



## Medical Center and Motion Tablets Combine to Streamline Workflow Saving Time and Money

### Overview

**Region:** Baltimore  
**Industry:** Medical Administration and Education

#### Customer Profile

The University of Maryland Medical Center (UMMC) is the nation's fifth oldest teaching hospital founded in 1823. UMMC cares for more than 32,000 inpatients and 300,000 outpatients each year and is one of the top 50 acute care hospitals in the nation.

#### Business Situation

The Medical Center, in the process of replacing its tired and cumbersome semi-mobile technology, needed a reliable, portable and personal alternative to complement its new system of data entry.

#### Solution

The Medical Center found a complete solution with the Motion C5 coupled with Cerner Software.

#### Benefits and Results

- Improves portability
- Personalizes patient experience
- Easily disinfected
- Eliminates paper waste
- Streamlines medicinal workflows

*"The clinicians that go to multiple floors were most impressed with the portability and believed it facilitated their workflow. They didn't have to engage in any competition with anyone for computers."*

Mark D. Kelemen, MD, MBA, chief medical informatics officer for UMMC

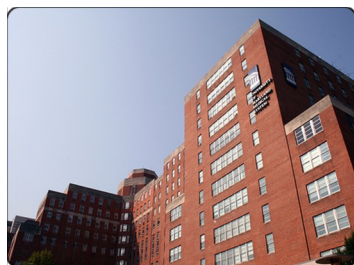
The number of institutions implementing electronic medical records (EMRs) has been steadily increasing in recent years. When deploying computerized documentation systems and other healthcare IT solutions clinicians must be provided with convenient access to technologies at the point of care (POC) wherever the patient might be within the facility.

When The University of Maryland Medical Center implemented its EMR network it needed a new way of allowing its medical professionals to distance themselves from the old methods of data input and patient care. Consequently the selection of a more portable device was needed.

The Medical Center selected the Motion C5 after a brief pilot test confirmed that the C5 would not only replace the existing technology but would provide an improved workflow model across the board.



*“Motion made it clear they were very committed to building medical grade devices for healthcare.”*



## Executive Summary

The number of institutions implementing electronic medical records (EMRs) has been steadily increasing in recent years. When deploying computerized documentation systems and other healthcare IT solutions clinicians must be provided with convenient access to technologies at the point of care (POC), wherever the patient might be within the facility. The University of Maryland Medical System (UMMS) has implemented computerized provider order entry (CPOE) and electronic medication administration record (eMAR) at its academic flagship, the University of Maryland Medical Center (UMMC).

When UMMS initially deployed CPOE and eMAR, desktop PCs and workstations on wheels (WOWs) were installed. A key concern was ensuring all providers had computer access so as not to impede their workflow. This led UMMS's clinical and technology leadership to search for additional computer devices for clinicians to support specific clinical workflows, encompassing some of the key factors of successful implementation of technology in their study program.

When UMMS leaders began evaluating alternative computer devices they contacted Motion Computing®. After a variety of review sessions to determine scope of work, study objectives, risks and success criteria, UMMS and Motion Computing agreed to jointly conduct a Clinician Usability Study to ascertain the extent to which Motion's C5 mobile clinical assistant (C5 MCA) would meet the workflow, user acceptance and point of care device requirements that had been established. UMMC has implemented Cerner Millennium® PowerChart® for their CPOE and eMAR applications; therefore PowerChart integration was a primary requirement. UMMC piloted the Motion C5 MCA in a designated nursing unit and clinicians evaluated its performance and Cerner PowerChart integration.

The pilot study involved a multi-disciplinary approach. Although mainly conducted on a medical surgical unit, respiratory therapy, rehabilitative services and the physicians from the Minimally Invasive Surgery service also participated. The chief of radiology also assessed the C5's viewing capabilities for PACS display. The effectiveness of the C5 MCA in the clinical environment was measured based on the criteria established by UMMS leaders and the responses from clinical participants. Formal evaluation results indicated

the clinicians were satisfied to extremely satisfied with the performance of C5 MCA in clinical conditions. Clinicians believed the C5 provided satisfactory mobility tools for POC documentation. Additionally they provided a positive rating of C5 for its mobility, workflow compatibility, durability, and ease of cleaning and disinfection.

## Introduction

The University of Maryland Medical Center (UMMC) is the nation's fifth oldest teaching hospital founded in 1823. UMMC is a 669-bed facility located in downtown Baltimore and includes the University Hospital, the Greenebaum Cancer Center, the R. Adams Cowley Shock Trauma Center (Birthplace of the "Golden Hour"), and the University of Maryland Hospital for Children. The University of Maryland School of Medicine is the nation's first public medical school and a recognized leader in biomedical research and medical education. The Medical Center and the Medical School are partner organizations focused on high quality education, research, and clinical care. The Medical Center cares for more than 32,000 inpatients and 300,000 outpatients each year. They have been recognized as one of only 50 acute care hospitals listed as the nation's top performers in patient safety and quality of care by the Leapfrog Group. The University of Maryland Medical Center is one of the nation's top, standard-setting teaching hospitals for cardiovascular care, according to the 2007 Thomson Top 100 Hospitals: Cardiovascular Benchmarks for Success study.

UMMC installed the suite of Cerner applications to support inpatient clinical care services and ancillary systems, including laboratory, pharmacy, emergency care, and surgery. The computerized provider medication order entry (CPMOE) and the electronic medication administration record (eMAR) project were piloted July 24, 2007 in seven shock-trauma ICU units and in two acute care units. The remaining inpatient units were rolled out over the following month.

UMMC used a variety of desktops, laptops and tablet PCs that were connected to mobile carts of various generations. Caregivers used the devices to enter and view orders and results, as well as view PACS images. With the implementation of CPMOE and eMAR, clinicians required more computer access and thus additional devices. As a teaching institution, the clinician/patient ratio could be as high as ten to one, meaning a significant number of

clinicians required access to the electronic medical record (EMR) in order to view results, document care and place new orders. In addition to improving clinician access, UMMC determined their device strategy needed to address infection control, space constraints, and usability requirements.

One key issue was the inability to take the mobile carts into the medication room. “Our nurses would have to leave the computer outside of the meds room, light up Omnicell (the medication system) and there was a very good chance for error because the order was not in front of them,” explained Mark E. DeVault, Director of Clinical Information Systems for UMMS. “The medication rooms were never designed to have computers in them, had no wall or counter space, and we knew we had to come up with a solution.”

### Workflow and Device Access Issues

The International Standards Organization (ISO) states that usability can be measured only by taking in account the context of the use of the system (Bevan, 1999). After implementing PowerChart, UMMC’s workflow increased clinicians’ need to access the EMR from multiple locations. Physicians, nurses, and ancillary staff competed for computer device access throughout their daily routines. This impaired clinician productivity and job satisfaction. UMMC leadership realized that in order to maximize the EMR’s full benefits, the current device strategy needed to be reexamined in the light of future functionality.

As typical in the hospital inpatient setting, patient assessments and treatments primarily occurred at the bedside. Workflow efficiencies are maximized when clinicians have access to patient information at the point of care (POC). At UMMC, nurses frequently had to leave the bedside to access patient data because they lacked POC devices. These workflow inefficiencies often frustrated UMMC’s healthcare providers. Figure 1 illustrates a typical workflow experienced by registered nurses when administering nonscheduled pain medications using the paper state prior to piloting of the eMAR module.

*“Since the C5 doesn’t have as many external parts you don’t have as many things to break.”*

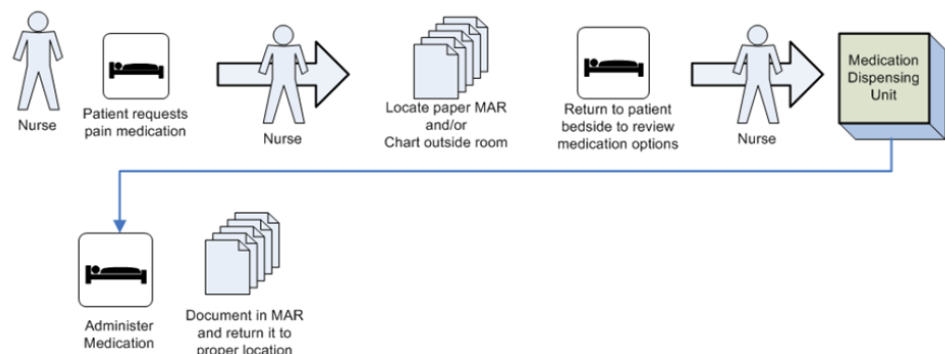
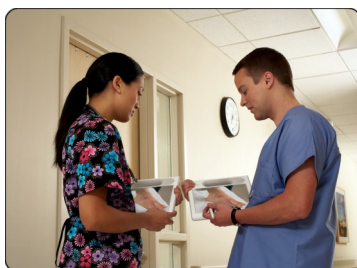


Figure 1: Current workflow for administering a nonscheduled pain medication

### Preparing for Change

Mark D. Kelemen, MD, MBA, chief medical informatics officer for UMMS summarized some of the device requirements. “Some parts of the hospital have an older infrastructure and having something portable and wireless made sense. Also, some spaces were too small to pull in and out a device like a WOW. We also had an increased demand for devices since rolling out CPOE, including from our mobile, moving therapists.”

Beverly Dukes, RN, Patient Care Services Manager for UMMS’ Weinberg 5 Surgical Acute Care unit summarized some of the nurses’ chief concerns. “We needed to reduce the glare issues we had with the WOWs, we needed something worker-friendly that stay charged, and we needed more availability.”

*“It was small enough to get into the medication room we had a much safer practice for comparing drugs with orders.”*



UMMS created a list outlining required features for their new devices. The needs and concerns of all their healthcare providers were considered. The final evaluation elements included:

- Ease of log-in
- Ease of use, including compatibility with workflow, easy data entry and simple access
- Mobility/weight/design
- Screen clarity
- Space utilization
- Battery life and ease of changing battery
- Durability and ease of disinfecting
- Ease of imaging and compatibility with application
- Power management
- Wireless compatibility and session stability
- Total cost of ownership
- Security
- Serviceability
- Effect on patients' impression of the organization
- Degree of impediment to patient care

UMMC believed that if they employed a device that satisfied clinician requirements, they would improve workflow, provider satisfaction and patient care.

UMMC clinical and information technology leadership collaborated with Motion Computing to formulate a project approach that would enable vigorous testing against UMMC usability, workflow and application fit, technology, and other requirements. Given the diversity of clinical participants and the significance for the health system, University of Maryland established a multi-disciplinary team of executive sponsors to approve and review the project and be generally available for issue escalation or to review material changes in project scope. This team included:

1. Timothy Babineau, MD – senior vice president and chief medical officer (UMMC)
2. Jon Burns – senior vice president and chief information officer (UMMS)
3. Mark Keleman, MD – senior vice president and chief medical informatics officer (UMMS)
4. Glenn Robbins, MD – senior vice president and chief medical officer (UMMS)
5. Lisa Rowen, RN – senior vice president and chief nursing officer (UMMC)

### **The Motion C5 MCA**

Motion's C5 MCA is the byproduct of years of research, focus group testing, workflow studies and collaboration with leading clinical software developers, component manufacturers, and end user clinicians. Intel was instrumental in formulating the original MCA reference design based on its ethnographic research. The C5 benefited from Intel's ethnographic research and

engineering innovation as well as clinician usability research Motion completed during the previous five years. The C5 was developed and commercially manufactured by Motion Computing as the Motion C5 MCA and began commercially shipping worldwide in August 2007. Created to meet the demands of the acute care environment, the Motion C5 provides a sure-grip handle, a sealed case for easy disinfecting, a lightweight design for portability, a 10.4-in screen for easily viewing clinical information with minimal scrolling, rugged construction that minimizes the impact of dropping the device, and pen and stylus input so clinicians can enter text and navigate the software without being tied to a keyboard. The Motion C5 also includes features such as integrated barcode and RFID readers for patient identification and/or electronic medication administration, an integrated camera, and built-in Wi-Fi\* and Bluetooth\* for wireless connectivity. University of Maryland clinicians, information technology personnel and clinical leadership were among many in the industry who provided input into the unique design and features of the C5 platform. Cerner Corporation also actively developed integration improvements with its software applications and contributed input to Motion that could enhance the clinician end-user experience and organizational value realization from using the Motion C5 with Cerner software. The University of Maryland C5 projects described here utilized a clinician usability study methodology and standard Likert scale developed by Motion Computing. This structured methodology uses a cliniciancentric model to introduce new technologies within workflow and practice patterns.

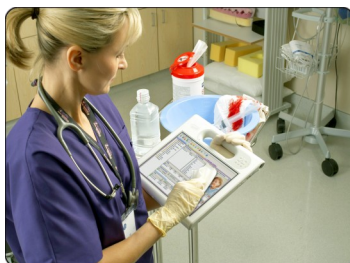
### **Enhancing Workflows with Technology**

The UMMS has designated Weinburg 5, a 32 bed acute and general surgical unit as the clinical unit for testing new Medical Center technology. The mission of this “nursing unit of the future” is to provide a medium for UMMS to gain experience with new information technologies and processes and to focus on optimal practices to be rolled out across UMMS nursing units. The goals for this unit include:

- Provide production laboratory for UMMS to experience new and emerging technologies prior to major acquisition and implementation
- Create an opportunity for nursing, physicians, and allied health professionals to validate workflow impact of new technologies
- Serve as a test bed for clinical and technology scenario building
- Develop optimal nursing practices before a large scale rollout

The pilot study participants were the 5th floor Weinberg unit nurses as well as other designated clinicians. Motion provided Weinberg 5 with six C5 evaluation units that had been imaged by the UMMS technical team. The C5s were prepared with tablet functionality in addition to the standard UMMS clinical image. Motion installed the C5s, the docking stations and the keyboards and provided end user training during the initial four days of the study. Training participants were the Weinberg 5 nurses, assigned physicians and other designated caregivers. The training program included a general overview of the C5 technology and handwriting tips. In order to validate different departmental workflows, two C5 units were later moved and made available for rehabilitative services, respiratory therapy, pharmacy, trauma and radiology. UMMS's EMR Support Team also provided end-user support during the three week study. Motion provided a customized set of parameters that would be used to assess evaluation of UMMS' specific performance measures. At the end of the study, participants completed surveys to validate the C5's usability and suitability to their specific workflows.

*“Everyone across the board liked the ability to wipe it down to enhance compliance with disinfection protocols.”*



### Evaluation Results

Figure 2: Workflow for administering a nonscheduled pain medication using the Motion C5 MCA  
Workflow improvements were noted when the C5 was used to facilitate the medication administration process.

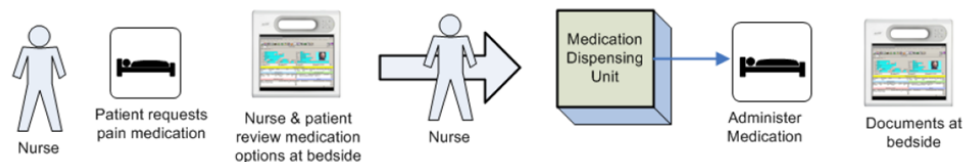


Figure 2 illustrates a typical workflow experienced by registered nurses when administering nonscheduled pain medications using the paper state prior to piloting of the eMAR module.

### Clinician Perspective

Seventeen clinicians completed study evaluations. The evaluators were from nursing, rehabilitative services, and pharmacy, plus one nurse practitioner. The clinicians used a Likert Scale Survey to indicate their relative satisfaction with the C5 MCA. The responses could range from extremely dissatisfied (1) to extremely satisfied (5). The specific evaluation questions corresponded with the initial assessment criteria UMMS established. The study coordinators also collected numerous observations and anecdotal comments from the Weinberg 5 nurses, the minimally invasive surgery physicians, and the chief of radiology.

The C5's primary documentation tool is the pen, which has mouse functionality and handwriting capabilities for free text entry. The clinicians indicated that entering free text data with the pen worked well, whether using the handwriting functions or the onscreen keyboard. Most of the PowerChart application is designed with point and click capabilities, adding to the overall documentation efficiencies. Though clinicians were generally satisfied with the overall logon process using the C5, Motion, and UMMS noted some user authentication inefficiencies. The PowerChart application requires physicians to re-enter passwords for order validation, slowing their workflow. To optimize this process UMMS and Motion are investigating the use of biometrics in lieu of passwords.

“Everyone across the board liked the mobility and the ability to wipe it down to enhance compliance with disinfection protocols,” said DeVault. “Because it provides the exact same display as you would get on a desktop the nurses found it very, very easy to do their medication administration documentation with the pen, since the application is point and click. Because it was small enough to get into the medication room we had a much safer practice for comparing drugs with orders.”

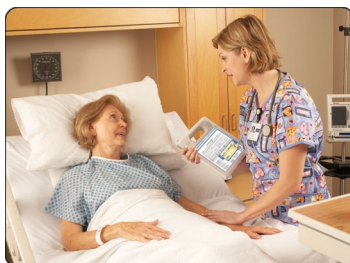
“The feedback was uniformly positive for different reasons for different people,” said Dr. Kelemen. “The nursing staff found it very useful to have the medication administration record open when they were administering meds. They liked the portability of it and found it very easy to have the record open while

collecting meds from the pharmacy.”

“Any drawbacks with the C5’s were totally overridden by the beauty of having a virtual clipboard for nursing documentation on hand in the patient room,” said Bret Anderson, R.N. “In the medication room the C5 proved so essential that even the more reticent nurses really loved it. They use it like they use a written document in a paper folder.”

Overall the clinicians rated the C5 MCA positively for its ability to be incorporated into the multidisciplinary workflows. The study proved the C5 could successfully integrate with the Cerner PowerChart application and enable patient chart access at the POC or anywhere else required. Using the C5, clinicians were able to enter and validate orders and medications and review test results. The C5 was proven to satisfactorily fit into the environment and enable real time POC documentation. These results are illustrated in Table 1 with indicating a favorable rating, a neutral rating and a less than favorable rating.

*“It was evident the nurses had a more engaging encounter with the patient.”*



Workflow Compatibility		Mobility	
Patient Lists		Room to Room Rounding	
Order Results Review		Privacy	
EMAR		Weight	
CPOE Functions		General Use	
Order Acknowledgment		Screen Clarity	
Care Plans, Intake and Triage			
Bed Management			
Space Utilization of the Docking Station		Ease of Login <small>Includes network/application log-on and password entry for physicians entering orders</small>	
Foot print		Found the soft screen keyboard ok, but less favorable	
Multiple docking Stations	none tested	Docking station with keyboard was preferred	
Ease of Use		Battery Life	
Point and Click Features		Change	
Tablet Input Panel		Duration <sup>1</sup>	
Handwriting		Heat	
Soft keyboard			
Data Access			
PACS		Durability	
Image Quality		Disinfectibility	
Mobility		Bash Proof	did not test
Function / Features			
Scrolling			

Table 1: Summary of clinician validation and evaluation of workflow and features

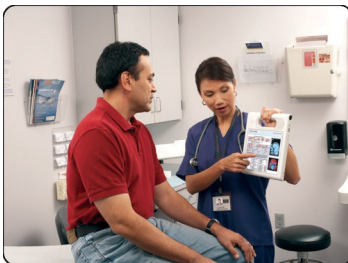
<sup>1</sup> The project did not incorporate recommended C5 docking stations for power management and battery trickle charging so this requirement was not able to be properly reviewed. For some usage scenarios the battery life without use of the recommended power management schema would have been deemed inadequate given long clinical shifts.

### Enhanced Image of Organization

Conversations with patients conducted by UMMS personnel indicated that use of the C5 enhanced the image of UMMS as a leader in technology. Patients felt the C5 was less intrusive to care and that the “WOWs are obnoxious.” Patient history could be easily taken at the bedside and patients generally found the device impressive and felt less threatened by the C5.

“Most of the verbal responses from patients were that it was cool and high tech,” said Anderson. “The non-verbalized responses were really interesting. Instead of a nurse rolling in an imposing WOW machine that was intrusive and hid the clinician, the clinician was able to stay right at the patient bedside. It was evident the nurses had a more engaging encounter with the patient.”

*“In the medication room the C5 proved so essential that even the more reticent nurses really loved it”*



### Additional Findings

In addition to the Likert Scale survey, clinicians were able to include free text comments regarding the C5 MCA. Below is a partial list of what participants said they liked most about the C5s:

- Portability
- Handy
- Had own personal device that didn't have to be shared
- Ability to document medication administration at the patient bedside
- User friendly
- Reliable
- Durable
- Easy to carry and use anywhere
- Have ability to take photos and have barcode access
- Fits on the medication cart
- Able to wipe down in contact room
- Smaller than a laptop

Dr. Kelemen said their mobile practitioners also provided favorable comments. “The clinicians that go to multiple floors were most impressed with the portability and believed it facilitated their workflow. They didn't have to engage in any competition with anyone for computers. The screen was of sufficient clarity to allow for review of radiology studies,” noted Kelemen. “The physicians found it useful for results viewing for reference purposes.”

Additionally, the radiologist participating in the study was extremely satisfied with the C5's viewing capabilities. His workflow was expedited because he was able to view reference copies of numerous PACS on the C5 unit.

The technology staff at UMMS also provided positive commentary on the C5. “The C5 is easy to build and has hot swappable batteries,” said Scott Johnson, a UMMS systems engineer and LAN administrator. “Support-wise, since the device is sealed, you have to ship the device off for repair and can't swap a component. From a technical standpoint you don't have to worry about touching it, though you probably need to keep some extras on hand. With WOWs we used to get a lot of broken wireless cards since they stick out but since the C5 doesn't have as many external parts you have don't have as many things to break.”

### Moving Forward

Successful technology acceptance is directly related to the merger of people, processes, and technologies. As UMMS advances its use of EMRs and other healthcare IT, mobile point-of-care solutions are vital to improving ROI, assuring quality patient care, and improving clinician satisfaction. In addition to the clinician workflow study, UMMS is taking additional preparatory steps to ensure successful, sustainable technology adoption. UMMS has now made additional investments to more pervasively use of the C5 beyond the pilot unit.

### Summary

UMMS teamed with Motion Computing to assess the Motion C5 MCA's suitability for their facilities. Key concerns were increasing patient chart access, especially at the point of care, and improving clinician documentation, patient care, and provider satisfaction. The study results proved the C5s could satisfy these goals. By incorporating the Motion C5 MCA into their device strategy, UMMS enhances the benefits of their EMR project and ensures the successful utilization of the Cerner PowerChart application. As one of the nation's leading healthcare delivery and education systems, UMMS has set a new benchmark for healthcare institutions.

By thoughtfully applying technology to improve workflow, healthcare leaders can create new ways to improve patient care while optimizing clinicians' expertise. Product innovations such as Intel's MCA reference design and Motion Computing's C5 MCA, backed by close vendor collaboration, can support healthcare institutions in achieving positive and lasting change.