

Smart Technology, Enduring Solutions

Technology Solutions Can Make Nursing Care Safer and More Efficient

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KEYWORDS

Technology, smart technology, CPOE, clinical information systems, interoperability, point-of-care devices, safety, workflow, waste.

ABSTRACT

The shortage of registered nurses in hospitals threatens to cripple healthcare delivery in the next three to five years. The demand for nursing care has increased while the willingness of nurses to stay at the bedside in acute-care settings has decreased. The American Academy of Nursing Workforce Commission developed and tested a process called Technology Drill Down in more than 200 medical-surgical patient care units in a study supported by The Robert Wood Johnson Foundation. The process identified workflow inefficiencies that could be addressed through the deployment of technology. Findings from the study indicate the need for smart, portable, point-of-care solutions that are interoperable across devices and systems. Nurses believe that technology can reduce waste and workflow inefficiency and enable nurses to provide safe, reliable, quality patient care.

Over the past two decades healthcare organizations, professional associations and the Institute of Medicine have warned the American public that failure to improve the practice environment for nurses and other health professionals would threaten our ability to provide safe, quality and effective patient care.^{1,2,3} The basis for these profound observations was the increasing complexity of acute-care environments, the increasing demand for nursing care, the aging of the American workforce and the lack of data on what work areas require improvement. In 2002, the American Academy of Nursing launched an investigation supported by The Robert Wood Johnson Foundation to identify practice environment and workflow practices that result in workflow inefficiencies, nursing dissatisfaction and turnover and ultimately affect the nurse's ability to meet the demand for safe, quality patient care.

BACKGROUND

The presence of nurses at the bedside is critical to the early identification of changes in patient conditions and the implementation

of evidenced based interventions to prevent patient harm. Nurses are essential to preventing harm to patients as documented by multiple research projects. A medication study over a six-month period determined that nurses intercepted 86 percent of potential medication errors. However, estimates of the amount of nurses' time spent in direct patient care range from 23 percent to 30 percent. Multiple factors pull nurses away from their patients, including documentation of assessments, interventions and patient response to treatment; being ready and waiting for information, supplies, equipment, medications or assistance from other team members; hunting and gathering items to provide care; traveling to and from central stations and medication rooms; and communicating with physicians and other members of the patient care team. Chaotic and complex inefficient environments contribute to nursing dissatisfaction, nursing staff turnover and diminished capacity to provide quality care.^{1,2,3,4,5,6} Flawed workflows result in inefficient use of personnel, delays in care, and compromise of patient safety and privacy.⁷

Most efforts to address the demand for nursing care have been targeted at increasing the supply of nurses. A surge in applicants to nursing schools has occurred, but the production capacity of America's nursing schools has been limited due to the shrinking numbers of nursing school faculty. In 2007, 145,000 qualified nursing school applicants were turned away due to the lack of capacity.⁸ Though more nurses are being produced, even more nurses are retiring or leaving direct patient care positions.

The aging American workforce represents a serious threat to the nation's ability to provide safe care for its populace. The average age of registered nurses is 48 with a staggering one and a half million eligible for retirement over the next five years. That represents 47 percent of the current workforce. In acute-care hospitals almost half of the workforce is age 50. The number of nurses working in acute-care settings has actually declined despite the increase in the number of licensed registered nurses in the United States from 2002 to 2004.⁹ Staff nurses increasingly cite their disappointment with their work environments and the inability to provide as much patient care as they would prefer as contributing factors to their intent to leave their job and the profession.⁵ Nurses demand changes in their practice environment to stay at the bedside. Along with their co-workers and patients, they also expect technologically advanced care. Healthcare leaders must ensure manageable workloads and provide the resources required for safe and effective care.⁷

The American Academy of Nursing (Academy) Technology Drill Down (TD2) research identified work environment factors that could be improved with the deployment of technology. Nurses and other patient care team members espoused a more efficient work environment that not only reduces waste, but also improves working conditions and the care they provide.

METHODOLOGY

The Academy engaged twenty five acute-care hospitals across the country including facilities participating in the Transforming Care at the Bedside (TCAB) initiative. Hospitals varied in size with 28

percent under 250 beds, 36 percent from 251 to 500 beds, and 36 percent greater than 500 beds. The majority were urban with only 20 percent suburban and 8 percent rural. All were not-for-profit, with 39 percent academic, 39 percent community owned, 18 percent private and 4 percent government. Seventy-two percent were teaching facilities and 44 percent were recognized as Magnet hospitals.

More than 200 patient care units representing more than 1,000 individuals participated in the two-day program. Each hospital

Nurses believe it is essential to have smart, portable, point-of-care solutions for capturing and transmitting data, as well as routine communication.

identified representatives to participate in a mapping exercise targeted to identify current workflow practices, envision idealized workflow patterns and recommend technology solutions to close the gap between current and ideal workflow practices. Representatives included registered nurses, pharmacists, information technology specialists, assistive personnel, unit clerks, therapists (respiratory, physical, occupational), social workers, pharmacists, clinical engineers, dietitians, materials management, environmental services, administrators and managers and, at some facilities, patients.

On Day 1, the participants reviewed their typical day, identifying normal workflow practices. They also described their current and ideal work environment. On Day 2, the teams selected the top workflow areas of concern, and engaged in "deep dives" to envision work environments that are enhanced through technology. The TD2 process unmasked workflow inefficiencies and impaired work environments. Participants worked in groups to prioritize the workflow practice improvements and recommend technology solutions.

FINDINGS

Nurses and colleagues across the country identified 327 workflow issues with 766 unique process issues that are part of the nurse's care delivery in medical-surgical units. When analyzed, these represented eight major workflow categories of concern: admission, discharge and transfer (ADT); care coordination; care delivery; communication; documentation; medication; patient movement; and supplies and equipment.

Each of these workflows can benefit from using technology. Nurses consistently emphasized the need for improved safety, desire for standardization of processes, and system integration. For example, an efficient clinical information system (CIS) with an easy-to-use interface, integrated with all other systems and departments in the institution would expedite the ADT process. Patients could initially enter their own information concerning reason for admission and medical history during the ADT process. Their smart cards or personal health chips could be scanned to begin to populate the CIS. Summaries from previous admissions would be obtained and available for review. Information obtained during the ADT process could automatically trigger a bed assignment and notify providers of the patient's arrival, impacting both the patient movement and communication workflows.

Information captured would begin the documentation process

Table 1: Categories of technology solutions.

IS	785
Device	569
Hardware	167
Telecommunication	16
Tool	8
Software	4
Non-tech/Non-InfoTech	42

and impact this workflow. Since systems would be integrated, documentation could occur at each point where care is rendered, increasing efficiency and reducing costs, and increasing safety of care. Bedside entry systems could interface to medication systems, supply systems, and equipment systems to trigger ordering, charging and instructions as the patient is examined and orders are entered at the bedside. Robotic systems can be used to deliver needed supplies and equipment to the bedside and deliver collected specimens to the laboratory. Thus the workflows of medications and supplies and equipment are also impacted by the technology. Needed tests would automatically enter into a centralized

Table 2: Specific types of technology. (Descending frequency)

Bedside	130	Smart pump	15
CPOE	94	WOW	14
EMR (CIS)	92	Smart card	13
Tracking	76	Kiosk	6
Barcoding	69	Pyxis	5
Robot	38	Laptop/tablet	5
RFID	33	Decision support	3
PDA	32	Camera	3
Tube system	30	Data warehouse	2
MAR	25	GPS	2
Smart bed	19		

scheduling system to positively impact the workflow of care coordination and communication.

One of the biggest problems identified by nurses is the availability of needed hardware to successfully complete their work list. Nurses walk miles during their shift finding equipment and supplies. RFID technology and robots could impact their care delivery tremendously. Improving this workflow would allow nurses more time for communicating discharge instructions with

patients and giving them needed time to counsel patients about medications and interventions included in their care.

TECHNOLOGY SOLUTIONS

In the TD2 study, nurses and colleagues identified 599 unique statements in the total of 1,591 technology solutions statements they felt would assist with safe and efficient patient care. In coding the statements the reviewers indicated if the statement pointed to an overall category of technology, if it indicated a specific type of technology, up to two descriptors or technology requirements denoted, and up to two functions the technology would address. Some statements named specific types of technology solutions, e.g., RFID technology for tracking equipment, others described desired features or technology requirements, e.g., voice communication device. When examining the overall category of technology, 785 statements indicated a need for an information system and more than 500 statements designated the need for a technology device to facilitate workflow. (See Table 1.) An additional 167 statements pointed to the availability of hardware in the practice environments. Sixteen statements pointed to the need for telecommunication technology.

When examining the specific type of technology indicated in the statement, the most frequent was bedside technology, followed closely by an electronic medical record (including clinical information system), and CPOE. The remaining list of specific types of technology named by study participants is as follows in descending order of frequency: tracking, barcoding, robot, RFID, MAR, PDA, smart bed, smart pump, wireless on wheels, laptop/tablet, smart card, tube system, kiosk, decision support, GPS, camera and data warehouse. (See Table 2.)

Nurses brainstormed functionalities that make technology faster, more convenient, compact, and easier to use. The need for interoperability and integration topped the list of functionalities followed by strong preferences for hands free features (voice activation) and portability (hand-held) for devices requiring user interface. (See Table 3.)

Technology use has become more common in healthcare but has not been adopted in a way that reaches its fullest potential of use. Technology should be ubiquitous in nursing practice and if applied appropriately can transform clinical care. Clinical transformation is defined as clinical

and non-clinical process improvement that is supported by technology. Technology must be seen as supporting and not driving the processes of care and improvement to reach the desired outcomes.

The technologies nurses envisioned reflect a broad range of functions touching every aspect of workflow and care. Nurses believe technology can greatly reduce the burden associated with the workflows of documentation, medication administration,

Table 3: Technology solution requirements.

Integrated	211	Translation	34
Voice-activated	133	Wireless	30
Handheld	84	Portable/mobile	25
Smart	41	Notification	19
Automatic/auto pop	39	Hands free	19
Biometric	37	Interactive	16
Touch screen	37	Centralized	16

Table 4: Categories of functions impacted by technology solutions. (Frequency greater than 10)

Category	Frequency
Documentation	232
Medication	167
Communication	157
Orders	109
Equipment	86
Supplies	65
Multifunction	64
Information	52
Education	51
(Patient)	(28)
(Unspecified)	(15)
(Provider)	(8)
Locator	47
(Patient)	(33)
(Staff)	(9)
(Physician)	(5)
Patient ID	33
Availability	30
Scheduling	28
(Patient)	(15)
(Unspecified)	(11)
(Staff)	(2)
Sign on/access	27
Report	27
Care delivery	26
Family	18
Plan of care	17
Discharge planning	14
Data entry	11

communication, orders, and securing equipment and supplies. Many devices and technology applied at the point of care can also be multifunction. Technology solutions can and should improve a variety of functions of work that complement hands-on care. (See Table 4.)

Most often individuals think of information systems, clinical information systems in particular, when technology is discussed. It is true that healthcare is an information intensive industry. In 2004, President Bush called for widespread adoption of interoperable electronic health records within 10 years. Today, only about one fourth of hospitals have comprehensive information systems in place. Nurses report that existing systems are often splintered, unable to interface and require multiple log-on to access or enter data. They call repeatedly for integrated systems to ease their workload and help them reach clinical transformation. In addition they want access to these integrated systems from the point of care, most often at the bedside. Some clinical information systems still use clumsy, word based interfaces rather than graphical user interfaces that save time and are more easily learned. It is time to develop systems that reduce the workload rather than requiring providers, nurses in particular, to develop a work around to use the clinical information system to support their practice.

Information systems are a crucial technology but only one kind of technology that can bring about clinical transformation.¹⁰ Another type of technology is biomedical monitoring systems including noninvasive blood pressure devices or wireless telemetry monitors used in acute care and even home care settings. Biomedical systems can increase patient privacy and confidentiality by using physiological scans such as retinal images or fingerprinting to authorize care providers to have access to patient data. This technology eliminates the need for remembering passwords and should stop the practice of taping passwords to keyboards or monitors in case they are forgotten. Wireless communication and connectivity technologies allow the care team to communicate readily at the point of care, avoiding unnecessary travel to a facility or walking within a facility that delays implementation of critical interventions while receiving expert consultation from a distance.

An additional class of technologies are instrumental in improving patient safety. These technologies imbed computer chips that gather information and respond within a range of preset parameters. Known as smart technology, because it performs a task we think an intelligent person can do, it includes smart IV pumps, smart beds, and smart cards. Smart beds are able to monitor patients' vital signs and mobility without using electrodes. Smart beds can interface with information systems to transfer information collected and alert healthcare providers when a patient is getting out of bed unattended. Smart cards collect and store information about patients that is crucial to providing safe care to that individual patient. Such information would help many individuals following natural disasters, such as hurricanes or earthquakes,

provided they keep the cards with them. A controversial proposal is to implant a chip into individuals so this crucial information is not lost as a result of lifestyle or disaster.

Barcode technology is also included in the class of technologies improving patient safety and is used predominately with medication administration systems to match patients and prescribed drugs, thereby reducing medication errors. Barcode technology can also be used for equipment and supplies distribution and charging, automating portions of the process. Related to equipment and supply distribution, is the use of RFID technology. Nurses spend an inordinate amount of time tracking supplies and equipment. Radio frequency identification (RFID) technology uses radio waves to locate and track items needed for patient care, reducing time used to hunt and gather needed items to deliver care. Robotic systems are another technology that assists with distribution of equipment, supplies, and specimens. Robots have needed computerization to allow them to pick up or deliver items throughout the institution. They can be programmed to summon elevators and enter them, assuring priority status for their task. They move freely on their planned route, stopping when an obstacle, including a person, is in their path and redirecting themselves on a safe route to their assigned destination.

Decision-support systems are another category of technology that can impact nursing practice. Mimicking the decision process of experts these systems can help novice nurses reach a safer decision about patient care when those experts are not available to them, such as during the night or on weekends when fewer resources are available. And finally educational and reference technology represents networked patient education systems, patient bedside Internet access, and unit-based Internet access for nursing personnel. This type of technology allows patients and providers continuous access to information needed to make informed decisions about care.

IMPACT

Nurses believe it is essential to have smart, portable, point-of-care solutions for capturing and transmitting data, as well as routine communication. They also want technology to reduce demand on nursing time by eliminating waste in care resulting from inefficient workflows. The study demonstrated the greatest impact of technology is on written communication and data, followed by improvement in safe delivery of care, system integration, supply chain, and oral communications. Technology can also eliminate waste, alleviate some staffing and workload issues, assist in tracking staff, physicians, and patients, facilitate the medication cycle, and improve the efficiency of the physical environment. Additionally technology can reduce some of the stressors that result in an emotional reaction to inefficient workflows or poor work environments.

Nurses expressed their disappointment with many existing technologies that lead to “work-arounds” or ways to adapt technology that is not user-friendly, or does not provide necessary functionality. It is clear from the descriptions of work practices, that the medical-surgical inpatient RN workflow is highly com-

plex. The environment is chaotic, and there is a need for speed in all transactions and interfaces with any type of technology. Around 60 percent of the study sites utilized some type of electronic nurse charting as well as CPOE (computerized provider order entry). The combination of part paper, and part electronic systems, was repeatedly cited as complicating workflows. Further, the desire for rapid retrieval of data as well as more user-friendly systems and devices, underscored the desire for efficiency at the point of care.

SHAPING AND ADOPTING TECHNOLOGY

It is time to build the technology nurses want. The voice of the nurse benefits hospital executives and technology producers.

The average age of registered nurses is 48, with a staggering one and a half million eligible for retirement over the next five years—47 percent of the current workforce.

Nurses do not want to be passive consumers of technology, but they do want to be partners in the design and testing of new and innovative applications and devices that are patient friendly and affordable. Involving nurses as end-users in the early stages of system analysis and design specifications can lead to better adoption of new technology, as well as identifying how current technology can be adapted for greater user acceptance. Nurses have articulated their needs for information systems and devices that automate manual functions, speed the delivery of information, and add incremental measures of safety. Nurses' unique needs should drive technology development, with better functionality and integration across systems. Nurses want technology solutions that will not only improve delivery of care, but also reduce nursing demand, and reduce the physical burden of work, thus improving retention. It is important to remember nurses often have information and work process needs different from other healthcare providers, which call for unique solutions.¹¹ Improved technologies can eliminate waste in nursing workflow resulting from inefficient work patterns, interruptions, inaccessible information and documentation and missing supplies, equipment and medications.

Reducing the opportunity for error improves patient safety. Technology driving medication administration systems, improved communications, timely acquisition of equipment and supplies, and fool-proof patient identification are just some applications that improve safety.

There is great value in point-of-care devices and systems that accomplish data entry or retrieval, and documentation more quickly. Wireless systems that provide rapid efficient communication, free up the nurse to spend more time on patient interaction, as well as higher-level cognitive functions such as planning and analyzing care are needed. The value added benefits of technology and automation in nursing, enable care to be delivered in a timely, compassionate manner.¹² Technology solutions should expedite multiple actions associated with a task, for instance documenta-

tion of vital signs when measured by an automated device, issuing a charge and adjusting inventory when retrieving a supply item, and eliminating duplicate communication either written or voice. Technology solutions should also provide access to resources in the moment—physicians, pharmacists, and interpreters ranking at the top of the list.

THE IDEAL MEDICAL-SURGICAL UNIT ENVIRONMENT

It is the beginning of the shift and the nurse has information about the patients assigned for the next twelve hours. The information is in a hand-held device which also allows easy retrieval of orders, medication list, task list, plan of care, and test results. The device also allows two way communication with nurse call, paging system, internal and external phones, the clinical information system and the inter- and intra-net. Smart equipment is collecting and downloading physiologic measurements along with patient location and movement within the bed, room, and bathroom. The patient and family use the bedside hardware to communicate with internal departments (e.g., meal selection, entertainment, patient education), external family and internet, and summon assistance from the nurse. The bedside device also provides translation services on demand, recording and transcribing essential information. Barcode or RFID readers in the patient's room ensure accurate patient identification, staff identification and tracking, complete monitoring and recording of the medication cycle, as well as reordering and charging for supplies and equipment. The clinical information system (equipped with bio-identification for logon) provides quick access to data and decision support software that alerts the nurse to changes in the patient's condition that are potentially threatening. Voice commands activate internal communications as well as data entry into the CIS. Throughout the shift, replenishment of medications, nutritional aids, supplies and linens occurs automatically without additional action on the part of the nurse. The room is programmed to dim lights and play soothing music, or conform with other pre-identified preferences so the patient can enjoy periods of rest and sleep. When the patient logs into the bedside hardware to check-out, a hard copy (or e-mail) record of discharge instructions prints for pick up as do prescriptions, and follow-up contact information. The check-out also signals the transportation team for pick up and the patient arrives at the front door to meet their family who are arriving in patient pick-up. The nurse activates the bed coordinating check-out system to ensure the room is made ready for the next patient. All in a day's work, but also mostly hands free.

HEALTH POLICY IMPLICATIONS

Nurses support implementation of standards for interoperability. Their repeated requests for sharing data across systems were consistent with the work of the Healthcare Information Technology Standards Panel (HITSP), and the Office of the National Coordinator supporting the harmonization of standards needed in products that enable the movement of electronic health information from one entity to another.¹³ Nurses support federal initiatives

to remove barriers to promote interoperable health IT that will improve quality and efficiency of healthcare, as well as empower consumers to manager their health information.

WORKFORCE IMPLICATIONS

Returning more RN time to direct patient care positively influences patient outcomes, increases nurse satisfaction, and helps address the shortage of nurses. It is well established that the greater presence of RN time with patients, the lower incidence of undesirable complications of hospitalization such as falls, urinary tract infections, pressure ulcers, and mortality. Not only nurses who are aging, but all nurses want a manageable workload unencumbered by inefficient systems. Nurses are not technology-

A patient relationship management application allows hospitals a better understanding of patients' needs and wants through improved communication via follow-up systems.

averse. They embrace tools that help prevent errors, improve process, and provide information to allow them to practice confidently and competently. Technology will not replace nurses, but will augment and automate essential work processes.

Technology should be ubiquitous, helpful and unobtrusive. If appropriately designed, technology will positively impact each of the workflows identified as areas of concern by the nurses in the TD2 study. We need to develop technology that will reduce the demand placed on nurses in today's fast-paced and labor intensive environments. Nursing-technology partnerships are vital for our future.

The TD2 process can help identify inefficient and burdensome workflow processes that can be improved with technology. The Academy offers a free DVD describing the entire process on its website. The Facilitator's Guide can be viewed and downloaded from the website at AANNET.ORG.

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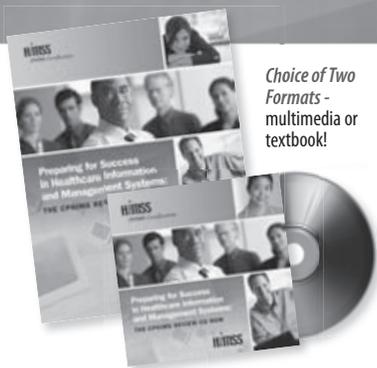
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