ISHE ISSUES 6.17.08

Clinician Mobility Demands Seamless Connectivity

Indiana Society for Healthcare Engineering

Clinician Mobility Demands Seamless Connectivity

White Paper

The workflow of clinicians is highly mobile, as patient care occurs both at the bedside and in many other areas in a health care facility.

Barry P. Chaiken, MD, MPH, FHIMSS describes the special needs of this environment and discusses wireless networking considerations to meet these needs.

TRAPEZE NETWORKS
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Executive Summary

When attorneys interact with their clients and work to solve client problems, they most likely do it from their desk. When accountants prepare financial statements for their clients in an effort to solve client problems, they most likely do it from their desk. When clinicians interact with their clients (i.e., patients) and work to solve client problems, they most never do it from their desk.

Clinicians, whether working in a hospital or an ambulatory care setting, are a mobile bunch, moving from room to room, floor to floor and care setting to care setting to help their patients. This big difference in the way clinicians work presents unique challenges to organizations building IT infrastructure to support those technologies designed to improve patient care, enhance safety and increase efficiencies.

In many enterprises, strategic deployment of wireless provides great flexibility in the delivery of network access in work settings. Most organizations offer both wired and wireless network access to allow useful network connections in conference rooms and other common areas. This allows for effective collaboration during meetings and seamless access to internal documents and external

information resources. For most organizations, the existing reliability of standard commercial wireless offerings provides more than enough "up" time to be useful. The wireless service need not be available everywhere, and the absence of wireless does not prevent workers from getting their jobs done. They just move to a different location where the signal is stronger, secure a wired connection or simply go without access for a period of time.

As most access to wireless networks is done while the user is stationary, and not moving from place to place (e.g., a conference room) it is relatively easy for network technicians to configure a network to provide broad coverage over each well circumscribed area. In addition, users quickly learn where in the building they obtain the best and most reliable access to a wireless signal, and position themselves accordingly to secure that signal.

As noted above, the workflow of clinical care is anything but stationary. This unique, highly mobile workflow also follows a different pattern each day and for every patient. Such mobility creates significant challenges for network technicians tasked with providing highly reliable wireless access to clinicians using a variety of healthcare information technologies.

Applications Useful to Clinicians

With the expansion of information technology use throughout healthcare, physicians, nurses and other clinicians rely more and more on networked software applications to care for their patients. Some of these mainstream applications are described below.

Electronic Health Records

Electronic health records (EHRs) form the basis of the movement to a paperless healthcare delivery and management system. The Health Information Management Systems Society (HIMSS), a non-profit association that brings together all stakeholders in healthcare information technology issues, defines EHRs as follows:

"The Electronic Health Record (EHR) is a longitudinal electronic record of patient health information generated by one or more encounters in any care delivery setting. Included in this information are patient demographics, progress notes, problems, medications, vital signs, past medical history, immunizations, laboratory data and radiology reports."

Clinicians utilize EHRs for almost all patient documentation, completing that work at the patient bedside, nurse's station, examining room or private office.

Internet Portals

Clinicians also access clinical information via Internet portals. These portals aggregate patient information from multiple data sources generated in a variety of care venues (e.g., hospital, clinic, physician's office), and present it in a single viewer application. Customization of interfaces by users, allowing them to be personalized to the needs of the clinician, greatly facilitates clinician adoption.

Patient Orders - CPOE

Computerized practitioner order entry (CPOE) systems offer those entering patient orders, usually in an in-patient setting, the ability to place those orders directly into a clinical information technology system.

CPOE systems are often paired with clinical decision support (CDS) modules. Broadly speaking, clinical decision support refers to applications that provide clinicians with targeted patient specific medical knowledge at the point of care by intelligently utilizing all available patient information.

Alerts and reminders form a subset of clinical decision support. While a clinician uses computerized practitioner order entry, they inform the practitioner of items that may require evaluation or review. These include such things as unexpected out-of-range lab results and the monitoring of specific blood parameters. Alerts are also pushed out to enabled mobile phones and pagers as automated text messages.

Medication Management

The focus on medication management promoted the deployment of a variety of inter-related systems. Generally, the medication

Increasing numbers of clinicians are utilizing personal digital devices such as Blackberry™, Windows Mobile™, iPhone™, and Palm™ phones that tap into local wireless networks in addition to their inherent cellular phone networks.

management system encompasses four key areas: prescription, transcription, dispensing and administration.

Electronic prescription, covering the writing of patient medication orders, occurs through the use of computerized practitioner order entry (CPOE) systems. CPOE often includes clinical decision support (CDS).

Transcription utilizes pharmacy systems that help pharmacists process medication orders and assist in pharmacy management.

Dispensing, the preparation of the medication for delivery to the patient, can occur through the use a variety of hardware devices that are tied to the pharmacy system. These include robots that pick single dose medications and package them together for delivery to patients, and dispensing cabinets located in inpatient areas that facilitate the accurate picking of medications.

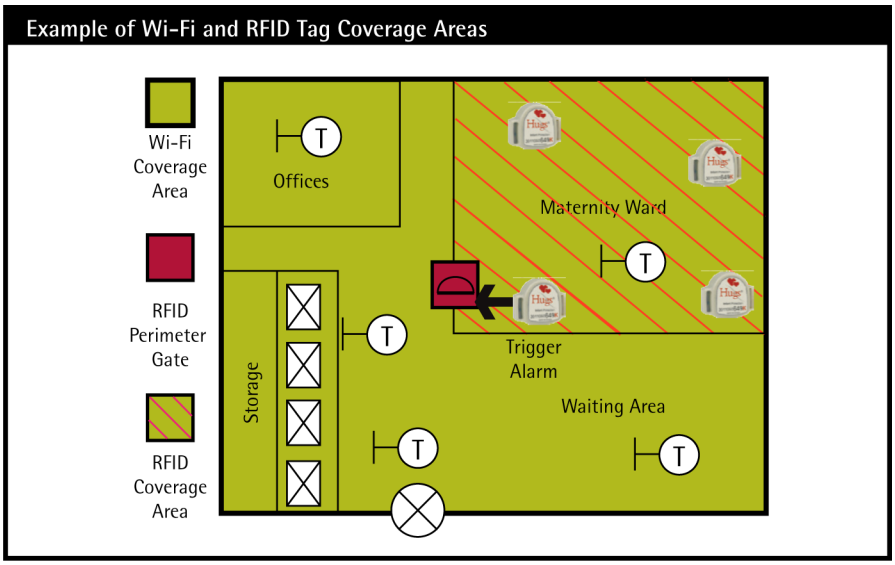
Lastly, administration works to ensure the five rights of medication administration: right patient, right drug, right dose, right route and right time. Systems employed during this phase often utilize bar-coding of both patients and medications to ensure accuracy and tracking of medication administration.

In addition to bar-codes, radio frequency identification (RFID) tags (see below) are currently being deployed to assist in medication management. Medication administration systems, utilizing either bar-codes or RFID, make use of wireless networks.

RFID, Wi-Fi Tags and Location Tracking

Radio Frequency Identification Device (RFID) tags provide a simple means to track the location of both objects and people. Commonly used to prevent theft in retail stores (these small devices are often hidden in the product packaging, and set off an alarm if not deactivated before leaving the store premises), these relatively inexpensive devices are now being attached to hospital resources (e.g., portable X-ray machines, infusion pumps) and personnel. Tags come in both active and passive forms.

Example of Wi-Fi and RFID Tag Coverage Areas



Passive RFID tags require passing through an electromagnetic field to be activated. For example, RFID tags are often used to monitor new born infants in hospitals to prevent abductions. A perimeter security field is established around the maternity ward to indicate, through an alarm, if any of the tagged infants pass through the perimeter field. However, once through the barrier, the tagged infant's location cannot be tracked.

Wi-Fi tags function in a completely different way. Unlike RFID tags that require an electromagnetic field to be activated, Wi-Fi tags are active, they come with their own power source that continually broadcasts to the Wi-Fi network. Functioning much like a Global Positioning System (GPS) device but using a completely different technology, the Wi-Fi tag signal can be tracked dynamically to continuously locate, through triangulation or other means, the exact position of an object or person in realtime. Therefore, in using the example above, a Wi-Fi tagged baby that unexpectedly leaves the maternity ward can be tracked throughout the facility using available Wi-Fi coverage. (See Diagram 1.)

Unreliable wireless networks disrupt clinician workflow, just as poorly designed applications do, leading to low clinician adoption and in turn, failed implementations.

Hospitals are just beginning to utilize these tags to identify the location of portable diagnostic and treatment equipment, facilitating the routing of the equipment to where it is needed. Some organizations are utilizing tags to track their skilled workers, but not on the same scale as for inanimate assets. Currently no artificially intelligent routing program exists that matches patient needs with available equipment and personnel to maximize efficiency of workflow. As existing technology exists to provide such guidance, this may be available to hospitals in the near future.

Both RFID and Wi-Fi tags have their specific uses within a healthcare facility. Careful consideration of workflow, benefits and costs is necessary to choose the correct solution.

Wi-Fi Voice, Cellular Voice and Messaging

As noted above, healthcare delivery requires extreme mobility of its workforce. With the increased functionality now inherent in mobile phones, physicians, nurses and other healthcare providers utilize these devices as critical communication tools in care delivery. Communication modalities include both voice and messaging. Text messaging takes the form of both person to person and automated computer generated results, alerts and reminders.

As in most steel frame buildings, cellular service is both spotty and unreliable. This limited service quality hampers the use of these very valuable mobile communication devices in a hospital setting. Fortunately, the development of Wi-Fi based voice and text communication helps fill the void presented by the limitations of cellular technology.

Communication devices exist today that employ both cellular and Wi-Fi technology within one handset. Utilizing cellular and Wi-Fi based location tracking to determine which communication technology provides the best connection, communication management software can now route voice and text requests to and from handheld devices utilizing the best backbone technology and frequencies. As this process takes place continuously, communication requests are transferred seamlessly between cellular and Wi-FI communication backbones.

Utilizing standard PBX functionality, communication software can route, for example, calls to PBX extensions to the cellular phone of a physician utilizing the Wi-Fi signal. Nurses within the facility carrying Wi-Fi enabled phones can communicate with each other instantaneously, through voice or text messaging, eliminating the need for asynchronous paging and callbacks. In addition to providing workflow efficiencies through this communication, incremental costs are essentially zero once the Wi-Fi network and communication devices are purchased.

Lastly, phones with Wi-Fi and cellular access to the Internet present seamless access to clinical Internet portals, a valuable tool in managing patients.

Technology Drivers

In addition to expanding clinical application functionality and usefulness, hardware technology continues to enhance HIT capabilities and options. Although COWS (e.g., computers on wheels) attempted to fill the need for computer mobility in hospitals and clinics for the past decade with only mixed success, slate computers and handheld devices are quickly replacing the awkward roving computer cart. Slate computer manufacturers are working with both HIT application vendors and hospitals to design and test slate computers that satisfy the demanding needs of the medical environment and its workflow. Portability in healthcare demands light weight devices, large, bright screens and long-life battery hot-swapping. In addition, these devices require tolerance of regular cleaning, frequent disinfection and occasional liquid spills.

As noted above, increasing numbers of clinicians are utilizing personal digital devices such as Blackberry™, Windows Mobile™. iPhone™, and Palm™ phones that tap into local wireless networks in addition to their inherent cellular phone networks. This permits these users to access portals and other clinical applications as they care for patients.

Organizations that plan on deploying robust clinical systems must invest in carefully designed, intelligent wireless networks that provide reliability exceeding that of almost all other industries.

Application vendors, recognizing the new capabilities of these and other hardware devices, are starting to take advantage of the increased functionality through redesign of user interfaces. Such changes include use of touch screens, voice recognition (dictation) and active synchronization.

Due to the mobility inherent in healthcare workflow all these hardware devices integrate within them wireless network capabilities.

Wireless Impact on Workflow

With the expanded use of these hardware and software solutions in the clinical setting, comes the demand for robust and reliable wireless access. As clinicians rely upon clinical applications to deliver care, in turn, they rely upon the network to be functioning optimally to complete their work. Unreliable networks that interrupt connections to clinical applications stall workflow, slowing if not halting patient care until the network is returned to normal. In addition, such networks create a dangerous environment threatening patient safety and quality of care, where clinicians are forced to care for patients without the minimally necessary medical information.

Workflow's Impact on Wireless

As wireless reliability impacts workflow, workflow greatly impacts the requirements of a wireless network. As noted above, clinicians are very mobile while providing care. Care delivery can occur at any location in a facility, and is not limited to the patient's room or clinician's office. Caregivers require access to patient data in all parts of a facility including examining rooms, lounge areas, laboratories, surgical suites, and administrative offices.

Physicians, in particular, direct patient care remotely as patient care decisions are often made after additional laboratory or other test data become available throughout the work day. Therefore, care decisions are made when the physician is not physically near the patient. If patient information is electronic, and the means to direct care through order entry is also electronic, it is imperative that the physician be able to access patient information independent of where the physician is in the facility. This fact creates a tremendous challenge for wireless network designers and administrators who must architect a wireless network that provides ubiquitous and reliable wireless access in every nook and cranny of the care facility. To fail to address this critical issue, fails to satisfy the requirement of providing access to complete patient information throughout the facility.

Therefore, the unique nature of clinician workflow, as characterized by its mobility, is the critical factor that separates clinician workflow from other workflows that utilize wireless networks.

Wireless Impact on Patient Safety

Treating patients with incomplete medical information delivers substandard and inefficient care. The movement to using EHRs, and the related digital applications, is an effort to increase the reliable information available at the point of care and offer efficiencies in its access. As clinicians embrace clinical applications integrated into their workflow, network reliability directly impacts patient care. In addition, the number of clinical applications deployed is expanding. Unreliable networks that on occasion prevent access to patient data may cause unnecessary morbidity and mortality. Clinicians, without access to patient data or supportive clinical decision support tools, may be forced to make care decisions without a complete picture of the patient or the proper medical knowledge.

Wireless Impact on Adoption

For clinicians, adoption is all about workflow. Poorly designed clinical applications that impair clinician workflow have little chance of securing high rates of adoption, the necessary ingredient for clinical applications to deliver on their promise of improved patient safety, enhanced quality of care and elevated efficiencies.

Wireless networks are an important factor also. Unreliable wireless networks disrupt clinician workflow, just as poorly designed applications do, leading to low clinician adoption and in turn, failed implementations. As important as clinical software interfaces may be, intelligently designed, robust, reliable wireless networks form a critical part of the effort to secure clinician adoption. Therefore,

when organizations develop plans for the deployment of clinical applications they must devote an equal effort in designing the supportive wireless infrastructure.

Success Factors for Clinical HIT

Although fewer than 20% of hospitals currently utilize full EHRs, most organizations have deployed some health information technology (HIT) applications and have plans to roll-out an EHR in the near future. Before clinical transformation and the inherent workflow and process re-engineering takes place, organizations must choose the correct tools that will be used to transition from paper-based to digital patient care. These tools fall into three key categories:

1. Applications — Software programs that form the basis of the healthcare information technology
2. Appliances — Computers, laptops, PDAs, phones that are the hardware interface
3. Supporting infrastructure — Wireless networks, servers, backup systems

Historically, organizations invest the greatest amount of their time researching the applications contained within a HIT system. This effort focuses on user interfaces, response times and overall functionality. Secondarily, organizations consider the appliances (e.g., slate computers) that clinicians use to interface with the application. Lastly, the supporting network is often cobbled together in an effort to satisfy the "specs" provided by the application vendors.

For organizations intent on obtaining the greatest impact from their HIT applications, focus must be on clinical transformation that changes current processes and workflows to new ones leading to better results. Clinical transformation leverages new information technology tools to produce enhanced patient outcomes, safer care and increased efficiencies. Organizations that fail to embrace clinical transformation experience relatively unchanged overall outcomes. The new HIT is prevented from delivering its maximum effect due to the results embedded in the "DNA" of the unchanged processes and workflows.

Impact of Wireless Network on Clinical Application

Clinical Application	Impact	Comment
Electronic Health Records	High	Clinicians require access to patient EHRs throughout an organization as care decisions are often made away from the bedside.
Internet Portals	High	Portals allow the monitoring of patient care away from the bedside.
Patient Orders — CPOE	High	Per Med. Mgmt. Prescription, patient care decisions are made throughout the facility.
Med. Mgmt. — Prescription	High	Like CPOE, orders are placed both at and away from the bedside.
Med. Mgmt. — Transcription	Low	Most of this activity occurs in a fixed location, the pharmacy.
Med. Mgmt. — Dispensing	Med	Dispensing occurs either on the floor or in the pharmacy (e.g., dispensing robot, medication cabinet).
Med. Mgmt. — Administration	High	At the bedside ensuring the five rights.
RFID and Location Tracking	High	Highly mobile and dependent upon the quality of the network.
Voice and Messaging	High	Seamless network connectivity between cellular and Wi-Fi backbones is critical to clinician acceptable levels of reliability.

To achieve truly revolutionary HIT where outcomes dramatically change for both the patient and the provider, organizations must choose the correct tools — applications, appliances, and infrastructure — that support clinical transformation. Our focus here on the mobility of healthcare professionals suggests an enhanced appreciation of the importance of infrastructure (i.e., wireless network) on clinician adoption and successful deployment.

Healthcare delivery requires that systems work effectively all the time, day and night, every day. Unlike other industries, the healthcare factory never closes. Clinician acceptance of HIT tools is initially linked to the ease of use and overall functionality of the software applications and secondarily to the appliance used as an interface. As important as these two items may be, the long term usability of the application is dependent upon the infrastructure supporting the application. It is the usability and "up" time of the supporting network that determines whether the application is acceptable.

For clinical users deep into their workflow, the application, appliance and infrastructure become one. Deficiencies in any one part are perceived as failures of the whole. Therefore, as organizations plan the implementation of their clinical applications, they must view the roll-out of applications, appliances and infrastructure equally. Each factor is dependent upon the other. Considering the impact of clinician mobility, special attention to the configuration of wireless network is required.

Summary

Clinical information technology applications offer great promise in improving the delivery of patient care. As these applications provide functionality that allows clinicians to utilize them throughout their mobile workflow, wireless networks become more and more critical to the successful use of these applications. Organizations that plan on deploying robust clinical systems must invest in carefully designed, intelligent wireless networks that provide reliability exceeding that of almost all other industries. Failure to do so will have a deleterious impact on patient care, healthcare costs and clinician adoption obtained from these most valuable and desired systems.

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Over the past 15 years Chaiken provided expertise in quality and patient safety to provider and payor organizations helping them utilize information technology to improve clinical and administrative activities. He has served as guest lecturer and consultant on topics including patient safety, clinician adoption of information technology, quality improvement and managed care. Chaiken also assisted hospitals and technology firms in the creation of medical software products and authoring of marketing communication materials.

Chaiken is board certified in General Preventive Medicine and Public Health as well as Health Care Quality Management. He is currently Chief Medical Officer at DocsNetwork, Ltd. where he provides thought leadership and offers clients his expertise in clinical transformation and quality improvement. Chaiken has delivered more than 50 CME lectures, and is currently on the editorial board of the Journal of Patient Safety and the journal of Patient Safety and Quality Healthcare. He currently writes a column on technology and quality for the journal Patient Safety and Quality Health Care and a healthcare IT blog at www.healthcarefusion.com. Chaiken received his medical degree from SUNY Downstate Medical Center, NYC, his masters in public health degree in health services administration from the Harvard School of Public Health and his bachelors of arts degree in psychology from the University at Albany. He acquired his specialty training from the Centers for Disease Control as an Epidemic Intelligence Service Officer and from the New Jersey State Department of Health as a preventive medicine resident. He is also a Board member, Board Liaison to HIMSS Europe, 2009-2010 Board Chair and a Fellow of the Health Information Management and Systems Society (HIMSS). Chaiken holds an appointment as Adjunct Assistant Professor in the Department of Public Health and Family Medicine at Tufts University School of Medicine.

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Further Reading

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