# The Use of Mobile Devices To Improve Alarm Systems

David Hoglund and John Elms

The Joint Commission 2007 Annual Report stated, "Inadequate communication between care providers, or between care providers and patients/families, is consistently the main root cause of sentinel events."[1] Critical components of communication regarding the health status of a patient are the alerts and notifications originating from the various patient monitors; yet according to the *American Journal of Emergency Medicine,* as many as 99.4% of alarms are false and less than 1% result in change to patient management.[2] Looking to 2011, alarm hazards remain an ongoing challenge, listed at number two on the ECRI Institute's *Top 10 Health Technology Hazards* for this year.[3] This paper addresses how the use of mobile devices such as the iPhone, the Android smart phone, and the Blackberry with intuitive interfaces and messaging coupled with an integrated alarm management platform will improve clinical satisfaction and operational workflow and decrease risk at the point of care.

Comparison to Other System Models

In flight control, multiple alarms led to the development of a "heads up display" (HUD). The purpose of a HUD is to provide critical data to the viewer while not distracting him or her from the primary task for which the data is needed. A HUD informs a fighter jet pilot of heading, altitude, air speed, and orientation to the horizon line, among other data, which lessens the need for the pilot to look down at the instrument panel.
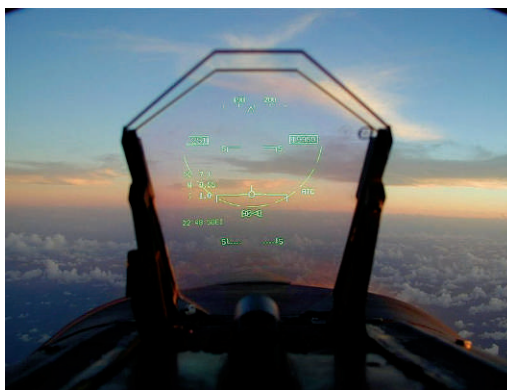
Fighter jets employ what's called a "heads up display," developed in response to multiple alarms.

It is simply beyond the capability of an individual to effectively manage all the different subsystems involved in commanding a complex and sophisticated aircraft. Automating these separate subsystems and correctly providing the right notification at the right time with a one-screen presentation significantly increases safety.

In healthcare, a similar effective automation and prioritization of alarms would create positive handoffs between discrete tasks to streamline workflow and reduce the cost of care, improve patient satisfaction, and assure patient safety. A clinical notification solution could quantify who actually needs to know the alarm situation; what process is required of that person; what else needs to happen once that alarm occurs; and who else therefore needs to be notified. Such a solution could codify and manage responses to specific clinical and

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non-clinical events without relying on clinicians to carry out complex processes solely by training and personal recollection.

In short, what is needed is an alarm management integration platform that can aggregate disparate communications from multiple systems including multiple "smart" medical devices; provide intelligence in routing communications to mobile devices via predefined workflow rules; and provide centralized management, logging, and reporting of all events.

Alarm Management Platforms

The dominant players offering broadly based alarm management platforms listed alphabetically are Amcom (through their acquisition of Commtech Wireless in September 2008) Ascom with its Unite product, GlobeStar Systems' Connexall application, and Emergin (acquired by Philips in December 2007). Of these, Emergin and Connexall command dominant market share; of the four only Connexall is independent of a device manufacturer focused only on connectivity.

Each of these vendors does an able job interconnecting the various medical devices and health information systems with fixed and mobile communication devices. Because of the relatively small size of the market, independent evaluations of the products' relative strengths vis-à-vis competitive offerings are not readily available. Buyers are advised to carefully review each offering for fit with both current and future needs. Other vendors providing more narrow offerings include the likes of Extension, Radianta, and Rauland-Borg with their Responder V nurse call system.

When evaluating alarm management solutions, the key criteria include:
- The depth and breadth of the vendor's library of connections available (i.e., does it support the full breadth of devices currently deployed at a particular facility?)
- The track record of new releases
- The roadmap for future development as new devices and protocols are introduced to the healthcare market
- Depth of experience in order to guide buyers on best practices as they deploy

In addition, the buyer should always consider the application's ability to facilitate workflow automation and the robustness of any workflow

Mobile devices provide clinicians with more options to review and update patient information.

engine capabilities once alarms are being intelligently routed to fixed and mobile communication devices.

An initiative to implement standards in device-based data communication holds promise to change the way alarm systems are integrated in the future. The Integrating the Healthcare Enterprise (IHE) Patient Care Devices (PCD) domain was formed in 2005 to address the integration of medical devices into the healthcare enterprise, from the point-of-care to the electronic medical record (EMR), potentially resulting in significant improvements in patient safety and quality of care.[4] The organization promotes the coordinated use of established standards such as DICOM and HL7 to address specific clinical need in support of optimal patient care.

While this initiative holds promise for future connectivity efforts, today's integration environment remains complicated. While HL7 has been widely adopted as an interface to EMR applications, in 2011 various other

protocols continue to dominate at the device level. Moreover, the legion of legacy installed base devices will assure a heterogenous protocol environment for many years to come. That said, as the industry continues to move toward achieving "meaningful use" goals and EMR adoption, the increasing focus on structured data exchange will surely accelerate standards adoption.

The New Mobility Model

With the advent of alarm automation and new mobile devices, the clinician can for the first time have a mobile data platform rather than having to rely upon overhead paging or monitoring of the central station. These new mobile devices can provide user interfaces that are intuitive and do not force clinicians to adapt to a specific operating system.

In the late 1990s, efforts to adopt applications like bar-coded medication administration using personal digital assistants (PDAs) or early tablet computers were undertaken. The PDA never really caught on because it was application-specific, not tied into alarm management, and the user interface was inadequate. The early tablet computers were expensive, cumbersome, and again specific in the operating system and application.

Today, the opposite is true with new mobile devices. Now, hundreds of unique applications are available to provide maximum flexibility in this clinical care process. Security is no longer a concern because thin-client sessions can be run so that no patient-sensitive information is contained on the device. These new mobile devices have become the preferred devices for clinicians because of their lower cost, longer battery life, intuitive interfaces, and the fact that they are lightweight and easy to carry.

Thin clients give the information technology (IT) department complete control over security, performance, and user experience with no need to own or manage the physical device or location of that device. However, the hospital should look at providing new security models to handle these new mobile devices. They should include but not be limited to the use of basic device management such as Microsoft Active Synch, mobile device management software for more sophisticated control of corporate-issued mobile devices, and a walled garden to allow corporate access from personal devices. But it would need to be walled off from the device's personal content, and employ the proper risk management that will set policies that restrict corporate access of these new mobile devices with high-risk factors such as unauthorized applications.

The New Infrastructure Model

These devices also provide various ways of connectivity including the wireless networking protocols 802.11a/b/g as well as the cellular network protocols GSM/CDMA/3G and soon to be 4G/LTE (Long Term Evolution). To ensure that this mobile presentation model of alarm management actually works, hospitals are rapidly making the wireless LAN (WLAN) simply part of the overall infrastructure. Wireless connectivity is no longer a nice-to-have, but a must-have. That said, as additional wireless devices and voice communications are layered onto what were once data-only networks, wireless network architecture becomes a critical consideration and is often the major component in the success of any deployment.

Ubiquity in coverage is key. Coverage holes are unacceptable when patient alarms are being routed to a mobile device, the carrier of which is expected to take action immediately. Admission control is an often overlooked function that must also be planned for. One must determine if there are enough connections available for the various devices that will seek to roam on and off the access points throughout the facility.

Consider also that patient care is no longer confined to within the hospital walls, but extends across the integrated delivery network to include clinics and traveling physicians. Thus, devices must be multi-modal in connectivity to handle this new era of patient care management and alarm notification. Just like the requirement for 100% coverage in the hospital for WLAN, the requirement for these

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mobile devices to operate in a 3G environment will demand adequate in-building cellular coverage as well. With 4G and Long Term Evolution (LTE) devices available in 2011, the high improvement in bandwidth will provide clinicians with access to significant amounts of data in a reliable fashion. LTE delivers a highly compelling user experience with ultra-broadband speeds and almost instantaneous responsiveness for mega multimedia applications. LTE networks make more efficient use of the wireless spectrum, providing two to five times greater efficiency than 3G networks.

Summary

While we have had disparate alarming systems for notification and medical devices for years, the need is increasing for converging those systems onto a single robust platform for their overall management, routing, and reporting. The overall management of these separate alarm systems will allow the right prioritization of alarms to be parsed out either on an in-house WLAN or broadband (3G/4G) model. An abundance of new mobile devices provide for the first time the right user experience, portability, and access to multiple types of networks. By having the right alarm management system in place using these new mobile devices, and building out the internal WLAN and broadband infrastructure, the tools will be available for clinicians to improve alarm responses, patient safety, and satisfaction while reducing the cost of care. ∎

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