White Paper

Digital Health
Intel® Mobile Point-of-Care Value Model

Demonstrating the Business Value of Optimized Workflows Based on Mobile Point-of-Care Technologies

Salford Royal NHS Foundation Trust, United Kingdom

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Introduction: Evaluating Mobile Workflows

Using the Intel® Mobile Point-of-Care Value Model, we calculated that the mobile workflow of the 10 phlebotomists would generate gross savings of £47,727 (approximately USD 97,660) annually, and would pay for itself within one year.

As part of ongoing efforts to improve operations efficiency, enhance quality of care, and add value to the patient experience, Salford Royal NHS Foundation Trust undertook a pilot with Intel Corporation and iSOFT Group to evaluate the impact of mobile point-of-care (MPOC) technologies on phlebotomist workflows in an acute elder care ward. Ten phlebotomists were equipped with innovative portable computers based on Intel's mobile clinical assistant (MCA) reference design. They followed an optimized workflow that took advantage of their ability to access clinical information in real time and chart their work at the bedside.

Although the size of the pilot was small, the trends were clear. The mobile technology-enabled workflow produced significant improvements to the quality, cost, and efficiency of care. The workflow reduced phlebotomists' administrative burden and enabled them to avoid drawing blood when an order had been discontinued. These factors reduced materials costs and produced a time savings amounting to 25 percent of the phlebotomists' work hours. The reduction in unnecessary blood draws also lowered patients' potential exposure to infection.

Using the Intel® Mobile Point-of-Care Value Model, we calculated that the mobile workflow of the 10 phlebotomists would generate gross savings on wages and materials of £47,727 (approximately USD 97,660) annually. Over three years, the investment would generate net present value of £70,000 (approximately USD 143,254) on these two factors alone, and would pay for itself within one year.

The study persuaded us that mobile technologies, accompanied by redesigned workflows, can play a crucial role in modernizing healthcare delivery. It further showed the Intel MPOC Value Model to be a practical tool that can help healthcare leaders discuss and determine the value of their IT investments and accelerate their use of information technology to improve healthcare delivery.

Extending Mobility, Increasing the Rigor of IT Planning

Salford Royal NHS Foundation Trust manages one of England's top hospitals and is a leading center for training the next generation of healthcare workers. The Healthcare Commission, an independent group that inspects healthcare organizations in England and Wales, ranks Salford Hope Hospital as the best-performing hospital in northwest England and among the top four percent of England's trusts[1]. Salford is one of only two trusts in England to receive a prestigious accreditation for patient safety and quality.

1. http://www.srht.nhs.uk/about-us/trust-profile/

Located in the suburbs west of Manchester, Salford provides medical, surgical, maternity, and emergency services to the local population, as well as specialist care for brain, kidney, bone, intestine, and skin conditions to people from throughout the UK. A large and busy teaching hospital, Salford is affiliated with the Universities of Manchester and Salford, and its staff of approximately 4,200 cares for an average of 320,000 people annually.

Salford's Service Development Strategy spells out a vision of adding value to the patient experience by making it more effective, efficient, convenient, safe, and patient-centered. The trust has also set ambitious goals related to further reducing waiting lists and infection rates.

Healthcare information technology is critical to achieving Salford's objectives and improving its already high levels of care and management. The hospital uses iSOFT Group's i.Clinical Manager* software (i.CM*) for electronic medical records (EMRs) and other clinical information, and is working to equip physicians with mobile EMR devices. Hospital leaders are also interested in exploring innovative devices such as the Intel mobile clinical assistant (MCA) reference design, as well as additional usage models where mobile computing can support further efforts to improve the patient experience.

Salford also has a strong track record of exemplary performance in financial management. Like other healthcare institutions, Salford faces multiple demands on its IT acquisition budget, making it imperative to prioritize the many potential investments we could make in healthcare IT-based initiatives. Accordingly, the trust is always on the lookout for tools that can bring added rigor to its IT investment strategies.

These issues converged in a proof-of-concept deployment Salford undertook with Intel Corporation and iSOFT Group using the Intel MPOC Value Model to examine the benefits of mobile workflows for rounding clinicians.

Healthcare IT is critical to achieving Salford's goals of delivering care that is more effective, efficient, convenient, safe, and patient-centered.

Understanding Business Value: The MPOC Value Model

Rounding work is inherently mobile: clinicians move from patient to patient in the hospital to perform and document clinical tasks. Physicians are the most obvious rounding clinicians, but this category also includes phlebotomists, nurses, dieticians, physical therapists, respiratory therapists, and many others.

The Salford pilot focused on phlebotomists—the allied health professionals who draw blood. These individuals traditionally follow a paper-based workflow that involves considerable pre-work to prepare for rounds, sheaves of paper to reference throughout the rounding activity, and data entry at a ward computer at the end of the round.

Intuition suggests that phlebotomists and other rounding clinicians would benefit from an optimized workflow that used mobile computing devices to enable real-time access to clinical information systems. But Salford's healthcare IT professionals want to base their investment decisions on solid information. What specific value would investments in MPOC solutions for phlebotomists produce? Where would the benefits accrue? Would they justify an investment in the mobile point-of-care solution? The pilot was designed to answer these questions.

The Intel MPOC Value Model is a practical tool based on a proven approach developed by Intel's Digital Health Group and IT Innovation Centers to analyze Intel's own IT investment strategies. The value model has been refined and used in the finance, manufacturing, and other industries. More recently, the Intel Digital Health Group has worked with global healthcare leaders to adapt the model to meet the needs of hospitals, clinics, government agencies, and ministries of health. The result is both a broad Healthcare IT Value Model, which is useful for discussing enterprise-wide transformation initiatives, and the more targeted MPOC Value Model for departmental workflow optimization initiatives. Salford was the first institution to utilize the MPOC Value Model.

Both models start from Intel's core belief that all IT investments are business investments that should support strategic priorities. For healthcare, that means that IT investments should address core objectives related to the delivery of high-quality, efficient healthcare services.

Using the models begins by identifying relevant value dials—broad categories of benefits through which an IT investment may deliver strategic value. Discussions of what value dials are relevant to an investment can help focus attention and achieve agreement on what core organizational objectives you're trying to achieve with a given investment. It can also help to prioritize among potential benefits. These discussions can influence project planning and thereby enhance implementation success. For the Salford phlebotomist workflow, we determined that the relevant value dials were quality of care, workflow optimization, and cost of care.

The Intel Mobile Point-of-Care Value Model helps healthcare professionals identify and measure the impact of IT investments on improving healthcare services.

With the value dials established, we determined which key performance indicators (KPIs) we would use to measure meaningful changes for each value dial. KPIs are observable, quantifiable, operational metrics. The Intel model provides a set of suggested KPIs for major value dials as a starting point for discussion. The model emphasizes quantifiable benefits for which a financial impact can be determined, but full understanding of IT investments also acknowledges the many intangible gains that are produced.

Table 1 summarizes the Value Dials and KPIs we focused on for the Salford pilot. Note that many performance indicators can be applied to multiple value dials; for determining financial value, we count each KPI only once.

Table 1. Value dials and key performance indicator overview

Value Dials	Key Performance Indicators	Comments
Quality of care	Reduced length of stay	Potential reduction due to lower risk of infection and faster collection and processing of samples. Patients who are waiting for a blood draw before discharge can be released sooner.
	Reduced risk of infection	Estimated reduction of 10 percentage points++ in the number of venipunctures lowers the risk of infection, which in turn reduces the cost of treating acquired infections.
	Compressed order lifecycle	Samples get to the lab faster.
Patient satisfaction	Improvements in patient satisfaction	Bedside charting gave phlebotomists more time with the patient and resulted in their being perceived as more caring.
Staff productivity (via workflow optimization)	Productivity improvements (time savings)+	Mobile workflow generated 20 percent time savings, improving capacity management and timeliness of blood draws. Overall time savings saved two headcount positions, freeing two phlebotomists to handle growth in other areas.
	Efficiency	Approximately 10 percent of blood draws (for canceled orders) can be eliminated, adding further time savings and bringing total time savings to 25 percent.
Cost of care	Reduced lab work+	Fewer blood draws reduces load on lab (time and materials).
	Reduced materials+	Fewer blood draws reduces use of gloves, syringes, etc.

+ These indicators were quantified and used to determine solution value.
++ Based on Salford estimates.

Transforming the Phlebotomy Workflow

Salford collaborated with Intel and iSOFT Group to develop a paperless workflow that gave phlebotomists access to the i.CM clinical information software as they went about their jobs.

For the pilot, Salford equipped 10 rounding phlebotomists with a mobile clinical assistant (MCA), a mobile computing platform developed by Intel's Digital Health Group and clinicians to meet the unique needs of medical professionals in acute care settings. To provide convenience for clinicians, the MCA is a lightweight, portable device whose features include:

- A sure-grip handle for easy carrying
- A sealed and hardened case that's designed to be easy to wipe off with disinfectant and shock-resistant if dropped
- A stylus that enables handwriting or keyboard entry
- Built-in barcode or radio frequency identification (RFID) readers that, with software support, can reduce time on user authentication, and support positive patient identification and electronic medication administration, to help reduce errors.

Salford collaborated with Intel and iSOFT Group to develop a paperless workflow that gave phlebotomists access to the i.CM clinical information software as they went about their jobs on the hospital's acute care elderly ward and other units. Along with the mobile clinical assistants, Salford purchased and installed a set of printers that connected via wireless Bluetooth* technology to the MCA and were used on rounds to print blood labels. A wireless LAN was already in place.

Phlebotomy workflows were observed and measured before the pilot to determine the current baseline for key performance indicators. They were measured again during the pilot, and improvements were compared against that baseline.

Paper-Based Workflow

Under their pre-pilot, paper-based workflow, the head phlebotomist prepared for each shift by:

- Compiling lists of blood orders
- Printing out work lists, order requisitions, and specimen labels for each patient
- Assembling the paperwork into packets for each ward
- Assigning phlebotomists to the wards

As phlebotomists conducted their rounds, they manually checked patient IDs, affixed labels onto specimen tubes, performed the blood draw, and left specimen bags in a ward collection bin for collection by lab staff. They generally charted their work only after they had performed all the blood draws for that ward, often competing with physicians, nurses, and other allied health professionals for an available ward PC.

In addition to the general inefficiencies intrinsic to paper-based processes, this workflow was static and inflexible. Once work lists were generated and requisitions and labels printed (around 7 a.m.), phlebotomists could not accommodate new orders. Any new or rush orders were performed by ward staff, and often resulted in patients having multiple blood draws within a short period of time. Other orders were held until the next day.

Since phlebotomists lacked visibility into orders that had been canceled after the work list was drawn up, they often ended up drawing blood for orders that had been canceled. This negatively affected their productivity and subjected patients to unnecessary needle sticks—a source of both pain and potential infection.

Figure 1. Time spent on tasks for the baseline workflow

Baseline

Pre-Preparation		Preparation		On-Ward	
Task	**Time**	**Task**	**Time**	**Task**	**Time**
Print Labels / Requisition Forms	0	Work Distribution	15	White Board Check	3
Sort Labels / Requisition Forms	30	Trolley Preparation	15	Take Bloods	10
Work Allocation	30			Ward Completion	3

Pre-Preparation Time:	*Mins*	**Preparation Time:**	*Mins*	**On-Ward Time:**	*Mins*
1 X Printing / Sorting	30	10 X Work Distribution	150	10 X 4 X White Board check	120
1 X Work Allocation	30	10 X Trolley Preparation	150	180 X Take Bloods	1800
				10 X 4 X Ward Completion	120
	60		300		2040

Total Time:	2400 **40 hrs**

Notes:
- There are, on average, 10 phlebotomists on duty per day
- The average daily capacity is 180 bleeds in a 3.5-hour period
- Including travel time, the time per blood draw is 10 minutes
- The work allocation is a 30-minute task, but this also includes trolley preparation

Results: Optimized Workflow and Productivity Savings

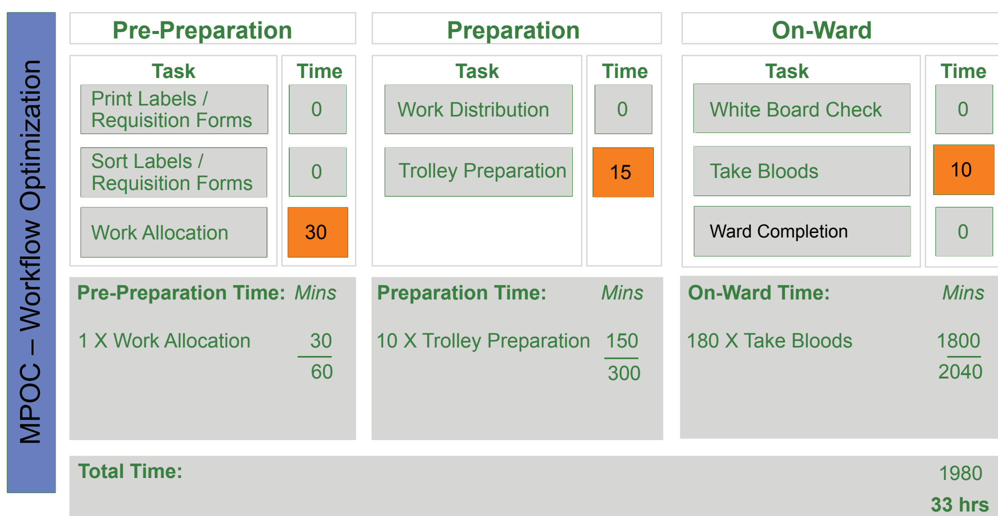
Using the mobile point-of-care solution, phlebotomists created their own electronic specimen collection work lists and could wirelessly print the work list and other clinical information as they moved through their rounds. They charted their work at the patients' bedside, as soon as they completed the blood draw. This information then went directly to the lab, which could anticipate their workload and possibly turn results around faster.

This mobile workflow eliminated the sorting of labels, requisitions, and work distribution. It returned time to supervisors and freed them for other tasks. It eliminated the phlebotomists' paperwork, enhancing their productivity by 20 percent.

It also gave phlebotomists the flexibility to respond to changing clinical demands by adjusting their work lists on the fly. With portable information access and wireless printing, phlebotomists could accommodate new orders and rush orders. As orders came in, phlebotomists could add them to the work list in real time and wirelessly print the necessary order requisitions and specimen labels.

With real-time access to i.CM on the ward or at the bedside, phlebotomists had the latest available information on what lab tests had been ordered. If an order had been discontinued, phlebotomists were able to avoid a blood draw. This improved efficiency, saving phlebotomists the time that would have gone into performing the draw. Salford estimates that 15 percent of blood draws prior to the pilot were unnecessary, and that widespread deployment of the MPOC solution would drop this by 10 points, to 5 percent.

Figure 2. Time required for each phase of the optimized workflow



Notes:

- There are on average 10 phlebotomists on duty per day
- The daily capacity is increased from 180 to 222 bleeds in a 3.5 hour period
- Including travel time the time per blood draw is *10 minutes*
- The work allocation is a 15 minute task but this also includes trolley preparation.

Phlebotomists were reluctant to hand in the mobile clinical assistants and return to their paper-based workflow when the pilot was complete. Patients liked having phlebotomists spend more time with them.

Quality of Care

Along with improving productivity and efficiency, the mobile workflow enhanced the patient experience and improved the quality of care Salford provides. By enabling phlebotomists to avoid unnecessary blood draws, the MPOC solution reduced patients' risk of contracting methicillin-resistant staphylococcus aureus (MRSA), clostridium difficile (C-Dif), or other serious infections. It also reduced patients' need to experience the stress and discomfort of a needle stick.

The optimized workflow enabled phlebotomists to chart each blood draw as soon as it was complete. Charting while the information was fresh minimized the risk of forgetting relevant information or tasks. Data got into the system faster, letting nurses and physicians know that specimens had been collected. Immediate vial labeling and updating of each patient record at the bedside reduced the potential for mixing up blood draws compared to updating multiple patients at once.

In some cases, the optimized workflow enabled lab processing to begin sooner. Lab staff picked up lab specimens from the wards, but could not process them until phlebotomists had charted each test in i.CM. By charting in real time, phlebotomists removed this potential delay. The ability to add new orders in real time potentially allowed blood to be collected, analyzed, and reported sooner, which in turn allowed clinicians to evaluate the results and, if necessary, adjust treatment plans sooner.

There were also instances where phlebotomists were able to combine their blood draws with orders that had been designated for ward staff to perform. This saved valuable time for ward staff and further reduced the need for additional venipunctures.

Patient and Phlebotomist Satisfaction

Patient and staff satisfaction were not among our targeted value dials, but it was clear that they were impacted. Phlebotomists liked the MPOC solution so much, they were reluctant to hand in the mobile clinical assistants and return to their paper-based workflow when the pilot was complete. Phlebotomists enjoyed the reduction in paperwork. They liked not having to complete their charting at the end of their shift and possibly having to wait for an available PC. Although it added to their workload, phlebotomists actively solicited additional work requests from other clinicians, suggesting that they felt a new sense of empowerment and ownership of their flows. Since clinicians who must "stick" a patient would appear to run a higher than average risk of violent attack, reducing the need for blood draws may have the potential to increase phlebotomist safety.

Phlebotomists enjoyed spending more time with patients as they did their charting at the bedside. Several said the MCA helped them feel more professional. Improving phlebotomists' job satisfaction would add to the solution's financial impact if it results in lower staff turnover and increased adoption of an optimized workflow. In turn, patients responded positively to having phlebotomists spend more time with them.

Table 2. Workflow optimization benefits

Phlebotomists' Task Reduction	**Per Round (daily) Hours**			**Per Round Wage Costs***		
(for necessary draws = 153/round)	Before MPOC	With MPOC	Savings	Before MPOC	With MPOC	Savings
Pre-round preparation	6.0	3.0	3.0 50%	£57	£29	£29
Blood draw	25.5	25.5	0.0 0%	£244	£244	£0
Ward specific tasks	4.0	0.0	4.0 100%	£38	£0	£38
Daily Total	35.5	28.5	7.0 20%	£339	£273	£67
Annual	9,230	7,410	1,820	£88,254	£70,852	£17,402
*Wage is national average						
Additional Impact From Reducing	**Per Round (daily) Hours**			**Per Round Wage and Material Cost Costs***		
Unneeded draws (from 27 to 9)	Before MPOC	With MPOC	Savings	Before MPOC	With MPOC	Savings
Phlebotomist time	4.5	1.5	3.0	£43	£14	£29
Blood draw material				£71	£24	£48
Lab time	2.7	0.9	1.8	£26	£9	£17
Lab material				£35	£12	£23
Daily Total	7.2	2.4	4.8 67%	£175	£58	£117
Annual	1,872	624	1,248	£45,488	£15,163	£30,325
*Wage and material costs are national average						
Overall Phlebotomists' Task-reduction Savings	**Draws**	**Hours**	**Wages**			
Daily	18	10.0	£96	10 hours of phlebotomist time represents: 25% of work hours, 45 blood draws		
Annual	4680	2,600	£24,860			
Total Gross Annual Savings:	**Wages**	**Material**	**Total**			
Plebotomy and Lab*	£23,335	£18,392	£47,727			
*Gross savings prior to implementation costs						

Cost of Care

As noted, the optimized workflow produced average time savings of 20 percent in the phlebotomists' workflow. Over and above that, it reduced the number of blood draws, bringing the time savings up to 25 percent. The time savings were significant enough to free two phlebotomists for other tasks.

Using average industry salaries, we calculated that the mobile workflow of the 10 phlebotomists would generate gross savings on wages and materials of £47,727 (USD 97,660) annually (Table 2).

Balanced against capital and annual maintenance and replacement fees, the investment would generate net present value of £70,000 (USD 143,254) over a three-year period on these two factors alone (Table 3). The investment would pay for itself within one year.

We were conservative in calculating cost impacts. In addition, some anticipated savings, while highly significant, were not included in the calculation of value because they were either not the value dials we chose to analyze or because we lacked data. For example, lowering the number of venipunctures would be expected to reduce the incidence of infections and thus avoid the costs to treat those infections. Thus, our financial analysis likely understates the mobile solution's full financial value.

Table 3. Net present value calculations

IT Costs GBP				Maintenance			
Item	**Cost**	**Qty**	**Initial Investment**	**Year 1**	**Year 2**	**Year 3**	**Total 3-year Cost**
MCA	£1,365.99	10	£13,660	£4,553	£4,553	£4,553	£27,320
Docking Station	£185.00	10	£1,850	£617	£617	£617	£3,700
Additional Battery	£86.00	5	£430	£143	£143	£143	£860
Mini-printer	£619.00	10	£6,190	£2,063	£2,063	£2,063	£12,380
Total Cost			£23,130	£7,377	£7,377	£7,377	£44,260
Benefit				£47,727	£47,727	£47,727	£143,183
Net Benefit			£-22,130	£40,351	£40,351	£40,351	£98,923
Project NPV			£70,000				

Moving Forward

The Salford pilot showed the ability of MPOC technologies to optimize the workflow of rounding clinicians at one of England's leading hospitals. The resulting optimized workflow reduced phlebotomists' administrative burden, enhanced their productivity and satisfaction, and improved quality of care. It enabled phlebotomists to spend more time with patients and to avoid drawing blood when orders had been discontinued.

MPOC solutions and other healthcare IT initiatives are enabling hospitals such as Salford to provide higher quality care more efficiently to more people in a timelier manner. The Intel MPOC Value Model, by providing a tool for discussing, quantifying, and monetizing the value of HIT investments, is helping Salford make more data-driven planning decisions. This in turn should accelerate its time-to-value in achieving the benefits enabled by healthcare IT investments.

Salford's goal is to apply the MPOC Value Model or HIT Value Model to all its clinical IT initiatives going forward. In addition to making mobile computers more available to physicians and nurses, Salford is exploring wider use of mobile technologies for rounding clinicians, as well as the use of location-based services to improve the management and flow of patients and equipment.

For more about the Intel Healthcare IT Value Model, talk to your Intel Digital Health representative or download the paper, The Value of Healthcare IT,
http://www.intel.com/healthcare/hit/providers/hit_value_model_whitepaper.pdf.

For more about the business value of IT, see the whitepaper, Measuring IT Success at the Bottom Line at
http://www.intel.com/it/pdf/measuring-it-success-at-the-bottom-line.pdf

and David Sward's Measuring the Business Value of Information Technology (Intel Press, 2006).
http://www.intel.com/intelpress/sum_bvm.htm

For more information about the mobile clinical assistant, please visit
www.intel.cm/healthcare/ps/mca.

2/08/TC/CMD/XXX/PDF 319207-001