Connected Care…Communication, Collaboration, Compassion – Wirelessly Enabled.
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Executive Overview

Healthcare Information Technology (HCIT) is undergoing a renaissance fueled in large part by a surge in clinician need for easy-to-use tools that promote efficient, cost-effective, high-quality patient care. Since clinicians are highly mobile knowledge workers and the market is focused on "point-of-care" (patient and clinicians) and "point-of-use" (equipment and supplies) solutions, the preponderance of new technology offerings are wirelessly enabled. In fact, the HCIT market is about to experience a veritable boom in wireless IT.

The projected growth in the wireless market is a result of IT investments by healthcare organizations (HCO) seeking to meet cost savings, quality of care, compliance and service improvement goals. Since the landmark 2000 Institute of Medicine report, “To Err is Human: Building a Safer System,” patient safety initiatives have led the agendas of most HCOs. For increasingly better-informed consumers, safety is a crucial issue in choosing a provider.¹ (See Figure 1) Thus, many recent wireless initiatives are driven by the need to continually improve patient safety, for example:

- Electronic Medical Records (EMR) – wireless carts, tablets and notebooks
- Computerized Physician Order Entry (CPOE) and clinical decision support (CDS)
- Bar-Code Enabled Medication Administration (BCMA)
- Bedside and remote monitor and device data capture
- RFID-enabled personnel and asset tracking
- VoIP-enabled nurse call systems

Wireless solutions target a myriad of broad clinician goals, from improving MD billing to facilitating more compassionate end-of-life care². However, with the growing numbers and types of applications leveraging the wireless network, HCOs existing network infrastructures are being heavily taxed. Early generations of wireless applications exposed severe network limitations that plague clinicians, who work in mission-critical environments where data access, speed and voice clarity are “life and death” matters. Rather than improving communications, wireless applications that depend on unreliable or poor quality networks can add more complications to already overburdened clinicians, and at times can even compromise patient care.

Hospitals and other HCO IT departments are resource-constrained and cannot afford to support unreliable, high-maintenance, rapidly obsolescing network infrastructures. With wireless network

¹ Medstat PULSE Healthcare Survey (2005)
² Supporting Family Caregivers at the End of Life: “They Don’t Know What They Don’t Know” JAMA (January 28, 2004; 291: 483 – 491)
expansion, users may begin experiencing increased interference on links and transmission interruptions, resulting in availability problems, data loss and performance degradation. If ad hoc growth continues unmanaged, technology that would potentially offer a way to improve productivity and cut costs could also add uncertainty, cost and regulatory vulnerability. The need for a single, overall network management platform for different wireless systems has become even more critical as network use spreads to different departments and locations within healthcare facilities and across the enterprise and community.

To fully profit from the power of wireless networking, a more technologically advanced (yet easier to use), secure, reliable, flexible and scalable wireless LAN (WLAN) architecture is needed. Without a robust, wireless network, organizations would not achieve clinician adoption or satisfaction goals nor optimize return on investment (ROI) in existing wireless applications. Looking to the future, organizations need to easily and inexpensively expand existing networks to harness the wealth of new and innovative wireless solutions that promise to be of enormous value to HCOs, clinicians and patients.

Recognizing the key challenges facing the HCIT industry today, Meru Networks, a global manufacturer of advanced wireless technology based in Sunnyvale, CA, has developed a suite of standards-based products that address the most complicated needs of the mission-critical healthcare market.

Established in 2002, Meru Networks offers a superior WLAN solution and unmatched technological innovation at a lower total cost of ownership than competitive alternatives. Meru delivers a proven, advanced network platform “purpose built” to support converged voice, data and video applications, and overcome existing network limitations that can vex clinicians.

Meru’s “single channel wireless architecture” provides unprecedented performance in a converged WLAN. With its Air Traffic Control technology embedded in all devices, the Meru WLAN System supports wireless data, voice and video on a single, unified platform, offering clinicians continuous, secure application connectivity and best-in-class voice-over-IP (VoIP) quality of service (QoS). In an environment where speed really counts, Meru Networks’ fourth-generation WLAN performs up to five times faster than early generation WLAN products. (See Figure 2)

While many successful deployments of wireless applications exist, clinician response to wireless technology remains mixed. Chief among nurses’ frustrations with IT are “incompatible systems, lack of reliable systems and limited access to necessary systems.” Clinician acceptance of wireless applications depends not only on the perceived value of the application but also, as importantly, the quality of the network supporting it. Emerging multi-specialty, interdisciplinary, community-wide care models require that physicians and RNs be data integrators and synthesizers. In this role, clinicians require immediate access to continual, seamless communications with a wide range of applications, devices and care team members – all increasingly connected wirelessly via the network. If the network is not reliable, nurses have been known to incorporate workarounds that are inefficient and at times even unsafe (e.g., bar-coding patient ID bands at the nursing station). These practices can introduce error and negate the intended benefits and potential advantages of wireless IT. By enabling secure, reliable, high-quality data and voice communications, Meru optimizes clinician use and satisfaction with wireless applications, at times turning even skeptical clinicians into raving fans of the technology.

**The Treatable Ills of Healthcare Processes**

Walter Cronkite’s maxim, “the U.S. Healthcare System is neither healthy, caring, nor a system,” rings even truer today than when pronounced more than a decade ago. Healthcare professionals face increasingly stressful and often non-rewarding work environments, with sicker patients, fewer resources, and increasingly onerous third-party reporting requirements that detract from direct patient care time. Inherent challenges can be compounded by misaligned HCO goals, competing priorities and stakeholder agendas, disjointed sub-optimized processes and non-“clinician friendly” information systems.

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4 eWeek: Study: Nurses Not Trained for IT (September 6, 2006)
Despite spending the most (~16 percent of GDP), the United States lags behind other industrialized nations on many dimensions of health system performance. The U.S. healthcare system is rife with unsafe, poor quality, and inefficient care, with an excess of duplicated tests and unnecessary or inappropriate treatments. It is reported that 17 percent to 49 percent of diagnostic laboratory tests are performed needlessly, because medical history and the results of earlier studies are not available when the new tests are ordered.5

Medical errors, many of which are preventable, are rampant and costly. The Institute of Medicine estimates that 44,000 to 98,000 people die each year from medical errors in hospitals alone.6 While some believe these statistics are inflated, HealthGrades, a leading independent healthcare quality company, relays that the IOM in fact may have underestimated this number. A 2004 HealthGrades study based on 37 million patient records reports an average of 195,000 people in the U.S. died due to potentially preventable, in-hospital medical errors with little evidence that patient safety has improved in the last five years.

Patient safety incidents accounted for $8.54 billion in excess in-patient costs to the Medicare system over the three years studied. Extrapolated to the entire U.S., an extra $19 billion was spent and more than 575,000 preventable deaths occurred from 2000 to 2002. Dr. Samantha Collier, HealthGrades vice president of medical affairs reflects on the magnitude of the problem:

“The equivalents of 390 jumbo jets full of people are dying each year due to likely preventable, in-hospital medical errors, making this one of the leading killers in the U.S.”7

Injury to patients is rarely caused by simple failures of health care professionals. More often it results from “flaws in complex interactions among several individuals or problems at the interface of people with sophisticated technologies, products and organizational systems.”8 This is an area where reliable and high-quality wireless technology can clearly help.

A Call to Action for Reforming the U.S. Healthcare System

A recent Commonwealth Fund Commission report calls for a complete overhaul of the nation’s healthcare system and identifies the urgent need for an accelerated rate of innovation and improvement, which includes healthcare IT.9 To achieve the overreaching mission of a high-performing healthcare system – “to help everyone, to the extent possible, lead long, healthy and productive lives” – the commission states the system will need to:

- Create a clear national strategy
- Deliver care through models that emphasize coordination and integration

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5 HIMSS. EHR and the Return on Investment (2003)
6 To Err Is Human: Building a Safer Health System, Institute of Medicine (1999)
7 In-Hospital Deaths from Medical Errors at 195,000 per Year in U.S.; Medical News Today (2004)
Establish performance metrics to track health outcomes

Reform Requires a Commitment to a Strategy

It is impossible to envision any national or local healthcare strategy in which IT does not play an integral role. The U.S. can no longer afford to maintain the status quo. Without wider and more enthusiastic clinician adoption, no HCIT strategy can fully succeed. Wireless IT offers clinicians both a stronger “connection” to systems and providers as well as the freedom to be fully mobile in their normal patterns of care delivery. This liberates clinicians from sole dependence on hard-wired workstation-based solutions, allowing “anytime, anywhere” availability of patient data and ready access to the physicians and the care team. Wireless IT supports more informed, responsive, personal and compassionate care – the ultimate payback for HCO investments in wireless IT.

Figure 3. Computerized Physician Order Entry (CPOE) can reduce records errors, but the majority of hospitals have not yet implemented such a system.

Physician IT adoption can achieve many HCO clinical, financial and service benefits, as well as play a crucial role in an organization’s ROI in IT. Physician IT adoption has been generally lackluster and modest to date. (See Figure 3)

However, a sea change is expected as solutions become more cost effective and physician-friendly and MDs raised with ubiquitous technology enter the profession. For younger physicians, availability of current technology is an expectation and an increasingly important factor in deciding where to practice. In community hospitals, where most MDs are not employed, physician satisfaction is critical because IT adoption is not mandated in the vast majority of these organizations. Physicians value many advantages wireless solutions afford, including more real-time data and voice communications that wireless nurse call systems enable. In fact, wireless IT is making a strong contribution to growing physician adoption rates.

Nurses play a key role in MD and interdisciplinary communications, acting as the primary care team coordinator and key data “integrator.” Ironically, while nurses represent the single largest healthcare professional group, user and potential beneficiary of HCIT, they have been long under-valued and under-served by industry. Via wireless applications, nurses are receiving heightened attention with recent emphasis on point-of-care and point-of-use solutions – acknowledging that the bedside is clearly the nurses’ domain.

The HCIT industry is seeing a convergence of IT and biotech, accentuating the need for a clear IT strategy. There is a growing realization that wide-scale benefits are derived from more accurate and timely data captured wirelessly from numerous bedside monitors and devices, which recoups hours per patient day lost in redundant and error-prone data re-entry. This time can be reinvested in direct patient care, improving patient safety, quality of care, and MD, RN and patient satisfaction. Increasing RN hours
of direct care per patient day has been proven to decrease medication errors and save money. Medstat estimates that the cost per preventable adverse drug events (ADE) is $8,750. Given the estimated 400,000 medication errors occurring in hospitals every year, the cost for in-patient ADEs alone is $3.5 billion annually.\(^{10}\)

With an aging population, sicker (co-morbid) patients, and acute resource shortages, physicians and caregivers are challenged to deliver safe, cost-effective care in an increasingly complex and data-intensive environment. A glut of recent national and state legislative efforts reflects a new era in government promotion (if not funding) of clinically-driven IT initiatives. The chief goal of government-led initiatives is to enhance the quality, cost-effectiveness and continuity of care. The ultimate aim is to promote the health of populations via a variety of “connecting the community” data-sharing schemes powered by the Internet. “Interoperability” is the current mantra of the HCIT world.

**Clinicians seek tools that add value and can be seamlessly embedded into their workflow and practice patterns.** To date (with notable exceptions), for a variety of reasons, there has been a dearth of robust, well-designed clinician-friendly solutions that take full advantage of available technology to achieve business and clinician goals. To realize the potential of HCIT, the industry must deliver well-integrated, easy to use, patient-centric solutions that are embraced by clinician end-users based on clear benefits and usefulness. Increasingly, these solutions will leverage wireless technology to optimize acceptance and effectiveness.

**Wireless technology can enhance clinician productivity, information sharing and decision making.** An untethered healthcare workforce can more effectively deliver, coordinate and manage care, while improving provider satisfaction and the organization’s bottom line. Clinicians universally express the desire to spend more quality time with patients, who seek and deserve informed and compassionate care. Time recouped from inefficient and redundant data gathering can be reallocated to data analysis and direct patient care activities. Thus wireless technologies can enable a stronger and more caring “connection” among the patient and care team.

**IT can’t solve underlying fundamental problems in the U.S. healthcare system.** Nor can it overcome a lack in leadership, poorly designed processes or failure to infuse a “culture of quality” within individual organizations. Nevertheless, HCIT is a long under-valued, under-funded, and under-utilized resource that can be far better leveraged to improve the well being of clinicians, organizations and the patients they serve. Wireless solutions have sparked significant clinician interest by mitigating key limitations of earlier generation hard-wired HCIT solutions and solving real problems of significant import to all clinicians.

**Reform Requires Care Models that Emphasize Coordination and Integration**

**New care models are increasingly community-wide and patient- (not department-) centric.** Delivery models are multi-specialty (physicians) and interdisciplinary (nurses and allied health professionals, such

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\(^{10}\) Institute of Medicine (2006)
as respiratory therapy, physical therapy, social services, et al.), requiring a highly collaborative team approach to deliver coordinated, holistic care. With shorter in-patient stays, patients’ rapid movement within facilities and across points of service, growing community-based services and increased patient home monitoring for chronic disease management, the network is the glue that binds the care team and patient.

Clinicians acquire more and increasingly complex data, from multiple diverse sources, that support patient diagnosis and treatment, care planning and delivery, and evaluation of care outcomes and services. One study concludes that 14% of hospital admissions occur because physicians do not have access to complete patient information.11 With a coordinated network, more data can be shared among ever-increasing numbers of clinicians, business stakeholders and information systems. As the number of wireless data and voice communication systems grows exponentially over time, a robust, easily managed and extensible WLAN architecture will be required.

Improving the content and quality of MD and care team communication via VoIP-enabled nurse call systems has proven to significantly improve patient care and provider satisfaction. Without improved care coordination and better data integration, no significant improvement in patient outcomes is likely. The need for convergence of wireless voice, data and video is becoming clear and driving the emerging market demand for a single converged wireless platform. (See Figure 4)

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Recent clinical wireless IT efforts focus on patient safety and clinician efficiencies. HCIT industry leaders state “productivity will be the focus over the next several years as hospitals need to reduce operating expenses per adjusted admissions.”12 This is born out by the 2006 Medical Records Institute survey which reports that “when it comes to making decisions about HCIT, the need to improve clinical processes and workflow efficiency trumps everything else.” Few technologies can offer an equal promise of improved patient safety and enhanced productivity as wireless IT.

12 CHIIME Meeting – Sr. VP of HR, HCA (2006)
To improve the timeliness, accuracy and quality of data collected – and reduce redundant data entry – wireless technology can be exploited within departments and across the continuum of care. Importantly, wireless technology enables more accurate, timely data collection at the point of care where most CDS data are collected.

Renewed efforts have been placed on automating core clinical processes – e.g., medication management, prescribing and clinical documentation, and empowering clinicians who are highly mobile, knowledge workers. Beyond direct patient care management, wireless IT enables case, disease and population management programs that are key strategic initiatives for many HCOs. (See Figure 5)

**Case management tools are increasingly being used within hospitals, primarily in support of the utilization management process.** Disease management programs have shown to be a cost-effective means of caring for people with select diagnoses, for example, diabetes, including home monitoring to enable collection of key clinical data. Remote clinical monitoring programs in California have resulted in a 50% reduction in emergency room and hospitalization costs13. In addition, population management initiatives, such as epidemiology studies and bioterrorism surveillance efforts, are being deployed for monitoring and tracking of defined groups and locations. Each of these care management activities is being supported with wireless IT.

In addition to targeted care management activities, wireless IT supports a growing list of diverse high-priority HCO strategic initiatives – for example, patient and visitor entertainment services, PACs, and others. RFID-enabled personnel and asset tracking systems are gaining market traction and proving to be successful in early adopter organizations. While the RFID market overall is experiencing blistering growth (projected $15 billion market by 200914), based on a recent Medical Records Institute (MRI) survey, RFID “remains a far off concept” for many HCOs. Survey respondents report that less than 2% are using RFID today, about 3% are currently implementing RFID, and approximately 10% are planning to use RFID in the future.15

RFID faces unique challenges in HCIT and is currently cost-prohibitive for some organizations. While medication management is a key HCO buying priority and industry focus, RFID technology today cannot be successfully or cost-effectively deployed to support medication ID, for a number of ergonomic and

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13 Clinic to use Web to check patients; Florida Times-Union (Sept 19, 2006)
14 Health Industry Insights (Sept 2006)
15 Medical Records Institute Survey (2006)
economic reasons. While not without its own challenges, wireless enabled barcode technology is the current approach for high priority HCO medication administration initiatives. (See Figure 6)

**HCIT Buying Priorities - HIMSS 2005 Leadership Survey**

**Most Important Application in Next Two Years**

- **EMR – 62%**
- **Bar Coding – 55%**
- **CIS – 52%**
- **CPOE – 50%**
- **Info Sharing - 44%**
- **PACs - 42%**
- **CDR - 42%**
- **CDS – 37%**

*Source: HIMSS Leadership Survey 2005
Published in HCIT News Jan 2006*

**Figure 6. Buying Priorities for Healthcare IT**

Wireless solutions are clearly key HCO investment strategies in today’s highly competitive, consumer-driven healthcare environment. It is clear that a robust, reliable, expandable WLAN is a key enterprise IT resource and an increasingly important business asset.

**Reform Requires Performance Metrics for Tracking Health Outcomes**

Establishing goals and associated key performance indicators (KPIs) should be a fundamental process for managing business and enabling IT initiatives. Three broad categories of metrics include:

- People (MD, clinician and patient satisfaction and service metrics)
- Product (patient safety and quality-of-care metrics)
- Profit (revenue, expense and productivity metrics)

In all too many IT efforts, this critical first step is overlooked. Some HCOs take a Nike (“Just Do IT!”) or an “Alice in Wonderland” (“if you don’t know where you’re going, anywhere will get you there”) approach. Thus, it’s not surprising that many executives and business owners are unclear – or even in conflict – regarding the specific outcomes of IT investments, unable to quantify the benefits or ROI achieved. When juggling a multitude of IT projects and competing for capital with brick-and-mortar projects, it becomes critical that a benefits-driven approach be taken that both clearly lays out goals and
metrics as well as assigns clear accountability for benefits and ROI realization. (See Figure 7)

Failure to establish key goals and KPIs was called out in the September 1, 2006 GAO report. This report involving national healthcare IT initiatives concluded that:

“The president’s goal of achieving widespread adoption of interoperable electronic health records by 2014 is at risk because HHS’ strategy for achieving that goal lacks detailed plans, milestones and performance measures. Until these plans, milestones and performance measures are completed, it remains unclear specifically how the president’s goal will be met and what the interim expectations are for achieving widespread adoption of interoperable electronic health records by 2014.”

Care delivery organizations universally share broad common goals to improve financial, quality of care and service performance. However, each entity's strategic business and supporting IT plans differ depending on its specific mission, market, competition and culture. Nevertheless, patient safety and clinical efficiency improvements are viewed as the most compelling benefits of clinical automation. (See Figure 8)
To optimize IT benefits, clinician leaders do more than establish goals and KPIs. In addition, in high-performing organizations, roles are clearly defined, business processes are redesigned, and change management programs are funded and carried out – and clinicians are fully engaged in the process. (See Figure 9) When wireless solutions are adopted, clinical executives must be assured that a high-performing network and sufficient numbers of hardware devices are in place in order that high-quality data and voice communications are provided for users so that clinician and business goals can be achieved.

![Figure 9. High Performing Organizations](source: Farrell Associates)

Wireless Solutions Not Without Risk or Challenges

Some early enthusiasts envisioned wireless IT as a panacea or “silver bullet” for increasing clinician IT adoption. Albeit with good intent, numerous CIO and vendor technical staff fail to appreciate the limitations of some devices (e.g., PDA screen size) for some groups and settings or the requirement for process redesign prior to introduction of IT.

In several cases, early wireless solutions were virtually unusable in clinical settings. This usually occurs when the vendor or CIO is focused on “state of the art” technology and not on work setting ergonomics and clinician workflow. A more enlightened approach is to view wireless devices in the context of data and workflow integration, considering specific characteristics of targeted users, e.g., the average age of an RN is 45.2 years old\(^{16}\), and viewing dense data on PDAs is problematic, if not virtually impossible.

Physician-oriented vendors all too often design wireless solutions for MDs assuming they will work for RNs. While MD and RN roles and processes overlap, there are clear distinctions in requirements for each discipline, for sub-groups within disciplines, and for specific points of service, such as the Emergency Department, Operating Room, Clinic, etc.

Although wireless point-of-care data collection has proven to improve efficiency, timeliness and quality of data collected, MDs and RNs generally reject 100% bedside charting. There are sound clinician and patient considerations for this preference, although CIOs and engineers often don’t understand the rationale, at times blaming “clinician resistance” to IT or change. Clinicians should not be forced to adopt sub-optimal approaches simply to meet CIO or vendor expectations, yet all too often that has been the case.

The Challenge for Clinicians

While IT should meet clinician requirements, clinicians need to abandon “sacred cows,” e.g., RN end-of-shift and “bulk charting,” which deter benefits of wireless solutions. In addition to application training, clinicians value education regarding goals and rationale for process changes made to better leverage wireless capabilities. When clinicians fully understand the IT benefits to the HCO, care team and patient, they are far more likely to embrace change.

Clinicians need specific tools for specific jobs at specific points of service. IT leaders need to learn and respect the unique requirements of each clinical user type and work setting and not assume that “one size fits all.” Clearly hard-wired and wireless solutions can and should be compatible and co-exist. IT, in the end, needs to recognize they are a service organization whose mission will increasingly be to serve clinicians, with WLAN support an increasingly key service offering.

CIOs Justifiably Concerned About Wireless Technology

While not all processes will be 100 percent wirelessly enabled, an increasing majority of clinician-centric applications will have a significant wireless component. In addition to clinician frustrations with poor network availability and quality, CIOs and bio-technical engineers report significant worries regarding network security, reliability and scalability. Per the 2006 MRI Survey, lack of security is cited as the biggest barrier to wireless connectivity with 39.3 percent of respondents citing this as a serious concern. Inconsistent connectivity when moving about the healthcare facility was a close second, at 36.4 percent. Without adequate “HIPAA-compliant” security and consistent connectivity, even best-in-class wireless applications will not succeed.

The term “wireless” has gotten a bad name in some circles, mainly due to early generation networks that could not support the challenges and demands in HCIT. The topography of hospitals combined with clinicians’ demands make healthcare a challenging environment for many network vendors, including industry leaders. While early generation network capabilities may perform adequately when wireless demands are limited, the explosion of electronic and RFID- and VoIP-enabled applications is expected to tax even the most robust existing networks. VoIP-enabled nurse call systems are often the first application to highlight network limitations.

With poor quality or unreliable voice communications, time is lost while nurses attempt to establish and maintain contact with physicians or other care team members. At sites with poor network support, nurses can be seen literally “freezing in their tracks” in an attempt to maintain voice connections while racing down a hall or between floors to care for or rescue a patient. This unfortunately is an all too typical response of nurses using VoIP-enabled call systems implemented on unreliable, discontinuous networks reliant on access point authentication and re-authentication as users move within and across facilities.

17 Medical Records Institute Survey (2006)
“Failure to rescue,” decubitus ulcer and postoperative sepsis represent the three highest reported patient safety issues, which account for almost 60 percent of all patient safety incidents that occur. In all cases, failure to maintain a consistent connection and poor voice quality obviates potential benefits inherent in VoIP-enabled nurse call systems aimed, ironically, at streamlining communications. It is clear that once we free up clinicians from total dependence on hard-wired, workstation-based IT solutions, we must provide them with the requisite network support to realize the advantages that a VoIP-enabled call system can afford.

The Case for Wireless Is Clear, with the Need for High-Performing WLANs Critical

What’s In It for Physicians?
Physicians especially value wireless connectivity that enables efficient retrieval of patient lists, test results and care summaries that facilitate more rapid diagnosis, treatment and evaluation of care. And, wireless applications can support MD revenue optimization via enabling the charge capture and physician billing processes. Whether at home, in their office, or in remote buildings or clinics, physicians want assurance of seamless, high-speed, high-quality data and voice connectivity. For physicians this means access to information anywhere, anytime via wireless IT, resulting in more efficient, higher quality of care.

When data are collected wirelessly from bedside devices, physicians have access to more timely information. These data often exist on scraps of paper in RN or CNA pockets, waiting for reentry later into electronic or paper-based charts at the nursing station. In this situation, MDs and care team members accessing the patient’s EMR remotely are at risk of acting on incomplete or aged data. In some surgical intensive care units, nearly 1,000 data elements can be captured per patient, per shift. Thus the ability to streamline and automate this process and eliminate double charting has profound impacts on nursing productivity and quality of care. Immediate access to device, monitor and nursing assessment data prior to morning rounds can enable physicians to make better, timelier clinical decisions, e.g., judgments regarding patient discharge. Lack of availability of timely (near real-time) patient assessment data can result in unnecessary interventions and potentially uncompensated increases in length of stay.

What’s In It for Nurses?
Perhaps no group has more to gain from wireless applications than nurses, who have been long under-served by IT. The bedside is the domain of nurses, thus recent industry focus on point-of-care (clinicians and patients) and point-of-use (equipment and supplies) solutions has put the spotlight on nursing IT.

18 18 In Hospital Deaths from Medical Errors at 195,000 per Year in U.S.; Medical News Today (2004)
The public admires, trusts, and respects the nursing profession and recognizes their contribution to the care process.\textsuperscript{19} Nursing shortages nationwide are threatening the very fiber of the U.S. healthcare system. According to the 2005 survey by American College of Health Executives on the Top Issues Confronting Hospitals, 85 percent of hospital CEOs reported having a shortage of registered nurses. Recent data from the American Hospital Association Survey of Hospital Leaders reports on the growing vacancy rates for nurses, certified nursing assistants (CNAs) and other health care professionals as well as the impact these shortages are having on patient care. (See Figure 10)

\textbf{Figure 10. Survey of healthcare staffing shortages}

Nurses, physicians and patients alike complain about the time nurses spend in clinical documentation that is required to adhere to legal, quality of care, compliance and professional standards. Many facilities report nurses are spending 25% to 50% (and astonishingly 80% at the high end) of time documenting care – often “out of sight” and out of touch with patients. Far too often this includes redundant and non-productive vital sign data collection. RNs and CNAs often take digital data from numerous bedside monitors and transcribe the information temporarily on paper for entry into paper charts or EMRs – a total waste of time and energy for nurses who are an increasingly scarce and precious resource.

For nurses, the number of communications may actually increase, albeit the content changes, with electronic medical records and nurse call systems. Rather than convey to physicians and therapists basic

information easily accessible in the EMR, nurses can facilitate more collaboration among multi-specialty physicians and the interdisciplinary care team regarding patient status and plans versus goals. This can raise the level of communication among nurses and physicians, potentially elevating the status of the nurse. This is key for nursing that as a profession has failed to achieve deserved stature and for whom respect is cited in national surveys as “as important” or “more important” than compensation and other workplace issues.

With EMRs, BCMA systems, RFID-enabled patient and equipment tracking systems and VoIP-enabled nurse call systems, nurses more than any other group have a key stake in the quality of the network. Clearly, not all patient data entered by nurses will be entered at the point of care or service, e.g., careplans. However, data collected at the bedside are best entered or verified (with monitor or device interfaces) there in order to capture more timely data and avoid duplicate and potentially error-prone data entry into the EMR or paper chart. This both improves nursing productivity and provides remote physicians with immediate access to near real-time information for patient assessment and clinical decision support. Clinical Decision Support has proven to reduce inpatient adverse events by 55 percent and ambulatory adverse events by 60 to 70 percent.20

**As wireless solutions evolve, they will become an even more critical component of the HCO IT investment portfolio.** A new generation WLAN – a more advanced, lower cost network solution – can best address clinician demand and HCO ROI expectations. The CIO’s ability to provide high-performance network services to clinician stakeholders is a key factor in realization of potential benefits and cost savings of wireless IT. It is important to note that vendors need to adopt HCIT “market sensitive” pricing models for devices and applications if market growth expectations are to be fully realized.

The good news regarding well-designed wireless applications is that they can address patient safety, quality of care, cost savings, productivity, service, and clinician satisfaction goals – and improve the bottom line. As new challenges continue to emerge, senior HCO executives will continue to walk a fine line in maintaining economic viability, at times balancing sometimes-competing patient care and fiscal goals. With some clinical applications, benefits and ROI are difficult to quantify and at times elusive at best. With escalating building, labor, supply and capital costs and constrained revenues, savvy HCOs are looking to IT to improve financial performance. In fact, better, more clinician-friendly information systems are viewed by many as essential to reducing healthcare costs. Until clinicians broadly adopt technology, the industry will be unable to dramatically address core financial, quality of care and service problems the industry faces. Until we offer clinicians more wirelessly-enabled solutions, few clinical IT initiatives can realize full potential.

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20 CMS: Clinical Decision Support, Improving Safety, Efficiency and Quality of Care (December 2005)
Meru Networks: Delivering Secure and Proven Healthcare WLAN Solutions

Meru Networks offers a WLAN solution that helps solve important organization, clinician and HCIT problems successfully and cost effectively. Meru presents a compelling “value proposition” and delivers a proven and tested solution that has enabled impressive clinical and financial benefits, including improving clinician IT adoption and satisfaction.

Meru doesn’t simply offer incrementally better network performance at a lower price point than competitors, including those with greater name recognition. Rather, its best-in-class wireless technology and products surpass earlier generation WLAN systems to offer far superior capabilities, at significantly lower TCO.

Meru Meets Diverse Needs and Challenges Inherent in the Healthcare Industry

The Meru WLAN System can support the needs of diverse care delivery and academic organizations and settings – hospitals of all sizes, clinics, long-term care facilities, campuses, etc. Meru’s single-channel architecture and embedded Air Traffic Control technology combine to provide a single, stable “self-managing” network infrastructure. Unlike alternative solutions, the Meru WLAN creates a pervasive coverage zone that envelops the targeted setting – be it a single department or community. Meru’s Virtual Cell technology eliminates access point-to-access point handoff delays and creates seamless communications to wireless voice and data. In providing predictable network performance and highly reliable application delivery, Meru assures that clinicians have ready network access and continuous, high-speed, high-quality data and voice communications, regardless of location, topography of the facility or mobility of the user. For all clinician users of wireless IT, the comfort and value of a high performing network – available, reliable, secure (HIPPA compliant), with excellent quality of voice service – is undeniable.

Meru Networks WLAN Offers Lower TCO than Competitive Alternatives

CIOs and IT directors report far lower network support requirements with the Meru WLAN System. Network data and voice traffic is “self-managed,” responding seamlessly to predictable peak time access as well as to unpredictable fluctuations in use inherent in healthcare settings. Looking to the future, the Meru WLAN can easily and inexpensively grow, over time, in lockstep with the organizations’ IT plan and application evolution. While constant availability and excellent quality of service provided by Meru is “transparent” to clinicians, it is a critical component in clinician adoption and thus overall wireless application success.

Meru offers a significantly lower total cost of ownership (TCO) than wired LAN solutions. Initial acquisition and ongoing maintenance costs are significantly lower than competitors’ offerings with inferior solutions. Minimizing or eliminating costs associated with site surveys or RF planning enables significant cost savings. Meru’s WLAN System integrates with existing wired network solutions enabling organizations to recoup their investment in existing network capabilities.
Meru Supports a Benefits and ROI-Driven Approach to IT
Meru believes that a strategic, benefits-driven approach to IT is key to its clients’ long term success and continual performance improvement. Enabling and documenting clients’ achievement of benefits and ROI is a stated corporate goal for Meru. ROI in the Meru solution is twofold – first, directly via significantly lower TCO for the Meru WLAN System compared to alternatives and second, via optimal clinician use of Meru-enabled wireless applications. Moreover, network performance improvements, network management cost savings and clinician and patient benefits are clear, easy to document and impressive.

Meru Consistently Exceeds Performance Expectations
With the expected boom in clinician- and patient-centric wireless applications, it is crucial that network connectivity be 100 percent reliable and that communications be continual. Pervasive coverage is an ever important issue today with the current VoIP-enabled nurse call systems used by nurses who roam freely in care delivery. Networks designed and architected with earlier generation WLANs cannot adequately support VoIP applications, nor can many of the WLANs easily scale with the implementation of new wireless applications. Meru is unique in that it can support high-density voice solutions, while leveraging existing infrastructure without the expense of site surveys or RF plans typical with alternative approaches.

Meru WLAN Benefits Organizations, Clinicians and Wireless Application Vendors
Assuming requisite processes are designed and wireless applications and devices are well integrated, the “final frontier” for benefits realization is establishment of a high-performing network. Without this, CIO, clinician and wireless vendor preparatory efforts and investments will be hindered. Thus, it is in each party’s best interests (clinicians, HCOs, wireless application providers) that a truly advanced, best-in-class network is in place.

Meru Success Story: University of Miami Miller School of Medicine
Numerous Meru clients provide refreshingly clear and compelling proof statements regarding the unique capabilities of the Meru WLAN System, implemented in diverse healthcare delivery and academic settings. Meru Networks can enable rapid results for clinicians and big wins for CIOs by dramatically improving voice and data communications wirelessly. Meru delivers a lower cost, higher performing solution that engenders a stronger ROI than competitive alternatives. And, Meru better positions the organization for the expected growth of wirelessly-enabled data and voice solutions.

The University of Miami Miller School of Medicine is a remarkable success story and excellent case study to demonstrate the power of Meru’s WLAN System. The challenge was to provide high-performance mobility to the clinical and educational staff, medical students and visitors of the medical center and it’s geographically dispersed network of facilities throughout South Florida. The University of Miami Miller School of Medicine serves more than five million people and has earned international acclaim for research clinical care and biomedical innovation.
Chris Bogue, IT Director at UM School of Medicine, was an early and enthusiastic wireless proponent and visionary. A conversation with Chris is a welcome respite in the current IT storm. Beyond just sharing a good news story, Chris is genuinely passionate about the dramatic benefits and ROI received as well as how patient care has been transformed via the Meru WLAN System. Beyond an impressive list of well quantified benefits, Chris relays that a call system used in the OR has reduced connection time among anesthesiologists from a peak (not infrequent) 9 to 10 minutes per connection to an average of 3 to 4 seconds. It is easy to see how this can save time, lives and money with the OR being a high risk, high cost point of service.

These and other benefits achieved by Meru’s clients impress HCO execs and clinicians seeking best-in-class, lower cost solutions. Chris recognizes that Meru’s WLAN System is integral to the organization’s exceptional success in deployment of wireless solutions. Success at UM School of Medicine has meant creating not only satisfied users, but clinicians ready to spread the benefits of their Meru solution.

University of Miami Medical Center continues to phase in diverse wireless applications, easily and less expensively upgrading the network without recurring site surveys and RF plans or any degradation in network performance. Initial high-impact wireless initiatives included support for mobile information systems in cellular biology classrooms and operating rooms. Subsequent projects that leveraged Meru’s WLAN System included smooth and successful deployments of:

- Mobile carts for diverse uses throughout the hospital, including patient registration, medical records, patient scheduling and clinical systems
- IP voice communication badges that link staff and physicians among geographically disperse clinics – eliminating long distance telephone charges
- A facilities work order system to support equipment maintenance
- RFID-enabled asset management tracking of 130 PCA devices
- A “community cloud” providing 1.5 square miles of outdoor wireless coverage for hospital and campus – “blanketing” coverage across the community, which enables continuous connectivity and reliable quality and speed of wireless and voice data

Wireless IT Key to Healthcare Reform, with High-Performance WLAN Critical for Success

A study that appears in the September issue of the New England Journal of Medicine concludes that 40 years of investments in medical technologies, including HCIT, have paid off for Americans in extending life expectancy by nearly 7 years. While the investments to achieve this goal have been significant, clearly IT can support the ultimate overarching goal that the Commonwealth Fund Commission set out for reforming the healthcare system - “to help everyone, to the extent possible, lead long, healthy and productive lives.”

Well-designed and well-integrated wireless technologies can support clinicians who are highly mobile knowledge workers, empowering them to better use all available human and electronic resources in
caring for patients and populations. Wireless IT both connects clinicians and frees them from tethered solutions that can interfere, and even interrupt, normal workflow and care processes. With clinical vigilance and mitigation of risk, wireless solutions hold the promise of dramatically improved efficiencies, patient safety and quality of care. Meru’s “best in class” WLAN makes these goals more achievable.

Conclusion
In the brave new world of interdisciplinary, community-based, consumer-driven care, the importance of a solid wireless infrastructure provider coupled with a sound WLAN platform and a scalable architecture cannot be overestimated. Many existing networks are ill prepared to take advantage of the influx of existing and new wireless applications or meet clinician demand for availability, reliability and quality of service for voice and data communications.

Meru Networks offers a proven, superior, clearly differentiated, lower cost WLAN solution that optimizes the organization’s benefits and ROI in wireless applications, while simplifying network management and expansion. Meru offers clinicians the opportunity to provide more efficient, cost effective, safe and personalized care via wireless solutions with a supportive WLAN. It’s clear, for clinicians the network IS the computer. For patients, it can be a lifeline.
About Farrell Associates

Ann Farrell, RN, BSN, is a nationally recognized expert in electronic medical records (EMR), career long evangelist for clinician use of IT and long time champion of user friendly systems that create clinician “raving fans”. Ann is known for her "practical vision", independence and integrity based on work with diverse HCIT vendors and provider organizations. Ann is excited about the potential to look within and outside the healthcare industry for best practices, believing we can create IT solutions that better engage clinicians and leverage their time and talents.

Ann was a CIS pioneer as an ED nurse at El Camino Hospital in Mountain View California. Subsequently, she served as VP of Product Management and R & D for several industry leading vendors where she led high performing teams. Ann is an active HIMSS member including strong participation on Nursing Informatics and Management Engineering Task Forces and the Supply Chain Management and RHIO Committees.

Currently, Ann is principal of Farrell Associates, a strategic healthcare consulting firm that serves diverse IT and HCIT vendors and healthcare organizations in a variety of strategic initiatives aimed at optimizing organization success and clinician adoption and satisfaction with IT.

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About Meru Networks

Meru Networks is a global leader in wireless infrastructure solutions that enable the All-Wireless Enterprise. Its industry leading innovations deliver pervasive, wireless service fidelity for business-critical applications to major Fortune 500 enterprises, universities, healthcare organizations and local, state and federal government agencies. Meru’s award-winning Air Traffic Control technology brings the benefits of the cellular world to the wireless LAN environment, and its WLAN System is the only solution on the market that delivers predictable bandwidth and over-the-air Quality of Service with the reliability, scalability, and security necessary to deliver converged voice and data services over a single WLAN infrastructure. Founded in 2002, Meru is based in Sunnyvale, California.

For more information on Meru Networks, please contact: (408) 215-5300 or www.merunetworks.com.