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In This Issue…

What will the ICU of the Future look like?

Demand for intensive care unit (ICU) beds is increasing as the nature of medical practice shifts to become more multiprofessional and multidisciplinary. These trends likely will be reflected in both our critical care space design and working practices. Clinicians are spending more time at computers to complete documentation and more time discussing cases with the multiprofessional team.

Parallel to this shift toward healthcare provider teams is a growing awareness about the impact of evidence-based design principles on patient care and staff efficiency. The environment's impact on the healing process, infection control practices and safety increasingly are studied in the context of a unit's design and architectural layout. Hybrid professionals and interdisciplinary groups provide integrated solutions that cross disciplines in new ways. Members of the Society of Critical Care Medicine's ICU Design Committee and the task force assembled to update the Guidelines for Critical Care Unit Design are champions for change and healthcare improvement. We asked this diverse group to share their thoughts on the ICU of the future.

"What will the ICU of the Future look like?" p10

Society of Critical Care Medicine
The Intensive Care Professionals

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Clinical Spotlight

ICU Quality Improvement: Snapshots of Success

Better patient safety and quality of care have become post-reform mantras, and nowhere is that imperative more evident than in the intensive care unit (ICU). Technological advances have actually made ICU care more complicated, and hospitals are realizing the need to take a systems engineering approach to quality and safety – and move patients to the center of the process. *Critical Connections* asked program leaders to share their biggest challenges and lessons learned as they strive to make these goals a reality. From combatting data fatigue to integrating various systems, leaders are seeking new ways to improve electronic medical records, data collection and ultimately, patient outcomes.

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Photo courtesy of the newborn and infant critical care unit at Children's Hospital Los Angeles, winner of the 2013 Design Citation Award.

We asked leading experts and innovators …

What will the ICU of the Future look like?

Clinicians and architects share thoughts on informatics, life support systems, design trends, and use of design guidelines in renovation and new construction projects.

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Life Support Systems

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The ICU of the future will require a robust life support system that organizes information (e.g., multifunction physiologic monitor), delivers medical gas utilities and electrical capacity, and allows platforms or baskets to be attached for convenience items, such as sphygmomanometers, otoscopes, or useful supplies. Today's ICUs utilize three basic formats with some variation: headwalls, power columns, and overhead booms. In the future, these systems will be more advanced and wirelessly integrated with improved documentation and communication systems.

It is tempting to say the overhead boom offers the greatest flexibility and immediate access to the patient's head and airway during a code situation – but it not realistic to predict that all ICUs will adopt the most flexible and elaborate system, for reasons of clinician preference, patient acuity, or cost. It is possible, however, to imagine a rational hierarchical distribution of acuity levels, similar to that used in emergency and trauma centers.

Perhaps a community hospital with the lowest expected acuity, designated as level 3, would most often utilize an improved version of the headwall life support system. Large urban and teaching hospitals might have a level 2 ICU that utilizes an advanced power column. The level 1 ICU designation might be limited to tertiary and quaternary institutions or major trauma centers, and these facilities would likely need all the flexibility an overhead boom system could provide. Life support technology selection likely will be based on acuity.

A (Slightly Provocative) Description of Architecture

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As an architect specializing in healthcare for 30 years, and having studied and judged entries to the ICU Design Citation for 10 years, I've observed trends in ICU design that I believe will become the norms of future ICU programs and designs. Not all will apply to every ICU; large academic centers are fundamentally different than small, general community hospitals. Indeed, one shoe does not fit all – but a shoe is still a shoe. Here are my predictions:

1) Larger Units – Expect more ICU beds per unit, and larger unit size per bed. Support space will increase as units become more operationally independent.
2) Patient Room – All-private rooms will remain the standard, with a stable room size of about 250 square feet. Family, toilet and possibly shower space will be added to this square footage.
3) Family Zone – Designated and meaningful family and visitor space amenities will be included in the ICU and patient rooms.
4) Technology and Life Support Systems – Ceiling-mounted life support systems will become the norm in critical care units. See Kirk Hamilton's "Life Support Systems" for additional considerations.
5) Design for Interdisciplinary Teams – ICU teams will become more comprehensive, especially as the units become larger and include more specialties. A balance of centralized and decentralized work stations will be included.
6) Proximity to Diagnostic and Treatment Technology – More units will include diagnostic and treatment technologies, either adjacent to or within the unit. Improved mobile technology will be part of this trend.
7) Administrative and Related Spaces – Locating administrative, educational and research spaces within the ICU will be the norm.
8) Unit Geometry – ICUs will continue to adapt to surrounding conditions. Large units will be subdivided into smaller, manageable groupings of beds.
9) Unit Circulation – Segregation of public/visitor and patient/support circulations, horizontally and vertically, will be expected.
10) Access to Nature – The importance of nature to patients, families and staff is fully recognized and will be incorporated, regardless of unit size.

Advanced Informatics

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The patient will be at the center of a vast computer system in the ICU of the future. Therefore, primary design goals will revolve around the electronic integration of the patient with all aspects of care (i.e., devices, data, supplies, caregivers, medical and administrative applications and the electronic medical record [EMR]), utilizing the data and monitoring of the ICU environment.

The patient will be at the center of a vast computer in the ICU of the future. Therefore, primary design goals will revolve around the electronic integration of the patient with all aspects of care (i.e., devices, data, supplies, caregivers, medical and administrative applications and the electronic medical record [EMR]), data and monitoring the ICU environment.

Three elements are critical to the success of advanced ICU informatics. The first is the association of all data sources and their output with the ICU patient. This is accomplished by either linking the data with the patient or with the patient's location. The second element is synchronizing time across all bedside devices and systems to achieve a stable electronic flow sheet and medical record. The third is achieving "interoperability" among data sources, middleware and the medical record. This process converts and aligns the proprietary data output of medical devices with industry standards (www.ihe.net), thereby allowing the middleware to recognize the data.

ICU middleware has the potential to perform many functions that advance both ICU care and management. Alarm systems capture alerts and convert them into actionable information by filtering and transmitting them to dedicated receivers and personnel. Intelligent alarm systems can even analyze raw device data and create personalized alarms. Data "sniffers" monitor ICU data and the EMR and profile patients at risk for clinical deterioration. Real-time locating systems/solutions (RTLS) can improve management and workflow by tracking or locating tagged assets, monitoring device utilization and controlling product inventory. RTLS can also be integrated with existing systems to improve personnel location, infection control and patient room management. Devices (e.g., all ventilators) can be monitored by middleware, thereby supporting global device viewing (i.e., local telemedicine), alarm transmission, report generation, and remote troubleshooting. Lastly, ICU middleware can create smart displays that merge data from bedside devices and the EMR and process these data through artificial intelligence algorithms.

Design Guidelines

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Guidelines have a role in the design and construction of the modern ICU. Two important sources of guidelines are the medical literature and the documents created by organizations like the Facilities Guidelines Institute (FGI).

The FGI Guidelines for the Design and Construction of Health Care Facilities are produced by a committee of about 120 professionals from various backgrounds, including physicians and nurses, infection control personnel, architects and designers, structural and mechanical engineers, and others with particular expertise in the design of healthcare facilities. Devised to meet minimum standards for design and construction, these guidelines are adopted throughout the United States and are used in other countries. In the United States, these are integrated into state regulations, either partially or in their entirety. The FGI guidelines also reflect and incorporate other subspecialty requirements, such as electrical, air handling, Americans with Disabilities, and Life Safety Codes. Because these are minimum standards, they can be exceeded but not reduced.

The second source, the medical literature, contains the SCCM's Guidelines for Intensive Care Design, created from a different perspective – as optimal evidence-based design. For instance, these guidelines recommend larger rooms and clearances. The combination of guideline perspectives is complimentary and will help achieve a design that fits the individual unit and the particular program, with the potential to adjust costs.

An important consideration in both the FGI and SCCM guidelines is adoption of these tools early in the design process by developing the functional program, an understanding of spaces needed to comprise the ICU. The use of design guidelines and standards enhances the finished environment, and ongoing revisions are necessary to keep pace with the changing nature of medical practice, technology and evidence-based studies. Find the SCCM guidelines at www.LearnICU.org/guidelines.

Apply for the ICU Award Design Citation. See page 7 for details.