

# information edge

## I See You at the e-ICU

### EXECUTIVE SUMMARY

With apologies to Charles Dickens, it's the best of times and the worst of times when it comes to information technology in healthcare. We've developed CPOE systems that can cut medication errors, for example, but—as a recent Washington Post article noted (Dec. 3, 2002, p. HE01)—we haven't made significant progress in implementing such systems in the three years since the first Institute of Medicine report on medical errors.

However, examples have emerged of strategic use of IT that can help hospitals dramatically improve care in discrete clinical settings while they continue to implement the more complex CPOE over the long term. Our September Information Edge discussed how bar coding and other tools can automate pharmacy and medication processes resulting in significant cuts in errors and waste—all while increasing nursing morale. In this issue we highlight a use of IT in clinical care that grew out of telemedicine: the electronic intensive care unit or “eICU.”

Developed by physicians at Johns Hopkins Hospital and Health System, the eICU offers a compelling case for automation: it uses off-the-shelf, simple-to-install hardware like high-resolution video cameras to enable intensivists to visually monitor critical-care patients from miles away 24 hours a day, seven days a week, resulting in as much

as 20% decrease in mortality, according to experts at Norfolk, Va.-based Sentara Healthcare, one of the first healthcare systems to implement an eICU.

This report explores Sentara's eICU effort as well as one it helped inspire at Sacramento, Calif.-based Sutter Health. We also talk to a clinical expert at First Consulting Group and executives at Baltimore-based Visicu Inc., which makes eICU systems.

The eICU strategy could have legs. Besides its straightforward design and demonstrable impact on care, the eICU strategy helps fill the gap caused by a national shortage of intensivists. Only about 10% of hospitals have full-time intensivists, according to the Wall Street Journal (Nov. 21, 2002) while a study in the Journal of the American Medical Association concluded that increased use of intensivists could dramatically cut the 500,000 deaths in this country's ICUs each year and save some of the \$1.8 billion in annual cost of intensive care. The Leapfrog Group has also endorsed use of intensivists as a cornerstone of patient safety.

While the ICU is only a piece of the continuum of patient care, by definition it is the most intense piece. Successfully reengineering ICU processes using appropriate technology cannot only improve critical care but may provide a model for the other pieces of the continuum as well.

JANUARY 2003  
Volume 9,  
Number 1

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### Upcoming Events

**February 17,** "JCAHO Standards Update: Patient Care Technology," Angela Smeal, JCAHO Surveyor, reviews the new standards as it relates to technology in patient care.

**February 18,** "Health Plan Trends and Forecast," Tom Watford and Steve O'Dell, FCG, provide an overview of the strategic and technology related trends in the health plan market segment and how providers will prepare for them.

**February 20,** "Revenue Cycle Self Assessment and Benchmarking," Patrick Jennings, Dave Smith, and Leigh Drango, Stockamp & Associates, lead the continuing discussion about best practices in revenue cycle metrics. Updated blinded member survey data provides best practices and stimulates discussion of how members are improving their performance.

**February 26,** "Pay for Performance: Bonuses to Physicians for Improving Quality of Care," Beau Carter, Executive Director, Integrated Healthcare Association, presents the standards that have been adopted by 6 California payers and are now covering 8 million lives. The collaborative development process, the upside to physicians, and future standards being evaluated are included in this review.

*more events on next page*

## Sentara is watching over you

"Two years ago, I was trying to figure out how we were going to keep our pulmonary critical-care doctors," recalls Rodney Hochman, MD, CMO at Norfolk, Va.-based Sentara Healthcare. That's when a couple of physicians from nearby Johns Hopkins dropped by with their vision of the eICU.



**Rodney Hochman,  
MD, Chief Medical  
Officer  
Sentara Healthcare,  
Norfolk, Va.**

the actual ICU, a video camera, controlled by the remote doctor, is positioned at the end of each patient's bed and can swivel around to either view the patient—to ensure a tracheal tube is correctly positioned, for example—or view a whiteboard next to the bed with the latest nursing notes about that patient. To alert those nearby, a doorbell-like chime rings whenever the camera is activated.

Physicians in the remote ICU can also view data from the critical-care monitors next to each patient's bed. Evidence-based medicine data built into algorithms figure in such factors as heart rates and co-morbid conditions and trigger a flashing alert if they sense a patient's condition is deteriorating. This trending of vital signs occurs on a minute-by-minute basis and enables physicians to reassess a patient before a problem occurs—a major factor in lowering mortality rates.

A group of critical-care doctors from Sentara became excited about the system's possibilities, encouraged by the fact the vendor, Visicu, was physician-run.

The eICU concept is simple. Designed like a virtual doctor in Star Trek, a remote site is equipped with high-resolution video screens and critical care patient monitors so physicians can view 40 or more patients and their data from a remote site. In

## Spreading the word

The health system also involved nurses and finance personnel early on in the decision-making process to help ensure success. "We said, let's start unit by unit, and we spent a lot of time talking to the medical staff. This is about process change—and not about software. It's about how work in the ICU is done," says Hochman.

After launching a redesign of four ICUs in three of its hospitals two years ago, Sentara has extended eICU-monitoring to 65 beds: Norfolk General, a 569-bed trauma and transplant center (general ICU and vascular ICU) and 194-bed Sentara CarePlex account for 27 and 24 beds respectively; 110-bed Sentara Bayside, 30 miles from the eICU, has 14 ICU beds. Management expects to expand the system to 85 beds in early 2003.



**Bert Reese, Chief  
Information Officer  
Sentara Healthcare,  
Norfolk, Va.**

which would have undermined the efficiency of the strategy, says Bert Reese, Sentara CIO.

The result has been a 25% to 30% reduction in mortality at one ICU. "It's just phenomenal," says Hochman. "That's one additional person walking out alive each week, or 50 to 60 each year. At first we didn't believe it, so we brought in a third-party. [We know now that] there's no ambiguity in the data.

## Corrections in flight

"There are very few things we do in the clinical world that have that kind of dramatic clinical outcome," he says. The financial side

has also been quite positive, with a 155% return on initial cost within two years of launch. IT projects typically do not achieve ROIs of this magnitude. Another exciting benefit has been an improvement in the nurse-retention rate in the ICU. Turnover has dropped by as much as 50%. “Nurses have been tremendous supporters of this system,” says Hochman.

As part of its eICU strategy, Sentara has maintained existing nurse and onsite intensivist positions, layering the system on top of pre-existing care. “We didn’t change anything [in terms of staffing levels]. That was critically important. This is a way to support nursing staff—not decrease it,” notes Hochman.

The eICU allows doctors to fine-tune a patient’s care, making changes and adjustments before they become critical—the same way a pilot can make course changes. Most are very small corrections, says Hochman, but they avoid catastrophes downstream. “We’re preventing people from getting into more complicated scenarios.”

For example, in the middle of the night a patient’s potassium might be a little off and the intensivist on duty at the ICU can make slight changes to keep it at the right level, avoiding a precipitous drop by morning and the patient in complete arrhythmia.

## Low maintenance

Organizations can be flexible in their deployment of an eICU. It’s not necessary, for example, to monitor every bed in an ICU. “A lot has to do with the organization,” says Reese. Sentara operates its eICU from 12:00 noon to 7:00am the next day, leaving only five hours when the system is not on. Doctors continue to make rounds in the ICU itself during that time.

“What’s unusual about this is that it’s relatively simple,” he says. “It doesn’t take a lot of care and feeding like lots of other IT,” says Reese, adding that the eICU is simple to set up because it’s self-contained and doesn’t

require interfaces to other systems. The IT cost was also inexpensive—essentially the cost of two high-speed T-1 lines and cameras for the units—at less than \$50,000, not including the software cost from Visicu.

A side benefit of eICU implementation: it causes an organization to scrutinize its care model. “This forces you to really examine the way you do business, to radically rethink through workflow,” asserts Reese, adding that the experience prepares a hospital or delivery system to move forward on more demanding jobs like CPOE. “You’re really ready to radically redesign care.”

As such, the eICU is not so much IT-related as it is cultural. The eICU engenders an important confidence. “You say, ‘Look what we did with the ICU. Now, what can we do to our med/surge units?’” says Reese.

## Family Affair

Currently, Sentara has e-ICUs in three of its hospitals and continues to roll out others. Next year, Sentara will incorporate ADT and laboratory values into all its eICUs. The organization is also considering deploying the eICU at outlying hospitals that often send patients to Sentara for specialized care. The advantages would be improved health for that community, a further source of revenue to support eICU operations and bolstering of the referral base for procedures done within Sentara hospitals.

While better patient monitoring is the eICU’s primary benefit, there are side benefits, too. For example, the system’s teleconferencing equipment also allows family members present in the ICU to visually communicate with critical-care physicians at wee hours of the morning. That capability “addresses a consumer need within the restraints of limited resources,” says Hochman.

And there are other potential sites for using the technology, such as in the emergency department and step-down units.

**February 27**, “Continuous Computing and IT Service Management,” Dave Dimond and Robert Burgess, FCG, present the people, process and technology challenges and solutions for avoiding systems outages and maintaining appropriate back-up plans. The session helps you assess your organization’s ability to avoid system outages, provides best approaches to disaster recovery and disaster planning, and leading examples of disaster management.

**March 5**, “Data Center and Help Desk Consolidation,” Gayle Vernon Simkin, Office of the CIO, and Duayne Paul, Vice President for Administrative and Infrastructure Strategy, CHW, discuss the initiative that took CHW from 22 data centers to 1, and from 19 Help Desks to 1 serving 42 hospitals and 400 service sites.

**March 12**, “How Recent Pharmaceutical Regulations in Marketing, Advertising, and Training Impact Prescribing,” Chet Shemansky, FCG, describes what we can expect to see as a result of changing regulations in pharmaceutical marketing.

**April 17**, “Electronic Health Records Research Report: Quality Outcomes Justify Government Investment,” Dr. David Westfall Bates, Chief Director of General Medicine, Partners Healthcare, Boston, MA, and Associate Professor in Medicine, Harvard Medical School, Associate Professor, Harvard School of Public Health, Department of Health Policy, presents his work published in JAMIA, January 2003, comparing the US to other countries in funding and the resulting use of EHRs.

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*The critical-care skill set is largely a decision skill set rather than one of technique like surgery. So, while there are some interventions, most intensivists work around complex decision-making.*

“I think we’re going to see the eICU concept all over. There are several exciting possibilities,” says Hochman, who sees an analogy in robotic surgery, which allows surgeons to operate on patients remotely.

## Envisioning the eICU

As a practicing critical-care physician, Brian Rosenfeld, MD, co-founder of Visicu and associate professor of anesthesiology, medicine and surgery at Johns Hopkins School of Medicine, was appalled at the high mortality rate for ICU patients and the shortage of intensive care doctors. Driven to find a solution, he developed a remote care delivery model that includes imbedded care algorithms.



**Brian Rosenfeld,  
MD, Co-founder  
Visicu  
Baltimore, Md.**

“You can only do that kind of clinical factoring with computers,” says Rosenfeld. “One algorithm has over 250,000 permutations. If it’s going to work it’s got to be explicit.”

Visicu’s e-ICU system incorporates several components:

- Decision support software
- “Smart Alerts” that run real-time data through rules engines
- Computerized surveillance of the critical-care patient

More specific than clinical guidelines, which provide generalized steps in treating patients based on a specific illness, the algorithms consider the interplay of localized factors such as the fact that a patient might have hospital-acquired pneumonia, has underlying diabetes, that it is influenza season and there’s the presence of nosocomial cases of Legionella.

- Diagnostic information from bedside critical-care patient monitors,
- Continued intensivist presence on the ICU itself.

## ‘Glorified post-op’

Rosenfeld says traditional ICUs are ripe for such change. “There are so many points of failure. The system is flawed from a design standpoint. If you think about what an ICU is, it evolved out of the room where you’d bring a patient out of surgery to be on a ventilator. It’s still a glorified post-operative center.”

However, that department has grown to account for 10% to 20% of hospital beds and 20% to 30% of hospital costs, he asserts. “It has never been designed from the ground up. It’s just mushroomed with technology added on,” Rosenfeld argues, adding that staffing patterns haven’t changed over the years either. Nurses continue to staff the ICU and doctors visit irregularly.

He cites studies in Israel showing a 1% error rate for 178 interventions on average per day per ICU patient, or the equivalent of two “near-misses” each day. If that error rate were improved ten-fold and applied to the postal service, that would mean 16,000 letters delivered to the wrong house daily.



**Frank Sample,  
President, Visicu  
Baltimore, Md.**

Frank Sample, president of Visicu, says the cost of an eICU varies with hospital size—the number of ICUs and ICU beds—but startup costs for a system to cover 40 patients range from \$1.6 million to \$2

million, including hardware, software and training.

Future plans include more sophisticated alerts as well as a “Smart Reports” component

that provides feedback on how well the ICU is managed, including such factors as hospital length of stay and number of patients with sepsis.

### Sutter strikes gold

Sutter Health, a not-for-profit network of community-based health care providers throughout Northern California, has the dot-com collapse to thank for perhaps the most advanced eICU building architecture. A year-and-a-half ago, the health network was able to acquire for pennies on the dollar a state-of-the-art data center in Sacramento previously slated as the flagship of a national Internet company. Sutter uses a relatively small portion of this facility—which has biometric sensors, Kevlar-lined walls and three complete diesel generators to help make it bullet, bomb and earthquake-proof—to house its remote ICU less than four blocks from the nearest hospital.



**Van Johnson, CEO  
Sutter Health  
Sacramento, Ca.**

But it's what happens inside the building that has impressed Sutter CEO Van Johnson "The eICU makes a lot of sense," says Johnson, who became convinced of the technology after observing intensivists in an

eICU at Sentara catch and correct a wrong medication that was given by house staff. "This is one of those technologies that enhances the power of intensivists. It's awfully hard to hire these guys" because of their scarcity, he says.

Johnson was impressed by the fact that an already top-performing hospital like

Sentara could improve its mortality rate by 20% by adopting an eICU. "Our affiliated hospitals operate more than 400 ICU beds in northern California. We asked ourselves – what if we implemented this safety technology system wide," he says, adding that he wasn't sold on eICU by its economy but by its patient-safety aspects. For one thing, California state law requires one RN for every two patients in the ICU, so the eICU was never meant to reduce FTEs.

Sutter's goal in the next three years is to extend the eICU to all ICU patients at the organization's hospitals, thereby adding an extra layer of safety and complementing the care provided by on-site clinical staff.

### De-intensifying intensivists

"The driver is the intensivists—there simply aren't enough to go around," says Johnson. Sutter's strategy is to have intensivists rotate between the floor and the eICU, giving the doctors a much-needed breather. "Intensivists usually burn out by age 45," he says.



**Gordon Hunt, MD  
Senior Vice  
President and Chief  
Medical Officer  
Sutter Health  
Sacramento, Ca.**

single ICU patient can absorb most of a doctor's attention.

Hunt—a 20-year veteran of pulmonary critical-care medicine—says after carefully scrutinizing the new system he became "really excited" about its possibilities.

*Sutter's strategy is to have intensivists rotate between the floor and the eICU, giving the doctors a much-needed breather.*

Senior VP and CMO at Sutter Health, Gordon Hunt, M.D., agrees with Johnson's assessment. "Most intensive care units do not have full-time intensivists," says Hunt, noting a nationwide shortage of 30,000. That figure is even more compelling given the reality that a

*“One of the system’s challenges is the lack of integration of content and protocols with a full electronic medical record.”*

**Mitch Morris, MD**  
First Consulting Group

## Complex decision-makers

“The eICU allows us to take the knowledge base and make it available in a much broader fashion. The critical-care skill set is largely a decision skill set rather than one of technique like surgery. So, while there are some interventions, most intensivists work around complex decision-making. The physician does not need to be present, but does need to be able to view the patient and access to EMR data, including alerts, reminders, protocols and laboratory results,” says Hunt.

He hopes to extend the eICU concept to trauma units, where the so-called Golden Hour or first hour is key to patient survival. Every hour in the ICU is the Golden Hour, Hunt says.

In the future, Hunt predicts that there will be an increasing exchange of digital information allowing doctors who have always made remote decisions by telephone to improve their decision-making with much richer information and with access to critical information sources—pharmacy information, medical records and automated decision support. For example, the ability to view skin lesions remotely in conjunction with medical record data could greatly enhance pathology, radiology, recovery rooms and ERs.

Hunt also expects to see the concept used similarly to a heart-monitoring terminal for patients who require high visibility but not necessarily with high acuity, such as those with pain medication, anesthesia and so on. “I can see us developing this technology.”

## Conclusion

The eICU has demonstrated a very positive impact early on, but it also has some flaws.



**Mitch Morris, MD,**  
Vice President and  
Manager of Health  
Provider Practice  
First Consulting Group  
Long Beach, Ca.



“As a standalone solution, this eICU system is pretty good,” says Mitch Morris, VP and head of First Consulting Group’s health provider practice. “It can

produce good results in terms of lowered morbidity, mortality and hospital length of stay.

“However,” he says, “one of the system’s challenges is the lack of integration of content and protocols with a full electronic medical record. It’s not yet fully integrated with CPOE systems. At the entry and exit points of the ICU, the handoffs are still missing. It’s also unclear where it fits in with full-featured ICU medical records from vendors such as Picis,” a Wakefield, Mass.-based vendor of integrated OR, anesthesia and critical-care IT systems, he says.

Despite the flaws, however, the eICU has demonstrated real results in improving the care of ICU patients and provides a strong foundation for implementing more complex clinical initiatives like CPOE. All in all, that’s a very good prognosis.



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