

How to Select End User Clinical Data Entry Devices

Rush University Medical Center Develops Tool to Identify the Quantity of Devices Needed for the Implementation of a new EMR and CPOE System.

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ABSTRACT

Selecting the right types and quantities of computers to support data entry to an inpatient Electronic Medical Record (EMR) can be challenging. In addition to software and hardware considerations, many other variables affect the decision including staffing levels, hospital workflows, and floor plans. Rush University Medical Center (RUMC) developed a tool to help identify the quantity of devices needed in a Patient Care Unit (PCU). RUMC successfully used the tool in selecting the quantity of devices needed for the implementation of a new EMR and Computerized Provider Order Entry (CPOE) system. This case study describes the use of the tool to determine quantities of PCU devices, the advantages and disadvantages of different types of computing devices for bedside documentation and areas that require special considerations in the selection of devices.

The deployment of EMRs and CPOE systems has challenged hospitals to provide ubiquitous computer access to clinicians. Studies have shown that CPOE in combination with clinical decision support capabilities can reduce health care costs by reducing the number of unnecessary tests and suggesting more effective and less expensive pharmaceuticals.¹ CPOE systems with clinical decision support require clinicians to have access to computers at the point of care. The need to access the electronic medical record efficiently at the point of care is particularly challenging. One of the first challenges is selecting the best end user device for the clinical need. There are many types of mobile computer devices available to deploy. A short list includes traditional PCs, workstations on wheels (WOWs), laptops, tablets and personal digital assistants (PDAs). Each of these devices have advantages and disadvantages for the clinician.

Table 1: Device advantages and disadvantages.

Device Name	Description	Advantage	Disadvantage
Workstation on Wheels (WOW)	<ul style="list-style-type: none"> A cart with an attached computer, monitor, keyboard and bar code reader The computer is powered by an onboard battery 	<ul style="list-style-type: none"> Most flexible option allowing documentation in the patient room, hallway, or nursing station Bar code reader attachment for medication administration Large screen size Allows caregiver to face the patient in the room while documenting 	<ul style="list-style-type: none"> Very expensive Battery life 6-8 hours Robust wireless network needed High electrical demand while charging
Laptop	<ul style="list-style-type: none"> Standard laptop with clinical software 	<ul style="list-style-type: none"> Less expensive than a WOW or tablet Allows flexibility to be used in a patient room or the nursing station 	<ul style="list-style-type: none"> Difficult to carry Small screen size Lack of space to set down in patient rooms Theft and breakage could be a problem Battery life 3-4 hours Robust wireless network needed Attaching a bar code reader for medication administration makes the device awkward to carry and use Theft and breakage issue
Tablet	<ul style="list-style-type: none"> Tablet PC with clinical software installed Uses a docking device at the nursing station to provide for charging and keyboard input 	<ul style="list-style-type: none"> Less expensive than a WOW Allows flexibility to be used in patient rooms or nursing station Some models have an integrated bar code scanner for medication administration 	<ul style="list-style-type: none"> Difficult to enter user name and password without a keyboard Clinical applications are frequently not optimized for tablet interface Small screen size Difficult to carry Lack of space to set down in patient rooms Battery life 3-4 hours Robust wireless network needed Theft and breakage issue
Stationary Computer at Nursing Station	<ul style="list-style-type: none"> Standard PC with keyboard and monitor located at the nursing station 	<ul style="list-style-type: none"> Less expensive than a WOW or tablet Large screen size No wireless network needed 	<ul style="list-style-type: none"> Not possible to document care at the bedside
Wall Mounted Workstation	<ul style="list-style-type: none"> Standard PC with keyboard and monitor mounted to wall 	<ul style="list-style-type: none"> Less expensive than a WOW or tablet Can be located in patient room for bedside documentation A bar code scanner can be attached Large screen size No wireless network needed 	<ul style="list-style-type: none"> Providing data outlet, electrical outlet and wall reinforcement make it expensive to install Difficult to position in the patient room so that the caregiver can face the patient while documenting
Personal Digital Assistant (PDA)	<ul style="list-style-type: none"> Many different types are available with varying screen sizes and some have the ability to attach a bar code reader 	<ul style="list-style-type: none"> Typically not an expensive solution Easy to carry to patient rooms, can be put in a pocket A bar code scanner can be attached 	<ul style="list-style-type: none"> Difficult to enter user name and password without a keyboard Clinical applications are frequently not optimized for PDA interface Small screen size Robust wireless network needed Theft and breakage issue

WOWs are frequently deployed in the inpatient setting for documentation at the point of care. A review of the literature reveals that WOWs have common problems, such as bulkiness, weight, storage, consistent wireless access, reliability and battery life.^{2,3} Computer tablets not only have these issues, but they also frequently do not have a keyboard, making them difficult to use for certain types of documentation.⁴ Laptops have a keyboard, but clinicians need to find a place to set the laptop down in the patient room in order to use the keyboard. Laptops and tablets are likely to be inadvertently dropped, causing damage to the unit. PDAs have small screens that are difficult to see and many EMR applications are not optimized for the use of a PDA.⁴

The selection of devices requires a collaborative approach between clinical staff and information technologists. Not all devices may fit all workflows and not all devices work well with an institution's technology standards. The information technologist evaluates the devices based on ruggedness, the ability to support the underlying technology, and the technical ability to use the

institution's clinical software. Technically, a device may not have the processing power to run the application properly.

The clinical staff evaluates the devices based on the clinical workflows. For example, tablets are very difficult to use for text-based entry, such as clinical documentation, because of the lack of a keyboard. However, one study did find them very useful for pharmacists rounding as a part of an interdisciplinary team.⁴ Collaboration between clinical staff and information technologists is key during the device selection process.

Not only must an institution decide on the types of devices that they need to purchase, but they also must decide on the number of devices that are needed. Then the challenge becomes determining the correct number of devices. Competition for devices among caregivers can occur within a PCU. An EMR or CPOE project can fail if there are not enough devices for clinicians to use to document care. Too many devices adds unnecessary costs to the project and increases the challenge of the storage of devices not in use, and increases ongoing maintenance costs. An extensive review of the literature revealed a paucity of articles that describe how to determine the correct num-

Table 2: Sample calculations for a critical care unit and a medical unit.

Unit Type	Peak RNs	Peak RN Students	Peak RN Assistants	Peak Physicians	Number of Devices based on Formula	Actual Number of Devices Deployed		Variance from Formula
						Mobile	Stationary	
Medical	13	8	4	9	33	23	12	+5
ICU	11	2	2	15	28	12	12	-4

ber of devices needed for the deployment of an EMR. A tool needed to be developed in order to calculate an ideal number of devices.

CASE STUDY

RUMC, a full service academic medical center located in Chicago, embarked upon the implementation of an integrated clinical system in the fall of 2006. The implementation of this system necessitated the purchase of end user data entry devices for clinicians for use on each PCU. Requirements of the devices included: minimal use of space/storage, PCU electrical capacity, the ability to document at the bedside, the ability to document outside of the patient room, enough devices for all clinical users at peak staffing times (including teaching rounds), ease of use and provision of the optimal device for each role. While ideally the support of one or two devices was deemed more economical for the organization, it quickly became apparent that a mixture of computing equipment would need to be selected in order to best meet the multiple needs of end users.

Various types of devices were defined and tested for use in the RUMC environment. While technically all of the device types could be deployed, a selection process needed to be developed to determine the right mixture of each device for each PCU. Table 1 defines each device type and the advantages and disadvantages for each.

The selection of the types and models of devices to deploy was made by an interdisciplinary committee composed of nurses, physicians and information technologists. The clinicians represented a cross section of the institution including critical care, medical, surgical, obstetrics and pediatric areas. Hospital Service Departments (HSD) were also represented.

RUMC had many stationary workstations already deployed in the nursing stations for CPOE, testing result review and viewing of PACS images. However, RUMC did not have a large deployment of devices that could be used at the point of care. Therefore, the focus for the committee was to determine the best device for bedside use.

The committee also determined that patient eye contact would be a problem with wall mounted workstations. Wall mounted workstations were also rejected due to the expense of purchasing one per patient room and the cost of mounting the unit and providing network cabling and electricity. The exception to this was in the bone marrow transplant unit. Each room was equipped with a workstation on a credenza located by the door. This was done in order to maintain the sterility needed within the specialized care environment.

Tablet computers were also reviewed. It was found that the tablet pen and small screen size could not create an optimized data

entry environment using RUMC deployed EMR software. Therefore, most of the clinical staff rejected the use of tablets for data entry. However, inpatient psychiatry preferred the tablets because they are a less intrusive device to use during a clinician / patient encounter. PDAs were immediately rejected because of the lack of support from the EMR vendor.

Upon consideration, the committee decided to pursue the WOW option because of its flexibility. The WOW can be moved (unlike a wall mounted computer) to another area that has a need for more units. The WOW also has a large screen and keyboard that allow for entering notes more easily. The height of the keyboard and monitor are also adjustable allowing a clinician to move the cart to a conference room or the nursing station and sit down in a chair to document.

Laptops were evaluated and it was determined that laptops would be difficult to use in patient rooms primarily because patient rooms lack areas to place the laptop and type while still facing the patient. However, Resident rounding teams found the laptops useful. One resident examines and interviews the patient while a second resident documents the encounter. A laptop was assigned to each team to use for order entry and results review while rounding. This resulted in increased WOW availability for use by nursing staff.

HSD's were assessed individually as each had special needs depending upon the services they provided. For example, Physical Therapy needs were very different than those for Dialysis. Generally, HSD needs were met with a combination of WOW's (providing intra-department mobility, especially for procedure areas) and laptops (providing extra-department data entry). Laptops were required for extra-department mobility (e.g. care on the patient care units) because of the lack of available WOWs in the units. The units did not have enough storage space for additional WOWs to be used by HSD personnel.

Once the question of what type of device to use was answered, the question of the quantity of devices to be deployed remained. A tool was developed that calculated the quantity of devices needed for documentation in the EMR. The primary input for the calculation was the peak number of clinical staff on the unit (physicians, nurses and nurse assistants). A 1:1 ratio of devices to nurses and nursing assistants was needed since they need continuous access to a mobile device in order to provide care.

RUMC is a teaching hospital with Residents, Fellows and Attending physicians. The physicians use both stationary computers located at the nursing station and mobile computers for rounding. The Residents round in teams and each team required one or two mobile devices when rounding. Attending physicians also peri-

odically use mobile devices throughout the day. Therefore, it was determined, in consultation with the physicians, that 0.83 devices, including stationary and mobile, for each physician based on the PCU would be a reasonable ratio. Table 2 contains sample calculations for a critical care unit and a medical unit. Table 2 also shows the actual number of devices deployed to the units.

Subsequently, it was determined that the actual number of devices deployed and the calculated number needed would be influenced by additional factors. These factors were the slight variation in each unit's workflow based on the acuity of their patients, the floor plan of the unit, and the frequency and number of nursing students assigned to the unit. The lack of available storage for unused carts resulted in many units receiving less carts than they requested. Ultimately, the actual number of devices deployed to each unit was determined by nursing leadership in consultation with their staff as they considered the various factors. Therefore, the calculation was really the first step in the process of determining the final number of devices per unit and provided a logical place to begin discussions.

One last but not insignificant value of the tool was its usefulness in defining the quantity of devices required to senior management. Senior management was able to see the logical approach and stages of refining the numbers that occurred.

After the selection of the quantity and type of devices was made, there were still a number of considerations and decisions that needed to be made prior to deployment. RUMC held a 'WOW Fair' to determine the selection of the manufacturer and model of the WOW. The WOW fair allowed for clinicians to come and see the proposed WOWs in a common area of the hospital. Survey feedback was obtained from the clinicians and some vendors were eliminated. The remaining two WOW models were then tested on the units. Clinicians completed online surveys after using the WOWs on the units.

Information Technologist team members were essential to selecting the best laptop to be used by HSD personnel and Resident rounding teams. The laptops selected have minimal functions and only allow access to the clinical applications. For security reasons, the laptops do not have any local data storage. This eliminates the potential issue of Protected Health Information (PHI) being inadvertently stored on the device and maintaining compliance with HIPAA regulations. The laptop model selected is a thin client terminal type that is less expensive to purchase and maintain. Laptops also require a place to be securely stored and charged. Special cabinets were purchased and located in some of the PCU conference rooms for laptop storage and charging when not in use.

Facility issues were also encountered. Older buildings could not support the electrical requirements of the new devices without infrastructure upgrades. Electrical circuits and closets supporting each PCU were assessed and upgraded for the anticipated electrical load and to maintain city and county codes. While RUMC has made a significant investment to implement wireless technology within PCUs, frequent complaints of areas where the

wireless connections were not available or dropped connections were encountered. A consulting firm fine tuned and upgraded the wireless access to significantly reduce problem areas. Processes were developed to meet bedside needs for patients in isolation. Generally, a device is assigned to and remains within isolation rooms. In addition, standard infection control procedures apply to all devices.

Locations to house the WOWs, whether within patient rooms, closets, alcoves or other areas needed to be found as fire codes will not allow WOWs to be left unattended in the hallways. Passage-

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way and egress minimums needed to be maintained. There was a belief by the clinical staff that certain vendor WOWs had a significantly smaller footprint than others and therefore would occupy less space when stored. Upon actual measurement of the vendor footprints, insignificant differences in size were found due to the universal requirement for stability of the cart.

The location of the medication dispensing station on some units also presented challenges. The clinician must access the electronic medication administration record at each automated medication dispensing station. Generally, WOW's are wheeled to these locations when medication dispensing is required; however, due to space limitations in some areas, secured stationary laptops were deployed on top of the medication dispensing stations.

Ongoing maintenance and support of devices must also be a planned activity. More computer support staff is required after device deployment. Nurses and physicians complained that devices were not in service and that repairs were not timely. An analysis of support tickets found a combination of problems with component durability as well as clinical staff training issues. Rounding teams were deployed to proactively find and repair devices out of service. Simple problems (broken mouse, loose cables, etc.) were fixed on the spot while more significant technical problems were escalated to the appropriate repair areas. PCU leadership contributed by reinforcing the training on the proper use of the devices with their staff. This improved customer satisfaction with the devices and ensured a fuller complement of devices that matched PCU needs as assessed by the tool.

Budget dollars also need to be allocated in subsequent years for the planned replacement of obsolete equipment, including computers, carts and batteries. This can be a significant amount of money depending on how many devices are deployed. RUMC had to replace all of the batteries in the WOWs after 18 months due to the batteries' age.

CONCLUSION

The selection of computer devices to document in an EMR needs to be a collaborative approach involving clinical staff and information technologist. The decision on the types and quantities of devices to deploy is based on many factors. The factors include

cost, size, durability, ergonomics and the ability to integrate into the organization's technical infrastructure. The tool presented in this paper assisted in communication to executive management of the quantity of devices needed for the patient care units. Devices are expensive to purchase and maintain. Therefore, providing a mathematical calculation to management is extremely helpful in articulating the need for devices. The tool, however, is just a starting point. The data from the tool needs to be validated by PCU leadership based on the individual units' workflow, staff scheduling, and physical layout. Every hospital will have areas with special needs, such as Hospital Service Departments. These areas need to be interviewed to determine the best types and quantities of devices needed for their use with the EMR. **JHIM**

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