

Introducing collaboration technology  
as a multi-dimensional solution to  
the handover process

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This report describes the progress of University Hospitals of Leicester (UHL) in transforming clinical handover on the surgical wards from a disorganised and often frenzied process to one that complies with best clinical practice.

# Introducing collaboration technology as a multi-dimensional solution to the handover process

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## Foreword from Antonia Parvanova, MEP

While a quick financial return on eHealth investments is always attractive, an eHealth solution that does not increase patient safety will not win the trust of healthcare providers. I am therefore delighted to be able to introduce this ACCA report which demonstrates clearly that an eHealth based hand-over system adopted at University Hospital Leicester (UHL) in UK not only increased patient safety, but also won the confidence of the doctors and nurses using it and promises to generate a good return on investment for the hospital.

European Member States have been investing in eHealth for well over three decades now – both in terms of direct investments in solutions such as electronic health records and remote monitoring by healthcare providers and in indirect investments through substantial EU level and national level research programmes. However, a certain level of skepticism about the value of eHealth still exists in some quarters.

The present ACCA study therefore serves a very important purpose of adding to the body of evidence that eHealth solutions are a good investment for health systems. We need more evidence to convince healthcare professionals, healthcare funders, and of course also patients, that eHealth is a core element of improving the quality

and efficiency of healthcare. It is therefore of huge benefit when eHealth leaders, such as UHL, work together with independent bodies such as the ACCA in sharing good practices and in disseminating evidence that clearly demonstrate the impact effect of using eHealth solutions in daily care delivery.

It is part of my role, as an elected member of the European Parliament actively involved in programmes and specific actions in the field of public health and well-being, to support the dissemination of evidence of good eHealth in order to allow the EU as a whole to reap the benefit that eHealth can provide. For this reason I engaged very actively in my role as shadow rapporteur on the report on the eHealth Action Plan 2012–20, which as well as calling for greater legal clarity around the use of eHealth solutions, underlines the importance of sharing of good eHealth practice in Europe.

I am, therefore, very pleased to support initiatives such as the present ACCA report, which provides an important contribution to the body of evidence on the benefits of eHealth solutions, which as a whole shows that eHealth improves access to healthcare, drives up quality and safety of care, supports the sustainability of health system, and empowers patients to be more actively engaged in their own health and wellness.



**Antonia Parvanova, MEP**

Vice-president of the Alliance of the Liberals and Democrats for Europe (ALDE), she seats as a full Member of the Committee on the Environment, Public Health and Food Safety (ENVI) and as a substitute Member of the Committee on the Internal Market and Consumer Protection (IMCO). She is also the ALDE group coordinator for the Committee on Women's Rights and Gender Equality (FEMM).

## Foreword from Dr Beverly Collett

I am delighted to write the preface to this excellent report detailing the results of the independent review conducted by ACCA on the electronic handover system that was trialed at UHL.

Handover is the system by which the responsibility for immediate and ongoing care is transferred between health care professionals. Effective handover is a vital part of every patient's care and an important hospital process. Poor handover contributes to excess mortality, morbidity and length of stay. Every hospital has a responsibility to ensure that it facilitates effective handover by all health care professionals for all patients.

A review of handover processes at University Hospitals of Leicester (UHL) identified a multitude of different handover systems and practices between specialties and disciplines. Communication between nursing and medical handovers was poor- meaning that valuable information was not always communicated.

A joint partnership project between one of our pioneering surgeons and Nervecentre was undertaken to configure a fully integrated mobile handover solution using hand held devices. The Nervecentre Application software was installed on the devices in March 2013 and the system was technically integrated with our clinical systems to capture real time data. A pilot study was undertaken on five surgical wards and the system was extremely positively received.

Doctors, nurses and allied health professionals all use the same system and have common information available to them. The handover system is easy to learn and to use. The system is quicker than the older electronic system and more accurate than a paper system. There is minimal chance for tasks to be overlooked- thus improving safety and accountability. These and other positive features are expanded upon within the full report.

Improving financial efficiency is a challenge to all NHS organisations. However, at UHL, we consider that this system will potentially save money in a number of areas. For example, it will support timely patient discharge throughout the week and over the weekend and will ensure that investigations, such as radiology and pathology tests, are actioned in good time to enable clinicians to spend more direct time with patients and less on administrative tasks. We anticipate integration with the H@N system and better planning of resources to increase our overall efficiency.

Most importantly, our aim was to develop a system clinicians want to use, that would increase communication about the status of each individual patient, highlight any outstanding tasks or concerns and ultimately improve patient care.

We now look forward to further developing our utilisation of information and communications technology (ICT) to support the delivery of safer and more effective care for patients.



**Dr Beverly Collett**

Associate Medical Director and Consultant in Pain Medicine.

## Executive summary

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**‘Handover could be so much better – it is ad hoc, unstructured and not taught. We should address all those issues and make a safer handover system.’ FY2, UHL**

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This report describes how University Hospitals of Leicester (UHL) has transformed the clinical handover process across five surgical wards to improve patient safety, increase clinical accountability and address concerns about information governance.

The story began five years ago with the unexpected deaths of two patients. In response, a thematic review was undertaken of all serious untoward incidents (SUIs), claims and inquests between April 2009 and March 2011, resulting in the identification of five critical safety actions (CSAs):

1. improving clinical handover
2. acting upon results
3. relentless attention to early warning triggers and actions
4. senior clinical review, ward rounds and notation
5. implement and embed mortality and morbidity standards.

The hospital board subsequently agreed to focus its safety actions in these areas and, more recently, has identified them as key patient safety targets to be used as performance measures by clinical commissioning

groups (CCGs) as part of the Commissioning for Quality and Innovation (CQUIN) programme.

It came as no surprise that clinical handover had been identified as a priority action area; anecdotal evidence had suggested that handover procedures across the organisation were often inadequate and lacking in rigour.

Clinical handover occurs when one team of health professionals transfers responsibility for patient care to another team: for example, when a patient is transferred from one location to another, and at the end of each clinical shift.

Nurses use the hospital Web-based handover system but for doctors there is no standard handover process in place; details of any particularly sick patients and any outstanding jobs are often passed from team to team by word of mouth or on scraps of paper. This introduces the risk that tasks will be forgotten, handed over incorrectly or misinterpreted. It also impedes clinical accountability and, if handwritten notes are mislaid, is a threat to patient privacy.

The associate medical director and the director of safety and risk, who have overall responsibility for implementing

the CSAs, organised a review of clinical handover across the organisation. This highlighted significant variations in procedures from ward to ward, from shift to shift and from clinician to clinician. A multitude of handover systems were in use, the majority of which were paper-based and produced using Word, Excel or the hospital Web-based database. The systems were workable but not particularly efficient and all introduced risks to patient safety, clinical accountability and information governance.

The risks were mostly related to the paper-based nature of the handover; the clinicians moved round the hospital so needed to carry with them the handover notes detailing outstanding tasks.

Handover processes were also found to be focused on shift-change; the overall aim, however, must be to ensure that patients’ conditions and all outstanding tasks are continuously updated and are available across the hospital. Any handover procedure that requires a clinician to print the handover notes will ultimately be reduced to ‘snapshot’ documentation of patient status at a particular point in time. The removal of paper entirely – in line with the government’s ambitions for a paperless NHS by 2018 (DOH 2013) – requires clinicians to have access to live patient information at the patient bedside; mobile devices therefore, are an essential enabler.

A number of different solutions were proposed; one was to provide clinicians with a live, mobile handover system similar to that used to support Hospital at Night (H@N) at UHL. That system, called Nervecentre, used collaboration technology to improve communication between clinical teams and to provide



safer, more effective care for patients. After discussions with the commercial supplier it was agreed to develop and then trial a handover version of Nervecentre across five surgical wards.

The solution proposed was a multifaceted system, optimised for wireless as well as wired environments, which would equip clinical teams with live, mobile information devices providing real-time access to complete, up-to-date patient information.

The new handover system, developed in full consultation with staff, provides clinicians with a mobile phone or tablet displaying a live task list that lets them see at a glance which patients are waiting to be seen, what tests need doing and which results are outstanding. As each task is completed the clinician is able to update the system directly at the patient's bedside.

Although the system has only been introduced on a small scale, significant benefits are already evident, including:

- improved patient safety as tasks cannot be lost or forgotten
- increased accountability from the system's built-in audit trail
- potential to cut costs from reduced length of stay (LOS) and a lower incidence rate of SULs
- reduced risks for information governance as patient details are held securely on password-protected devices
- greater staff satisfaction owing to improved communication.

# 1. Introduction

This report describes the progress of University Hospitals of Leicester (UHL) in transforming clinical handover on the surgical wards from a disorganised and often frenzied process to one that complies with best clinical practice.

The story began five years ago with the unexpected deaths of two patients. That was the impetus for change.

A thematic review was undertaken of all serious untoward incidents (SUIs), claims and inquests that had occurred between April 2009 and March 2011. This helped establish the root causes or significant contributory factors of each incident and led to the identification of five critical safety actions (CSAs):

1. improving clinical handover
2. acting upon results
3. relentless attention to early warning triggers and actions
4. senior clinical review, ward rounds and notation
5. implement and embed mortality and morbidity standards.

This report focuses on some of the subsequent actions taken by UHL to address one of these CSAs: improving clinical handover. It then discusses the impact that changes in the handover process are having on patient safety, accountability, information governance, staff satisfaction and operational efficiency.

## THE EUROPEAN COMMISSION'S E-HEALTH ACTION PLAN

For many years, the European Commission (EC) has encouraged and supported the introduction of innovative information communication technology (ICT) solutions to improve the quality and efficiency of health care provision. In its second eHealth Action Plan (EC 2012) the EC noted that, despite member states' demonstrable commitment to the eHealth agenda, there were still many barriers to success.

Some of the barriers, particularly the legal and technical ones, reach across borders and are particularly challenging. Others, however, can be addressed at a more local level. This study, for example, shows how one of the barriers identified in the Action Plan – lack of awareness of, and confidence in eHealth solutions among patients, citizens and healthcare professionals – is no longer an issue when the design and implementation of the project is led by health professionals. It also demonstrates that, with the rapid growth in personal technology such as mobile phones and tablets, another of the identified barriers – digital health literacy – is no longer such an issue.

The findings of the report will now be disseminated internationally to help increase awareness of the benefits that technology can bring for the safer, more effective care of patients.

## STUDY METHODOLOGY

Many studies have been undertaken measuring the impact or benefits of eHealth and ICT health projects, but there has been limited consistency in the methodological approach. This can be explained first by the uniqueness of each study: the scale, the breadth and the diversity of each project vary widely, making a structured, comparative, assessment of the outcomes challenging. Secondly, with no formally accepted framework for the evaluation of such projects, researchers have tended to develop their own preferred styles, which have worked well for individual projects but can make comparative assessment difficult. Recognised approaches, such as randomised control trials (RCT), for example, are not easily applied to the appraisal of telemedicine as the very nature of the study generally makes it impossible to undertake a blind assessment of users (Black et al. 2011; Shcherbatykh et al. 2008).

In recognition of this difficulty the EC funded the development of the Model for Assessment of Telemedicine (MAST) to provide a structure for assessing the effectiveness of ICT in health care and to support decisions about the procurement process. MAST is an evidence-based tool for evaluating ICT applications in health care. It was designed to assess the full impact of new health technology projects, including how they change the lives and working practices of the people using and working with them as well as the effect on patients and the organisation. MAST takes a qualitative as well as quantitative approach (NST 2013).

Wherever relevant and possible this report aims to follow the multidisciplinary assessment proposed by MAST, which spans the following seven domains:

- introduction to the problem and proposed solution
- organisational aspects
- patient perspective
- assessment of safety
- assessment of clinical effectiveness
- socio-cultural, ethical and legal aspects
- economic aspects.

(Note: For the purposes of this study assessment of safety and assessment of clinical effectiveness are considered in one section.)

## DATA SOURCES

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When preparing this report, wherever possible, attempts have been made to follow the best-practice recommendations of researchers specialising in the field of health informatics.

The data in this report, using the guidelines for multidisciplinary and multi-method data collection in eHealth studies proposed by Westbrook et al. (2004), is drawn from a number of sources including:

- semi-structured one-to-one interviews with clinical and managerial staff
- independent ethnographic observation
- extracts from internal work logs (both manual and computer generated)
- hospital committee and NHS Trust board reports.

## MY EXPERIENCE OF HANDOVER

### Foundation year-one doctor (FY1), UHL

Prior to starting as a junior doctor I was never given any formal training in handover. It was something I was expected to just pick up on the job.

Through working in different departments I have seen many different methods of handing over, with a wide variability between the directorates and no common structure. This makes it very difficult for acceptable standards to be maintained and introduces unnecessary risk.

#### **Poor handovers introduce threats to patient safety.**

Many of my junior doctor colleagues have experienced handovers where potential near misses have occurred. These are often related to chasing or acting upon abnormal blood [test] results. Sometimes chasing blood [test] results is seen as a menial task; however, when the results come back as abnormal, if the patient details, location or their clinical information is missing then this can potentially be very dangerous. Many are linked to potassium levels which, if abnormal and are not acted upon with the correct treatment in a timely manner, could potentially lead to arrhythmias and cardiac arrest.

#### **Poor handovers waste resources.**

The doctor's time is wasted tracking down patients and basic information; this sometimes leads to tests having to be repeated with the resultant financial implications, including prolonged stay for some patients. I have been at the receiving end of bad handovers myself, and have ended up wasting a lot of time just trying to hunt down information that should have been passed over with the task. Time needs to be allocated for discussion and clarification of certain aspects. Very often in handovers the severity of the patient's clinical condition is not fully communicated. Junior doctors need to be aware of the diagnosis, investigation results, the rationale behind any investigations ordered, and current observations, to enable them to assess the urgency of the jobs for each patient so that they can prioritise care appropriately. This is particularly important during busy out of hour periods.

The General Medical Council (GMC) carry out a national survey every year which is completed by junior doctors about various aspects of their training and working life. A key concern which was raised by many doctors in the 2012 survey was about the quality of handover with colleagues before and after night duty. One in four described it as either being an informal process or as not being in place.

The junior doctors committee recently produced guidance on clinical handover for both clinicians and managers. These guidelines highlighted the advantages of good handovers and how they benefit patients, including increasing safety and improving continuity of care. This guidance also highlighted that good handovers can benefit doctors in many ways, including reduction of stress, professional protection and job satisfaction.

## 2. Introduction to the problem and proposed solution

Two unexpected patient deaths were the events that triggered UHL to rethink their approach to patient safety. As part of the NHS Patient Safety First campaign, the associate medical director and the director of safety and risk were charged with undertaking a thematic review of all incidents, SUIs, complaints, claims and inquests that occurred at UHL between April 2009 and March 2011 with the aim of identifying those areas where improvement would prevent avoidable patient death or harm.

Following the review five critical safety actions (CSAs) were proposed:

1. improving clinical handover
2. acting upon results
3. relentless attention to early warning triggers and actions
4. senior clinical review, ward rounds and notation
5. implement and embed mortality and morbidity standards.

The hospital board decided to concentrate its patient safety efforts in these five areas and, more recently, has identified them as key patient safety targets to be used as performance measures by clinical commissioning groups (CCGs), as part of the Commissioning for Quality and Innovation (CQUIN) Programme.

It came as little surprise that clinical handover was identified as one of the five CSAs, given that anecdotal evidence at UHL implied that handover procedures were often inadequate, that they lacked accountability and carried

the risk of breaching patient confidentiality. There was no organisation-wide policy for clinical handover and the standard of handover on each ward was very much dependent on the skills and interests of the clinician in charge.

The importance of sound clinical handover procedures became more important following the introduction of new clinical working patterns instigated to meet European Working Time Directive (EWTD) legislation. Before EWTD, clinicians were often on duty or on call for 24 hours at a time. This extended working day enabled continuity of care; clinicians saw their patients over long periods so had a fuller understanding of their medical conditions and treatment plans.

Since the full introduction of EWTD in August 2009, however, hospitals have had to drop the 'on-call' clinical rota system and have instead introduced full-shift rotas. The Royal College of Surgeons stated in 2013 (RCS 2013), that it considers this change to have had an adverse impact on patient care as clinicians are no longer able to monitor their patient's progress over a sustained period of time. Instead, they have to pass clinical responsibility to another clinician; to someone who may have no knowledge of either the patient's condition or their medical history. Sound handover procedures are therefore an essential component of safe patient care.

On most wards, handover of patients between clinical teams takes place three times a day; usually at around 8am, then late afternoon and early evening. The morning handover tends to be well structured and is often combined with the clinical ward round

and teaching practice. The evening handover is, however, often rushed and disorderly and this potentially introduces a risk to the safe and effective care of patients.

On average, a consultant will see 80 patients a week, 10 of whom will be particularly sick and will require close monitoring. At each clinical handover, therefore, the medical conditions of around 80 patients along with their treatment plans and any outstanding tests or results must be passed accurately and yet succinctly to the incoming clinical team. Generally this happens without mishap, but occasionally a vital piece of information is not handed over and, when this happens, it can result in serious patient harm.

## MY EXPERIENCE OF HANDOVER

### Foundation year-one doctor (FY1), UHL

I have never had any specific training in handover procedures – it is not something that we covered in medical school. I learnt on the job. When I started at UHL I shadowed one of the other doctors so picked it up from him.

The handover process is not standardised across the hospital; it varies from ward to ward and from day to day. Sometimes handover is carried out at the patient's bedside, sometimes around a white board and, in the evenings, it may even be over the phone. It depends on who is on duty, really. The phone handovers are particularly difficult; handover needs to be done face-to-face.

We generally hand over the sicker patients first. I do sometimes worry about my patients, however; that something will get missed or that I will hand over a job to the next shift and that it won't get done. I just don't have time to write everything up in the notes.

On the surgical wards we use a Word template to record jobs during the day; the format is similar to that used by the nurses. Completing the sheet is time consuming; it can take up to 30 minutes a day. One of the problems with the sheet is that it does not show past medical history. The day team email this sheet to the night team when they go off duty.

I think handover works better when done at the patient's bedside. That way the patient gets to meet the clinician taking over their care. The clinician is then able to do a visual assessment of the patient's condition, which helps when planning workload: the sicker patients can be given priority care.

A nurse is generally present on the morning handover though not in the evening. I think it might be useful to have a nurse present on all handovers – though this might be difficult to organise as the shift times are different.

I do think the process needs to be standardised. The morning handover is generally very good but the evening less so. Often the only information passed over is the patient's name and the job that needs doing. There is no reason given for doing the job. This makes it more difficult to interpret the results when they come through; I have to read through the patient's notes to decide on what to do next.

Overall responsibility for implementing the five CSAs rests with the associate medical director and the director of safety and risk. A Five CSA programme lead was appointed and charged with undertaking a review of clinical handover procedures across the Trust.

The findings highlighted that there was significant variation in handover processes from ward to ward and from morning to night. All wards were found to have access to some form of electronic handover system but the format and design varied significantly; on some wards the systems were very basic and on others they were far more sophisticated. Whichever system was in use, however, paper was the common feature; at handover the incoming nurses and clinicians printed off a list of the patients on the ward, their diagnosis and treatment plans and then used this to note down any outstanding jobs or results passed on from the outgoing team.

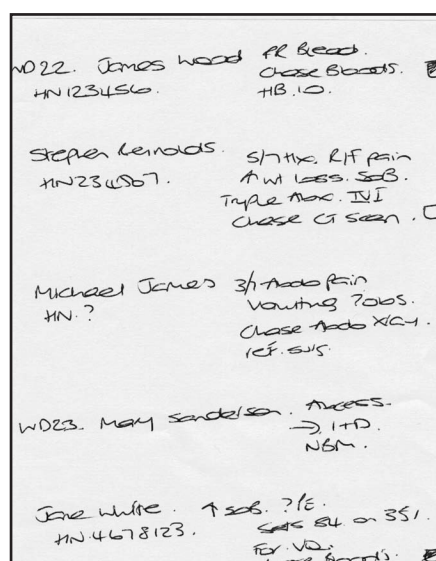
The three main handover systems in use were:

- paper
- Word or Excel template
- hospital Web-based system.

## PAPER

Although all wards have some form of electronic handover system, these were often perceived as cumbersome and so were not fully used – particularly in the evenings when severe time constraints discouraged their use and handover between clinicians often took place over the phone. The day team members would be rushing round trying to see all their patients before they left and finishing off any outstanding jobs; they could be working anywhere within the hospital, which often made it difficult to undertake face-to-face handover meetings. Evening handover, therefore, would often take place by phone, with the night team writing down any patient care instructions passed on by the day team on whatever scrap of paper came to hand (Figure 1).

Figure 1: Paper template used at handover



Note: patient identifiers have been changed to protect privacy.

Paper-based handover systems offer many advantages, particularly for efficiency.

- They are portable and offer quick and easy access to information: wherever they are working, clinicians can see at a glance which jobs are outstanding.
- They save time: there is no need to locate and then to log on to a computer to obtain an up-to date task list.
- They can be easily handed over to the incoming team.
- They can be photocopied to be shared with other clinicians.
- They can be kept as a record of experience for use when completing training logs.
- They are easy to use as they do not require any training or specific IT skills.

Paper-based systems also have many disadvantages, particularly for patient safety, accountability and information governance.

- The information may be incomplete or illegible, thereby compromising patient safety if essential tasks are missed or not completed correctly.
- There is a risk of a transcription error or that the clinician will note down an action against the wrong patient.
- There is no central record of which clinician is doing each job, so no built-in accountability.
- Paper sheets are easily lost, which introduces risks around patient confidentiality and information governance.

## WORD OR EXCEL TEMPLATE

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Some wards use a Word or Excel template for handover. This lists patient identification information, diagnosis and treatment plan. Before handover each clinician updates the template cells relating to their patients, adding in results of any tests and listing any outstanding tasks that will need doing by the incoming team. Copies of the template are then printed out and handed to each clinician coming on duty. The clinicians review the template at handover, updating it with handwritten notes as necessary (Figure 2).

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‘I don’t find the handover sheets we use particularly helpful. They are poorly laid out – just a jumble of bunched up words, really – which makes it is hard to pick out the crucial information.

‘The legibility of the sheets is important as handover is generally done in a public place. It is important to be able to read the sheet properly during handover, both to ensure patient confidentiality and because the patient may not yet be aware of their diagnosis.’  
FY1, UHL

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## EXAMPLE OF A SERIOUS UNTOWARD INCIDENT ATTRIBUTED TO INADEQUATE HANDOVER

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An 80-year-old female with an international normalised ratio (INR) of 5 was admitted to an acute medical assessment unit on a Friday. Her Warfarin was stopped but she was not given Vitamin K. On Saturday at 4am she fell in the ward bathroom and knocked her head. Her Glasgow coma score was 15 immediately after the fall and she received a documented review from a junior doctor.

On Saturday at 9am she was moved to base ward but the reason for admission and details of the fall were not handed over. The patient was confused on the base ward but as the staff did not know her and had not been handed over the necessary information, they thought that this was normal for her.

It was not until the patient’s daughter visited on the Sunday and staff were told that the patient was not usually confused that action was taken. A computerised tomography (CT) head scan showed that the patient had a large subdural bleed.

She was referred to the regional neurosurgical centre for intervention but it was agreed that this was not appropriate and she was managed conservatively. She continued to deteriorate and died 12 days after her admission.



Figure 2: Word template used at handover

Upper GI Inpatients					
	Patient	Diagnosis	Ix	Plan	Jobs
SAU 8 6519 5332					
SR 6		8/7 Hx of RIF pain	Bloods – normal	USS abdopelvis 18/12/12	
4.5		4/7 RUQ pain. Previous cholecystectomy	ALT-67 CRP-20 CXR-review	Triple Abx	USS abd requested
4.2		Abdo pain – adhesional incomplete SB	AXR – faecal loading R side, gas seen to stoma, no sig SB dilatation		
4.1		Abd pain + vomit 3/52 Heartburn + epigastric pain relieved by vomiting Dx by medics as constipation 1/52 ago ? incomplete SBO	Erect CXR-NAD urine dip-negative	IVF NBM	C CT Abdo
3.4		RUQ/epigastric pain relieved by vomiting ?gastric outlet obstruction	Bloods-alk phos- 48, calcium 2.62, Hb 12.8, INR-3 CT thorax abdomen	Bloods old notes NBM. IVI CT thorax abdomen	C CT Dose warfarin/ ? reverse Repeat INR
3.2		RIF pain. Mid-cycle. 1st episode	USS abd/pelvis showed ovarian cyst. No free fluid		
2.6 RW		Abdominal pain, ? several weeks. Lexy bony dementia, lives in RH. 1 x vomit. Loss of appetite	USS AP + MRCP report 11mm calculus in CBD	For rpt ERCP later this week at LGH – clopidogrel can be stopped	
2.42.2 2.4		Recurrent vomiting, weight loss-4 stone	K-2.9	OGD +removal of balloon mane	C calcium
2.3		BG PCOS. A/W RIF pain	Bloods- amylase 110,U&E-Normal, Wcc 5.5. CRP<5		C USS C urine dip for pregnancy
2.1		Jaundice. RUQ pain. Dilated CBD ?cause	USS abd showed dilated CBD but no gallstones Bloods FCF	Currently on yellow meds	Ue-normal Alk phos-329 Alt-38 Bili-202 Wcc 9.5 Hb 14.5 INR 0.9
1.2		Perianal abscess	Bloods normal	NBM. IVI Emergency I+D- carried out 18/12	Abscess drained
SR 9 SU		Vomiting and epigastric pain.	Bloods- normal	C AXR Urine dip	C AXR C urine dip
SR10		?Shingles Pain over skin. Extremely sensitive to touch UTI	AXR- no dilated loops CXR- clear Urine dip- pos nitrated and leukocytes	Commenced trimethoprim	
Ward 7					
Kinmonth 5327					
7 RW		Nissens + ivor lewis 2007, Laparotomy + JEJ change + small bowel resection leaked. Repeat JEJ	CT AP - anastamotic leak	TPN PICC Line Wed/Thurs	D/w nutrition team re. feeding through efferent JEJ C Histology
11 SU		Paraoes hernia rep 10/10/12 Oes perf repair (laparotomy and thoracotomy) 13/10 Cardiac Tx 1997. T1DM, recurrent DVT +PEs	CT 31/10/12 large R empyaema	For rpt CT once passed JEJ feeding + NBM until gut healed	D/w ENT re. Trachyostomy

Note: patient identifiers have been changed to protect privacy.

Use of the Word or Excel systems results in production of a paper print-out, so these systems share many of the same advantages as paper-based systems, particularly in efficiency.

- The printouts are portable and offer quick and easy access to information: wherever they are working, clinicians can see at a glance which jobs are outstanding.
- The template can be printed off for handing over to the incoming team.
- The printouts can be photocopied to be shared with other clinicians.
- The printouts can be kept as a record of experience for use when completing training logs.
- The system is relatively easy to use, requiring only basic IT skills.

Word or Excel systems have more disadvantages than a simple paper system, however, as in addition to introducing risks in respect of patient safety, accountability and information governance, they also introduce elements of inefficiency as the text is usually entered on a desktop personal computer (PC) shared by several nurses and doctors.

- The Word or Excel system is not available on a shared drive so access to the system is restricted to certain areas of the hospital; clinicians have to return to the ward to update the system.
- Producing and updating the templates absorbs valuable clinical time: the clinician has to locate a computer that is not in use, log on, update the system and then print off the list.

- There is no automatic logging of the identity of the person entering the data.
- The template can only be updated by one clinician at any particular time. Therefore, if another clinician is already logged on to the system – whether or not they are actively using it – the file will be available to others only as ‘read only’: updating it will not be possible. This wastes valuable clinical time and introduces unnecessary delays in updating patient notes.
- Being password protected, the information held on the system is secure but there is no central control over how frequently the password is changed or who is responsible for changing it. This means that the password can be altered by anyone in the team, locking out those not aware of the change.
- The design of the template frequently varies, which introduces issues for both efficiency and patient safety; the order of columns and rows, for example, is often changed from day to day.
- There is a risk of a transcription error or that a clinician will note down an action against the wrong patient.
- The amount of detail recorded by clinicians on the template varies from patient to patient. The level of detail required for handover is subjective but, if insufficient, may introduce risks to patient safety.
- If clinicians are short of time or forget to update the system then the list may contain out-of-date information that might compromise patient safety.
- The Word and Excel systems are completely independent of all other hospital systems; there is no interface with the hospital Web-based system favoured by the nurses, for example, so both doctors and nurses might have different information on a patient.
- There is no central record of which clinician is doing each job, so no built-in accountability.
- Paper sheets are easily lost, which introduces risks for patient confidentiality and information governance.

## HOSPITAL WEB-BASED SYSTEM

The idea for the hospital Web-based system was born when a relative of one of the surgical consultants was admitted to UHL and suffered as a result of poor handover. The incident fostered the consultant's deep interest in improving handover processes and inspired him to develop an electronic tool that would help standardise procedures and ensure best practice.

He began by designing an input sheet listing the key patient identifiers, diagnosis and care plans. The intention was for clinicians to fill out this template during their shift and then use the information to support handover. The consultant then approached the Information Management and Technology (IM&T) department to ask for their support in developing and building a suitable handover tool for PC use.

The IM&T team had been working on a project to computerise patient notes in the emergency department (ED) but, part way through development, the project had been dropped. When the request came through for a clinical handover system they decided to use the ED system as the base. Working in partnership with one of the clinicians, they agreed the design of the new system and, over time, it was embedded across much of the organisation.

Designed around a Web front-ended database, the system supports multiple data input at any one time. Fully integrated with the patient administration system (PAS), it automatically uploads patient demographic information, reducing the need for double entry of data and the related risk of transcription errors. Initially the system was very rigid but it has since been through a series of development phases with further

refinement added at each stage so that it is now much faster and far more flexible.

### Electronic 1 (E1) tool

When first launched, the tool was a relatively simple system with just two input boxes: one for the date and one for all other information. This early version soon proved inadequate for clinicians' needs; there were insufficient data input cells to meet clinical handover requirements. An upgrade quickly followed.

### Electronic 2 (E2) tool

This was an enhanced version of E1 that included additional input boxes covering: reason for admission and weekend treatment plan (Figure 3). It also gave users the option of customising and saving lists, with the ability to view and print outstanding jobs as one list (Figure 4). The upgrade was a welcome improvement and enhanced the handover process.

Figure 3: E2 handover screen

Next, click 'search' in the bottom right hand corner of the screen and your ward will be displayed.

**Clinical Forms**  
Welcome zhar Kler (PKar) Logout  
Patient Lists Patient Search Contact Us  
Version: 1.2.1 (DEV)

**Patient List**

Search Filters (Inpatient)  
Filter By Ward(s) selection(s): Gh Wld 15

Records 1 to 29 Total 29

System Number	Handover	Surname	Forenames	Age	Ward	Consultant	Acutely Unwell	Bay	Bed	Early Warning Score	Procedure / Diagnosis	Outstanding
S0015	Handover	BLI	ORY	34	F15	ARD						
S0019	Handover	MES	BERT	60	F15	ARD	N	Bay 2	Bed 3	12	Leg wound	Change bandage
S0012	Handover	S	CLAIRE	40	F15	ARD		Bay Yo	Bed Yo			
S0026	Handover	HELPI	GREZ	39	F15	GDJ		bay 4	bed 3	1	EWS OK but	
S0020	Handover	HUGB	Sz	45	F15	PUH						
S0020	Handover	JO	HA	10	F15	PUH						
S0020	Handover	JO	ER	12	F15	PUH				7		

Fig. 8  
In figure 8 above, the list shows all 29 patients currently on ward 15 according to our Hospital Information support system (HISS). The HISS provides all the patient demographic information for this handover system.

4

January 2012

Over 2,000 staff, mostly nurses, use the hospital Web-based system to support morning and evening handovers. No two wards use the system in the same way and so it is individually formulated at ward level. Despite these local configurations and numerous modifications and upgrades, the tool remains unpopular with doctors – particularly those on the medical wards, who describe it as being ‘slow, clumsy and cumbersome’.

The doctors’ general aversion to the tool is unfortunate as the hospital Web-based system has been proven to support the safer clinical handover of

patients. In March 2012 a comparative audit was undertaken of the paper-based and E1 methods of handover. This was followed by an audit of the E2 method in September 2012.

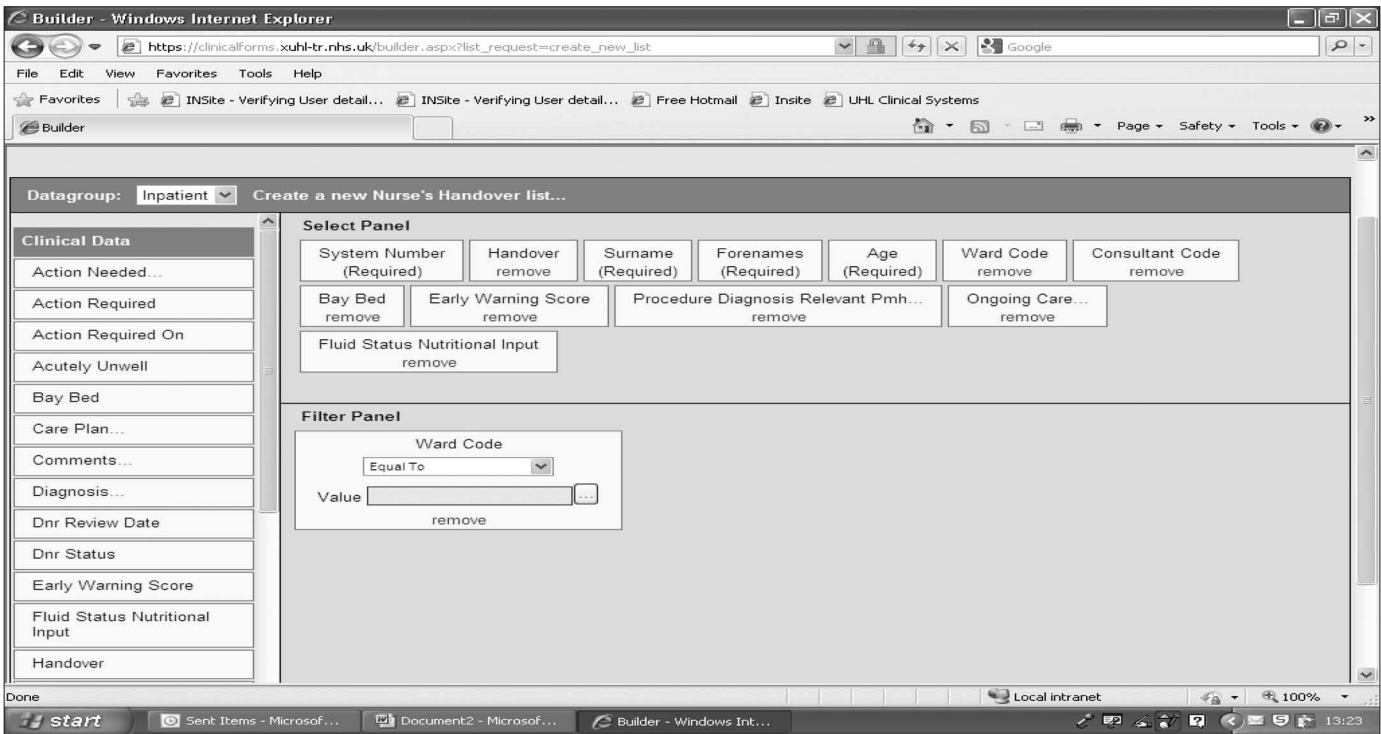
Data was collected by the clinician leading the audit and then anonymised with the order randomised. Three junior doctors, who had first been asked to read the publications on handover produced by the Royal College of Physicians (RCP), were then asked to undertake a blind, independent assessment of the information handed over.

In total, the junior doctors reviewed 41

paper-based handover notes, 53 E1 handover notes and 80 E2 handover notes (Table 1). The majority of these, they classified as being of an ‘acceptable standard’.

The data on each handover form was then compared with the recommended best-practice standards of the RCP by the clinician leading the study. He found that many of the handover notes described as being of an ‘acceptable standard’ by the junior doctors did not meet the standards of the RCP guidelines. Only 22% of the paper handover notes and 53% of the E1 notes, for example, included diagnostic

Figure 4: Features on E2 give the ability to use multiple filters and build customised lists with required boxes



Note: patient identifiers have been changed to protect privacy.  
The E2 tool is now subject to a continuous development programme. Requests for changes are submitted by users to the clinical handover review group and, if approved, are then executed by the IM&T department.

details. Overall E2 was found to provide the most detailed handover information with E1 coming a fairly close second. Although the sample size was relatively small, the results very clear: clinical handover information was more complete, and could therefore be considered safer, when clinicians used E2 to support handover (Tables 2 and 3).

In comparison with the paper, Word and Excel systems, the hospital Web-based system is by far the most sophisticated. Held on a central server shared drive, it provides clinicians with a standardised pro forma, pre-populated with questions and supported by drop-down

menus. Maintained by IM&T, the system is regularly backed up so that patient information can be retrieved if inadvertently lost or deleted. It also has a built-in audit trail to give improved accountability. In theory the system is secure as it is password protected, although as clinicians tend to print out patient lists, risks for information governance remain.

The Web-based system, therefore, offers improved data entry but, as the patient information is only accessible via a computer, it is not a truly paperless system; the doctors and nurses must still print off copies of the notes before

handover or ward round. The system, therefore, shares many of the same advantages as the paper-based solutions, but with improved security of information and accountability.

- The system is regularly backed up, reducing the risk that patient notes will be lost.
- It has a built-in audit trail, which offers accountability.
- The template can be printed off then handed over to the incoming team.
- These printouts are portable and offer quick and easy access to information: wherever they are working, staff can see at a glance which tasks are outstanding.
- They can be photocopied to be shared with other staff.
- They can be kept as a record of experience for use when completing training logs.

The disadvantages of the Web-based system mirror those of Word and Excel in that it introduces elements of inefficiency as well as risks for patient safety and information governance.

- Producing and updating the templates absorbs valuable staff time; they have to locate a computer that is not in use, log on, update and then print off the list.
- There is a risk of a transcription error or that staff will note down an action against the wrong patient.
- If staff are short of time or forget to update the system then the list may contain out-of-date information, which might compromise patient safety.

Table1: Number of handover sheets reviewed in audit

	Paper	E1	E2
Date collected	March 2012	March 2012	September 2012
Number of entries analysed	41	53	80

Table 2: Percentage of handover forms showing key patient identifiers

	Paper (%)	E1 (%)	E2 (%)
Surname	97.6	100	100
Forename	73.2	100	100
Date of birth	9.8	100	100
NHS Number	17.1	100	100

Table 3: Percentage of entries considered to be completed to an acceptable standard against Royal College of Physician guidelines

	Paper (%)	E1 (%)	E2 (%)
Diagnostic details	22.0	52.8	96.3
Risk warnings*	0	16.7	38.1
Reason for handover	29.3	92.5	92.5
Aims and limitations of treatment	0	35.8	47.5

\* For this category there were 7 E1 forms and 29 E2 forms.

- The acceptable level of detail on handover sheets is subjective and, if insufficient, might introduce risks to patient safety.
- Paper sheets are easily lost, which might introduce risks for patient confidentiality and information governance.

Although very different in design, the three handover systems therefore have very similar advantages and disadvantages. They also share one common component: paper. Clinicians want to carry their patient lists with them as they go about their work; they do not want to keep running back and forth to the ward computer to check on their next job.

*'In order to truly address the communication barriers which result in handover-related incidents, it is imperative that clinicians have access to up-to-date information on patients at all times. Any handover process which relies upon patient information being printed for consumption by clinical staff does not allow the hospital to fully address these communication issues, as the printed information is only valid at the time it is printed. It also leads to information only being entered at the point it is required for printing, as entering information earlier has no clinical benefit.'* Registrar, UHL

A number of clinicians across the hospital are looking at handover procedures and trialling different processes, but overall responsibility for improving handover procedures rests with the assistant medical director working in partnership with members of the clinical handover group. After reviewing the handover processes at UHL, and in recognition of the clinicians' desire to have patient lists close to

hand, the group began to consider the potential of introducing a live, mobile handover system; a small tablet or phone, perhaps, that would fit in clinicians' pockets and could be updated at the patient's bedside so would always hold the most up-to-date patient information.

*'Fully integrated mobile systems can capture and communicate vital patient information to support continuous care in real time – all the way through the patient journey – and help manage escalation and drive ward activity.'* Paul Volkaerts, managing director, Nervecentre Software Ltd

There was no in-house experience of developing mobile IT systems so, with IM&T support, the group began to consider possible commercial suppliers. The organisation had already decided to introduce Nervecentre, a mobile tool for managing the allocation of tasks to clinical staff at night, and the group questioned whether the same system could be applied to improving handover procedures. They approached the team responsible for introducing the Hospital at Night (H@N) tool and asked them about its potential for improving patient safety, operational efficiency and information governance at handover.

Working in consultation with UHL, the tool's developers studied the informational requirements for best-practice clinical handover and concluded that, with some software redesign, the tool would be well suited to this application.

As the organisation had previously invested significant time and resources in developing an in-house electronic system, however, it was not prepared to undertake any further investment in

handover systems unless they could be shown to provide significantly improved benefits; decisions could not be taken on the basis of hearsay. An agreement was reached between the UHL clinical handover group and Nervecentre management therefore that, in return for supporting the design of the software, UHL would be given the option of trialling the tool at no charge. If the trial proved successful and stimulated organisational interest in implementing the tool, standard procurement procedures would apply, starting with the preparation of a full business case.

The design of the software commenced in August 2012. The aim was to produce an efficient, portable handover system that would improve the accessibility of data; a system that would improve patient safety, would address concerns about accountability and that would eliminate risks in information governance.

Building on the existing functionality within the system, Nervecentre worked with UHL to understand the problems that could be addressed with the handover tool before presenting their proposed solution: a handover system that held live, up-to-date data and was accessible from any location within the hospital. Running off a mobile phone, the tool was designed to address:

- process delays caused by poor communication
- organisational efficiency through the provision of real-time data
- clinical governance linked to task ownership.

Once the new system had been fully tested, the next step was to assess its

performance on the wards. It was decided to do this by undertaking a comparative audit of handover procedures using the in-house hospital Web-based tool and the handheld tool developed by Nervecentre. This would begin in April 2013 with a process audit of the hospital system and would be followed, two months later, by a process audit of the mobile Nervecentre system. The results of the two audits would then be compared to assess whether the new system made any impact on:

- communication at handover and thereby patient safety
- operational efficiency
- information governance.

Following standard UHL procedures, the team submitted a clinical audit and quality improvement project planner and registration form to the clinical audit team, describing the intention of undertaking a comparative study of handover procedures before and after the introduction of the Nervecentre handover tool on the five surgical wards located at Leicester Royal Infirmary.

Once the audit had been agreed, a team of independent assessors, which included IT specialists, administrators and clinicians, was brought in to undertake the baseline audit and follow-up audits.

The remainder of this report describes their observations and discusses the impact that the new handover system had on patient safety, operational efficiency and information governance.

#### **TIMETABLE FOR DEVELOPMENT AND PILOT PROJECT**

##### **August 2012**

The associate medical director and consultant in pain medicine approached Nervecentre to ask if the firm was interested in working with UHL on the handover problems that medical staff were having.

After giving a presentation to the Handover Steering group it was agreed that Nervecentre would work in partnership with clinicians from the surgical department to configure a solution.

##### **February 2013**

The scope and dates for the pilot were agreed.

The participants agreed to trial three different handheld Apple devices: iPad2, iPad Mini and iPhone 5.

Apple units were ordered for delivery in early March.

##### **March 2013**

Nervecentre Application software was installed on the devices and the system was technically integrated and with UHL clinical systems.

##### **April 2013**

The Nervecentre handover tool was ready for configuration and testing.

The existing handover system had its baseline audit.

Staff received training over a two-day period. Further training and support were provided by the matrons, patient safety lead and by trained staff who passed on their knowledge.

The system went live and clinicians began using it for ward rounds and throughout the day.

##### **June 2013**

Nurses were trained on the new handover system.

An audit was undertaken of the new Nervecentre handover process.

### 3. Organisational aspects

#### NURSES' HANDOVER PROCESS BEFORE THE INTRODUCTION OF MOBILE TECHNOLOGY

Over a period of two days in April 2013, two researchers including a clinician and either an administrator or an IM&T specialist independently observed 10 nurse handover sessions on the surgical wards. Each researcher was equipped with a 'tick-box' clinical audit pro forma and asked to record, for each patient, how and where the handover took place and details of the information handed over (Figure 5).

Figure 5: Audit pro forma for nurses' handover

Date of observed handover (please complete): \_\_\_\_ / \_\_\_\_ / 2013

Day of observed handover  
(please circle):

Mon / Tues / Wed / Thurs / Fri / Sat / Sun

Time of observed handover  
(please circle):

7am / 7.30am / 12noon / 12.30pm / 1pm / 7.30pm / 8pm / 8.45pm

Place of observed handover  
(please circle):

Ward 7 / Ward 8 / Ward 21 / Ward 22 / Kinmonth

Location of handover:

\_\_\_\_\_

Staff present at handover:

\_\_\_\_\_

Please indicate with a tick if the following information was provided (verbally or in writing) at the time of handover):

Name	<input type="checkbox"/>	Diagnosis	<input type="checkbox"/>
Date of birth	<input type="checkbox"/>	Nutritional information	<input type="checkbox"/>
Responsible consultant	<input type="checkbox"/>	Infection prevention status	<input type="checkbox"/>
EWS score	<input type="checkbox"/>	Resuscitation status	<input type="checkbox"/>
Fluid management plan	<input type="checkbox"/>	Waterlow score and required actions	<input type="checkbox"/>
Pain score and plan	<input type="checkbox"/>	Wound and drain care	<input type="checkbox"/>
		Estimated day of discharge and plan	<input type="checkbox"/>
		Do staff shred handover sheet when going off duty?	<input type="checkbox"/>
		Were there any interruptions to handover?	<input type="checkbox"/>
		Was bedside handover undertaken?	<input type="checkbox"/>
		Was the patient involved in handover?	<input type="checkbox"/>
		What, if any, questions were asked by incoming staff?	
		Please specify _____	
		_____	



Following the audit, each researcher submitted a summary of the observed handover process along with the completed pro forma for analysis. A post-audit discussion was then held with each researcher to review the documentation and to support a better understanding of the handover process that took place on each ward. Interviews were also held with nursing staff at all levels of qualification and experience.

*'Handover is a key part of the day, if handover goes well, then generally my day goes well. So it is really important to me to have a structured and formalised handover system.'* Staff nurse, Surgical Assessment Unit (SAU)

Perhaps the key finding was how much clinical handover varies, not just from ward to ward but also from one shift to another. All the nurses observed had used the hospital Web-based system to support the handover process so were working from the same standard data set, which included name, age, hospital number and consultant, diagnosis or procedure and care needs as defined by a 10-point free-text system (Figure 6). The actual format of each handover, however, varied significantly.

In some cases, the different approaches observed were probably explained by the severity of illness of the patients; more time was devoted to handover on Kinmouth ward, the high-dependency unit, for example than on Ward 7, which has mainly short-stay patients. It was less easy, however, to understand why handover on one particular ward would vary so much from shift to shift or from nurse to nurse. On ward 21, for example, morning handover was shared between two nurses; one of these nurses reviewed each patient's

observational chart during handover whereas the other did not.

The involvement of health care assistants (HCAs) in handover was another observed inconsistency. On some wards the HCAs were not given the opportunity to take part in handover; when caring for patients they had to rely on the patients' bedside charts being up to date.

One HCA told researchers: 'I never go on handover as I start work at 7.30am, the same time as breakfast arrives. So I have to serve breakfast instead. The patients have a white board beside their bed which states whether they are 'nil by mouth' or have any special dietary restrictions so I refer to that before serving them meals and I usually get a copy of the nurses' handover sheet to refer to as well.'

On another ward, however, the nurse in charge took morning handover twice: once for the nursing staff and then again, after breakfast had been served, for the HCAs.

Engagement with patients during handover was significantly varied. On some handovers, patients were introduced to the incoming team and invited to comment on their treatment plans, pain levels, etc. but on others, although staff talked about each patient at the bedside, there was little, if any, acknowledgement of the patient.

The audit team found that nursing staff generally tried to make the best of the handover process, working round any difficulties rather than instigating change.

On Ward 21, for example, nursing staff complained that evening handover took

Figure 6: 10-point free-text used on nurses' handover sheets

1. Swabs and results
2. Post operation day
3. Nutritional status/ Intravenous infusion (IVI) / percutaneous endoscopic gastrostomy (PEG), etc.
4. Fluid balance
5. Interventions and investigations
6. Observations, frequency and pain control
7. Safety issues (pressure areas)
8. Wound care
9. Discharge, social issues, referrals
10. Other (eg intravenous antibiotics)

place during patient visiting hours, making bedside handover very difficult. So, to avoid the risk that visitors would overhear confidential patient information, staff talked in code at each patient's bedside, pointing out relevant information on the handover forms where necessary. The handover of one patient was given as: 'Mr A, with what you can see described in the patient record, has an EWS of 1 and a pain score of 5 and is under consultant Mr B.'

Another example was given by the solution staff found for addressing formatting issues on printouts; as the Do Not Resuscitate (DNR) box did not appear on the printouts nurses recorded it in the food column instead.

Some problems, however, are not so easily dealt with. Patient notes, for example, are often printed over more than one page; if the printouts are then not kept in order staff might inadvertently give the wrong treatment to a patient.

The team also heard rather a lot of complaints about the difficulties in updating the handover system. This was partly because of the number of clicks needed to access each individual patient record and partly the challenge of locating a ward-based computer that was not already being used by a clinician.

One of the nurses, however, explained how the computer shortage problem had been solved on her ward: 'The hospital web-based handover system has been in use for about six months and is relatively well established; the main problem is in locating a free computer to do the updates. We only have five computers on the ward which

the doctors tend to monopolise – though there is a computer on wheels which we generally hide in a side room for sole use by nurses.'

A few nurses also expressed concern about the 10-point free-text box used to list patient care needs, saying that it was difficult to remember what each of the 10 numbers referred to and that formatting issues often made it difficult to pull out key information. There was meant to be a card in the nurses' office explaining the 10-point system but the card often went missing so staff had to try to memorise the list.

## THE VARIABILITY OF NURSING HANDOVER

### Morning handover on Ward 8

Ward 8 is a surgical admissions ward with 30 beds arranged in four six-bedded bays and two side wards.

The observed ward round began at 7.10am. All the nursing staff met at the side of the nurses' station then grouped around the white board detailing the names of patients in each of the six-bedded bays. All except two of the patients had been admitted overnight so were unknown to the day staff. The senior nurse then assigned nursing teams (each comprising one staff nurse, one student nurse and one HCA) to each of the six-bedded bays and single-bay wards.

As this was happening, one of the nurses printed out copies of the handover sheets for each nurse coming on duty. (This took some time as the paper kept jamming in the printer.) The sheets held identification details on each patient and, for some patients, also included: bay/bed, EWS, fluid status, nutritional input, procedure, diagnosis, relevant past medical history (Pmh) and continuing care (Figure 7).

The nurses who had been responsible for each group of beds during the night then escorted the day teams around the bays, introducing them to each patient, notifying them of any problems that had arisen and detailing the patient's treatment plan.

Information relating to dietary requirements was listed both in the patient handover sheets and on small whiteboards at the side of each patient's bed. These boards enable the HCAs to see which patients could be served drinks and meals without the need to refer to patient notes. During the handover, the night nurse noticed that one of these boards said 'nil by mouth', which was incorrect so she erased it. The nurses' handover notes also said 'nil by mouth' for this patient. No explanation was given for the error.

The day team referred to their patient lists, throughout handover, occasionally adding annotations.

### Morning handover on Ward 7

Ward 7 is a short-stay, mixed, specialist ward with 29 beds. All the patients on the ward are in a stable condition.

The researcher noted that handover was quick and to the point. All 29 patients were handed over in 35 minutes: an average of one minute and 12 seconds per patient, with just each patient's name, early warning score (EWS), Waterlow score (see page 29), date of birth and name of the responsible consultant read from the record.

Handover was a one-way conversation; no one asked for clarification on any point, and there seemed to be no distinction made between patients with minor and major complaints.

There was little, if any, engagement with patients; any questions raised by patients were politely, but quickly, answered before the team moved on.

The researcher stated that the handover was hurried and appeared to be taking place to comply with policy rather than for any other purpose.

Figure 7: Nurses handover sheet

**Inpatient - (Unsaved)**  
The filters set for the list are:  
**Ward code** **Equal to** RSAU WARD 8  
**Total Records** 30 **Print Generated** 05/08/2013 13.15.30

System Number	Surname	Forenames	Age	Ward code	Consultant code	Bay Bed	EWS	Fluid Status Nutritional Input
12345	12345	12345	12	RSAU	JY	3.6		
<b>Procedure Diagnosis Relevant Pmh</b> Low GCS / chest infection pmh: hypertention, ihd hypothyroidism, diverticulitis <b>Ongoing care</b> Usually independent, not for IVI,MSU () had chest pain all obs stabled reviewed her says its more muscular , Please monitor pain..Referred to PT and OT SEC 2 SENT PT UNWELL TODAY 04/07/2013								
12345	12345	12345	12	RSAU	JY	A05		
<b>Procedure Diagnosis Relevant Pmh</b> LRT1 ? Lung disease, SOB, productive cough, yellow sputum pmh:Angina <b>Ongoing care</b> ECG – NAD,Trophi negative, lives alone in a house. urine dip done, chc and section 2 done. MFFD , discharged by physio. A/W POC.STOP 02								
12345	12345	12345	12	RSAU	AN1			
<b>Procedure Diagnosis Relevant Pmh</b>  <b>Ongoing care</b>								
12345	12345	12345	12	RSAU	ARN			
<b>Procedure Diagnosis Relevant Pmh</b>  <b>Ongoing care</b>								
12345	12345	12345	12	RSAU	RDS	C Oak 1	1	F&D
<b>Procedure Diagnosis Relevant Pmh</b> Had Aorta-iliac stent graft & Lt to Rt ilio-ilio x-over 19/9, angio 25/9/12 <b>Ongoing care</b> 1. Neg 2. 10 days post op, angio 4 3. F & D 5. 4hrly ews 8. For strict fluid balance 9. Will need wrvs transport home on discharge. 10 unwell in angio, vomited bile and back pain, abido slightly distended, PR nothing noted, urine dip NAD, had 1 unit of blood, abdo xray – NAD. Had CT Scan 26/9/12- a/w results, had USS shows cholecstitus Had OGD Friday today – NAD								

Note: patient identifiers have been changed to protect privacy.

The quality and quantity of information exchanged at handover varied significantly from ward to ward and from nurse to nurse. The clinical audit pro forma had been designed to capture up to 17 pieces of information for each patient. On some observed handovers most of these points were discussed but on others few were even mentioned. After discussion with the head of nursing and planned care, it was agreed to focus on just four of these for the study:

- pain score and plan
- nutritional information
- infection prevention status
- Waterlow score and required actions.

#### Pain score and plan

Effective pain assessment and management has many significant benefits, such as patient satisfaction, enhanced recovery times and shorter length of stay. It is important for the team responsible for the direct care of

any patient to understand the current assessment and whether the management plan has been effective in dealing with the pain.

#### Nutritional information

Nutritional status has a direct effect on recovery times and patient management. Ward staff are required to assess patients on admission to identify those who are at risk. These assessments are repeated at various stages of each patient's stay. Simple measures can be introduced, such as a food chart, or a referral can be made and nutritional support provided. It is important that current nutritional information is exchanged at handover as patients' needs can change.

#### Infection prevention status

To prevent hospital-acquired infections (HAI), it is important to note the infection status of all patients at handover. Any barrier nursing or restrictions that are in place should be noted in order to manage care safely and to help reduce infection within the hospital setting.

#### Waterlow score and required actions

The Waterlow score (or Waterlow scale) is used to give the estimated risk that a patient will develop a pressure sore. Although they can affect anyone, certain categories of patient, including the elderly, obese and malnourished, are more at risk. Health professionals use a grading system to determine the severity of a pressure sore; those with the most severe grade of pressure sore are at high risk of developing a life-threatening infection.

Analysis of the audit forms appears to support the researchers' statements about the lack of consistency in approach to handover (Table 4). The figures in the table should, however, be interpreted with caution as they are based on a small number of observations and they may be influenced by many factors – such as the severity of illness of each patient – and no adjustment has been made for this. The table is nonetheless a useful starting point for discussion about what should and should not be included at nurses' handover.

Table 4: Patient information included in nurses' handover before introduction of new system

	Number of patient handovers that included information on each of the four identified focus areas									
	Ward 7		Ward 8		Ward 21		Ward 22		Kinmouth	
	am	pm	am	pm	am	pm	am	pm	am	pm
Pain score and plan	24	10	1	1	0	1	2	11	7	7
Nutritional information	3	13	30	24	24	23	30	30	5	9
Infection prevention status	2	19	26	26	24	23	2	3	2	8
Waterlow score and required actions	9	14	5	9	0	1	4	11	7	6
Total patients present on ward	29	19	30	27	24	24	30	30	13	12

Figure 8: Audit pro forma for clinicians' handover

**Audit of medical handover**

Date of observed handover (please complete): \_\_\_\_ / \_\_\_\_ / 2013

Day of observed handover (please circle):

Thurs / Fri

Time of observed handover (please circle):

8am / 5pm / 8pm

Place of observed handover (please circle):

Ward 7 / Ward 8 / Ward 21 / Ward 22 / Kinmonth

Role of person handing over (please circle):

FY1 / SHO / Registrar:

**Please indicate with a tick if the following information was provided (verbally or in writing) at the time of handover**

Name	<input type="checkbox"/>	Diagnosis/problem list	<input type="checkbox"/>
Date of birth	<input type="checkbox"/>	Risks/warnings	<input type="checkbox"/>
Hospital number	<input type="checkbox"/>	Ceiling of treatment	<input type="checkbox"/>
Current location	<input type="checkbox"/>	Reason for handover	<input type="checkbox"/>
Responsible consultant	<input type="checkbox"/>	Management plan	<input type="checkbox"/>

**Please record jobs handed over**

Perform clinical procedure

taking blood

cannulation

other (specify) \_\_\_\_\_

☐  
☐  
☐

Review outstanding investigations

x-rays

blood tests

scans

☐  
☐  
☐

Prescribe/adjust medication

☐

Clinical review of patient

☐

Other (specify)

\_\_\_\_\_

CLINICIANS' HANDOVER PROCESS BEFORE THE INTRODUCTION OF MOBILE TECHNOLOGY

Over a period of two days in April 2013, 10 clinical handovers on the surgical wards were independently observed by a clinician and either an administrator or IT specialist. Each researcher was equipped with a 'tick-box' clinical audit pro forma and asked to record, for each patient, how and where the handover took place and details of the information handed over (Figure 8).

Following the audit, each researcher submitted a summary of the observed handover process along with the completed pro forma for analysis. A post-audit discussion was then held with each researcher to review the documentation and to support a better understanding of the handover process that took place on each ward. Interviews were also held with clinicians at all levels of qualification and experience.

The doctors used a template held on Word to support clinical handover (see Figure 2, page 17). The template begins by listing the contact numbers of all the clinicians on duty as well as commonly used internal phone numbers. It is then divided up into a grid with each row being used to list the diagnosis, results, plan and tasks for a particular patient.

The doctors dislike the system, describing it as cumbersome to use and time consuming to update. Each morning, a few of the junior doctors are required to arrive about an hour before the start of their shift to prepare the template for clinical handover and ward round. Their first task is to walk round the ward and check the location (bed and bay) of each patient. This information is input to the system and then the template is manually reordered. The list is then updated with

## THE VARIABILITY OF CLINICIANS' HANDOVER

### Morning handover on Ward 8

Ward 8 is a surgical admissions ward with 30 beds arranged in four bays and two side wards. Morning handover was a multi-functional event incorporating the ward round, clinical training and handover.

Around one hour before the scheduled ward round, most of the junior doctors had arrived on the ward to update the handover sheets and ensure that the patients on the ward correctly matched those listed in the notes.

One of the junior doctors then printed off the updated notes and distributed copies to each of the clinicians present. For each patient, the sheet included their location, name, diagnosis, details of continuing care and any outstanding jobs. Printed in a small font, much of the information was merged into a single paragraph, making it very difficult to extract key pieces of information such as the EWS.

Eleven clinicians, accompanied by the nurse in charge, followed the consultant from bed to bed, to discuss each patient's medical condition, to observe any necessary physical examinations and to agree each patient's treatment plan.

The large number of clinicians present made it difficult for everyone to hear what was being said so one of the junior doctors recorded details of all the tests ordered by the consultant on a notepad. Although the handover appeared chaotic at times, mainly owing to the number of participants, overall it was well structured and it appeared to work satisfactorily.

At the end of the ward round the junior doctors met in a side room and agreed who would take responsibility for completing each of the tasks requested by the consultant.

### Late afternoon handover on Ward 8

The late afternoon handover, unlike the morning one, was far less orderly. Information passed from the day team to the evening on-call team was limited to the names and hospital number of the sick patients with a list of outstanding tasks. No one used the Word template; everything was written down on scraps of paper that were then put in trouser pockets by the male clinicians or in shoulder bags by the female clinicians.

### Evening handover Ward 8

The evening handover took place during visiting hours. The clinicians met in a side ward and grouped around a whiteboard listing each patient's name. A few of the day team quickly briefed the incoming team on each patient and then handed over details of any outstanding tasks or results. The night team recorded details of these jobs on pieces of paper or on pocket-sized notepads; one clinician was seen to use four different scraps of paper to write down jobs, all of which he then stuffed in his pocket. Overall, handover of around 29 patients was completed in less than 30 minutes.

Not all the day team took part in handover. Some were too busy, rushing around and trying to finish off as many jobs as possible before they went home.

There was no suggestion of shift culture – where clinicians abandon the care of their patients immediately at the end of their shift. All clinicians appeared to want to complete their outstanding tasks before heading for home, so that the on-call team had just to chase outstanding results.

new patient information before copies are printed off for each member of the day team.

The junior doctors must also stay late each evening to update the system for the night team. On average, they estimate that updating the handover system extends their working day by up to 45 minutes.

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'Sometimes I find I stay on just to ensure I can do a one-to-one handover on a complex patient; I don't have confidence in the current system to be sure that all the key information will get to the right person.' FY2, UHL

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In terms of quality and quantity of information handed over it was difficult to find fault with the clinicians' morning handover as, being combined with both the ward round and teaching practice, it appeared fully comprehensive.

The afternoon and evening handovers were, however, more perfunctory. There appeared to be no established time, place or process for these handovers and the only participants appeared to be junior doctors; there were no senior clinicians present. The information handed over was brief and to the point: just the patient's name, hospital number and outstanding tasks or results. The doctors copied the details onto scraps of paper that they then stuffed into their pockets or bags. Patients not waiting for tests or results were not mentioned.

Perhaps the key finding from this audit, however, came from the interviews with the doctors; they all expressed concern about the risks handover introduced to patient safety. At the end of the shift, jobs are passed from one clinician to another, by paper or word of mouth; if

those jobs are forgotten or are not done for any reason, then patient care suffers.

One clinician said: 'Sometimes I hand things over and then I discover they are not done. I requested a blood test one Friday evening on a patient with elevated potassium levels but it wasn't done for over 24 hours. That was potentially a patient death.'

The risk that something will not be passed on, or will be passed on incorrectly, becomes more acute at the weekend or over holiday periods when staffing levels are low. The associate medical director and consultant in pain management said: 'Handover can become like Chinese whispers when a piece of information is passed from one junior to another over five or six handovers'.

Accountability was another concern raised at the interviews by clinicians. There is currently no record or audit trail to identify which jobs a clinician has handed over at the end of a shift. This has sometimes led to disputes between clinicians when a job that should have been handed over was not completed and the patient was subsequently harmed. This occurs when the clinician on the early shift claims to have handed over the job but the clinician on the later shift says this did not happen.

One clinician said: 'When something goes wrong it is essentially one person's word against another's.'

A few clinicians pointed out that most patients are handed over many times, and not just at the end of each clinical shift: it also occurs when they are moved to a new ward, for example, transferred to a different hospital or discharged to their GP's care.

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'At present, handover systems are largely set up to support hospitals during the traditional transition period at the end of shifts – and are not used at any other times of the day. In reality, handover has a much broader definition, encompassing admissions, transfers and discharges, as well as handling common fluctuation in staff availability. In every hospital, handovers routinely happen throughout the day. The emphasis needs to move from the narrow definition of 'end of shift' activity, to one of delivering continuous care.' Paul Volkaerts, managing director, Nervecentre Software Ltd

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A number of clinicians, particularly those at more junior levels, expressed the need for either UHL or medical schools to introduce training in best practice handover procedures that met the RCP guidelines.

One of the FY1 clinicians spoke for many when she said: 'I think it would be helpful if UHL included a session on handover during induction – just covering the process and setting out what is acceptable and what is not.'

Overall, the interviews highlighted clinician's dissatisfaction with the existing handover system. Many of them were aware of the mobile technology that UHL had introduced to manage workloads at night and suggested that a similar system might be suitable for handover.

One consultant said: 'If all tasks outstanding are shifted from one clinician to another electronically, then things cannot get missed and, if they do, an alarm is raised. Plus there is inbuilt accountability.'



## INTRODUCTION OF MOBILE HANDOVER SYSTEM

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The launch of the mobile system took place in April 2013. The four clinical teams covering the five surgical wards were chosen to trial the system. Each team was given basic training and then issued with three handheld devices (iPhone5, iPad Mini or iPad2) giving live access to the handover system from any location within the hospital. The nurses were given access to the system via static computers only; they were not given mobile functionality.

Overall, the implementation went smoothly. The system is user friendly – effectively no different from using an iPhone, already familiar to the majority of staff from personal use, so training needs were minimal. There were a few small teething problems but these were minor. One related to integration with PAS and the alignment of patient discharge information; this was quickly and easily addressed. The other issues were all cosmetic. Users requested patient names to be listed in reverse bed/bay order so that they mirrored the order of the ward round, suggested all information be displayed in landscape rather than portrait view and asked for a change to the print format. These requests have now been executed by the technical team.

After allowing for an initial settling-in period, the audit team revisited the hospital to assess the impact of the new system. As on the first visit, the team were asked to observe a number of nurse and clinician-led handovers and to complete an audit pro forma for each. They were also asked to provide feedback on their overall experience of handover and to undertake interviews with a selection of staff on each ward.

It was immediately clear that the new system was a success. Every person interviewed praised the system. The nurses spoke of the benefits of having a handover system that provides them with much of the same information as the doctors' system; this gave them a much better understanding of each patient's condition and care needs. The clinicians talked about the hours they saved in administrative work at the beginning and end of each shift, improved accountability and the clinical benefits of having up-to-date patient information close to hand.

## NURSES' HANDOVER PROCESS AFTER THE INTRODUCTION OF MOBILE TECHNOLOGY

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For the nurses, who have not been given mobile functionality, the actual process of handover has barely changed; each morning and evening the nurses still tour the ward from bed to bed, carrying paper printouts of the patient notes.

What has changed, however, is the quality of information contained within those printouts. Previously the nurses' and doctors' handover systems held completely different sets of information. In the main the resulting disparities were minor, and mostly related to differing levels of detail being held on each patient (Figures 9 and 10). The non-alignment of the two systems did, however, make it more difficult for the nurses to talk knowledgeably with patients about their care plans. It could also result in extended lengths of stay because, as nurses were not aware that tests or results were outstanding, they could not chase these.

Since the introduction of the new handover system this is no longer an

issue; the doctors' and nurses' handover systems are now fed from the same pool of data and share a number of common fields, such as diagnosis, EWS, ceiling of treatment and outstanding tasks. This helps support a more coordinated approach to care between doctors and nurses

The format of the nursing forms has also been changed to improve clarity. Designed in consultation with the nursing staff, each distinct element of the care plan is now printed on a separate line.

One of the nurses interviewed summed up the views of nursing staff when she said: 'It is a great tool. The patient record is now better structured. It is nicely set out. And it has everything on it. On the old system, it was a bit hit and miss whether fields such as EWS were filled in but it is always listed on the new tool.'

Figure 9: Comparison of different levels of information held on nurses' handover sheets before and after the introduction of the new system

Nurses' handover notes before introduction of new system								
System number	Surname	Forename	Age	Ward code	Consultant code	Bay Bed	EWS	Fluid status and nutritional input
HN123456	SMITH	JOHN	81	RSAU	CC1	1.1		NBM
<b>Procedure Diagnosis Relevant Pmh</b> PR bleeding and umbilical pain Pmh AF, ^BP, borderline diabetes								
<b>Ongoing care</b> 1) swabbed 3)NBM IVI 5) Needs stool sample if has loose stool, stool chart. Aspirin on hold. May require further investigations ? OGD. 10) Lives with daughter. Independent. Pressure areas intact.								
HN234567	SMITH	JANE	71	RSAU	CC2	2.2		NBM
<b>Procedure Diagnosis Relevant Pmh</b> 1/7 history of RUQ pain								
<b>Ongoing care</b>								

Nurses' handover notes after introduction of new system				
1-1	Smith, John HN123456      01/01/19xx (81 yrs) Carl Crookes      Male	EWS 4	<b>Diagnosis: PR Bleeding/ Umbilical Pain</b> <b>Fluid Balance/ Nursing Care:</b> Hold aspirin, may require OGD/ siggy. Needs stool sample if further loose stools NBM/IVI <b>Waterlow Score/ Plan:</b> 9 Self Care. 4* check <b>Wound/Drain Care.</b> Self care LTCBD <b>Discharge/ Mobility/ Referrals:</b> Lives with Daughter/ has stairs. No social care at present. Referred OT/Physio 15/5 <b>Nutritional Status:</b> NBM.	<b>Tasks:</b> CT Request/Review ECG Recording Blood Results Interpretation  <b>EDD:</b> 26/5/13  <b>Obs Frequency:</b> QDS
	<b>Ceiling of Treatment:</b> Not For Resuscitation <b>Risks / Warnings:</b> Allergic to penicillin MRSA swabs sent 16/5 <b>PMH:</b> AF ^BP , borderline Diabetes			
2-2	Smith, Jane HN234567      03/11/1941 (71 yrs) Carl Crookes      Female	EWS 3	<b>Diagnosis:</b> 1/7 history of RUQ Pain <b>Fluid Balance/Nursing Care:</b> Had USScan on 11/5 NAD. Plan to increase PPI. For contrast CT <b>Waterlow Score:</b> 6 Self <b>Wound/ Drain Care :</b> Pressure areas Intact <b>Discharge/ Mobility/ Referrals:</b> Lives with Husband. Independent with ADL, referred pain team 17/5 <b>Diet/Fluids:</b> NBM	<b>Tasks:</b> ABG Required X-Ray Request/Review Blood Results Interpretation  <b>EDD:</b> 22/5/13  <b>Obs Frequency:</b> BD/ daily BM
	<b>Ceiling of Treatment:</b> Full Active Management <b>Risks / Warnings:</b> MRSA neg 18/5  <b>PMH</b> Laporotomy. NIDDM			

Note: To protect patient confidentiality these are only representations of notes; they do not relate to actual patients.

Figure 10: Comparison of different levels of information held on doctors' handover sheets before and after the introduction of the new system

Doctors' handover notes before introduction of new system					
Inpatients on ward x					
Location of patient	Patient	Diagnosis	1x	Plan	Jobs
1.1	John Smith HN123456 01/01/19xx	PR Bleeding			C Bloods
2.2	Jane Smith HN234567 02/02/19xx	Cholecystitis			C bloods

Doctors' handover notes after introduction of new system					
1-1	Smith, John HN123456      01/01/19xx (81 yrs) Carl Crookes      Male	EWS 4	<b>Diagnosis:</b> PR Bleeding/ Umbilical Pain  <b>Results:</b> HB 7.9 was 10.4 on 15/3, CXRAY  <b>Management Plan:</b> For OGD/ Flexi Sig Repeat FBC Daily/ NBM/ IVI	<b>Tasks:</b> CT Request/Review ECG Recording Blood Results Interpretation  <b>EDD:</b> 26/5/13	
	<b>Ceiling of Treatment:</b> Not For Resuscitation  <b>Risks / Warnings:</b> Allergic to penicillin MRSA swabs sent 16/5				
2-2	Smith, Jane HN234567      03/11/1941 (71 yrs) Carl Crookes      Female	EWS 3	<b>Diagnosis:</b> 1/7 history of RUQ Pain  <b>Results:</b> Bloods Normal USscan NAD  <b>Management Plan:</b> CT with Contrast – booked	<b>Tasks:</b> ABG Required X-Ray Request/Review Blood Results Interpretation  <b>EDD:</b> 22/5/13	
	<b>Ceiling of Treatment:</b> Full Active Management <b>Risks / Warnings:</b> MRSA neg 18/5				

Note: To protect patient confidentiality these are only representations of notes; they do not relate to actual patients.

## CLINICIANS' HANDOVER PROCESS AFTER THE INTRODUCTION OF MOBILE TECHNOLOGY

For the doctors, the handover process is now much calmer and more orderly.

Previously, the junior doctors had to be on the ward about an hour before their shift commenced to update patient notes and to check the location of each patient (bed and bay). Outliers would often be difficult to locate if they had been moved overnight, this increased the risk that patients would be missed by the clinical team. The junior doctors then printed off paper copies of the notes and distributed them to everyone taking part in handover. The notes would be annotated during the ward round and then updated through the day. At the end of their shift the clinicians would locate a computer then

transfer their handwritten notes from their printout to the patient's computerised records.

Rather than reducing the clinicians' workload, therefore, the old handover system increased it and also extended their working day by up to 45 minutes.

The additional workload and resulting long days have been eradicated since the introduction of the new system. The nursing staff now ensure that the hospital patient management system correctly records the location (bed and bay) of each patient, this then automatically updates the new handover system.

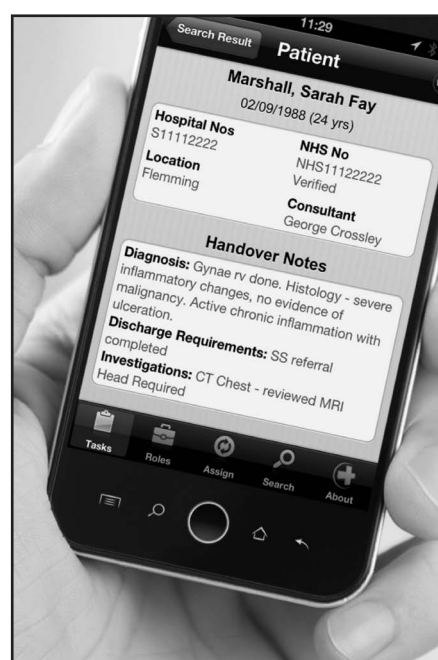
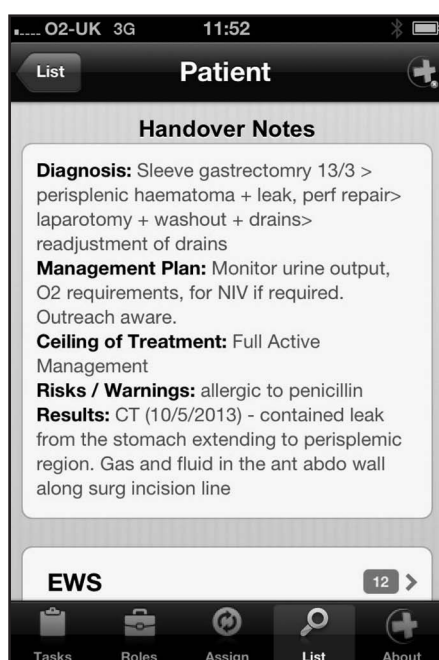
The patients' handover notes are then updated during the ward round. As the consultant examines each patient one doctor, generally the registrar, will

update the notes directly at the bedside using one of the handheld mobile devices – usually an iPad Mini. If any urgent tasks are required these will be colour coded red so that they stand out visually when the day's task list is generated at the end of the ward round.

The handheld tool allows the system to be continually updated throughout the day. As a task is completed it is recorded on the patient's notes before the clinician leaves the bedside. This ensures that the recording of tasks is not forgotten, reduces the risk of transcription errors and keeps other members of the team continually informed (Figures 11 and 12).

As there are currently only 12 handheld devices the full benefits of the mobile functionality are still to be realised but it has already made a noticeable

Figures 11 and 12: Images of the handover tools in use



change to the frequency with which patient notes are updated. Whereas previously patient notes were updated only at the end of each clinical shift, amendments are now made throughout the day. Figure 13 shows the number of updates made to either the patient management plan or patient diagnosis/background fields on the new system for the two-week period commencing 1 June 2013. Although there is still a definite peak in data entry between 8am and 11am, the late afternoon/early evening spike is no longer evident; updates are now undertaken throughout the day.

Handover of patients, however, occurs not just from shift to shift but also from one clinical team to another. One big disadvantage of the Word handover system was that it was not on a shared drive so that when a patient was passed

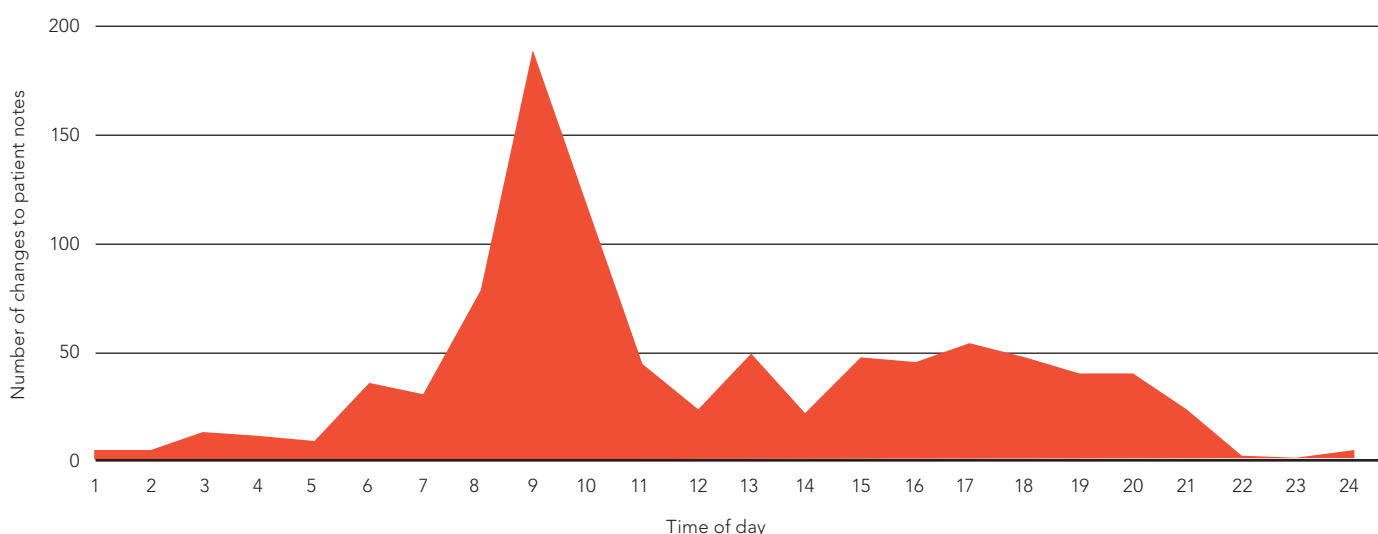
from the care of one clinical team to another the handover notes would have to be transferred on paper then manually input to the new team's system. This problem does not exist with the new system as it is Wi-Fi enabled so can be used throughout the hospital, helping to improve continuity of care for patients. Surgeons can now update a patient's management plan from theatres, for example, so that ward staff can prepare for the patient's return.

At the end of each shift, clinicians still meet to discuss any particularly sick patients and then to hand over any outstanding tasks. The big difference now, however, is that all the outstanding tasks are electronically recorded on the new handover system. This ensures that no tasks can be missed, by either the incoming or outgoing team, so improving both clinical safety and accountability.

As this was a limited trial, handover issues for information governance remain; clinicians still work mostly from paper notes. If the new system were to be fully adopted, however, so that each clinician was issued with a handheld tool, it would be expected that this reliance on paper would no longer be necessary.

The introduction of the new mobile handover system should, therefore, help improve patient safety, remove clinicians' concerns around accountability and, in time, address the information governance risks from the loss of confidential patient information.

Figure 13: Frequency of updates to patient notes using the new handover system for the two-week period from 1 June 2013



## 4. Patient perspective

For patients, in addition to improved clinical safety and information governance, both of which are discussed in detail elsewhere in this report (see chapters 5 and 6), the main benefit is better alignment of nurse and clinician care which, in some cases, will help reduce length of stay.

Doctors and nurses are now working from the same platform of information. This means that nurses can now see the doctors' outstanding task lists and so are more aware of the tests each patient requires and, where these are delayed, can chase them.

One consultant said: 'We are trying to move away from a model where the information on a patient is held in the head of one member of the team'.

## 5. Assessment of safety and clinical effectiveness

‘Handover of patient care from one professional or team to another is one of the very high risk transactions of health care services.’ Academy of Medical Royal Colleges

It is often difficult to narrow down the root causes of serious untoward incidents (SUI), but poor communication by health professionals is thought to be a causal factor in at least 60% of such incidents.

Handover, which depends on good communication, is a particularly high-risk activity.

An experimental study undertaken in 2007 (Bhabra et al. 2007), based on the simulated handover of 12 patients between two ear, nose and throat senior house officers (ENT SHOs), found that after five handover cycles, only 2.5% of patient information was retained using the verbal-only handover method, 85.5% was retained when using the verbal with note taking method and 99% was retained when a printed handout containing all patient information was used. Although artificial in nature the study did demonstrate the inherent risks in handover; the SHOs were seated in a quiet room and only had to retain the information for 30 minutes before handing it over, not till the end of their shift as would be the case on the wards.

‘When receiving handover we might like to think that we are able to sift through the information to retain important clinical details above less important ones. However, our results show that important data points were lost in handover just as frequently as those deemed less important. Hence, even essential information that may result in serious morbidity could be lost if an inadequate method of handover is used’. (Bhabra et al. 2007)

An analysis of SUIs at UHL over the past two years found that inadequate handover was identified as a root cause or significant contributory factor in 23% of SUIs related to patient safety incidents in 2011/12 and to 10% in 2012/13 (Table 5).

There have been no reported SUIs related to handover in surgery since the introduction of the new handover system. At this stage it would be wrong to assume a causal effect but it would be expected that improving communication would lead to a significant reduction in errors.

Table 5: Percentage of SUIs at UHL relating to patient safety incidents for which inadequate handover was identified as the root cause or a significant contributory factor

Year	% of SUIs related to poor handover
2011/12	23
2012/13	10

### SUI RELATED TO POOR HANDOVER

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A 55-year-old woman, with a recently diagnosed brain tumour, attended an outpatient oncology appointment in August 2011. The treatment plan for this patient was for palliative radiotherapy. The patient had attended clinic suffering with pain for a number of days since the biopsy. It was decided to admit the patient to the oncology ward for symptom control.

The consultant and registrar specified an action plan for symptom control and for a computed tomography (CT) of the head if the patient deteriorated. Regular Glasgow Coma Scale (GCS) observations were requested. Later in the afternoon the patient became less responsive and began vomiting. The nursing and medical staff were alerted and the patient's condition was attributed to the effects of the Oramorph that had been administered in the clinic.

The patient's condition deteriorated during the course of the evening with increasing loss of consciousness. The patient was certified dead at 02.40 hours with cause of death recorded as raised intracranial pressure.

Although the patient had an inoperable brain tumour, the focus of the palliative treatment was to slow the tumour growth and provide quality of life. The rapid deterioration in the patient's condition may not have been preventable but recognition and acting on her deteriorating state might have afforded the opportunity for intervention that might have changed the course of events.

Poor handover procedures were later identified as a key component in the patient's demise.

This started with the inadequate handover from the clinic to the ward, continued with inadequate communication and documentation between the nursing staff and the medical staff and then concluded with the poor handover between the day and evening clinical teams. When handover took place it was suggested that the patient's condition was stable; but it had already deteriorated. The result was further deterioration in the patient's condition and lack of escalation of care.

The recommendations from the subsequent investigation included revisions to the clinic handover sheet, as well as improved handover training education for staff, covering both communication and documentation.



## 6. Socio-cultural, ethical and legal aspects

### STAFF SATISFACTION

During the pre-implementation and post-implementation system audits, interviews were held with HCAs, nurses, clinicians, IM&T staff and clinical safety officers to give the audit team a better understanding of the handover process and how it is perceived by staff.

Nurses were found to be generally satisfied with the hospital Web-based system. They noted that the system had its limitations but they had successfully developed ways of working round most of these. There were some concerns about handover being disorganised but this seemed to relate more to staffing levels than the handover system; the nurses in charge complained that they did not know how many staff would be on the ward until after the start of the shift as rostered staff were often moved to cover sickness on other wards.

Clinicians, however, were far less happy with their Word-based handover system. They complained that it compromised patient safety and lacked accountability, and they found it a considerable administrative burden.

One of the surgical consultants said: 'I want a handover system that will provide accurate data sets on each patient, which will provide assurance that every job is handed over and that none are missed and [that] will ensure accountability.'

They also complained about handover being so disorganised. Researchers, watching the junior doctors dashing round the ward to locate patients and update the notes before handover, considered it to be rather an understatement when one of the doctors said: 'It can be a little chaotic before handover in the mornings'.

The new system appears to have successfully addressed most of the clinicians' concerns. At the very first of the post-implementation interviews the audit team were told that the new system was 'fantastic' and from that point onwards the praises kept coming.

One of the reasons for clinicians' delight is the significant reduction in administrative work. Clinicians no longer have to record their notes on pieces of paper and then transfer their scribbled notes to the Word system; they can now instantly update the handover system from the patient's bedside. This reduces the risk of transcription errors and also saves significant time; it is estimated that the tool has saved each clinical team five hours a day.

One junior doctor said: 'I now come in 45 minutes later and go home on time. It is brilliant.'

The new system has also improved accountability; another of the clinicians' concerns. For every entry on the new system there is an audit trail setting out the time the change was made and the name of the clinician who entered the data.

### STAFF SURVEY

To assess staff perceptions of the new system a post-implementation survey was undertaken. The survey, based upon the IBM Computer System Usability Questionnaire and modified to meet the specific needs of this project, aimed to compare the nurses' and doctors' views on handover before and after the introduction of the new handover tool. Respondents were asked to grade each question between 1 and 10 (where 1 was strongly disagree and 10 was strongly agree).

For nurses, who had not benefited from the full functionality of the system, there was little change in satisfaction levels (Table 6).

Table 6: Comparative satisfaction of nurses between old and new systems

		Average score	
		Old system	New system
1.	Overall I am satisfied with how easy it is to use the system	8	8
2.	It was easy to learn to use the system	8	8
3.	The system takes little of my time allowing me to spend more time with patients	6	7
4.	The system allows information on the patient to be accurately recorded	7	8
5.	I feel comfortable using the system	8	8
6.	Whenever I make a mistake using the system I recover quickly and without impact to safety	8	8
7.	The organization of information on the screens is clear	7	8
8.	I like using the interface on this system	8	8
9.	Overall I am satisfied with how easy it is to use the system	8	7
10.	Overall, I am satisfied that the system effectively supports my job	8	8
Total (%)		76	78

For clinicians, however, despite their having only limited access to the system, the survey suggested satisfaction levels increased from 58% to 73% (Table 7). In particular, clinicians noted that the new handover system gave them more time to spend on direct patient care.

**Table 7: Comparative satisfaction of clinicians between old and new systems**

		Average score	
		Old system	New system
1.	Overall I am satisfied with how easy it is to use the system	5	7
2.	It was easy to learn to use the system	6	7
3.	The system takes little of my time allowing me to spend more time with patients	4	8
4.	The system allows information on the patient to be accurately recorded	6	7
5.	I feel comfortable using the system	6	7
6.	Whenever I make a mistake using the system I recover quickly and without impact to safety	6	6
7.	The organization of information on the screens is clear	7	7
8.	I like using the interface on this system	6	8
9.	Overall I am satisfied with how easy it is to use the system	6	8
10.	Overall, I am satisfied that the system effectively supports my job	6	8
Total (%)		58	73

## TRAINING RECORDS

Many of the clinical staff working on the wards are still in training. To qualify and become a senior doctor these trainees, in addition to demonstrating competence in a wide range of acute medical skills, must be able to show that they are experienced in practical tasks (such as blood gas analysis and femoral line insertion) and they must be able to provide evidence that they have

certain ward-based skills (such as writing prescriptions). The trainees are required to document their knowledge and skills in e-portfolios to ensure career progression. The portfolios form a key part of the validation process of a junior doctor's assessment and must be produced for examination at every job interview.

The trainee doctors sometimes take home their patient job lists to be used as a memory prompt for when they are updating their training records; a practice that has potential for breaching confidentiality guidelines. The new system holds an audit trail detailing who requested a job, when it was requested, when it was completed and who performed it. This information will be anonymised and used to populate a training module for each doctor, which can then be uploaded to their e-portfolio.

The introduction of this module will mean that UHL will be able to guarantee that all its junior doctors can demonstrate that they have achieved the full range of required competencies. It is expected that this will be a significant differentiator in the recruitment of junior doctors, helping UHL stand out from its competitors.

## INFORMATION GOVERNANCE

UHL has established an Information Risk Governance Programme charged with overseeing information risk management and introducing continuous improvement standards aimed at ensuring security of patient information.

Monitoring and managing information governance, however, is not easy. Before the introduction of the new system the clinicians on the surgical wards each carried paper notes listing

their patients and detailing their conditions and treatment plans. If one of these patient lists was inadvertently left at the patient bedside or dropped, then not only was clinical safety threatened as patient care could be delayed, but patient confidentiality would be compromised.

Although the risk of this happening is very small, when it does the consequences may be severe. At UHL, for example, a handover sheet was reported lost by a staff member but was found on hospital property. In this instance there was no significant breach in confidentiality as the incident was contained on site but if the sheet had been found by a patient or visitor then confidential patient details would have been placed in the public domain.

Incidents such as these should no longer occur with the new system. All handover notes will be shared and stored electronically; thereby completely removing the need for staff to generate paper notes. Clinicians will review, annotate and update patient notes on handheld tools, not on printouts or scraps of paper. All records will be held centrally; no data is held on the handheld tools, so even if one of them were lost or stolen, patient confidentiality would never be compromised.

These benefits will be even more important when the new European Union Data Protection legislation comes into force, as this gives the authorities the capacity to impose heavy fines on hospitals and trusts that cannot evidence robust information governance systems for all aspects of patient information handling.

## 7. Economic aspects

The key aim in trialling the new handover system was to improve clinical safety.

Improving financial efficiency is, however, a challenge facing all NHS organisations so it was important that the new system provided value for money.

This was a relatively restricted trial, undertaken over just a few months, so calculating an actual cost saving is not possible at this stage.

The study did, however, point to a number of areas where savings could be anticipated.

One of these was in reduced length of stay (LOS).

During the interviews held before implementation of the new handover system the researchers were told many times about patients having extended lengths of stay due to:

- tasks, such as chasing blood results, being done late in the day, which resulted in some patients' remaining in hospital longer than necessary
- patients' being moved to a different ward and effectively 'lost' from the system. The surgical team would be unaware that the patient had been moved to another ward so would not arrange the discharge.

No records were available detailing how often these extended LOS incidents occurred but, from discussions held with clinicians, they seemed fairly frequent.

The delayed discharges were caused by poor information systems. Tasks were passed around on pieces of paper so it was not clear to members of the clinical team which jobs still needed doing and which had been completed. If one clinician had agreed to review a patient's blood test but then got delayed with another patient, for example, no one else in the team could step in to help as they were not aware the task was still outstanding.

This will no longer be an issue with the new handover system. The list of outstanding tasks is always up to date and is available at a glance through the mobile handheld tools, enabling the clinicians to work more productively as a team.

Another area where savings are anticipated is from a reduction in claims for clinical negligence; this would reduce the Trust payment to the NHS Litigation Authority. In the past, there have been a number of claims against the hospital related to poor clinical handover. Such claims should be virtually eliminated with the new system, as it provides no opportunity for tasks to be forgotten.

If a decision is taken to introduce the new handover system across the organisation then it will interface with many of the clinical systems already in use, such as H@N. This will support the better planning of use of human and other resources, increasing overall efficiency and the potential for many more cash-releasing savings.

### FUTURE PLANS

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The trial of the new handover system was immediately declared a success by clinicians and, within two weeks of the system's implementation date, a business case had been initiated for purchase of the necessary software and equipment.

The proposal seems likely to be approved. The new handover system marries well with other UHL initiatives.

UHL recently embarked on a managed partnership arrangement with IBM for its IT services. IBM will be assisting the trust in the implementation of a number of key transformational projects, one being for unified communications (UC). This project is expected to introduce smartphones for all key staff within 18 months, which will facilitate the Trust's ambition of moving away from its current pager system, which is inherently inefficient. The introduction of these phones would enable the new handover system to be quickly rolled out across the Trust and would reduce the initial investment costs.

The Trust is also considering replacing the existing handover system, which is no longer considered fit for purpose. If agreed this will release additional funds related to development and support of around £8,000 a year, which could potentially be invested in the new handover system.

## 8. Conclusion

The clinical team responsible for reviewing UHL handover procedures, working in partnership with the hospital IM&T team, has successfully used communication and collaboration technology to redesign the handover process across five surgical wards at UHL. The communication and accountability problems that previously threatened to compromise safe and effective patient care have been addressed and information governance has improved.

The new handover system has introduced transparency to the handover process; it has improved communication flows across the team, improving patient safety, clinical accountability, operational efficiency, information governance and staff satisfaction.

### PATIENT SAFETY

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When a doctor is responsible for a particular patient, a number of tasks, such as blood tests, will be generated. Under the old system these tasks were mostly recorded on scraps of paper with details of all outstanding ones generally passed on to the new clinical team by word of mouth, which introduced the risk that tasks would be forgotten, handed over incorrectly, or misinterpreted.

These risks have now been eliminated; under the new system all tasks are held on a central database and so cannot be lost or forgotten.

### ACCOUNTABILITY

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In the old handover system, as there was no record of which jobs had been handed over, disputes could arise between clinicians when an adverse incident occurred, with both denying responsibility.

This lack of accountability was a huge worry to clinicians so they have particularly welcomed the built-in clinical audit trail that features on the new handover system. The audit trail retains details of each update along with the name of the clinician making the entry so it has successfully addressed concerns about accountability issues.

### OPERATIONAL EFFICIENCY

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As this was a limited trial it was not possible to identify any cash-releasing savings but, in the longer term, these are expected from reduced LOS and the lower risk of clinical negligence claims.

There is also improved use of staff resources; clinicians are spending less time in front of a computer and so have more time for direct patient care and, with nurses and doctors working from the same platform of information, patient care is better aligned.

### INFORMATION GOVERNANCE

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The new system eliminates the need for staff to work from scraps of paper, reducing the risk that patient confidentiality could be compromised, something that was a very real threat with the old system.

To access the records, clinician's must now log on using their unique username and password; this helps to maintain the clinical audit trail and helps assure patient confidentiality. The tool automatically switches off if not used for five minutes and locks down if taken outside the reach of the hospital Wi-Fi system, ensuring that the loss or theft of the tool will not result in a threat to patient confidentiality.

### STAFF SATISFACTION

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All clinical and nursing staff expressed satisfaction with the new handover system and appreciated its many benefits. The nurses complimented the improved layout of the forms and were particularly pleased to have access to the same patient notes system as the doctors as this made it easier for them to provide the best patient care. For doctors, the most welcome features of the new system were increased patient safety, more time to spend on direct patient care and improved accountability.

In summary, the study has shown that the new handover tool is effectively supporting UHL in improving clinical handover on the surgical wards. It does have to be recognised, however, that the trial was limited to a small area of the organisation and would need testing on a wider scale before it could be declared a resounding success. Handover requirements are not all the same; they need to be tailored to the needs of each department, to the size of the ward and to the number and complexity of the patients. On the surgical wards, however, as one clinician said: 'The new handover tool ensures patient data is more accurate, that clinicians get to sicker patients sooner, that jobs don't get missed and, if they are, there is built in accountability.'

## Appendix A: University Hospitals of Leicester NHS Trust

UHL NHS Trust is one of the biggest and busiest NHS trusts in the country, incorporating the Leicester General, Glenfield and Royal Infirmary hospitals. It has approximately 1,500 beds across the three sites. It has its own children's hospital and runs one of the country's leading heart centres.

The Trust's team comprises more than 10,000 staff providing a range of services primarily for the one million residents of Leicester, Leicestershire and Rutland. The nationally and internationally renowned specialist treatment and services in cardio-respiratory diseases, cancer and renal disorders reach a further two to three million patients from the rest of the country.

The Trust works with partners at the University of Leicester and De Montfort University, providing world-class teaching to nurture and develop the next generation of doctors, nurses and other health care professionals, many of whom go on to spend their working lives with the Trust.

The Trust is proud of being at the forefront of many research programmes and new surgical procedures, in areas such as diabetes, genetics, cancer and cardio-respiratory diseases. In 2010 it earned £21.4 million in research grants for 825 clinical trials, bringing benefits to thousands of patients.

The Trust's heart centre at the Glenfield hospital continues to lead the way in developing new and innovative research and techniques, such as surgery with a Robotic Arm, TAVI (trans-catheter aortic valve insertion) and the use of the suture-less valve in heart surgery. It also has one of the best vascular services nationally, with more patients surviving longer after following an aneurysm repair (to fix a life-threatening bulge in a blood vessel).

The Trust also has some of the lowest rates of hospital-acquired infections, such as C.difficile and MRSA, in the country, with very good hospital standardised mortality rates, which is a good indicator of overall clinical quality; for the second year in a row the independent Consumers' Association journal, Which? has rated the Trust's car parking in the top ten in the country; and its food has been rated as 'excellent' by an independent panel.

The Trust's purpose is to provide 'Caring at its best' and its staff have helped to create a set of values that embody the Trust's identity, values and activities. They are:

- focusing on what matters most
- treating others as one would like to be treated oneself
- being passionate and creative in work
- doing what one says one is going to do
- acting as one team: 'we are best when we work together'.

Patients are at the heart of all the Trust does, in line with the belief that 'Caring at its Best' is not just about the treatments and services provided, but also about giving patients the best possible experience. This is why the Trust is proud to be part of the NHS and proud to be Leicester's Hospitals.

## Appendix B: Hospital Web-based Handover System

The following account provides a high-level description of the architecture used to build the clinical forms system (also called hospital Web-based handover system).

### IMPLEMENTATION

The Clinical Forms System has been built using Microsoft products. The system was designed and built in-house by the Integration and Development Team (IDT), a sub team within UHL's IM&T department.

### DATABASE

The back end databases have been implemented using Microsoft SQL Server 2008 – Enterprise Edition. There are multiple databases that hold the data used by the Clinical Forms web application. The databases have an underlying architecture that is designed to promote high availability (the database is always online) and prevent the potential of data loss (by never being on a single hard drive).

### WEB APPLICATION

The Web application has been built using Microsoft's ASP.NET (.Net Framework 4.0) and is network load balanced (NLB) across four Web servers in what's known as a 'Web farm'. A user who connects to the application via an internet browser is connected to one of the servers in the farm. The NLB will distribute the number of connected users across the farm evenly. This prevents a high volume of users from connecting to single server, which could lead to slow system performance and potentially a system crash.

### PATIENT DATA – DATA FLOW

The patient data used throughout the system is a 'real-time' copy of the data held by the Patient Centre system. This means that if a patient entry is created/updated/deleted on Patient Centre, the Clinical Forms system will be made aware of those changes almost instantly.

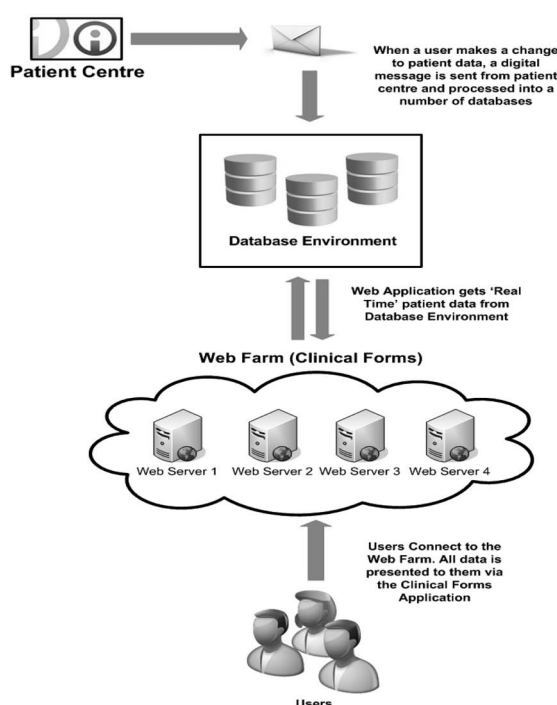
There are a number of steps that are taken to integrate the data from Patient Centre with that on Clinical Forms.

When a change is made on Patient Centre a 'message' is sent out from the system, which contains all the details related to that change.

The integration team uses the details within that message and processes the information into multiple SQL server databases.

The application connects to the database over ADO.NET (a database connection protocol) and presents the user with the data on screen via Internet Explorer.

Figure 14: Diagram illustrating how users see real-time data from Patient Centre



## Appendix C: Nervecentre overview

Nervecentre Software is a pioneer in the development of mobile software for improving communications, patient safety and governance in acute hospitals. Founded in 2010, Nervecentre's flagship Mobile Healthcare Workflow platform is used by some of the largest hospitals in the UK, including University Hospitals Leicester and Nottingham University Hospitals NHS Trust.

Nervecentre's Mobile Healthcare Workflow Platform uses strong presence-enabled Task Management capabilities to provide hospital-wide improvements in patient safety, treatment quality and efficiency, and patient flow. Mobile applications simplify day-to-day communications for clinicians and provide critical patient information at their fingertips, while providing comprehensive governance and visibility, allowing staff availability to be aligned with the dynamically shifting priorities of the hospital.

Nervecentre's mobile technology is closely integrated with Cisco's wireless networking, which is essential in enabling clinicians to access the Nervecentre application seamlessly, hospital-wide. Cisco's wireless network provides location and presence information to Nervecentre, supporting context-aware workflow decisions.

Nervecentre's integrated portfolio of capabilities covers the five key areas of task management, mobile handover, electronic observations, clinical assessments, and communication.

### TASK MANAGEMENT

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Nervecentre Task Management allows alerts, tasks and escalations to be allocated to the most appropriate clinician following a set of configurable business rules, to ensure that activities are performed according to Trust policy and priority.

Replacing the bleep as the main tool for communication with a mobile device, Trusts can employ Task Management in a range of hospital processes to remove delays normally associated with communication of information.

Tasks can be created by hospital staff by completing forms, or from a range of events including HL7 messages, nurse call systems and mobile devices.

Typical teams and processes that can use Task Management include:

- Hospital at Night
- escalation of triggering patients
- specialist referrals
- therapists
- test results
- portering and logistics
- Nurse Call.

Mobile Task Management reduces internal delays, enables accountability, and provides governance for staff communication and activity.

### MOBILE HANDOVER

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Traditional handover solutions focus upon the electronic documentation of real-time information to ensure a thorough handover of patients and tasks at shift-change.

Nervecentre's Mobile Handover encourages an evolution towards continuous care, where information and tasks are captured when they occur, such as during a ward round, and are up to date 24 hours a day.

This allows clinical staff across the hospital to have continuous and instant access to the latest information on a patient, right at their fingertips.

Nervecentre Electronic Handover provides a fully mobile-enabled handover solution that has the flexibility to meet the handover requirements of surgical, medical and nursing teams, allowing information to be shared between teams.

Electronic Handover improves patient safety during the critical handover period while reducing the administrative burden of entering data.



## ELECTRONIC OBSERVATIONS

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Nervecentre Patient Observations enables consistent, regular observations; accurate Early Warning Score calculations; and governed escalation according to Trust policies. The Trust can then reliably and consistently identify and promptly treat deteriorating patients, reducing intensive care admissions and mortality rates.

Recent studies indicate that up to 25% of Patient Observations are not carried out, are miscalculated, or are not escalated according to hospital policies. Without regular observations, sick patients will deteriorate, resulting in extended lengths of stay, negative outcomes and increased mortality. Proper governance of the observations process is critical to improving patient care but requires a move away from paper-based processes.

Nervecentre manages the entire workflow from ensuring that observations are recorded at the required frequency to ensuring that a doctor is informed and responds in a timely manner, all without the nurse leaving the patient's bedside.

## CLINICAL ASSESSMENTS

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At a time when Trusts are driving towards a paperless NHS, the number of clinical assessments required and the need for governance of these assessments is increasing, often driven by CQUIN payments.

Nervecentre supports a range of built-in assessments including:

- VTE
- dementia
- MUST
- falls
- MRSA.

Nervecentre's unique toolkit approach allow Trusts to customise assessments to meet local processes, and to create their own assessments as needs arise, without incurring extra software licence costs.

Clinical Assessments integrates tightly with other Nervecentre capabilities including Smart Lists and Electronic Handover to manage and provide visibility of the entire assessment workflow.

## COMMUNICATION

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Bleep pagers have provided the core communication tool in NHS hospitals for 30 years. This ageing technology is coming towards the end of its useful life, as mobile technologies and Wi-Fi become commonplace and paging systems become harder to maintain.

Nervecentre provides a comprehensive set of communication capabilities allowing mobile smartphones to replace bleep pagers, increasing the quality, speed and governance of hospital communications.

Nervecentre's communications capabilities include Bleep Replacement, Instant Messaging, Audio Paging and Tannoy.



## Appendix D: Cisco overview

### CORPORATE OVERVIEW

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Cisco Systems, Inc. is the worldwide leader in networking for the internet. Today, networks are an essential part of business, healthcare, education, government and home communications, and Cisco's solutions are the foundation of these networks.

Cisco hardware, software, and service offerings are used to create internet solutions that allow individuals, organisations and countries to increase productivity, improve client satisfaction and strengthen competitive advantage. The Cisco name has become synonymous with the internet, as well as with the productivity improvements that Internet business solutions provide. Cisco's vision is to change the way people work, live, play and learn.

Founded in 1984, Cisco now has over 300 offices in 140 countries, and employs over 70,000 people.

Our commitment to innovation and research and development is a core component of its corporate culture. Cisco spends nearly \$5.3 bn a year in R&D, making it one of the top R&D spenders in the world.

Information on Cisco (NASDAQ: CSCO) can be found at <http://www.cisco.com>.

For current news, please go to <http://newsroom.cisco.com>.

### CISCO AT UNIVERSITY HOSPITALS LEICESTER

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To help the reader of this report, there follows a brief overview of the benefits of the Cisco network as deployed in UHL, and its use in supporting the day-to-day work of a major teaching hospital.

In order to ensure that technology can effectively address the needs of modern health care provision, Cisco recommends the adoption of an architectural approach to IT system design and operation. There are a number of such architectures in use across the European Union and beyond, each designed to ensure the strategic linkage of business to technology. Cisco has published a number of detailed documents describing the approach, including a detailed description of the Network Architecture Blueprint for the NHS, known as C-NAB. Full information about the Cisco architecture approach for the NHS can be found at:

[http://www.cisco.com/cisco/web/UK/public\\_sector/health\\_care/index.html](http://www.cisco.com/cisco/web/UK/public_sector/health_care/index.html)

### CONVERGED IP NETWORKS

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The internet is the largest IP network. Every day, users exploit the internet to access websites, video information for business, research or entertainment, to interact with friends, family and colleagues using messaging, or audio and video telephony. New applications and providers emerge constantly. The internet acts as a conduit for business and consumer services into homes, businesses and public sector bodies.

UHL use their network in the same way, as the single conduit for all business and clinical services; its IP network is critical infrastructure, essential for service provision.

Applications, such as Nervecentre currently used by UHL can be virtual (cloud based), national, regional or local in nature, and can be accessed from a clinical modality, PACS viewing station, desktop PC, laptop, tablet, or smart phone, with processing done locally (fat client) or virtualised (thin client). Local ICT considerations include how the applications perform, are prioritised, and are secured; the protection of person identifiable data is paramount. The C-NAB approach provides an environment that is available (no single point of failure), scalable and secure, allowing interactions between all users and systems to occur seamlessly.

### MOBILITY SOLUTIONS

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Mobile working is increasingly important at UHL and has been shown to be a key feature of their re-development of the handover procedure as reported in this study.

Mobility solutions provide a key to improved productivity and effectiveness for hospital and community-based staff. They also enable solutions that help identification and use of key resources. Mobility solutions are very widely deployed and early concerns around safety and security have been addressed – partly by regulatory compliance. Today wireless is robust and fast, and is secured to transport person-identifiable data. It also provides the base for bedside or mobile computing in hospitals so that patient information can be available directly at the point of need.

In summary - wireless networking is an enabler for location-independent working, supporting key initiatives such as the handover system described in this report.

## INFORMATION AND SERVICE ASSURANCE

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Hospital ICT infrastructure and services are designed and deployed so that they can offer the highest levels of reliability and availability, and provide assurance for sensitive patient information. In the past ICT services in healthcare were not designed with end to end security in mind. ICT security provision was usually limited to perimeter protection via firewall devices or similar. NUH has implemented a 'self-defending network' with pro-active security provision along the end-to-end path between user and data centre. Some of the principal concerns addressed are:

- governance – particularly that for handling patient information in the new, collaborative environment
- person identifiable data – ensuring the integrity of such data particularly in those applications without inherent encryption capability
- data loss prevention – ie prevention of loss due to accidental loss/theft of assets, the misuse of removable storage devices, malicious hacking of systems, and human error.

Key areas for security provision are at the client device, at the network edge, in the core of the network and within the data centre. In each of these areas there have been major technological advances – such as non-signature based threat detection at the desktop, admission control at the network edge and virtualised services offering very fine granular control within the data centre.

A full C-NAB based network can address many more issues than those highlighted above – including video solutions to support remote and multi-site collaboration, data centres to support secure and robust data accessibility anytime and anywhere, and intelligent building technology to support physical infrastructure use optimisation. This overview highlights only those elements pertinent to the re-development of the handover system as described in the study.

Full details about Cisco's health care offerings are available at: <http://www.cisco.com/uk/healthcare>

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