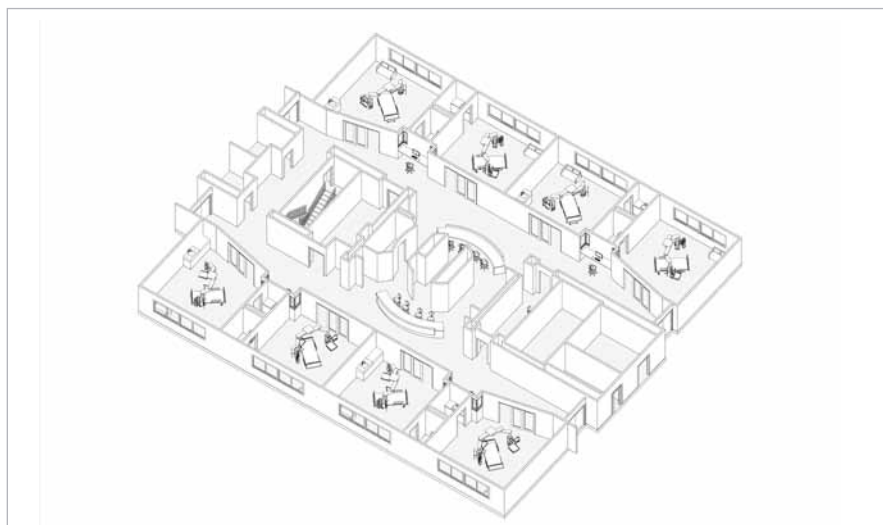


Figure 3: Concentric unit within bed tower footprint. Illustrations credit: Behzad Yaghmaei

unlike traditional acute care patient rooms. In a code or crisis situation, the bed must be pulled away from the wall and someone must step over the various cords, tubes, and umbilicals in order to access and protect the patient’s airway. Life support configurations that don’t require repositioning the bed or patient in the event of a crisis, such as overhead booms that allow complete 360° access to the patient, are desirable (Pati et al. 2008). The relationship to patient visibility in the case of booms and columns must be considered in design.

A retrospective analysis of APACHE II data, mortality, visibility of the patient and patient outcomes revealed that the staff nurses’ specific field of view to the patient from a central or decentralised station independently impacted patient outcome (Lu et al. 2014). It is important for staff to be able to visualise the patients and to be able to promptly recognise a change in patient condition. During an emergency or code situation, multiple staff members swarm into the room to provide assistance.

Visibility of Staff

The authors believe the greatest current threat to effective ICU design is the mistaken assumption that decentralised charting allows the unit to be configured like an acute

patient unit with a linear, non-concentric organisation. Criticism of straight corridor designs is beginning to appear (Hamilton 2017b; Hamilton et al. 2018).

Decreased visibility impacts communication, teamwork, mentorship and collaboration among all members of the healthcare team. Staff, especially nurses, need to be able to see and communicate with their colleagues. They may need support or backup, as in the case of a code situation. Nurses may be able to observe the patients of others and to intervene when the responsible nurse is away seeking medications, supplies, or equipment (Wheelan et al. 2003).

One staff development and learning function of the unit is to provide mentorship opportunities in which experienced nurses provide support for less experienced nurses and other staff members. To do so requires the ability to see each other and speak to one another.

The ICU of the future needs to return to the high visibility configurations of the past: small units in concentric shapes that allow staff to see all the patients and each other. There are potential configurations that achieve the visibility goal while fitting into the footprint and structural grid of an acute bed tower (**Figure 3**).

Visibility of Resources

An ideal design for critical care provides the nurse with directly visible resources to support caregiving, and minimal travel distances to medications and frequently needed supplies or equipment. Some contemporary designs feature supply carts in the patient room (Hamilton 2017a) where a position opposite the foot of the bed offers equal distances to both sides of the bed.

Design Recommendations for Future ICUs

For reasons of safety, the ICU of the future needs to provide high visibility for staff to easily observe patients and other staff members. Documentation, medications, frequently needed supplies and equipment should be located in proximity to the bedside, and decentralised or duplicated as necessary to reduce unnecessary travel.

Decentralised charting: The ICU of the future should feature decentralised charting positions allowing critical care nurses to be as close as possible to their patients. Charting in proximity to the patients will include fixed and mobile computers in the patient room, and just outside. At the same time, centralised functions should occur in a team work station supportive of clinical collaboration and full observation of the unit. Designs of the future should not mix the positives of decentralised charting and the negatives of poor visibility.

Central functions: There should still be a centrally located team station to serve the numerous staff members who are not resident in the unit. It also serves as a place for a unit clerk, telephones, and the charge nurse, along with pneumatic tubes, printers, and shared functions. Other common functions serving the entire unit include staff restrooms, locker rooms, staff lounges, and in some cases, on-call rooms. Satellite labs and point-of-care testing should be within, or convenient to, the unit.

Electronic consultation: While variations of providing ICU expertise via electronic means have been effective for multiple large system providers, the direct caregiving and medication administration is always local. Similarly, even when the expertise and consultation may have originated elsewhere, the documentation benefits from proximity to the bedside.

Pod and cluster configurations: In order to maximise visibility of patients and staff, the ICUs of the future should be designed in configurations of 8-12 bed pods with multiple pods assembled for units requiring larger numbers of beds. These pods should be designed to provide clear ability for nurses and other staff to see their patients and each other.

Life support configuration: The ICU of the future should feature systems other than the headwall configuration, such as overhead boom or bridge systems that allow full access to the patient, including the head. The future deserves a better solution than the headwall configuration.

Resource proximity to the bedside: The ideal location for needed medications and supplies is, of course, the patient room. The recommendation for future designs is to decentralise medication and supply functions as close as reasonably possible to the patient bedsides.

Conclusion

The ICU of the future will need to provide high visibility for critical care nurses, physicians, and other staff members. While the future will produce advances in technology and treatment, the requirement for someone to see the patient will not change. Electronic surveillance (Zhou et al. 2014), although desirable, will be no substitute for person-to-person, face-to-face observation and communication. Future ICUs should be organised in pods or clusters of smaller numbers of beds to permit the needed high

levels of staff-patient and staff-staff visibility. These new units will need to have a mix of decentralised and centralised positions serving as workstations for the staff and will need to be organised to reduce travel distances as team members seek resources to serve their patients. ■

Key Points

- High levels of staff-patient and staff-staff visibility contribute to safety.
- Charting and staff positions should be both decentralised and centralised.
- Intensive care units should be configured in pods of smaller numbers of beds.
- Medications, supplies, and equipment should be proximate to the patient beds.
- Life support systems should offer complete access to the patient.

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