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# Trends in and Considerations for Implementing eICU Technology

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## RESEARCH IN BRIEF

Hospital administrators are implementing electronic intensive care units (eICUs) within hospitals primarily to improve clinical quality and patient safety. They have found that effective implementation of eICU technology can lead to substantial costs savings and improved ICU physician and nurse satisfaction. Hospital directors that utilize eICUs cite initially garnering clinical enfranchisement, expending a high amount of capital, and developing brand awareness as primary obstacles to successful implementation and utilization of eICU technology. This Original Inquiry brief highlights selected trends and observations pertaining to the implementation of eICUs derived from interviews conducted with administrators at institutions with eICU technology.

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**THE ADVISORY BOARD COMPANY**  
**WASHINGTON, D.C.**

## I. RESEARCH METHODOLOGY

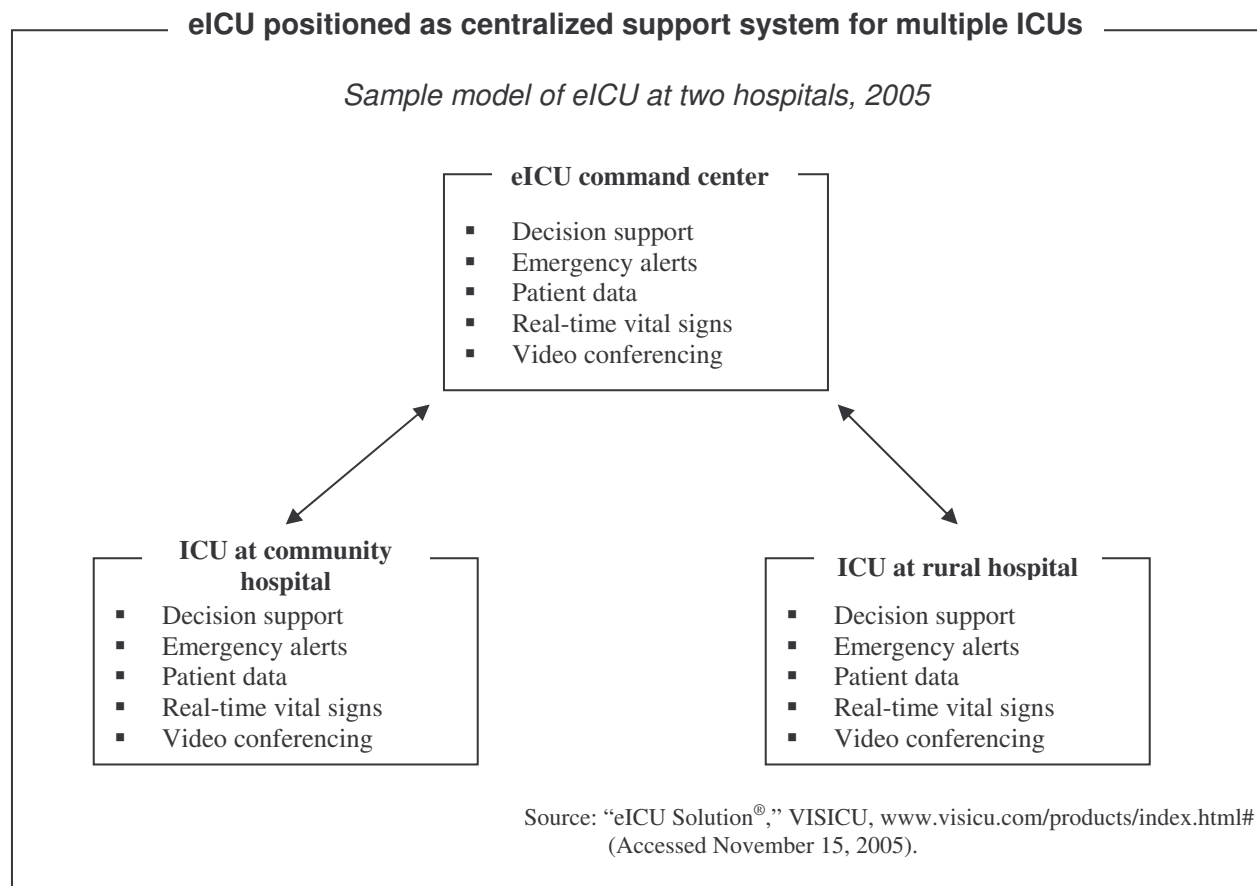
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The findings detailed in this report were drawn from interviews with the following sources:

| <b>Institution</b>  | <b>Source(s)</b>                                | <b>Year of Inception</b> | <b>Telehealth vendor</b>  | <b>Impetus for implementing eICU</b>   |
|---|---|--------------------------|---|--|
| <b>Hospital A</b><br>500-bed, not-for-profit, community hospital that is part of a multi-hospital system in the Southeast | Director, Electronic Intensive Care Unit (eICU) | November 2004            | Contract with VISICU for technology platform and Phillips for monitoring equipment                                | Counter impact of intensivist staffing shortage  |
| <b>Health System B</b><br>2,000-bed, not-for-profit, multi-hospital, community health system in the Midwest               | Manager, eICU Care Center                       | December 2004            | Contract with VISICU for technology platform and multiple vendors for monitoring systems                          | Improve clinical quality and reduce mortality rates                                    |
| <b>Health System C</b><br>1,500-bed, not-for-profit, community health system in the Southeast                             | Director, Patient Care Services                 | June 2000                | Contract with VISICU for technology platform and Phillips for monitoring equipment                                | Improve clinical quality and patient safety, and reduce costs associated with ICU care |
| <b>Hospital D</b><br>500-bed, not-for-profit, community hospital in the Midwest   | Director, eICU                                  | August 2004              | Contract with VISICU for technology platform and inTouch for monitoring equipment, which includes clinical robots | Improve clinical quality per the suggestion of quality management administrators       |

## II. BRIEF OVERVIEW

Electronic intensive care unit (eICU) technology was developed in 1998 by two Baltimore, Maryland-based Johns Hopkins Health System intensivists to improve intensive care unit (ICU) patient outcomes by adding a computer database and 24-hour per day monitoring services to the care continuum.<sup>1</sup> The technology utilized is primarily composed of a series of cameras, videoconferencing equipment, and computer software installed at a patient's bedside to connect an ICU to a centralized monitoring workstation. To operate eICUs, board-certified intensivists and critical care nurses staff an off-site command center and monitor patient data received electronically from participating ICUs. The following graphics further illustrate how eICUs operate:



The eICU command center is positioned as the central point of remote monitoring services. However, in order to effectively operate an eICU, ICU administrators are best served to allow for two-way interaction and knowledge-sharing to ensure that the patient care is conjointly managed. As a result, the diagram above reflects the two-way communication sharing and knowledge management that the eICU and an ICU maintain in order to provide high quality patient care.

<sup>1</sup> Atwater, A. "Virtual ICU, Real Benefits." *Wichita Eagle*. (October 2005). (Accessed November 15, 2005).

Although the technology is considered to be comprehensive and highly progressive—according to the interviewed administrators—opportunities for growth exist that reflect expansion of technology capabilities and extension into additional service lines. For instance, the development of portable eICU technology and introduction of additional patient care metrics—such as vital signs, medication dispensation, and end-of-life indicators, and increased utilization of electronic medical records (EMR) applications—represent trends that are projected to significantly impact eICU technology.<sup>2,3</sup> Additionally, administrators indicated that remote monitoring services could easily be implemented into most inpatient care units in hospital settings. Although developments in eICU technology have not been widely reported—most likely due to the relative novelty of the technology itself—the interviewed administrator at Hospital A believes that the possibilities that exist within other service lines will impact the development of eICU technology, with the strongest emphasis likely to be on metrics capable of being measured.

### **Implementation process considered seamless but requires initial involvement by vendor**

As with the implementation of most new technologies, eICU technology requires initial involvement by vendors to assist hospital personnel in installing and refining functions as well as providing critical care nurses and command center staff with introductory training. However, each of the interviewed eICU administrators considered the overall implementation process to be seamless and indicated that it did not interrupt the ability of clinicians to provide care to ICU patients.

### **First mover advantage impedes maturation of market**

Although the market for monitoring technology—with specific regard to ICUs—has rapidly developed since 1998, the utilization of comparable technology has not resulted in a competitive market. In particular, the aforementioned Johns Hopkins Health System intensivists, in combination with venture capitalists, founded Baltimore, Maryland-based VISICU and, thereafter, patented the eICU technology application. VISICU is currently the sole provider of remote monitoring technology dedicated to the ICU. However, the eICU administrator at Health System C believes that VISICU's first-to-market approach afforded the company's leadership to position the product as progressive and unique. Additionally, the introduction of the technology at national health care conferences reinforced the company's reputation as being first-to-market of this technology, ultimately resulting in implementation of VISICU technology at 33 sites across the nation and administrators reliance on one provider during decision-making stages. However, the eICU administrator at Health System C cited the development of a potentially competitive eICU application at Kansas City, Missouri-based Cerner Corporation. To date, Cerner Corporation has not released any information on a comparable product.

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<sup>2</sup> Advisory Board interview. (November 2005).

<sup>3</sup> Orr, A. "Hospitals Look to the Virtual ICU." *News.com*. (October 2005). [https://news.com.com/2102-11393\\_3-5913059.html](https://news.com.com/2102-11393_3-5913059.html) (Accessed November 16, 2005).

### III. SELECTED RECOMMENDATIONS FOR IMPLEMENTATION

The following recommendations were derived from the interviews conducted with administrators at four institutions with eICU technology:

#### **Recommendation #1—Administrators should develop relationships with existing eICU command centers.**

Due to the large initial capital investment required to develop an eICU, the interviewed administrators indicated that, as an alternative to a dedicated command center, developing a relationship with an institution that already maintains a dedicated eICU would provide similar services to a hospital's ICU without requiring as large of a capital investment. Additionally, the eICU director at Hospital D indicated that other options to obtain monitoring services included forming cooperatives to share the burden of eICU costs.

#### **Recommendation #2—Involve physicians and nurses in implementation phases to support enfranchisement and develop relationships with clinicians.**

Given that physician and nurse buy-in is considered to be the primary obstacle in successfully implementing eICU technology, each of the interviewed administrators believes it is imperative to include clinicians during the implementation phase. As a result, administrators feel strongly that employing various strategies associated with enfranchisement will overcome sentiments of feeling threatened and form stronger, long-term relationships. The table below reflects strategies that all the interviewed hospital administrators employed to facilitate physician and nurse enfranchisement.

#### **Enfranchisement strategies centered around medical education for implementation of eICU technology**

*Enfranchisement strategies, 2005*

| <b>Institution</b>     | <b>Enfranchisement strategies</b>  |
|------------------------|--|
| <b>Hospital A</b>      | <ul style="list-style-type: none"> <li>▪ Conduct medical education seminars that allow clinicians to utilize the technology and understand the ICU care process with the eICU technology in place</li> <li>▪ Utilize portable units to demonstrate at physician offices and within ICUs how the technology works</li> </ul>  |
| <b>Health System B</b> | <ul style="list-style-type: none"> <li>▪ Collect qualitative and quantitative data on patient satisfaction and improvements on outcomes to show physicians and nurses the benefit of eICUs on ICU performance</li> <li>▪ Install buttons to warn eICU staff of any changes to patient status or what stage a patient is during the care process, which pushes both clinicians and eICU staff to proactively approach one another</li> <li>▪ Leverage outcome facilitation teams to jointly identify with physicians and nurses how to develop a unified approach to providing care within the ICU</li> </ul> |
| <b>Health System C</b> | <ul style="list-style-type: none"> <li>▪ Conduct demonstrations that introduce the technology and capabilities of monitoring systems</li> <li>▪ Leverage the role of the Chief Medical Officer (CMO) in acting as advocate of the technology through seminars and roundtable discussions to alleviate any concerns</li> </ul>  |
| <b>Hospital D</b>      | <ul style="list-style-type: none"> <li>▪ Promote the benefits via demonstrations at physician practices and in the ICU</li> </ul>  |

Source: Advisory Board interviews, (November 2005).

**Recommendation #3—Mitigate the impact of disparate clinical IT applications and records management processes.**

eICU technology serves to combine disparate pieces of important data into a single package that makes it easier to analyze and respond to patient care, the interviewed administrator at Hospital A cited the importance of an integrated and interfaced clinical IT model to ensure that eICU staff members have the ability to provide patient care with the support and knowledge of other departments and their respective protocols. Emphasizing the use of EMR further supports the effectiveness of an eICU as records management across a unified platform will facilitate the integrated delivery of care.

**IV. BENEFITS OF eICU TECHNOLOGY**

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Though the development of eICU technology is still considered to be in its infancy—and as a result, has not been widely adopted within health care industry—the benefits of its utilization have been significant. Administrators cite numerous indicators related to clinical, operations, and human resources (HR) functions as evidence of eICU technology’s effectiveness. However, the administrator at Health System B noted that the limited adoption of eICUs has impeded the ability of hospital administrators to measure the success of an eICU operation. More specifically, administrators are currently only able to track the most prominent ICU metrics—most notably length of stay (LOS), mortality rates, and incidence of critical care processes such as ventilator associated pneumonia (VAP). Nonetheless, the presence of an eICU is considered to have a significant impact on the ICU.

**Consistent monitoring can significantly reduce LOS, complication rates, improves overall patient safety**

All four of the interviewed eICU administrators indicated that the decision to implement eICUs at their respective institutions was heavily influenced by the desire to improve patient care through consistent monitoring. Although the novelty of the technology has impeded administrators’ ability to comprehensively measure effectiveness, overall ICU complication rates, LOS, discharge metrics, and infection rates have been significantly impacted. Health System C, for example, has reduced severity adjusted mortality rates by 27 percent and LOS by 17 percent since installation. Furthermore, patients maintain constant access to both physicians and critical care nurses as a result of the eICU system. The implementation of monitoring equipment can mitigate the possibility of complications arising or intensifying as the application allows eICU intensivists to proactively—as opposed to the more common reactive nature of ICU care—identify trends in patient status.

**eICU technology reduces clinician workload and maximizes physicians’ availability**

Intensivist shortages and complaints influenced the interviewed hospital’s leaders’ willingness to implement eICU technology. Prior to the adoption of eICU technology, the administrator at Health System B indicated that the frustrations that intensivist as well as critical care nurses experienced—which were related to grueling shifts and physically taxing activities—negatively impacted the quality of care patients received at the hospital’s ICU. However, the quote on the following page—provided by the administrator at Health System B—reflects how the presence of the eICU has positively influenced clinician’s demeanor in the ICU:

“The eICU has allowed nurses to rotate shifts and reduce the amount of physically burdensome activities that they engage in on a day-to-day basis. More importantly, nurses have relayed to us that having a system in place enables highly skilled practitioners to do the job they want to do in more places and with more patients during the same time.”

Source: Advisory Board interview,  
(November 2005).

Additionally, eICUs have eased physicians' workload and logistical complications as the use of the technology limits traveling between patients and ultimately allows intensivists to visit more patients during the same time periods. However, the eICU director at Hospital A indicated that clinician satisfaction is predicated on willingness to include eICU technology during the care process and that a majority of physicians are unaware of the benefits of the technology. Inquiries are lodged to senior administration—who have been overwhelmingly supportive and positive with regards to the eICU—to determine why the eICU is present in the ICU. The eICU director at Hospital A notes that once physicians understand the eICUs were introduced to augment their efforts during the patient care process—not replace clinicians—then satisfaction will significantly improve. Administrators indicated that formal employee satisfaction forums are being developed to truly understand the level of staff satisfaction and provide another opportunity for staff to inquire about the presence of eICU technology. Currently, eICU staff members rely heavily on indirect feedback offered by bedside nurses and are typically provided through the cameras in patient rooms.

### **Patients and family overwhelmingly positive about integration of eICU technology into care process**

Largely due to the condition of most ICU patients—meaning these patients are typically unaware of the care being provided to them—administrators do not receive direct or indirect feedback from patients. Rather, the family members of ICU patients typically provide the majority of recognition after eICU technology is included in the care process. Only the administrator at Health System C indicated that patient satisfaction was monitored via a customer service survey; nonetheless, satisfaction scores are heavily based on immediate, direct feedback offered by the family of patients. All the interviewed administrators overwhelmingly found that approval from patients' family members is positive.

### **Implementation of technology has improved throughput and LOS metrics as well as has positive downstream impact on operational costs**

eICU technology, although minimally adopted at this time, has resulted in significant operational efficiencies, most notably improved throughput and lower LOS metrics. The improvements in operations of the ICU has led administrators to experience cost savings; the director of the eICU at hospital D indicated that the initial investment for the technology in 2004 has already been realized in the form of cost savings in the ICU. However, the operational efficiencies experienced have only been tracked within the ICU; the lack of data reflecting the impact on hospital operations is primarily due to the limited utilization across other departments in the hospital, and therefore hospital leaders have not been able to track the hospital-wide impact of the eICU technology. However, if implemented across multiple departments, such monitoring equipment is projected to positively impact the hospital's operations in a more comprehensive manner.

## V. CHALLENGES TO IMPLEMENTATION

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As with any technology introduction, many challenges and drawbacks exist that impede efficient implementation of eICU technology at hospitals and health systems. The interviewed administrators primarily cited variables such as high capital expenditures, reimbursement issues, and lack of clinician buy-in as major obstacles to implementation and utilization.

### **High, initial capital investment, longer installation time hinders adoption amongst more hospitals**

Although eICUs can have a positive impact on most hospital, the initial capital investment to acquire and implement technology can be perceived as an obstacle to consideration of utilizing the system. The current high cost of eICU technology is likely due to the lack of adoption across health care and the relative novelty of the technology itself; as a result, acquisition cost still impedes adoption.<sup>4</sup> Additionally, the eICU director at Health System C noted that the longer installation time that was experienced during implementation also caused hospital leaders to be concerned about when the benefits of the technology would be realized. This director felt that such lags in implementation time has likely influenced other hospitals administrators' decisions in deciding to adopt eICU technology.

### **Clinicians threatened by presence of eICU, prefer not to integrate technology**

The primary challenge to implementing eICU technology does not lie in the technology itself, but rather in enfranchising physicians and nurses to integrate the technology into their care processes. All of the interviewed administrators indicated that physicians are typically reluctant to utilize eICU systems due to clinicians feeling threatened that the eICU staff will provide the preponderance of care. More specifically, clinicians have brought concerns to administrators regarding the loss of control they experience in the presence of eICUs. Additionally, the reaction of physicians has impacted nurse response to eICUs as critical care nurses perceive the technology to require extensive training and significantly add to their already burdensome workload. Thus, the integration of the technology into the ICU's care continuum requires additional effort and time to overcome the lack of physician and nurse buy-in.

### **Regulatory issues eliminate opportunities to collect for services**

Medicare and Medicaid regulations currently eliminate any opportunity for hospitals to be reimbursed for the provision of care at an ICU which utilizes an eICU due to the categorization of an eICU under telehealth services.<sup>5</sup> Additionally, each of the interviewed administrators indicated that hospital leadership does not charge patients for the utilization of monitoring systems during their stay at the ICU. Both actions are based on the perception that utilizing eICU technology provides hospitals with a cost benefit that does not merit additional financial benefits such as self-pay patients or reimbursement. As a result, eICU technology does impact profitability by generating cost savings to hospitals but does not impact revenue positions at this time.

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<sup>4</sup> Advisory Board interview. (November 2005).

<sup>5</sup> *ibid.*

**Administrators find it difficult to appropriately market the services, develop community awareness**

Largely due to low patient volumes and the limited adoption of eICU technology, each of the interviewed administrators has found it difficult to generate awareness within their respective communities. Hospital administrators primarily rely on word-of-mouth, anecdotal marketing from patients and their families, and an overview of the eICU within marketing for specific service lines to promote eICU technology. However, although word-of-mouth has generated positive reactions from members of the community who are aware of the eICU—as evident by the indirect feedback outside of the hospital given to all four of the interviewed directors—no formal marketing endeavors have been undertaken. The eICU director at Hospital D believes this is primarily due to the difficulties experienced internally in developing enfranchisement, which has prohibited administrators from employing push marketing strategies onto the community given that administrators are finding it difficult to market the technology internally.

## Research Methodology

During the course of research, we searched the following resources to identify pertinent information:

- Advisory Board's internal and online ([www.advisory.com](http://www.advisory.com)) research libraries
- Factiva™, a Dow Jones and Reuters company
- Internet, via search engines and multiple websites, including the following websites:
  - ✓ American Telemedicine Association at [www.atmeda.org](http://www.atmeda.org)
  - ✓ Association of Telehealth Service Providers (ATSP) at [www.atsp.org](http://www.atsp.org)
  - ✓ Blue Cross and Blue Shield of South Carolina at [www.southcarolinablues.com](http://www.southcarolinablues.com)
  - ✓ Center for Telemedicine Law at <http://telehealth.hrsa.gov>
  - ✓ Centers for Medicare and Medicaid Services (CMS) at <http://cms.hhs.gov>
  - ✓ *Critical Care* at <http://ccforum.com>
  - ✓ Frost and Sullivan at [www.frost.org](http://www.frost.org)
  - ✓ General Electric (GE) at [www.gehealthcare.com/usen/index.html](http://www.gehealthcare.com/usen/index.html)
  - ✓ *Health Leaders* at [www.healthleaders.com](http://www.healthleaders.com)
  - ✓ *Healthcare Informatics* at [www.healthcareinformatics.com](http://www.healthcareinformatics.com)
  - ✓ Healthcare Information and Management Society (HIMSS) at [www.himss.org](http://www.himss.org)
  - ✓ *Healthcare IT News* at [www.healthcareitnews.com](http://www.healthcareitnews.com)
  - ✓ Hewlett Packard (HP) at [www.hp.com](http://www.hp.com)
  - ✓ *iHealthbeat* at <http://ihealthbeat.org>
  - ✓ *Journal of the American Medical Association (JAMA)* at [www.jama-assn.org](http://www.jama-assn.org)
  - ✓ *Modern Healthcare* at [www.modernhealthcare.com](http://www.modernhealthcare.com)
  - ✓ National Library of Medicine (NLM) National Telemedicine Initiative at [www.nlm.nih.gov/research/telemdinit.html](http://www.nlm.nih.gov/research/telemdinit.html)
  - ✓ Philips at [www.philips.com](http://www.philips.com)
  - ✓ PYXIS at [www.pyxis.com](http://www.pyxis.com)
  - ✓ Siemens Medical Solutions at [www.siemensmedical.com](http://www.siemensmedical.com)
  - ✓ Telemedicine Information Exchange at <http://tie.telemed.org>
  - ✓ *Telemedicine Today* at [www.telemedtoday.com](http://www.telemedtoday.com)
  - ✓ VISICU at [www.VISICU.com](http://www.VISICU.com)
  - ✓ WelchAllyn at [www.welchallyn.com/medical](http://www.welchallyn.com/medical)
  - ✓ World Health at [www.worldhealth.net](http://www.worldhealth.net)

Based on leads generated by the resources above, researchers contacted eICU directors at institutions that utilize such technology within the ICU.

## Professional Services Note

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