White Paper

Field Study

Intel Digital Health Group

Mobile Clinical Assistant Platform Prototype: Mobile Point-of-Care Technology for Rounding Clinicians

Salford Royal NHS Foundation Trust, United Kingdom

Executive Summary

A wide range of clinical support healthcare professionals (allied health professionals) conduct rounds in a hospital, including physicians, physical therapists, ward nurses, dieticians, and phlebotomists. These rounding "clinicians" often have far more restricted access to healthcare information technology than a hospital's resident staff. Intel's Digital Health Group conducted an ethnographic field study at Salford Royal NHS Foundation Trust, located in Greater Manchester, U.K., to try and improve the effectiveness of mobile point-of-care (MPOC) solutions for these clinical support healthcare professionals.

Phlebotomists in the study were provided with a mobile clinical assistant (MCA)—a new mobile point-of-care (MPOC) platform prototype developed by Intel Digital Health Group to meet the unique needs of clinicians in acute care settings. They were trained on a paperless workflow based on iSOFT plc i.Clinical Manager* (i.CM) software, and were observed by a member of the Digital Health Group's ethnographic research team as they used the MCA to perform their rounds.

The results of the study suggest that phlebotomists' use of MPOC solutions can improve patient experience, the quality and efficiency of care, and clinician work experience and satisfaction. By leveraging the MCA's portability and its access to clinical information, phlebotomists were able to function in a more natural, real-time workflow.

The improved workflow produced some interesting results. Phlebotomists were able to:

- Accommodate new orders and stat orders on-the-fly. This enabled lab processing to begin sooner—potentially speeding result-reporting, as well as treatment plan adjustments.
- Resolve questions quickly. The MCA's portability made it easy for phlebotomists to locate requesting clinicians, address questions, and capture corresponding order-updates.
- Chart each blood draw at, or close to the time of the event. This gave phlebotomists a sense of completion, minimizing the chance of forgetting important information, and making information more quickly available to other clinicians.
- Ensure positive patient identification. The MCA's built-in radio frequency identification (RFID) reader enabled phlebotomists to positively identify those patients wearing RFID wristbands.
- Reduce paperwork.
- Eliminate the need to wait for access to a hospital ward's personal computers (PCs) to enter patient data.
- Avoid unnecessary blood draws resulting from previously unrecognized discontinued orders. Needle sticks are painful and stressful for patients. Avoiding these draws benefited patients and enhanced overall service efficiency.

While the field study primarily focused on phlebotomists, mobile information access and portability is expected to produce comparable benefits for other rounding clinicians as well.

The results of the Intel study highlighted the importance of software design and workflow integration, specifically when integrating an MPOC solution. What is particularly important for rounding clinicians is to support the demands of their emergent workflow, which involves more on-the-fly decision-making than with static, paper-based work environments.

Focusing Upon Rounding Clinicians and Clinical Support Professionals

Intel's Digital Health Group (DHeG) developed a new mobile point-of-care (MPOC) platform prototype designed specifically for acute care environments. To ensure that these mobile clinical assistant (MCA) platforms truly meet the needs of healthcare professionals, researchers from the Digital Health Group have worked with hospitals throughout the world. Collectively, the DHeG team has conducted ethnographic field studies of the MCA in a range of practical situations. Each hospital environment (and corresponding end-user community) has presented unique demands and requirements. The better we understand these requirements, the more effectively we can tailor technologies and solutions to support them.

Intel's earlier ethnographic studies[1] examined the MCA's use by nurses in inpatient acute care units in the U.S., and by physicians and nurses in an Accident and Emergency department in Singapore.

This current paper reports on a study that examined the MCA's use by phlebotomists in the U.K. This study gave us an opportunity to better understand the needs of both clinical support healthcare professionals as well as rounding clinicians. While much attention has been paid to the benefits of portability and mobile information access for physicians and nurses, it is important to consider that clinical support healthcare professionals have highly mobile workflows which can also benefit from mobile point-of-care solutions. Since technology-change is complex, we also sought to identify those issues and challenges which might arise when deploying MPOC solutions to rounding clinicians.

Study Overview

The study was conducted at Salford Royal NHS Foundation Trust, a large University teaching hospital. The hospital is among the top four in England and the best in the North West, following the Healthcare Commission's Annual Health Check results. The Healthcare Commission independently assesses the quality and performance of NHS Trusts. Salford Royal has a staff of approximately 4,200. On an average day, it cares for 1,000 outpatients, 840 in-patients, 74 day-case patients, and up to 250 Accident and Emergency Department patients.[2]

Salford Royal uses iSOFT plc i.Clinical Manager software to manage electronic medical records. iSOFT is a leading worldwide supplier of advanced software applications for the healthcare sector.

To prepare for the study a field test team comprised of staff from Intel and iSOFT plc conducted ethnographic observations to obtain a baseline of clinical working practices and challenges at the hospital. From this activity the appropriate study areas were identified and new MCA supported workflows developed. This groundwork identified the potential benefits of implementing mobile point-of-care technologies to improve the rounding phlebotomists' workflow.

[1] See Mobile Clinical Assistant Platform Prototype: Mobile Point-of-Care Technology in an Acute-Care In-Patient Setting, El Camino Hospital, California, 2006; and Mobile Clinical Assistant Platform Prototype: Mobile Point of Care Technology in a Trauma Care Setting, Changi General Hospital, Singapore, 2006.

[2] http://www.srht.nhs.uk/

Following the initial data gathering phase, the team developed a paperless workflow that enabled rounding phlebotomists to use the mobile clinical assistant (MCA) to perform the following transactions:

- Positive patient identification
- Real-time charting of drawn blood samples
- Real-time order-change notification
- Real-time checking of data conflicts

The MCA used in this study provides the capabilities of a standard mobile tablet PC, along with additional features designed to add value in clinical settings. For this study, iSOFT enhanced the application configuration and provided software enhancements to their i.Clinical Manager application to take advantage of two value-added features. First, it used the MCA's Bluetooth* wireless technology to enable phlebotomists to wirelessly print specimen collection requisitions and labels (as needed). The MCA also used an integrated radio frequency identification (RFID reader) to support positive patient identification and provide an enhanced user logon experience. Table 1 summarizes the MCA's capabilities.

Seven phlebotomists were trained on and used the MCA and i.Clinical Manager with Bluetooth enabled mobile printer as they went about their rounds. The live-study phase was conducted over a four-week period ending in December, 2006. While the phlebotomists were the study's primary subject, maternity and elderly care ward nurses as well as a diabetes specialist were also observed as other clinical users.

Table 1

Feature Summary:	
Mobile Clinical Assistant Prototype	
Feature	Benefit
Slim, lightweight design	▪ Enhance portability and bedside ease-of-use
Hardened chassis and hard drive	▪ Minimize damage caused by accidental drops
Sealed case	▪ Enable the device to be easily wiped with disinfectant—reducing infection-transfer as well as system damage
Sure-grip handle	▪ Promote a secure grip during use and transport
10-inch display	▪ Provide easy-on-the-eyes viewing of clinical information ▪ Minimize scrolling
Pen/stylus data entry	▪ Simplify system navigation and text entry ▪ Eliminate cumbersome keyboards
Integrated camera	▪ Facilitate visual point-of-care clinical documentation (for example: photographic wound illustration)
Barcode reader	▪ Support positive patient identification and electronic medication administration
RFID reader	▪ Enable clinicians to log into each system "layer" without using a keyboard, mouse, or stylus ▪ Speed user authentication and authorization ▪ Support positive patient identification and electronic medication administration
Wi-Fi* and Bluetooth* wireless technology	▪ Provide easy, robust, wireless area network connection ▪ Enable automatic vital-sign uploads and data uploads (to the EMR) ▪ Enable wireless connectivity to other devices (for example: local printer)
Docking station	▪ Safely store and / or charge the MCA ▪ Enable battery hot-swapping (while continuing system use)

Mobile Platforms Accommodate a Mobile Workflow

"Rounding" work is inherently mobile. Clinicians move from patient to patient to perform and document one or more clinical tasks. At Salford Royal, phlebotomists' regular workflow was largely paper-based. Before each shift, the manager printed out the required documents (work lists, order requisitions, and specimen labels) for each patient, then assembled them into packets for each ward, and then assigned phlebotomists to the wards. Phlebotomists conducted their rounds, manually checking patient IDs, placing the appropriate requisition in a specimen bag sleeve, affixing labels onto specimen tubes, drawing blood, and leaving specimen bags in a ward collection bin for collection by lab staff. The clinicians charted their work on a ward PC only after they had performed all the blood draws for that ward.

While hospital environments and clinical workflows are often dynamic, the phlebotomists' paper-based workflow was static and inflexible. Once work lists were generated and the requisitions and labels printed, phlebotomists could not accommodate a stat order or, in fact, any new order. They also lacked visibility into orders which had been cancelled after the initial work list was prepared.

The MCA and paperless workflow process aimed to enable a more dynamic and flexible workflow. Phlebotomists took it upon themselves to use the MCA and the i.Clinical Manager software to create an electronic specimen collection work list. They then placed the MCA on their mobile trolleys along with the mobile printer and took it with them, giving them access to the electronic work list and other clinical information as they proceeded through their rounds. By eliminating the initial paperwork and accessing orders in real time, managers were freed from the initial paper processing and were able to perform higher-value tasks. It also provided the phlebotomists with a real time, emergent workflow and the flexibility to respond to changing clinical demands by adjusting their work lists "on-the-fly."

Clinicians in our other study groups at Salford Royal did not use the MCA to directly alter their workflow process, but they did use it in conjunction with the i.Clinical Manager software and the RFID wristbands to establish patient identification and to access real-time patient information at the medical point of care.

All of this provided benefits for the patient experience, patient care, and clinician satisfaction. Some examples of the benefits observed during this study are outlined below.

Avoiding Unnecessary Blood Draws

MCA provided real-time access to the i.Clinical Manager on the ward or at the bedside, enabling phlebotomists to access the latest available lab test orders. If orders were discontinued, the phlebotomists were able to avoid a blood draw. With the paper workflow, the phlebotomist had no way to know about an order change, so patients were subjected to unnecessary blood draws. Real-time knowledge of the latest order allowed some phlebotomists to combine their blood draws with those that were designated for ward staff. This further reduced the need for the patient to be subjected to excessive blood draws.

No patient likes to have blood drawn, so this benefit alone is greatly appreciated by patients. Reducing unnecessary blood draws also improves the phlebotomist's interaction with the patient population and improves overall efficiency—saving time for other important tasks.

Figure 1. Phlebotomist checks printed requisition against i.Clinical Manager orders.

Adding New Orders

Since the MCA and i.Clinical Manager software provided wireless printing and portable information access, phlebotomists were able to accommodate new orders, including stat orders. As orders came in, phlebotomists could add them to the work list in real time and wirelessly print the necessary requisitions and specimen labels. This potentially improved the quality of care by allowing blood to be collected, analyzed, and reported sooner. This, in turn, allowed clinicians to more quickly adjust treatment plans.

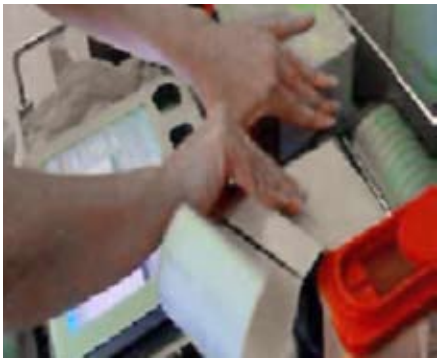


Figure 2. Phlebotomist removes printed requisition and label.

Resolving Questions Quickly

When phlebotomists had questions or concerns about lab orders, the MCA's portability helped them get answers quickly. In one case, the phlebotomist used the MCA to identify who requested the order. She located the requesting clinician on the ward and walked him through the steps of amending the order. The MCA made it possible to take the questionable information directly to the relevant clinician, regardless of his or her location. Having information at their fingertips helped phlebotomists quickly resolve problems.

With the previous, paper-based workflow, the phlebotomist would have had to log into an available ward PC to identify the ordering clinician. Even then, the phlebotomist wouldn't have been able to review the order with the clinician and the process changes to the order.

Figure 3. Resolving and addressing questions in real time.

Charting as You Go

In the paper-based workflow, phlebotomists charted their work only after they had completed their rounds on a specific ward. To do their charting, they had to compete with physicians, nurses, and other clinical support healthcare professionals just to access an available ward PC. The MCA enabled phlebotomists to chart each blood draw as soon as it was complete.

Real-time charting benefited the quality and efficiency of care. Phlebotomists could manage each patient transaction in a more holistic fashion, providing a sense of completion. Charting while the information was fresh, minimized the risk of forgetting relevant information or tasks. Data was captured in the system faster, informing nurses and physicians that the requested specimens were collected.

In some cases, the chart-as-you-go model enabled the lab to begin processing the specimens sooner. With the paper-based process, lab staff picked up lab specimens from the wards, but couldn't process them until phlebotomists had charted each test in the i.Clinical Manager software. By charting in real time phlebotomists removed this potential delay.

Figure 4. Phlebotomists uses MCA to check off collected specimens.

Ensuring Correct Patient Identification

Accurate patient identification is an important patient-safety issue for all clinical tasks, including that of the rounding clinicians. In contrast to clinicians who spend their shift working with a relatively small number of patients, rounding clinicians frequently encounter patients unknown to them. On one of the wards we studied, the i.Clinical Manager software was used with the MCA's built-in RFID reader to positively identify those patients wearing an RFID wristband. This change helped ensure blood was drawn from the right patients for the right tests.

Figure 5. Looking up patient using RFID wristband.

Efficiency and Empowerment for Clinical Support Healthcare Professionals

Despite new work routines and intermittent connectivity problems, phlebotomists expressed positive feelings about the MCA. They liked the way the MCA reduced the amount of paper they carried on their trolleys. Using the MCA enabled them to complete their charting in real time—as opposed to queuing up the work, running the risk of having to wait for an available PC. Although it added to their workload, we observed instances where phlebotomists actively solicited additional work requests from other clinicians. This suggests that the phlebotomists may have been acting from a new sense of empowerment and ownership derived by the new work practices enabled by the MCA.

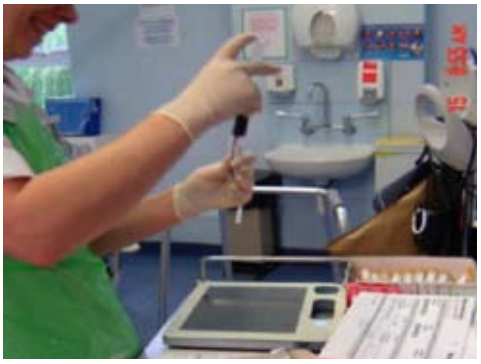


Figure 6. MCA on the cart, phlebotomist transfers blood into a specimen tube.

Software Design and Workflow Analysis

This field study provided several examples that showed how important it is to thoroughly analyze workflow to make sure that software enhances—rather than constrains—workflow. These examples are not a reflection on i.Clinical Manager, which is a widely used solution developed by a global healthcare leader. They are instead an indication of how important it is to properly integrate software applications with the clinical workflow—and of how challenging it is to do so in a short-term pilot or observational study.

System-Level Integration

Hospitals are complex environments. Changes in one department often affect others. For instance, changes to phlebotomists' workflow can affect lab and ward staff. Workflow analysis should encompass these stakeholders as well as the primary clinical users, with a goal of maintaining consistent system-level interfaces between affected groups and ensuring that any interface changes are deliberate and well thought out. Care must be taken to ensure that local optimizations don't inadvertently introduce errors or workflow problems at the system level.

Support for Emergent Workflows

Shifting from a paper-based system to real-time mobile information management facilitates a more emergent workflow in which clinicians accommodate changing circumstances by altering their work in real time rather than following a pre-defined task list. Given the dynamic nature of the typical acute-care environment, this flexibility is a significant plus. It also highlights the importance of software capabilities that enable clinicians to manage changing workflows.

As an example, phlebotomists, like other rounding clinicians, must deal with numerous contingencies in their workflow. A patient may be away from their bed, busy with another clinician, unable to wake up—all common reasons for postponing a blood draw. In a paper workflow, phlebotomists noted the issues on the work list. However, with a paperless process it is equally important to ensure that the software can make it easy to record the delay, as well as enable the ability to quickly check the status of all specimen collections.

This direct link and dependency between workflow and software highlights the significance of taking a holistic approach when introducing new technology in the workflow and ensuring all aspects of the workflow are addressed and supported by the technology solution.

Visibility and Simplicity

With the paperless workflow, phlebotomists arrived at the ward not knowing which patients—or how many patients—they would be required to see. With a paperless, emergent workflow, software provides the visibility to workflow. With the MCA solution, phlebotomists used i.Clinical Manager software on the MCA to build a work list by "discovering" which patients had specimen collection orders. With more time and attention to workflow analysis, this task could be automated.

Phlebotomists also had to review the ward's white-board to find the patients' bed numbers and then toggle between several windows and dialog boxes to enter the bed numbers into the work list. Again, these are tasks that could be automated and streamlined. New features to quickly identify blood-draw patients, and to sort them by bed number, would also produce significant productivity savings for rounding clinicians.

Figure 7. Phlebotomist selecting patients on the ward patient list.

Deployment Considerations

The Salford Royal field study highlighted several deployment issues that can help healthcare organizations successfully deploy mobile point-of-care solutions for rounding clinicians.

Privacy and Security

Platform security and confidentiality are often balanced against ease of use. Overly strict policies can inhibit busy professionals from achieving the benefits of mobile technologies. Lax procedures can compromise security and privacy. Whatever policies an organization puts in place, due consideration should be given to physical device security and training and reinforcement are essential to compliance.

Infection Control

Infection control is important in virtually any clinical setting, particularly when body fluids are being sampled and when the MPOC device is being used at the bedside. The MCA has a sealed case that makes it easy to wipe-down with disinfectant. For the field study, all clinical users were able to use disposable "wipes" to disinfect the platform. To avoid contributing to the spread of hospital-acquired infection, MPOC solutions should support the hospital's infection control policies.

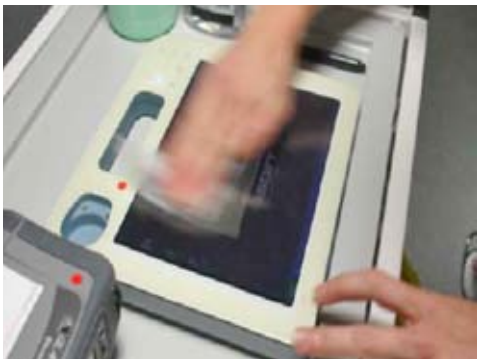
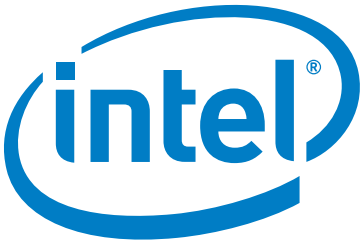


Figure 8. Phlebotomist disinfecting device at the beginning of ward rounds.

Summary

Clinical support healthcare professionals comprise a large population of clinicians who have inherently mobile workflows. Like many other rounding clinicians, they are "outsiders" on the ward and must compete with other clinicians for access to a PC.

In this field study, Salford Royal, Intel's Digital Health Group, and iSOFT plc collaborated to observe the use of the mobile clinical assistant prototype by rounding phlebotomists and other clinical users. The study indicated that the MCA combined with workflow enabled capabilities in software applications such as i.Clinical Manager can improve the quality and efficiency of patient care, as well as improve patient and clinician satisfaction. The study highlighted the need to ensure that software provides optimal support for the real-time, emergent workflow made possible when rounding clinicians have mobile access to clinical applications. Insights from the study can help hospitals successfully deploy mobile point-of-care solutions as well as improve the efforts of Intel and other technology vendors as we collaborate to meet the previously unresolved needs of rounding healthcare professionals.



Learn more.

To find out more about Intel in healthcare, visit us at **www.intel.com/healthcare/**

Copyright © 2007. Intel Corporation. All rights reserved. Intel, the Intel logo, Intel. Leap ahead., and the Intel. Leap ahead. logo are trademarks or registered trademarks of Intel Corporation or its subsidiaries in the United States and other countries.
*Other names and brands may be claimed as the property of others.

0207/SM/CMD/XX/PDF 316496-001 US