



**Collaboration and communication
technology at the heart of
good clinical governance**



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I welcome this report, which offers timely additional evidence of the central role of Information and Communication Technologies in driving patient safety, efficiency and staff satisfaction in one of the biggest hospitals in Europe. The report provides a persuasive account of the wide-ranging impact of a new approach to handling requests for clinical support outside core working hours.

The report follows the continued work of Nottingham University Hospitals NHS Trust in using networked communication and collaboration technology to re-engineer the day-to-day working processes of its clinical teams. The report sets out in detail how the Trust managed to address not only more efficient care, but also created an environment more conducive to high quality and safe patient care, in which both clinical and support staff were able to make better use of their time and benefit from greater support from senior colleagues.

The striking benefit of the new approach is more time for care and less paperwork! The processing of out-of-hours requests has transformed a highly administrative desk based role performed by experienced nurses into a mobile role in which nurses can support administrative functions while still being actively involved in hands-on patient care. By reducing a complex six step procedure for requesting clinical support to a streamlined three step mobile procedure, more than 60% of shift time has been released back into clinical care. This has led to a safer working environment, in which patients receive more timely care and has also raised staff satisfaction.

I am sure this report, which is the fourth in a series conducted by the ACCA in association with the European Commission's services, will become a valuable reference point. It bears testimony to the fact that eHealth technology is being successfully integrated into day-to-day care and shows its potential to bring benefits to patients, healthcare systems and the economy.

Robert Madelin
Director General for Information Society
European Commission



As a fervent advocate of the long term vision for eHealth in Europe, I am delighted to contribute to the flagship initiative on the *Digital Agenda for Europe* applied to health and the 'eHealth governance initiative' by endorsing this latest study from ACCA and published in collaboration with the European Commission.

The study complements the previous report, published in 2010, on the use of collaboration technology in an emergency department. It describes the application of ICT to support improved delivery of clinical services outside core working hours at Nottingham University Hospitals NHS Trust, one of the largest and busiest hospitals in Europe.

Using the methodology of the Model for Assessment of Telemedicine (MAST) developed by the EU project Methotelemed, the study assesses the benefits delivered by Nervecentre; a tool designed to address process delays caused by poor communication and poor clinical governance. In addition, the new system provides hospital managers with real time performance management data to support innovative process redesign.

The new system successfully bridges the communication gaps that had been plaguing the Hospital at Night (H@N) team. It allows the H@N co-ordinator, a senior experienced nurse, to fully manage service delivery whilst being actively engaged in hands-on clinical care. As a result it has put an additional 8,000 hours back into direct patient care.

The results are impressive: the study shows that following the introduction of the system, patient safety and comfort levels have significantly improved from better handover procedures and the ability to escalate and prioritise care.

In this time of difficult economic conditions, the sustainability of the system is furthermore highlighted by the cost saving benefits identified in the study that were delivered through the better utilisation of resources. The estimated return on investment of the new system is very promising – at less than four months.

As the European Commission services are preparing the second eHealth action plan, mirroring the roadmap set in Europe 2020, the Digital Agenda for Europe and the Innovation Union, I strongly believe that this report will increase awareness of the benefits and opportunities of eHealth in the best interest of patients, healthcare systems and society as a whole. I am convinced that this will contribute to the dissemination of best practices and allow other hospitals to learn from this very valuable experience.

In this vein, I call on the European Commission and the member states to continue the work towards removing the barriers which prevent the large scale deployment of eHealth solutions such as the one presented in ACCA's study.

Dr Antonia Parvanova MEP
Committee on the Environment,
Public Health and Food Safety



As deputy chief executive and director of nursing at Nottingham University Hospitals NHS Trust (NUH) I have a keen interest in the operational performance of the service we deliver.

Striving for excellence in healthcare delivery can be broken into a few key strands: focus on patient outcomes, staff training and motivation, a correctly resourced environment, value for money and improving productivity. I have watched

with considerable interest as technological solutions have emerged which aim to address some or all of these areas, but I have learned that for applications to truly succeed they must provide indisputable benefits, while being straightforward to use.

This is why I have enjoyed seeing our staff using the new solutions described by the ACCA both in this study and in the previous study at NUH (<http://www.accaglobal.com/documents/CCT.pdf>) which focused on our emergency department, and I would like to formally acknowledge and thank the ACCA for their diligent and extensive work in preparing both reports.

In essence, what the new technology at NUH has achieved is improved communication. It is now simpler for our staff to request help or assistance from others. When laboratory or other results are available, the people who need to know get to know. Our reliance on paper is reducing, which is improving clinical governance, and we can clearly see that we are becoming more efficient. At the same time, the interactions between staff are becoming richer, and the ethos of teamwork within departments and teams is very obviously improving.

Technology has not solved problems, but it has meant that we can simplify and streamline our processes. While the new ways of working implemented in NUH are predominantly change programmes, with significant input from many areas of the organisation, it has been extremely gratifying to see the way that our ICT team has become fully integrated into the various projects. NUH now expects ICT to contribute in the earliest discussions when we consider redesigning our services, and the team can often provide valuable leadership in the process.

Of course, all of this is pointless unless the outcomes for our patients are improved. In the report you will read about specific pre-implementation cases where our new systems would have prevented serious untoward incidents from occurring. You will see that waiting times for care are reduced, and that effective prioritisation decisions can now be made. You will understand how the most qualified individuals can be contacted to provide timely advice in critical circumstances, and how we have been able to return highly qualified clinical staff from the back office to patient care. Most importantly you will understand why I believe the quality of care offered at NUH has been positively affected by the changes.

Jenny Leggott
Deputy Chief Executive and Director of Nursing,
Nottingham University Hospitals NHS Trust

Following on from the highly successful and widely cited study undertaken by the Association of Chartered Certified Accountants (ACCA) on Nottingham University Hospitals NHS Trust's (NUH's) investment in wireless telephony and messaging in the Emergency Department in 2010, this study considers the impact of a further roll out of the technology to the Hospital at Night (H@N) service.

The story begins in 2006, when NUH, one of the busiest acute hospitals in England, introduced the H@N concept on both its City Hospital Campus and Queen's Medical Centre Campus. This concept, adopted by many of the hospitals in England, aims to reduce the number of hours worked by junior doctors while having no negative impact on their training and without compromising the clinical quality or safety of patient care.

NUH recruited a number of H@N co-ordinators, all experienced nurses, to run the H@N service which, at City Hospital Campus (the main focus of this report), is also staffed by a registrar, four junior doctors and two clinical support workers. This relatively small team is responsible for providing the full spectrum of clinical care for all acutely ill patients across the 37 hectare campus outside core working hours.

After its introduction, concerns were expressed about the outdated pager and landline method of communication being used by the team. There were fears that the system was introducing unnecessary delays that threatened the quality and safety of clinical care. Other issues included potential breaches of patient confidentiality, poor medical record keeping, disengagement of senior clinicians and the deskilling of H@N co-ordinators: experienced nurses who now spent most of their time behind a desk answering telephone calls.

NUH organised an internal review of the H@N service and this recommended a number of operational changes. It also heavily criticised the computerised log sheet that underpinned the delivery of the H@N service, describing it as a generator of inaccurate information and as being unfit for purpose. The report concluded that investment in an intelligent H@N ICT system was essential.

Armed with a detailed requirements specification and after much searching, NUH chose Nervecentre as the solution to its H@N problems. Nervecentre is a tool designed to address:

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

These were the three key issues hampering the delivery of a safe and effective H@N service at NUH.

In full consultation with staff, the new system was tailored to meet NUH's requirements and within six months was fully operational across both hospital campuses. The system enables the H@N co-ordinator to remain in full contact with all members of the H@N team through a tablet device (Cius) which provides secure, mobile collaboration and computing capabilities. Using the Cius tablet, the H@N co-ordinator can instantly identify which patients are waiting to be seen, the status of all outstanding tasks and the workloads of each member of the team. The Cius tablet has successfully put the H@N co-ordinator back in charge of the H@N service and has given them the freedom to leave their desks and get back on the wards, providing clinical support where it is needed most.

This has helped NUH address its problem in recruiting H@N co-ordinators. While previously nurses had been reluctant to take on a desk-based job, the new mobile system has meant that NUH has reduced its persistent vacancies for H@N co-ordinators from four full time equivalents (FTEs) to none.

The new system has provided NUH with the tools to pioneer change in the delivery of its H@N services. Although at the time of writing the system has been in place for only a matter of months, significant benefits are already evident, including:

- patient safety has been enhanced by the introduction of tools to support the prioritisation of care for acutely sick patients and by improved handover procedures
- staff satisfaction has increased due to improved communication across the team
- digital information processing has greatly enhanced both information and clinical governance.

It is clear also that NUH will reap significant financial benefits from the new system through:

- better utilisation of resources including the identification of real cash releasing savings of €¹133,000 per annum and the reinvestment of €412,000 (equivalent to 8,000 hours) of additional clinical support into patient care
- a reduction in patient lengths of stay in hospital
- a forecast return on investment in less than four months.

This report explores in further detail the benefits outlined above and the considerable impact the new technology is having on the delivery of H@N services at NUH.

¹£1 = €1.373 Rate correct at 4 April 2011

This report continues the story, begun by ACCA in March 2010, of the impact that Nottingham University Hospitals NHS Trust's (NUH) investment in wireless telephony and messaging is having on the safer and more effective delivery of care to patients.

The study focuses on NUH's continued deployment of collaboration technology to provide a new core workflow management platform to support the delivery of out of hours care. Optimised for wireless as well as wired environments, this multi-faceted system aims to bridge the communication gaps obstructing the smooth workflow of the clinical team by allowing them to remain in full contact with one another - wherever they are working within the hospital. Other features within the system's capacity include the automatic allocation of clinical tasks according to pre-defined skill sets, a full and complete clinical audit trail on all out of hours activity and provision of real time data for performance management.

The implementation of the new system has enabled significant changes to be made to the operation and management of the out of hours service (Hospital at Night – H@N); this report assesses the difference that this has made to the safe and effective delivery of clinical care.

Study methodology

Many studies have been undertaken measuring the impact or benefits of eHealth and Information Communication Technology (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 assessment 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 assessment methods, such as Randomised Control Trials (RCT) for example, are not easily applied to the assessment of telemedicine as the very nature of the study generally makes it impossible to undertake a blind assessment of users².

In recognition of this difficulty the European Commission (EC) funded the development of the *Model for Assessment of Telemedicine* (MAST)³ to provide a structure for assessing the effectiveness of ICT in healthcare and to support decisions around the procurement process. MAST is an evidence-based tool for assessing ICT applications in healthcare. It was designed to assess the full scale 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. As such MAST takes a qualitative as well as quantitative approach.

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

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

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

Data sources

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 multi-disciplinary and multi-method data collection in eHealth studies proposed by Westbrook et al⁴, is drawn from a number of sources:

- one-to-one interviews with clinical and managerial staff
- independent ethnographic observation
- extraction from internal work logs (both manual and computer generated)
- hospital committee and Trust Board reports.

²Black AD, Car J, Pagliari C, Anandan C, Cresswell K, et al. (2011) **The Impact of eHealth on the Quality and Safety of Health Care: A Systematic Overview**. PLoS Med 8(1): e1000387. doi:10.1371/journal.pmed.

and Shcherbatykh I, Holbrook A, Thabane L, Dolovich L (2008) **Methodologic issues in health informatics trials: the complexities of complex interventions**. J Am Med Inform Assoc 15: 575–580.

³ www.telemed.no/methotelemed.

⁴Westbrook JI, et al **Evaluating the impact of information communication technologies on complex organizational systems: a multi-disciplinary, multi-method framework** (pp 1323 – 1327) in M. Fieschi et al. (Eds) (2004) MEDINFO 2004 IOS Press

The study

Introduction to the problem and proposed solution

The Hospital at Night (H@N) concept was developed by the Joint Consultants Committee (representing the British Medical Association and the Academy of Medical Royal Colleges) and the NHS Modernisation Agency. The aim was to reduce the long working hours of junior doctors with no negative impact on their training and without compromising the quality or safety of clinical patient care⁵.

The term H@N is something of a misnomer as the service actually covers every weekend, every public holiday and every week night from 17.00 – 09.00. In other words, H@N is responsible for providing full clinical care for a wide range of medical, surgical and other specialties for over 75% of hospital hours each and every week of the year.

All English National Health Service (NHS) hospitals have taken a slightly different approach to H@N but most have appointed a multi-disciplinary team of clinicians, nurses and clinical support workers (CSWs) who work in partnership to provide the full spectrum of clinical care outside core working hours.

Nottingham University Hospitals NHS Trust took the decision to introduce the H@N concept on both its Nottingham City Hospital Campus and its Queen's Medical Centre Campus in August 2006. The two hospital sites provide very different clinical services but managerially and operationally the H@N services are similar; therefore, for logistical purposes, we have chosen to focus this study mostly on the City Hospital Campus.

The H@N service is required to provide full clinical care for acutely ill patients in all 39 hospital wards at City Hospital Campus including the Emergency Admissions Unit (EAU). The H@N team comprises a H@N co-ordinator, a registrar, four junior doctors and two CSWs. In addition to the on-site H@N team there are also 10 different on-call teams, each comprising a registrar and clinical consultant; these staff are based at home but may be called into hospital at any time if the H@N team decide more senior input or advice is required.

The H@N co-ordinator, a senior nurse, has overall responsibility for the operation of the H@N service. The doctors undertake all the tasks listed on Table 1 with the exception of taking blood, placing intravenous cannulae and electrocardiogram (ECG) recording; these three tasks are generally allocated to the CSWs.

Table 1 – H@N classification of clinical conditions by priority

Clinical condition	Priority
Critically ill/Immediate response	Red
Early warning score >4	Red
Clinical review/management	Red
Urgent admission	Red
Chest pain	Red
Fall where patient has suffered major injury or had change in Glasgow Coma Scale (drop of 2)	Red
Neutropenic sepsis	Red
Acutely unwell/Urgent response	Red
Cardiac arrest	Red
Sudden onset of breathlessness	Red
Post operative bleeding	Amber
Wound dehiscence	Amber
Confused	Amber
Clinical review/management	Amber
Drug administration	Amber

5. See **Hospital at Night 2008 Assessment** published by NHS National Workforce Projects accessed on 28 March 2011 at http://www.healthcareworkforce.nhs.uk/working_time_directive/hospital_at_night/hospital_at_night_2008_uk_implementation_survey_report.html

Clinical condition	Priority
ECG interpretation	Amber
Abnormal blood results	Green
Clerking	Green
Certification of expected/unexpected death	Green
Drug prescribing	Green
Microbiology	Green
Cannulation	Green
Catheterisation	Green
Venepuncture	Green
X ray review	Green
IV fluids prescribing	Green
Discharge	Green
Assessment post fall	Green
ECG recording	Green
Liaison with other services	Green
Advice to nursing/junior staff	Green
Blood results interpretation	Green
Clinical review/management	Green
Discussion with relatives	Green

The H@N system prior to introduction of collaboration technology

Each H@N shift would commence with a clinical handover giving staff the opportunity to exchange information about acutely ill patients. The H@N co-ordinator would then hand each doctor and CSW their initial paper-based task list detailing the patients they needed to see, the medical condition of the patient and the treatment required. These patients either would have been notified to the H@N co-ordinator in advance electronically via the Nottingham Information System (NotIS) or would be patients still waiting to be seen from the previous shift.

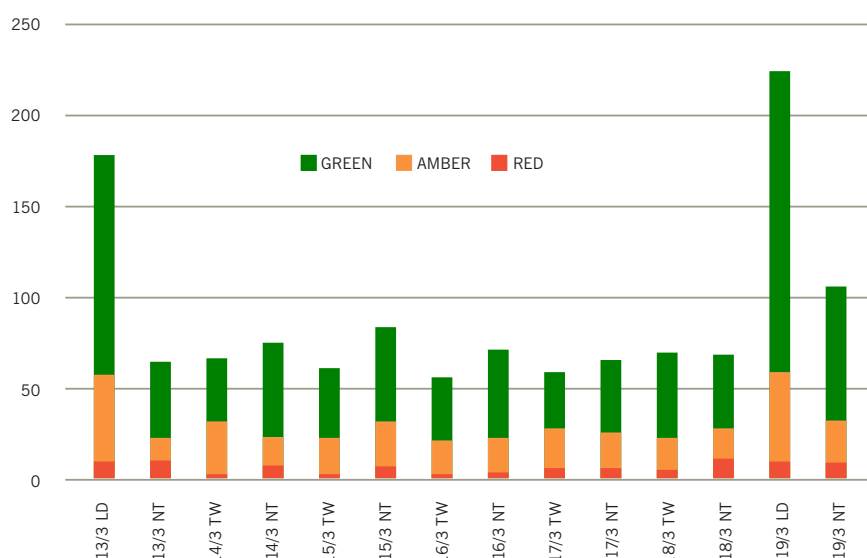
Once the doctors were dispatched to the wards the H@N co-ordinator would take on a liaison role, passing information between ward staff, doctors and CSWs as necessary. Neither the doctors nor the H@N co-ordinator were aware of the geographical location of any other members of the H@N team so, after handover, all communication was through pagers or landline telephones.

If ward nursing staff become seriously concerned about the well-being of a particular patient then they would page the H@N co-ordinator's office. The H@N co-ordinator would respond to each page request in turn by using a landline telephone to speak to the ward staff, to assess the problem and to action the appropriate response. Details of the call and the action taken would then be recorded by the H@N co-ordinator on an open text computerised log sheet.

The action taken by the H@N co-ordinator was determined by the severity of the patient's condition. Approximately 8% of calls received out of hours are classified as red calls; these patients need to be seen by clinical staff within 10 minutes. Around 25% of calls are classified as amber calls; these patients need to be seen within one to two hours. The remaining calls are requests for routine support and are classified as green. (Figure 1)

Note: Crash calls, those relating to life threatening emergencies including cardiac arrest, respiratory arrest or significant deterioration of a patient, are not managed by the paging system described anywhere within this report. The hospital has always had completely separate procedures in place to ensure that these are quickly and effectively addressed.

Figure 1 – Numbers and classifications of calls received out of hours w/c 13 March 2011



'The system required you to be on the computer all the time. I didn't like that. I'm not a computer person; I'm a hands-on clinical person.'
Claire Welsh, H@N co-ordinator, NUH

Legend: shift hours

LD: Long day (weekend)
 (09.00–21.00)

NT: Night (22.00–09.00)

TW: Twilight (17.00–22.00)

For red calls the H@N co-ordinator would immediately page one of the doctors. Unless the doctor was treating an extremely ill patient, the doctor would stop whatever they were doing, locate a landline phone, call the H@N co-ordinator, write down the patient details (name, ward, medical issue) on a sheet of paper and then, depending on the nature of the call, either return to the patient they had been treating or go to treat the newly notified, more acutely ill patient.

Less urgent calls were passed onto the doctors and CSWs in batches. The H@N co-ordinator would wait to page the doctors or CSWs until perhaps 10 tasks had been requested. The doctors and CSWs would then locate a landline phone, call the H@N co-ordinator and jot down the details of the new tasks on their paper based work sheet (see Figure 4, p23).

Once the task had been assigned to a doctor or CSW then, from the H@N co-ordinator's point of view, it was assumed to have been completed; ownership of the task had successfully been passed on to someone else.

Problems in the old system

Although initially the H@N service appeared to work well, as time went on it soon became clear that there were a number of relatively serious flaws in the system that had to be urgently addressed.

First, NUH had difficulty recruiting a sufficient number of suitably qualified senior nurses to run the H@N service. Across both sites, 14 experienced nurses were required to take on what was effectively an administrative or call centre role of answering the phone, logging tasks then passing messages between wards, doctors and CSWs. It was a role with very little appeal to a skilled nurse. This recruitment issue was a major problem; the safe and effective operation of the H@N service was dependent on it being managed by a nursing team possessing a wide range of clinical skills.

Secondly, the process being used to notify the H@N team of acutely sick patients had the potential to compromise the safe and effective care of patients. When a patient became acutely ill, the ward staff would page the H@N co-ordinator. Some page requests would naturally be more urgent than others but, with no way of prioritising the calls, the H@N co-ordinator could only respond to each call in turn by phoning the ward, assessing the problem and then taking the appropriate action. This meant that some patients, those who needed to be seen very urgently, might have to wait longer than they should for treatment.

At busy times, such as after handover, this risk was heightened. The H@N co-ordinator might receive 15 or more page calls at the same time but the pagers only had the capacity to store a maximum of 10 numbers – so some of these calls would get automatically deleted. Ward staff could then waste considerable time waiting by a telephone for the H@N co-ordinator to call them back about a page call that the system had effectively deleted.

A major concern for ward staff was that they never knew how long their patients would need to wait before being seen by a doctor or CSW. As a result, they often telephoned the H@N co-ordinator more than once to check if and when a doctor or CSW would arrive. The H@N co-ordinators, however, could only confirm whether or not someone had been asked to see a particular patient. The City Hospital Campus covers over 37 hectares and they had no way of locating members of the H@N team or checking what they were doing without first paging them and then waiting for them to phone back.

When a doctor did arrive on the ward the nursing staff would often ask them to see a number of additional patients, not just the one that the H@N co-ordinator had allocated to them. Some of these patients would have already been notified to the H@N co-ordinator and perhaps already assigned to another doctor. Others were patients about whom the ward staff just wanted advice. Each ward was staffed by two qualified but relatively junior nurses and, with no senior nursing support available, they often felt isolated and in need of added reassurance. (This is considered an acceptable staffing level on such wards.) The doctors generally found it difficult to refuse to see these patients, thereby significantly increasing their workload. This also meant, of course, that the doctors sometimes arrived to see a patient only to discover that they had already been seen by another doctor.

In summary, with such a poor communication system, it is not surprising that the H@N co-ordinators found it such a challenge to manage the H@N team. They did not know where the team members were and they did not know the extent of their workload. They did not even know which tasks had been completed and which were still outstanding.

There were numerous other concerns relating to the H@N service including:

- risks in relation to patient confidentiality
- reporting of clinical incidents
- disagreements between ward staff and H@N co-ordinators on the details reported in respect of some patients
- deskilling of the H@N co-ordinators
- noise levels on wards
- the non-availability of data for workforce planning purposes
- evidencing the training experiences of junior doctors.

Therefore, although the H@N service had been successful in its aim of reducing the working hours of junior doctors, NUH could not say with confidence that there had been no negative impact on either the quality and safety of clinical care or the training of doctors.

As a result, there was widespread dissatisfaction with the H@N service – from ward staff, clinicians, H@N co-ordinators and management – but finding a solution was not an easy task.

Addressing the problems

NUH commissioned a review⁶ of H@N in spring 2009. This described numerous problems with the service and recommended that NUH put in place a formal project management programme to address all of the clinical and non-clinical issues identified.

A second review⁷ was undertaken in spring 2010 which reiterated many of the points made in the 2009 report. Following on from these studies, in July 2010, NUH appointed an Assistant General Manager to take responsibility for the future delivery of H@N services. The person selected had previously been employed as a ward manager in the hospital so, having been a user of the H@N service, had first hand knowledge and experience of its many problems.

'H@N comprises a mixture of doctors, nurses and support workers. It has to cover a wide geographical area and has to be flexible. Tasks covered range from the simple, rewriting a drug chart, to the complicated, organising a brain scan for a critically unwell unconscious adult at 4am; this needs the coordination of a registrar, nurse, anaesthetist, radiographer and radiologist. Our system did not accurately capture the breadth and depth of the complexities involved, making workforce planning almost impossible.'

Dominick Shaw, associate professor and medical lead H@N, City Hospital, NUH

6. Teahon K, *Medical Out of Hours Service City Campus, Report on a Study from May 2009* (Internal report)

7. Wallace S, McKinnin S, Guy D, *External Review of Hospital at Night, February/ March 2010* (Internal report)

Having appointed a manager to lead the change process, one of the next steps was to address the ICT issues. The review of H@N undertaken in spring 2009 had heavily criticised the computerised log sheet that was used to manage the service, describing it as cumbersome to use, as a generator of inaccurate information and as being generally unfit for purpose. One of the main conclusions of the report was that investment in an intelligent ICT system to support the H@N service was essential.

This system would need to be sufficiently flexible to work across both City Hospital Campus and QMC Campus as, although the hospitals employ different models of care, the junior doctors and other members of the H@N team rotate across both sites so would need to be confident in its operation.

The purchase of an off-the shelf package to manage out of hours clinical services had been approved by the Trust Board previously, as part of a business case for ward management. After four years of searching, however, NUH had come to the conclusion that no suitable package existed.

At around the same time as the ward management business case was approved Cisco was asked to evaluate the NUH network. As a result of this evaluation, NUH agreed to invest €8.238 in a medical grade, industry standard communications network across both sites. This network is the platform that supports all applications used at NUH, one of which is Nervecentre.

After issuing a detailed requirement specification, NUH selected Nervecentre as the H@N application. Nervecentre leveraged the investment NUH had made in the medical grade network, and provided a strategic platform that could not only meet the H@N requirement but could also support workforce and workflow improvement in many other areas of the hospital.

Nervecentre is a tool designed to address:

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

These were three of the key issues that NUH faced with its H@N service. The functionality of the system offered solutions to most of the problems challenging the H@N team. A number of meetings were held with Nervecentre staff, clinicians, hospital managers and ICT staff to discuss the opportunities offered by Nervecentre and it was agreed to trial the system during 2011.

Work then began on tailoring the solution to NUH's requirements. Bespoke data input forms were developed in September 2010 with testing and user training commencing one month later. Considerable attention was paid to the H@N user interface. The forms display clear and concise menus to eliminate the risk of transcription errors and to ensure that raising a request for clinical support is both quick and easy. A free text box is also included to allow additional data to be added if required.

The new system enables the H@N co-ordinator to remain in full contact with the H@N team through a tablet device (Cius) designed specifically for business use which provides secure, mobile collaboration and computing capabilities. These tablets, weighing just 0.52kg (1.15lb) and measuring only 225mm x 140mm x 15 mm (8.85 in. x 5.5 in. x 0.59 in) are easily transportable in the H@N co-ordinator's uniform pocket. Doctors and CSWs are contactable through handheld phones and ward staff through desk top PCs.

End users were involved at every stage of the deployment process. Implementation was broken down into stages to ensure that staff were comfortable with each step of the change process. The H@N coordinators were first to adopt the system, then the ward staff and finally the doctors and CSWs. This iterative approach was important to ensure a safe and effective roll out and it also helped ensure that staff satisfaction remained a focal point of the project.

'It has been a fantastic opportunity to be part of the ICT technical delivery team working collaboratively with the H@N team, who have embraced all of the latest technologies ICT have been deploying as part of the NUH Medical Grade Network. Clinicians have shaped the Nervecentre application to meet all their needs rather than using an off the shelf product that only satisfies part of their requirements. This project has been led throughout by clinicians with ICT working as an enabler to help them deliver service improvement that can be measured and quantified. I am proud that the technologies designed and deployed have been the key enabler of this success.'

Lee Willerton, technical design consultant ICT, NUH

Training requirements have been minimal, using a 'train the trainer' approach which has proved very successful.

Within just six months of NUH agreeing to trial Nervecentre, by March 2011, the system was providing a complete management service for all non-emergency H@N tasks at City Hospital Campus and plans were on track for QMC Campus to be fully operational by June 2011.

The remainder of this report describes the impact that the new system has had on the H@N service and considers some of the ways its use may be extended in the future.

Organisational aspects

Changing the H@N co-ordinator role

When H@N was set up at NUH, the position of H@N co-ordinator was established specifically to provide clinical support to the registrar, junior doctors and ward staff. However, with, on average, 300 phone calls to make, 180 calls to log and three hand-over sessions to manage each night, it was actually very much a desk bound job. It was also often very stressful. The study undertaken in May 2009 estimated that, at peak times, H@N co-ordinators had less than two and a half minutes to answer, prioritise and allocate calls.

This caused severe recruitment difficulties for NUH; senior nurses want to use their clinical skills in direct patient care, not telephone triage.

Much of the new system's success is that it has put the H@N co-ordinator, a senior, experienced health professional, back on the ward. Instead of being in an office, responding to page calls, answering phones and keying in data, the H@N co-ordinator is now able to work out on the wards, providing clinical support as and where it is required.

The H@N co-ordinator is now able to manage the H@N service remotely using a Cius tablet. All job requests are listed on the tablet, enabling the H@N co-ordinator to monitor and allocate tasks from anywhere within the hospital; it also allows them to escalate the priority of a task if clinically necessary. The skill set of each doctor and CSW is held within the system and this helps the H@N co-ordinator to allocate each task to the most appropriate person.

This innovative pattern of working has significantly eased recruitment difficulties and the number of H@N co-ordinator vacancies within the H@N team has now reduced from four FTEs to none.

Prior to implementation of the new system H@N co-ordinators would rarely have the opportunity to go out on the wards. Occasionally, if it was very quiet, they might leave the office in the early hours of the morning, but generally they were far too busy dealing with calls to even leave their desk. In the w/c 14 March 2010, for example, the H@N co-ordinator was not able to leave the office once. (Table 2, overleaf)

Just one year later, with the new system now operational, the role of the H@N co-ordinator has been totally transformed. In the w/c 13 March 2011, for example, the H@N co-ordinators spent, on average, 60% of their shift providing direct clinical care on the wards. Using the Cius tablets they were able to quickly and easily allocate tasks, manage the doctors' and CSWs' workloads, monitor and, if necessary, reprioritise outstanding tasks as well as make instant contact with any member of the H@N team from anywhere within the hospital. (Tables 3 and 4, overleaf)

The new system has given the H@N co-ordinators the freedom to escape the office, a change that they have fully embraced. Being experienced senior nurses they are now able to make full use of their clinical skills and this has effectively increased clinical capacity within the team. A number of tasks previously allocated to the junior doctors are now handled by the H@N co-ordinator, reducing the time acutely sick patients are kept waiting for medical care. (Figure 3, see page 18)

'The senior nurse had turned into a receptionist; chained to a desk.'

Dominick Shaw, associate professor and medical lead H@N, City Hospital, NUH

It also means that they can provide support, advice and assistance to ward staff wherever it is needed. This is important. The qualified but relatively junior nurses left in charge of each ward at night tend to require extra reassurance and will often phone to request support for fairly minor queries which a more experienced nurse would have been able to handle directly. A key benefit for ward staff of the new system, therefore, is having the H@N co-ordinator 'on call'.

Table 2- Log of time spent on clinical tasks by the H@N co-ordinator on City Hospital Campus before implementation of the new system (w/c 14 March 2010)

Date	Shift	Total shift time (hours)	Office based work		Ward based work
			Time spent logging calls on phone (hrs-mins)	Time spent giving clinical advice over the phone (mins)	Time spent providing direct clinical care (mins)
14/3/10	Weekend day	12	11-50	10	0
14/3/10	Night	11	10-40	20	0
15/3/10	Twilight	5	4-55	5	0
15/3/10	Night	11	10-25	35	0
16/3/10	Twilight	5	4-55	5	0
16/3/10	Night	11	10-10	50	0
17/3/10	Twilight	5	4-50	10	0
17/3/10	Night	11	10-55	5	0
18/3/10	Twilight	5	4-45	15	0
18/3/10	Night	11	10-40	20	0
19/3/10	Twilight	5	4-40	20	0
19/3/10	Night	11	10-55	5	0
20/3/10	Weekend Day	12	12-0	0	0
20/3/10	Night	11	10-55	5	0
Total for week		126	122-35	3-25	0

Table 3 - Log of time spent on clinical tasks by the H@N co-ordinator on City Hospital Campus after implementation of the new system (w/c 13 March 2011)

Date	Shift	Total shift time (hrs)	Office based work		Ward based work
			Time spent logging calls on phone (hrs-mins)	Time spent giving clinical advice over the phone (mins)	Time spent providing direct clinical care (hrs-mins)
13/3/11	Weekend day	12	3-15	0	8-45
13/3/11	Night	11	4-20	10	6-30
14/3/11	Twilight	5	3-0	0	2-0
14/3/11	Night	11	0-35	0	10-25
15/3/11	Twilight	5	2-40	0	2-20
15/3/11	Night	11	1-50	10	9-0
16/3/11	Twilight	5	2-0	0	3-0
16/3/11	Night	11	5-0	0	6-0
17/3/11	Twilight	5	3-0	10	1-50
17/3/11	Night	11	7-50	10	3-0
18/3/11	Twilight	5	3-10	0	1-50
18/3/11	Night	11	5-0	0	6-0
19/3/11	Weekend Day	12	3-10	5	8-45
19/3/11	Night	11	4-25	5	6-30
Total for week		126	49-15	0-50	75-55

'It has given me my job back.'
*Tony Drakeford, H@N
 co-ordinator, NUH*

Legend: shift hours

Weekend day: 09.00 – 21.00

Night: 22.00 – 09.00

Twilight: 17.00 – 22.00

Table 4 – Comparison of time spent on clinical tasks by the H@N co-ordinator on City Hospital Campus for one week before and after implementation of the new system

	w/c 14 March 2010		w/c 13 March 2011	
	Hours	%	Hours	%
Total H@N hours per week	126	100	126	100
Time spent in the office logging calls	123	98	49	39
Time spent in the office giving clinical advice	3	2	1	1
Time spent on the wards providing direct clinical care	0	0	76	60

Improving clinical task governance and work-load management

The task of recording requests for clinical support now rests directly with the ward staff. Previously wards would often store tasks up and then phone them through to the H@N co-ordinator in batches. This was a more efficient way of working for ward staff as, after paging the H@N co-ordinator, only one nurse had to sit by the phone waiting for the call back to report all the patients that needed to be seen by a doctor. It did not, however, make managing the workload of the H@N service easy for the H@N co-ordinator. Immediately after hand-over periods, for example, they would often be paged by a number of wards, each of which had up to 15 tasks to report.

At other times wards would phone through just one task but, when the doctor arrived on the ward, nursing staff would hand over a long list of patients needing to be seen. This could create friction between ward staff and doctors and, since the additional tasks were not passed through the H@N co-ordinator, it also meant that, from the compliance perspective, the record of clinical work undertaken that night was incomplete.

With the new system, this batching or stockpiling of tasks is no longer necessary. All ward staff can now quickly and easily request clinical support as and when it is required via the NUH intranet; each nurse is responsible for entering requests relating to their patients directly, thereby reducing the risk that a patient will be left waiting longer than necessary to be seen by a doctor.

The system incorporates drop down menus designed specifically to meet the precise needs of NUH. (Figure 2) A key feature is that it forces ward staff to use Situation Background Assessment Recommendation (SBAR): a tool that is designed to support effective communication between clinical staff and to foster patient safety. Before the introduction of the system, 50% of ward staff had not been using SBAR when they requested clinical support out of office hours. As a result, time was wasted and delays in patient care occurred as the H@N co-ordinator had to ask the ward to collect additional information to avoid the risk of the task being classified incorrectly.

Figure 2 – Nervecentre screenshot for submission of a H@N request

The screenshot shows a web-based form titled "Submit a Hospital At Night Request" from Nervecentre software Ltd, Nottingham University Hospitals NHS Trust. The form is divided into two main sections. The left section contains patient and ward information: "Raised by:" (text input), "Time of Request:" (dropdown menu set to "Now"), "Patient Name:" (John Smith), "Hospital Number:" (K12345), "Age/DOB:" (23), "Ward:" (Fletcher), "Speciality:" (Surgical), "SBAR Used:" (radio buttons for Yes, No, N/A), "Repeat Call:" (radio buttons for Yes, No), and "Allocate To:" (dropdown menu). The right section contains clinical details: "Nature of Call:" (Chest Pain), "Priority:" (RED), "RR:" (text input), "Sats:" (text input), "B/P:" (text input), "Temp:" (text input), "SpO2:" (text input), "UO:" (text input), "IV Access:" (Yes/No dropdown), "IVABX:" (Yes/No dropdown), "IV Fluids:" (Yes/No dropdown), "EWS:" (text input), and "Is Patient for Resus:" (Yes/No dropdown). At the bottom are "Clear" and "Submit" buttons.

'It's great how the new system categorises everything. It forces you to provide all the necessary information so that the doctor is properly prepared and turns up in the right place, at the right time and with the right patient details. It also stops unnecessary referrals.'

Louise Bolton, ward manager, NUH

As well as completeness of data, the system helps ensure accuracy. Previously task requests were passed by word of mouth: from ward staff to H@N co-ordinator and then on to doctor or CSW. This sometimes created difficulties as one person in the chain might copy down a patient's name incorrectly or might mishear the name of the ward. Since ward staff now enter the data directly, however, this type of error can no longer occur.

Once all the data for a job request has been correctly and completely entered onto the system it is submitted automatically to the H@N co-ordinator. The H@N co-ordinator reviews the request on the Cius tablet and then electronically allocates the task to the most appropriately qualified person on duty.

On average, around 30% of the total requests received are for taking blood or placing intravenous cannulae: tasks that are generally assigned to CSWs. In the future, allocation of these relatively straightforward tasks will be automated using the skill sets of each member of staff held within the system but, for the short term, it has been decided that this responsibility should remain with the H@N co-ordinator. (Table 5)

Table 5 - Volume of tasks allocated to H@N team (w/c 14 March 2010)

	Shift	Total number of requests	Clinical advice over phone by H@N co-ordinator		Tasks allocated to CSWs		Tasks allocated to doctors	
			Number	% of total	Number	% of total	Number	% of total
14/03/2010	Weekend day	190	2	1%	41	22%	147	77%
14/03/2010	Night	85	4	5%	31	36%	50	59%
15/03/2010	Twilight	75	1	2%	19	25%	55	73%
15/03/2010	Night	82	7	9%	23	28%	52	63%
16/03/2010	Twilight	81	1	2%	14	17%	66	81%
16/03/2010	Night	96	10	11%	28	29%	58	60%
17/03/2010	Twilight	50	2	4%	26	52%	22	44%
17/03/2010	Night	84	1	1%	19	23%	64	76%
18/03/2010	Twilight	65	3	4%	22	34%	40	62%
18/03/2010	Night	79	4	5%	16	20%	59	75%
19/03/2010	Twilight	112	4	4%	18	16%	90	80%
19/03/2010	Night	83	1	1%	29	35%	53	64%

Once a task is allocated the details appear on the doctor's or CSW's wireless handheld phone, providing staff with all the information that they need to plan and manage their workloads.

Geographically the City Hospital Campus is very large; it has 39 wards spread over 37 hectares and is connected by corridors some of which stretch over a quarter of a mile long. Prior to the introduction of the new system, staff were often paged by the H@N co-ordinator while between wards and some distance from a phone; they had no way of assessing the urgency of the call so had no option but to rush to find the nearest phone to speak to the H@N co-ordinator.

The call may have been very urgent. Equally it may have been non-urgent. Whichever, often the doctor or CSW would find they were being asked to retrace their steps to see a patient on a ward located at the other side of the hospital and that they had left just 20 minutes ago. This could be very frustrating and staff sometimes felt they were spending more time walking around the hospital than they were on direct patient care.

The problem was further exacerbated by the number of patient admission points in the hospital. Previously patients were all admitted to the hospital through one central point, but now there are eight entry locations (more than the number of doctors on duty at night) and, as each patient needs to be booked in or clerked by a doctor, clinical staff spend a lot of time travelling between wards.

'I must have noted down the wrong ward name so couldn't find the patient. I kept phoning the H@N co-ordinator but the phone was engaged so I just handed the job back at the end of the shift.'

Jo Short, junior doctor, NUH

Legend: shift hours

Weekend day: 09.00 – 21.00

Night: 22.00 – 09.00

Twilight: 17.00 – 22.00

The senior doctor on duty, the registrar, is now automatically sent details of all logged red calls on their handheld phone. This enables them to remotely monitor the condition of all acutely sick patients from whichever ward they are working on and to step in with advice or support wherever necessary. This is a very important and useful feature of the system as the doctors covering H@N are mostly trainees so often need the guidance of a more experienced clinician to help them reach a diagnosis quickly and accurately. It also has the effect of pulling together the medical staff working at night so that, rather than feeling isolated and unsupported in a very large hospital with a long list of patients to treat, they become part of the H@N team.

When a task is completed it is noted on the system so that there is a full audit trail from the time a task is requested through to its completion. Any tasks that are still outstanding at the end of the shift are automatically identified and can be reassigned to staff on the incoming shift, which ensures that no tasks ever get overlooked.

Previously completion details were not captured on the computerised log sheet and this created a number of problems. Often doctors would go home at the end of their shift without handing over outstanding tasks. This could create confusion both on the wards and in the H@N co-ordinator's office. No one knew which tasks were still outstanding, which tasks had been passed to the doctors arriving for the next shift and which had been forgotten. As a result, at handover times, ward staff would often phone through the tasks again. The H@N co-ordinator would assign the task to another doctor, which often meant that, if the task had been passed on by the out-going doctor, two doctors would turn up on the ward to see the same patient.

This no longer happens. Ward staff can now use the system to review the H@N team workload. This gives them a better understanding of waiting times and the pressures that the team are working under each night. They can see which doctor their patient has been assigned to and, as a result, are reassured that their patient has not been lost or forgotten in the system.

It also makes it easier for the H@N co-ordinator to manage the H@N team. The number and nature of calls submitted to the H@N team, particularly for doctors, is very difficult to forecast. In the records we reviewed for the period 21 February 2011 – 20 March 2011, for example, the number of red calls varied from two on one night to 22 on another, and on another night, the team received four red calls within nine minutes.

With most red calls taking between one and three hours, and very complex calls sometimes taking six hours or more, it is possible that a junior doctor can be engaged in the care of a single patient for the major part of their shift. With only four junior doctors and a registrar covering each shift it can therefore be extremely challenging to manage the workload.

With the new system, however, the H@N co-ordinator can see at a glance the extent of the workload and the number and type of tasks that each member of the team has outstanding. If they note that one doctor has a heavier workload than any of the other doctors then they can transfer some of the outstanding tasks either to themselves or to another doctor.

As well as balancing workloads, this facility can also be used to send staff on meal breaks as appropriate. Previously, identifying the most suitable time for H@N staff to take breaks, particularly the doctors, had been very difficult. The H@N co-ordinator had no idea how many tasks the doctors had outstanding and the doctors had no idea how many tasks were lined up for them. As a result, they rarely took breaks. They may have had a hot drink as they wrote up a patient's notes but they did not take time out to sit down, to relax and refresh; they just worked straight through their shift, from 22.00 – 09.00.

In addition to supporting the management of daily workloads the new system will better inform the future operation of the H@N service. The computerised log sheet used previously captured only the minimum amount of data which made its usefulness as a management information tool extremely limited. The new system, however, incorporates a full reporting module with rich data mining functionality that will provide H@N management with the detailed information that they have been asking for to support more informed decision making.

'Patient outcomes will improve as the efficiency of the new system, with nurses not needing to chase doctors, will mean nursing staff can spend more time with patients.'

*Rea Dickens, staff nurse,
Fleming Ward, NUH*

A report can be generated, for example, to help assist more intelligent staff rostering. Patterns of call intensity can be examined by ward, specialty and urgency on an hour by hour, week by week or month by month basis to enable the H@N management team to gain a better understanding of the type of clinical work being undertaken during the night. This information can then be used to ensure that the right number of staff with the right set of skills are on duty at any particular time.

Data is also being gathered on the number and types of tasks being wrongly referred to the H@N team. The prescribing of intravenous fluids for maintenance, for example, is classified as being low priority and, as such, should be undertaken during the day. Tasks such as these, however, were increasingly being passed to the H@N team, which introduced delays to the care of more critically ill patients. The hospital is now reviewing internal processes to ensure that this no longer happens so that the H@N team will have more time to focus attention on the acutely ill patients who need them the most.

Figure 3 - Comparison of 90 minutes of a H@N co-ordinator's time before and after system change

H@N Coordinator Vicki Kaluza Midnight to 1.30 Tuesday 25 January 2011		H@N Coordinator Vicki Kaluza Midnight to 1.30 Tuesday 22 March 2011	
00.01	Page call 1 received	0:00	En route to south corridor
00.02	Phoned ward for details of page call 1 Page call 2 received	00.01	Assigned amber task on Cius
00.03	Keyed in details of page call 1 on log sheet Call assigned priority green Batched to assign to doctor at 2 am meeting	00:05	Arrived at Southwell ward
00.04	Phoned ward for details of page call 2 Keyed in details of page call 2 on log sheet Call assigned priority amber Paged doctor and waited for doctor to phone back Passed on details of page call 2 to doctor	00:05	Assigned amber task re patient 1 to self on Cius
00.05	Page call 3 received Phoned ward for details of page call 3 Keyed in details of page call 3 on log sheet Call assigned priority green Batched to assign to doctor at 2am meeting	00:20	Performed observations on patient 1
00.18	Page call 4 received Phoned ward for details of page call 4 Keyed in details of page call 4 on log sheet Call assigned priority green Batched to assign to doctor at 2am meeting	00.24	Assigned amber task on Cius
	Page call 5 received. Phoned ward for details of page call 5 Keyed in details of page call 5 on log sheet Call assigned priority green Batched to assign to doctor at 2am meeting	00:25	Performed amber task on patient 1
	Page call 6 received Phoned ward for details of page call 6 Keyed in details of page call 6 on log sheet Call assigned priority green Batched to assign to doctor 2am meeting	00:35	Updated notes on patient 1
00.44	Page call 7 received Phoned ward for details of page call 7 Keyed in details of page call 7 on log sheet Call assigned priority green Paged CSW and waited for CSW to call Passed on details of page call 7 to CSW	00.36	Assigned green task on Cius
00.53	Page call 8 received Phoned ward for details of page call 8 Keyed in details of page call 8 on log sheet Call assigned priority green Batched to assign to doctor at 2am meeting	00.38	Assigned green task on Cius
1.13	Page call 9 received Phoned ward for details of page call 9 Keyed in details of page call 9 on log sheet Call assigned priority amber Paged doctor and waited for doctor to phone back Passed on details of page call 9 to doctor	00:40	Phoned junior doctor re: review of patient 1 Informed doctor of what H@N co-ordinator had done Notified doctor what they were required to chase later
1.30	Page call 10 received Phoned ward for details of page call 10 Keyed in details of page call 10 on log sheet Assigned task to self	00:45	Assigned 3 tasks on Cius
		00.46	Assigned green task on Cius
		00.46	Assigned amber task on Cius
		00.47	Assigned green task on Cius
		00.49	Assigned green task on Cius
		00:50	Assigned amber task on Cius
		00:50	Ward phoned H@N co-ordinator re red task
		00:55	Finished call to Fletcher ward Phoned senior doctor to inform them of red task Sent details to doctor via handheld phone
		01:10	Handed over re: patient 1 to ward nurses
		01:15	Updated task on the system and referred to junior doctor Allocated self task via Cius patient no 2 on Berman ward 1
		01:20	En route to Berman ward 1
		01:25	Reviewed patient no 2 (charts and notes)
		01.25	Allocated green task on Cius
		01:30	Updated plan in the notes

Patient perspective

More timely care

The improved communication enabled by the new system is helping the H@N team to reduce delays in care of acutely sick patients in a number of ways.

The system does not just support one-way messaging, from H@N co-ordinator to the H@N team working on the wards, for example, but it also facilitates two way communication allowing doctors and CSWs to stay in full contact with the H@N co-ordinator at all times from anywhere within the hospital – either through messaging or by phone.

CSWs, for example, if allocated a task that is subsequently discovered to be outside their area of expertise, are able to use a button on their handheld phones to abort the task. This action registers the task as incomplete on the system and prompts the H@N co-ordinator to reallocate the task to a doctor. This process now only takes seconds to carry out. In the old system whenever this happened the process would be long and drawn out:

- CSWs would locate a phone
- CSWs would page the H@N co-ordinator
- H@N co-ordinator would phone the CSW back
- CSW would explain the problem
- H@N co-ordinator would re-enter the task on the computerised log sheet
- H@N co-ordinator would batch the task for allocation later
- H@N co-ordinator would page a doctor
- doctor would locate a phone and call the H@N co-ordinator
- H@N co-ordinator would allocate the task to the doctor.

It is impossible to say exactly how long this took as it depended on how quickly each person in the chain responded, but it certainly wasted a significant amount of staff time and added unnecessary delay to patient care.

Another feature of the new system that is successfully helping to reduce delays in patient care is the facility to escalate the priority of tasks.

Previously, once a task had been assigned to a doctor or CSW then, from the H@N co-ordinator's point of view, it was presumed to be done. There was no way of telling which tasks assigned to CSWs or doctors had been completed and which had not.

Often an amber task would be allocated to a doctor who was already busy treating another seriously ill patient. It can take up to two hours, however, to assess and treat some patients - one suffering with chest pains for example – so a doctor caring for such a patient would be unavailable to respond to another amber call within the recommended time period of one to two hours.

If the doctor was not able to leave the patient they were treating to notify the H@N co-ordinator that they were busy then the H@N co-ordinator would just assume that all patients were being seen within the recommended time period. Ward staff would have no idea what was happening. Unless they phoned the H@N co-ordinator to ask, they did not know when to expect a doctor or even if a particular task had been allocated. As a result there could often be an unsatisfactorily long delay in patient care and, with no inbuilt process for escalation of calls, there was a risk that the patient's condition would become significantly more serious.

To assess the likely frequency of such events, we asked the H@N doctors to record the time they completed each of their assigned tasks for a period of two weekend days and seven nights. This information was then added to the computerised log sheet and then the total length of time taken to complete each amber task was independently examined by a clinical consultant. The aim was to determine whether any of these patients might have suffered any clinical consequences from delays in care. On average, the review identified one or two incidents of concern on each shift.

'We have no idea when a doctor has completed a task or how long they are with a particular patient. If we page them we often take them away from a patient.'

Claire Welsh, H@N co-ordinator, NUH

On one night, for example, a doctor was asked to examine a patient with a chest drain. The task was assigned a priority of amber so the patient should have been seen within one to two hours. The patient was not seen for over three hours, however, which potentially placed them at risk of a chest infection. In another example, taken from the same day, a doctor was asked to review a patient who had suffered respiratory failure. This task was also classified as amber but the patient was not seen until more than three hours later. In both cases, if the H@N co-ordinator had been made aware of the delay, then they would have raised the priority of the task to red and these patients would have been seen more quickly.

With the new system, if a doctor is assigned a task that, for whatever reason, they cannot complete then they either call the H@N co-ordinator to explain the problem or return it electronically using their handheld phones.

Reduction in noise and disturbance

One aspect of the new system that benefits all patients is a significant reduction in noise levels on the wards. Previously the H@N co-ordinator would phone the ward in response to every page call. If the ward staff were busy with patients, however, they would be unable to answer the phone and as a result the phone would be left ringing for relatively long periods of time. The constant ringing disrupted patients' sleep and was often a cause of complaint.

Patients were also subjected to unnecessary disturbance when the H@N co-ordinator paged the doctors and CSWs. The H@N co-ordinator had no way of knowing whether the doctor or CSW that they wanted to speak to was busy with a patient or not and, as a result, would often page them when they were midway through treating a patient. As well as being generally upsetting to patients this could also be disruptive to staff.

Usually the H@N co-ordinator was only paging to pass on a new batch of tasks, but the doctors had no way of knowing that. They had to assume that every page call was to notify them of a patient requiring urgent, life saving treatment. As a result, they had to leave the patient that they were treating, locate a phone and speak to the H@N co-ordinator.

We witnessed this many times on our observational visits prior to the introduction of the new system. On the night of 11 February 2011, for example, an elderly female patient was admitted to the hospital following a fall. At 01.20 a doctor arrived at her bedside to take her medical history and to assess her condition. Part way through the examination the doctor received a page call. The doctor left the patient, phoned the H@N co-ordinator and was asked to see another patient who had been reported as acutely sick on the cardiology ward. Subsequent to this, the doctor was asked to review a further five acutely sick patients by the H@N co-ordinator. Three hours passed before the doctor was able to return to the patient they had been examining.

The patient was now asleep. The doctor woke the patient up and resumed taking the medical history but was soon interrupted and asked to review another patient's notes. This was followed by two further interruptions by the pager. This time the doctor took the decision not to respond to the page calls. The patient was confused and distressed from the circumstances of the fall, and so the doctor did not want to further delay the examination. Finally, over four hours after first seeing the patient, the doctor was able to complete the patient's medical history and clinical assessment.

With the introduction of the new system, there has been a noticeable reduction in noise levels on the wards; communication between the ward staff and H@N co-ordinator is now electronic - through PCs and the Cius tablets - and communication between the H@N co-ordinator, doctors and CSWs is achieved noiselessly through handheld phones set on vibration mode.

'We used to get complaints from the patients about the phone ringing all night. But now the noise is kept to a minimum.'

Louise Bolton, ward manager, NUH

Assessment of safety and clinical effectiveness

Like all organisations NUH is working to eliminate the occurrence of critical incidents. Reducing the number of such events is dependent on:

- the availability of accurate information
- the provision of timely and appropriate care
- good clinical governance.

Accurate information

*'Inadequate handover of clinical information carries significant risks for individual clinicians, their organisations and for their patients.'*⁸

One particular area of concern to NUH in this respect was handover periods. The H@N handovers are managed by the H@N co-ordinator. All clinical workers from both outgoing and incoming H@N shifts are expected to attend the meetings, including the registrars.

Handovers are crucial to ensure safe and effective continuity of patient care. Patient notes may be long, complex, illegible or even incomplete and they are often produced from the legal rather than clinical perspective. The explanation of why a clinical test was requested for a particular patient may not be readily apparent to another doctor and it may not be documented in the clinical notes. The handover period works to avoid any potential confusion by giving doctors the opportunity to discuss, in private, the patients they are treating and any related concerns.

Unfortunately, before the introduction of the new system, this transfer of knowledge between clinical teams did not always work as well as it should. Handover sessions would be frequently interrupted by page calls to the H@N co-ordinator. As there was no way to tell whether the page call was urgent or not, the H@N co-ordinator had no option but to leave handover and go to phone the ward. As a result, they would often miss key parts of discussions so would start their shift ill informed.

Registrars were also often unaware of what was happening around the hospital. They attended the 17.00 handover but were unable to attend later ones as their shift patterns were differently aligned to those of the H@N team. This made it difficult for them to know which patients in the hospital were acutely sick. Many of the registrars, unless they were asked to see a particular patient in another part of the hospital, would just assume that there were no real problems elsewhere; they became disengaged from the H@N team.

This limited contact between registrar and H@N team was of concern because, ultimately, it is the senior medical team who have overall responsibility for the patients.

*'Daily involvement of senior clinicians is essential. This ensures that appropriate management decisions are made and that handover forms a constructive part of medical education conveying the seriousness with which the organisation takes the process.'*⁹

Locum doctors also have different shift patterns to the H@N team so are rarely available to attend handover and junior doctors sometimes miss handover because they are busy treating a patient. Previously, with no central record of which tasks had been completed and which had not, tasks could get forgotten or 'lost' when doctors on the out-going shift went home without passing on their outstanding work to the incoming team – resulting in unnecessary delay to patient care.

Tasks could also get 'lost' because the storage capacity of the pagers was limited to 10 calls. This meant that whenever the H@N co-ordinator had more than 10 calls waiting to be dealt with some calls would be instantly deleted. The H@N co-ordinators tried to circumvent this by writing down the page calls as soon as they came in but at certain times, if they were involved in a crash call for example, this was just not possible.

These communication issues have now been successfully bridged. The pagers and telephone system has been replaced by the Cius tablets so, if any urgent requests are sent through by wards during handover periods the H@N co-ordinator can deal with them

'All these things have a knock on effect. If they are not done on time they have a detrimental effect on patients.'

*Val Dethick, H@N
co-ordinator, NUH*

8/9. Safe Handover: Safe Patients. Guidance on Clinical Handover for Clinicians and Managers, Junior Doctors Committee, BMA (August 2004)

instantly with no need to leave the meeting. The new system maintains a full clinical audit trail of all requests logged to the H@N team so the H@N co-ordinator can see at a glance which tasks are still outstanding, and which have been completed.

All records on the system will be held for the statutory period¹⁰ of eight years and in line with the Trust Records Retention & Disposal Policy – a product that brings about medico-legal requirements and best practice. This will ensure that, if there are any subsequent questions about the care of a particular patient, NUH can provide a clear and evidenced response; something that had not been possible with the computerised log sheet.

The provision of timely and appropriate care

The new system has also successfully drawn the registrar back into the H@N team. The registrar now receives automatic notification of all red calls on a handheld phone. This ensures that they have real time information on each of the acutely sick patients within the hospital, including the name of the junior doctor assigned to treat them, whether or not they are able to attend handover. It also means that the registrar is now able to review the treatment plan prescribed by the junior doctor and, if deemed clinically necessary, suggest revisions or changes in approach.

In future, the availability of more accurate information will help ensure the provision of more timely and appropriate care; something that was often hindered in the old system by reliance on verbal rather than written messaging. On the night of 11 February 2011, for example, a junior doctor was paged while attending to another patient. The doctor completed the task and then phoned the H@N co-ordinator from the nurses' station on the ward, where, at that time, it was particularly noisy. The doctor spoke to the H@N co-ordinator, wrote down details of a request to review a patient's prescription and, deciding it was not critical, allocated the task to later in the shift.

The doctor later found out that they had misheard the H@N co-ordinator and should have seen the patient much sooner. The request had not just been to review the prescription, it had also been to review the patient's haemoglobin count as the ward staff were concerned that the level was too low and the patient might need a transfusion. Although, in this case, there were no adverse consequences it does demonstrate the risks that were sometimes introduced to patient care by the old system.

Improved clinical governance

Another key factor in the elimination of critical incidents is being able to identify when and where they are occurring; it is only then that procedures can be put in place to stop them - but encouraging staff to report critical incidents can often be a challenge.

There were 26 incidents reported involving H@N for the six month period from 1 July 2010 – 31 Dec 2010. NUH estimates, however, that this was only the tip of the iceberg and that the number of such events was closer to 200. This view is backed up by independent research undertaken in other health organisations. A study in the Netherlands¹¹, based on a patient record review with sample size 5,375, for example, identified 498 incidents of which only 18 (3.6%) had been reported.

Our observations support this. When shadowing staff, for example, we observed two such incidents within one hour. We also asked members of the H@N team, during one-to-one interviews, whether they reported all potentially critical incidents. Most said that they only reported major incidents as the process was so cumbersome. Since NUH can only investigate and learn from known incidents, this is an issue which urgently needed a solution.

The new system offers such a solution. It incorporates an Incident Reporting Facility which is both quick and easy to use and is anonymised. NUH will therefore be able to extract regular reports detailing all potentially serious incidents that happen out of hours, enabling new safeguards to be implemented.

In the short term, as the number of critical incidents is thought to be under-reported, the new system is expected to show an increase in such events. In time, however, the safeguards introduced by the new system will take effect, and the actual number of incidents should significantly fall.

'It is a really clever system which will mitigate risks.'
Peter Homa, chief executive, NUH

10. Records Management: NHS Code of Practice Parts 1 & 2 (Department of Health 2006)

11. Christiaans-Dingelhoff I et al. To what extent are adverse events found in patient records reported by patients and healthcare professional via complaints, claims and incident reports? BMC Health Services Research 2011, 11:49
<http://www.biomedcentral.com/1472-6963/11/49>

Socio-cultural, ethical and legal aspects

Information governance

Information governance is an issue that NUH takes very seriously but, as with critical incident reporting, it is not always easy to manage or monitor. NUH, like all NHS organisations, is required to comply with Department of Health guidance and European law (Directive 95/46/EC of the European Parliament and of the Council of 24 October 1995 on the processing and protection of personal data).

Previously during H@N working hours, as in many other healthcare organisations, when called urgently to the phone, doctors would tend to scribble down notes on the first piece of paper that came to hand; this might be their work list, in a pocket book, on a handover sheet or sometimes just a scrap of paper. The note often contained the patient's name, the ward and other sensitive information. Technically this document, even if it was just the back of an envelope, should then have become part of the patient record. In reality, it was very rare for the 'document' to be treated in this way. In practice, these 'notes' were often taken home as evidence of the doctor's practical training experience, kept as a reminder of patients who needed further review the following day or were just discarded as refuse in standard waste bins – either on the premises or elsewhere – and, on some occasions, simply dropped or left lying around for people to see. (Figure 4)

Figure 4 – Doctor's log sheet on old system

HOSPITAL @ NIGHT LOG SHEET

2301

20:15	REU	VF, VT (multiple arrests) ^{intubated} DRLV for overload (on IV) 22:45	
20:30	Bylin S	↑ BP	
20:50	CSSU	Clotting (pre-procedure)	
21:00	CSSU		
21:30	CSSU	Clotting (pre-procedure)	
21:45	Bylin S	↑ BP, ↑ capillary refill, ↑ RR, ↑ HRV - 57	
22:15	Nin-2	↑ RR, ↑ capillary refill, ↑ RR, ↑ HRV - 57	
22:30	Sadman	↑ RR, ↑ capillary refill, ↑ RR, ↑ HRV - 57	
22:35	Sadman	↑ RR, ↑ capillary refill, ↑ RR, ↑ HRV - 57	
22:50	Sadman	↑ RR, ↑ capillary refill, ↑ RR, ↑ HRV - 57	
23:00	ACE	DRLV → procedure	
23:15	Clotting	(P) PE - PVR - 62 (ST), 6 Pa - 92 (35%), 206:00	
23:30	Clotting	(P) NIV - CAPD - (22/8; via 6L) Air > 53%, SpO ₂ 70%, 23:00	
23:45	Nin-2	RES.	

Note: Patient names have been removed to protect their identities

When 'notes' are mislaid or lost then not only is clinical safety threatened as patient care is likely to be delayed, but also patient confidentiality is compromised.

Although the risk of this happening is very small, when it does the consequences may be severe. At NUH, for example, a serious untoward incident (SUI) occurred when a handover sheet which included detailed information regarding the sexual health of a patient was inadvertently left on a nurses' station. The notes were seen by a relative of the patient who was unaware of the condition. The unintentional disclosure of this information caused a huge amount of distress for both the patient and their family. For the organisation, it resulted in an Action Plan being agreed with the Information Commissioner's Office (ICO) which has the power to impose significant financial penalties on the organisation.

Incidents such as these should no longer occur. All information is now shared and stored electronically; thereby completely removing the need for staff to generate paper notes. The system provides a legible record for future clinical review, and eliminates the risk of information being seen by anyone who should not see it. All records are held centrally; no data is held directly on the handheld phones, so even if one of them is lost or stolen, patient confidentiality can never be compromised.

'Love the fact that I don't need to carry paper around. There is no risk anymore that I'll lose my patient list.'
Heidi Archer, junior doctor, NUH

Doctors' training records

The detailed records held electronically on the system also mean that there is no longer a need for junior doctors to take home their scribbled notes detailing the patients seen and the treatments prescribed as evidence of their experience for their training records.

All doctors staffing the H@N service, with the exception of the registrar and on call staff, 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 20 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 up prescriptions and breaking bad news to relatives). The trainees are required to document their knowledge and skills in personal 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.

Before the introduction of the new system, the doctors would often take home their nightly work lists and would then use these to populate their training records. As these papers sometimes contained patient information this practice had the potential to breach confidentiality guidelines. The new system effectively addresses this issue by giving each doctor access to a training module which enables them to record an anonymised summary of all the work they have performed. The H@N co-ordinators are also able to use this functionality to help them allocate tasks appropriately and to ensure that each trainee is able to gain the full range of experience necessary to fulfil the training competencies.

This means that, in future, NUH 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 NUH stand out from its competitors and to attract the highest calibre staff.

Staff satisfaction

It is not just the doctors who have benefited from the new system. During one-to-one interviews with H@N co-ordinators, ward staff and CSWs we found widespread satisfaction with the new system. Staff said that they found it easy to use, that it gave them more time away from their desk to spend on direct clinical care of patients and that it helped them better manage their workloads.

These comments were later backed up by responses to a staff survey. The survey, based upon the IBM Computer System Usability Questionnaire¹² and modified to meet the specific needs of this project, aimed to compare the H@N team's views on the old and new systems. Respondents were asked to grade each question between 1 and 10 (where 1 was strongly disagree and 10 was strongly agree). Overall, the survey showed an increase in staff satisfaction from 66% to 90%. (Table 6, opposite)

'It was incredibly difficult to document experience gained at night.'

*Barry Evans, junior doctor,
NUH*

12. James R. Lewis, International Journal of Human-Computer Interaction, 1995

Table 6 – Comparative satisfaction of users between old and new H@N systems

	Question	Average score	
		Old system	New system
1	Overall I am satisfied with how easy it is to use the system	7	9
2	It was easy to learn to use the system	8	9
3	The system takes little of my time allowing me to spend more time with patients	6	9
4	The system allows information on the patient to be accurately recorded	5	9
5	I feel comfortable using the system	7	9
6	Whenever I make a mistake using the system I recover quickly and without impact to safety	8	9
7	The organisation of information on the screens is clear	6	9
8	I like using the interface on this system	6	9
9	Overall, I am satisfied that the system effectively supports my job	6	9
	Total	59	81
	Total %	66%	90%

Staff engagement in implementation process

Staff do seem to be genuinely happy with the new system and this is due, in part, to their being closely involved in all stages of its design, development and implementation. The new H@N communication system will be used by doctors, H@N co-ordinators, nurses, managers and CSWs at NUH for over 75% of each and every week of the year and so it was critical to its success that staff were fully engaged in the project from the very start.

The Lead Nurse H@N, with the support of NUH ICT team, led the project with other clinical staff brought in to provide support and to advise as and when required. Ward staff, for example, contributed to the development of the data input screens that they now use to record details of acutely sick patients. Implementation was carefully staged and this helped ensure that the transition from old to new was both smooth and seamless.

Overall it appears that the implementation was very successfully managed and that the benefits, to staff and patients, are already becoming apparent.

‘The system is so easy and user-friendly that the H@N co-ordinators started using it within half an hour of getting the system.’
Debbie Guy, lead nurse, H@N, NUH

Economic aspects

Financial efficiency is a key objective of all NHS managers. The NHS has been set the target of reducing its spending by €21bn – €27bn by the end of March 2014 and the impact of this will be felt by every NHS organisation across the country.

For NUH, this translates to recurrent cost improvement savings of €55m in 2011/12 (5.5% of budget); €45m in 2012/13 and €41m in 2013/14. Achieving this will be a significant challenge.

The three prime reasons that NUH decided to invest in the new system, however, were not cash related. The aims were to:

- improve patient safety
- support better utilisation of resources
- increase staff satisfaction.

The intention was to test the concept on H@N, to assess whether it had made a real impact on service provision and then to take a decision on its continued use -including its possible extension to other areas of the organisation. The expectation was that, although the new system might not deliver cash releasing benefits for H@N, there was definitely the potential for it to deliver a broad range of savings in other areas of the organisation.

Our study has, however, identified three possible areas for savings on H@N following the introduction of the new system:

- changing the shift patterns of CSWs
- putting H@N co-ordinators back on the ward
- reducing the length of hospital stays.

These have all been made possible by the implementation of the new system.

Changing staff shift patterns

In the past, the H@N management team had no data with which to monitor demand for H@N services; the computerised log sheets were designed only to register calls, not as a management information tool. This has now changed. The new system boasts a rich reporting functionality that can provide management with everything from a detailed analysis of activities on a minute by minute basis to a summary of all activities for the year. This is now being used to help get a better understanding of the work being undertaken by the H@N team and to ensure that it is staffed appropriately.

An initial review of CSW work flows, for example, has shown that on average CSWs undertake 33 tasks each night (taking blood, placing intravenous cannulae and the recording of ECGs) with the majority of tasks being scheduled before 01.00. (Table 7) As each task takes approximately 10 minutes this equates to about six hours' work a night. The hospital, however, is staffed by two CSWs each night. Each shift lasts for 12.5 hours (from 19.00 – 07.30) at an hourly cost per person of €14.09 per person.

Table 7 - Average number of tasks undertaken by CSWs (w/c 14 Feb 2011)

	14/03/11	15/03/11	16/03/11	17/03/11	18/03/11	average
19.00 - 20.59	11	16	14	8	12	
21.00 - 22.59	4	4	4	4	7	
23.00 - 00.59	4	8	6	8	4	
Total	19	28	24	20	23	23
01.00 - 03.59	5	4	3	4	4	
04.00 - 05.59	2	5	4	4	4	
06.00 - 07.30	2	0	3	4	5	
Total	9	9	10	12	13	11

'The new system is a huge improvement. I can easily contact the H@N co-ordinator and she can see my outstanding workload at any time. It has taken away the worry that I'm leaving patients waiting.'

Heidi Archer, junior doctor, NUH

As a result of this review, NUH is working towards changing CSW shift patterns so that they finish at 01.00. Across the two sites, this would deliver real cash releasing savings of – over €133,000 per annum. Any urgent requests for taking blood, placing intravenous cannulae or recording of ECGs that were placed after 01.00 and that could not be undertaken by ward staff would be performed by the H@N co-ordinator or by a doctor.

H@N co-ordinators back on the ward providing clinical support

In the past the H@N co-ordinators were desk bound so could not provide such support. This had proved to be a major source of staff dissatisfaction. The H@N co-ordinators were experienced nurses and wanted to use their clinical skills working with patients but instead they were gradually becoming deskilled.

Prior to the introduction of Nervecentre, data collected in the week commencing 14 March 2010 showed that on average, the H@N co-ordinators received 83 page calls each night, 76 page calls each twilight shift and 157 page calls each weekend day shift. For each of these calls they had to phone the ward, log the call on the computerised spreadsheet, page a doctor or CSW then wait for them to phone back. As a result they could only rarely leave the H@N co-ordinator’s office; they were tied to the desk.

The new system has changed this. Now, after handover, the H@N co-ordinator picks up the Cius tablet and goes out to provide clinical support to the wards. The ward staff input requests for clinical support directly onto the new system. The H@N co-ordinator receives the task on the Cius tablet and then allocates it to the most appropriate member of the H@N team using the touch screen pad. The simplification of the process means that it now literally takes seconds.

Data collected in the week commencing 13 March 2011, for example, showed that on average, although there was still a similar number of calls logged (85 each night, 72 each twilight shift and 211 each weekend day shift) the H@N co-ordinator allocated 93% of them while out of the office. (Table 8)

Table 8 – Comparison of number of tasks assigned by H@N co-ordinator

Shift	w/c Sunday 14 March 2010			w/c 13 Sunday March 2011		
	Total tasks	Number of tasks assigned by H@N co-ordinator from a desk	Number of tasks assigned by H@N co-ordinator away from desk	Total tasks	Number of tasks assigned by H@N co-ordinator from a desk	Number of tasks assigned by H@N co-ordinator away from desk
Weekend day	190	190	0	188	10	178
Night	85	85	0	77	11	66
Twilight	75	75	0	75	3	72
Night	82	82	0	83	8	75
Twilight	81	81	0	65	3	62
Night	96	96	0	92	8	84
Twilight	50	50	0	61	3	58
Night	84	84	0	75	4	71
Twilight	65	65	0	75	7	68
Night	79	79	0	72	6	66
Twilight	112	112	0	86	5	81
Night	83	83	0	81	12	69
Weekend day	123	123	0	233	10	223
Night	75	75	0	116	9	107
Total	1280	1280	0	1379	99	1280

‘I wouldn’t have stayed in this job if things hadn’t changed. I would have left.’

Vicki Kaluza, H@N co-ordinator, NUH

The H@N co-ordinators are now able to spend around 60% of their shift (or 76 hours per week) providing direct clinical care on the wards. The average cost of a H@N co-ordinator is €66,000 and NUH employs 10.5 FTE, therefore this suggests a potential annual saving across both sites of over €412,000. It does not, however, translate into a direct cash releasing saving; the H@N co-ordinator is responsible for managing the H@N team so the role will always be required. What it does do is provide additional clinical support to the areas of the hospital where it is needed most; it puts over €412,000, which equates to about 8,000 hours per annum, back into direct service delivery. (Table 9)

Table 9 - Comparison of time spent on clinical tasks by the H@N co-ordinator on City Hospital Campus for one week before and after implementation of the new system

	Total hours	Time spent in desk task allocation of work		Time spent giving desk based clinical advice		Time spent in hands-on clinical work	
		%	Hours	%	Hours	%	Hours
w/c 14 March 2010	126	97	122	3	4	0	0
w/c 13 March 2011	126	39	49	1	1	60	76

Reduced length of hospital stays

In the longer term, the increased clinical support from H@N co-ordinators should, however, deliver real cost benefits as it will minimise delays in patient care which will result in reduced lengths of stay. One of the reasons that patients are sometimes kept longer in hospital than the norm is not because of clinical need but because they are detained by the lengthy discharge process. Prior to discharge, for example, a doctor will generally be asked to prescribe a set amount of drugs for the patient to take home or 'to take out' (TTO).

As these requests are not clinically urgent the doctors treat them as low priority and may not deal with them for a number of hours. This delay, however, could mean that the patient's prescription is then filled too late for them to be discharged until the following day; perhaps because of difficulties organising patient transport or arranging for a carer to help the patient in their home. As a result, the patient has to stay in hospital for an additional night increasing both their risk of catching an infection and the overall cost to the hospital.

A case such as this arose when we were observing the H@N team. Following dialysis, a renal patient became unwell. A doctor reviewed the patient and requested that the patient be sent for a chest x-ray, an ECG and blood tests. The task of reviewing the results was allocated to a junior doctor on the H@N team but the doctor was busy and went off shift at 22.00 without handing the task over. After handover at 22.00, the ward staff resubmitted the request to the H@N team. At 02.00 a junior doctor arrived on the ward to review the patient's results; no problems were found. Unfortunately by this time it was too late to send the patient home and they had to be kept in overnight.

To investigate the impact of such delays we reviewed pre-nerve centre data from a typical night and week-end day in January 2011 and, on each shift, found that there were one or two significant delays in the allocation of red calls and considerable delays in the allocation of over 20 green calls. A clinical consultant, asked to assess the likely impact of these delays, estimated that, on average, 25% of delayed red calls, 10% of delayed amber calls and 1% of delayed green calls would have resulted in extended length of stay. If these estimates are correct, then on a typical night or week-end day on the City Hospital Campus it is likely that at least 0.8 additional bed days will have arisen as a direct result of the delays in allocating calls. Calculating this impact over two sites and over a whole year this would amount to an additional expenditure on avoidable bed days of €401,000 per annum.

In the new system requests for clinical support that have the potential to adversely impact on a patient's length of stay in hospital will be proactively managed by the H@N co-ordinator. If a doctor has not responded within a reasonable time period the H@N co-ordinator will be able to reprioritize the call to ensure that the patient is able to go home as soon as clinically possible thereby reducing costs from unnecessary extended lengths of stay as well as avoiding any costs that might have arisen as a result of clinical complications caused by a delayed response to a red call.

'If you get the out of hours service right you get the in hours service right too.'
Dominick Shaw, associate professor and medical lead, H@N, City Hospital, NUH

Return on investment

Although the new system is still fairly recently deployed and, over time, we expect further areas of savings to be identified, attempts were made to identify how long it would take for NUH to recover the costs of the new system. This was not a straightforward exercise as it is not a stand-alone solution. Like many hospitals across the globe, NUH had understood the value and benefits that they would derive from the implementation of a medical grade WiFi network.

The Trust Board had previously approved a business case, leading to a procurement in 2007, which provided for voice quality WiFi across both campuses. (At a simple level, a choice of data only, data plus location, and data plus location plus voice support may be deployed, depending upon the density of the installation of access points). For this purpose, therefore, it has been assumed that the following are already deployed:

- wired data network supporting desk top PCs
- Unified Communications manager supporting IP telephony and other unified communications
- WiFi network offering voice support.

The additional elements required for the H@N solution, across both sites, are then

- purchase and deployment of Nervecentre
- 40 x WiFi/dual mode phones
- 4 x Cius tablet devices.

The cost for these three elements was €162,000.

An NUH-wide Out of Hours Operational Group chaired by the Deputy Medical Director was established in Feb 2011 with the primary objective of enhancing the safety of patients when being cared for by the Out of Hours team. Any decisions around the future operation of the H@N service will be made by this group. If the group decided to change the CSW shift patterns, however, then the costs of the new system would be measurably recouped in just over one year. If the estimated savings from reduced length of stay are also taken into account then the costs will easily be recouped in less than four months.

These are, however, conservative estimates; in time, as learning curves settle and staff become more familiar with the system's potential, NUH expects to identify further areas to make savings on H@N. Discussions are already taking place, for example, on the feasibility of extending the new system to cover the notification of test results on H@N. At present when doctors request blood tests or x-rays they have no way of knowing when the results are ready for review. They may return to the ward a number of times, only to be told on each visit that the results are still not back. In response, doctors have learnt not to check back on results till near the end of their shift – and sometimes to just leave the review for the incoming doctors. This wastes doctors' time and unnecessarily delays patient care.

Consideration is also being made to broadening Nervecentre's scope to other areas of the hospital including:

- provision of stroke services
- management of the estates function
- co-ordination of Professionals Allied to Medicine (PAMs)
- patient geolocation visibility
- links to the bed management system.

In the longer term NUH believes that the new system has huge potential, particularly if expanded across multi-agency/multi-care provider workflows, where there are significant process delays, sometimes of many days, due to lack of available (or contactable) resource. The organisation can now choose to share the availability status information for its staff with external groups (known as federated presence), so there is the very real possibility to deliver the same benefits on a much wider scale. This could be of great value by delivering more efficient management and maximising the use of appropriate resource across an entire patient pathway.

'This tool has helped us work more intelligently.'
Peter Homa, chief executive, NUH

Conclusion

The NUH H@N team, working in partnership with the hospital ICT team, has successfully utilised communication and collaboration technology to redesign the delivery of out of hours services. The communication gaps that were previously compromising the delivery of safe and effective patient care have been effectively eliminated and there is now improved utilisation of resources and increased staff satisfaction.

Patient safety has improved

When a patient becomes acutely sick, the details are now logged directly by ward staff. The data input screens force ward staff to submit complete SBAR details and this helps ensure that each task is prioritised and allocated appropriately. Requests for clinical support can no longer be overlooked. All tasks logged by the wards remain live until the H@N co-ordinator, a doctor or CSW signs them off as completed.

A full clinical audit trail is held on the system for each patient seen out of hours so there is no longer the need for staff to carry patient details on scraps of paper and this reduces the risk of patient confidentiality becoming compromised.

It has also simplified the process for critical incident reporting which should enable NUH to act immediately to stop any recurrence.

In addition to improved safety patients are also benefiting from fewer interruptions when being seen by a doctor and a significant reduction in night time noise levels on the wards following the replacement of the pager and telephone system by noise free electronic messaging.

Better utilisation of resources

The new system incorporates rich reporting functionality that will enable management to gain a far better understanding of variations in demand. This has already shown how changing the shift patterns of CSWs will deliver cash releasing savings of €133,000 per annum. Further cash releasing savings of around €401,000 per annum are anticipated from reductions in length of stay.

There is now also improved utilisation of staff resources. In particular, the H@N co-ordinators are now able to work on the wards providing direct clinical care to patients; providing NUH with an additional 8,000 hours of clinical care per annum at no extra cost.

Staff satisfaction has increased

As well as allowing the H@N co-ordinator to resume clinical work and thereby contributing significantly to their job satisfaction, the new system has given all out of hours staff the tools they need to communicate efficiently and effectively with each other so that, rather than feeling isolated, they are now working as a single team.

The H@N co-ordinators now have the information that they need to properly manage the team. They know the skill sets of each member of the team so can allocate tasks appropriately and they know the outstanding workload of each individual so can provide support or encourage the taking of meal breaks at appropriate times.

Ward staff can now spend more time on direct patient care; they no longer waste time sitting by a phone waiting for the H@N co-ordinator to phone them. They are also able to request senior nursing support from the H@N co-ordinator when they need it and are benefiting from the 'on the job' training that these senior nurses can now provide.

Junior doctors now have easy access to the registrar so can seek support or advice as and when required and registrars no longer feel disengaged as, with full details of all acutely sick patients on their hand held phones, they no longer feel disengaged from the H@N team.

Our study has shown that the new system has achieved the aims set out by the trust: there has been demonstrable improvement in patient safety and there is improved use of human resources and as a result staff morale has increased significantly. In summary the new system has been a resounding success.

'For me the two biggest wins are putting senior nurses back on the wards and improved patient safety.'

David Campion, assistant general manager, NUH

'This tool has helped us work more intelligently.'

Peter Homa, chief executive, NUH

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The staff from the H@N Team, Nottingham University Hospitals NHS Trust

The staff from the ICT department, Nottingham University Hospitals NHS Trust

About the organisations

ACCA

ACCA (the Association of Chartered Certified Accountants) is the global body for professional accountants. We aim to offer business-relevant, first-choice qualifications to people of application, ability and ambition around the world who seek a rewarding career in accountancy, finance and management.

We support our 140,000 members and 404,000 students throughout their careers, providing services through a network of 83 offices and centres. Our global infrastructure means that exams and support are delivered – and reputation and influence developed – at a local level, directly benefiting stakeholders wherever they are based, or plan to move to, in pursuit of new career opportunities. Our focus is on professional values, ethics, and governance, and we deliver value-added services through our global accountancy partnerships, working closely with multinational and small entities to promote global standards and support.

We use our expertise and experience to work with governments, donor agencies and professional bodies to develop the global accountancy profession and to advance the public interest.

Our reputation is grounded in over 100 years of providing world-class accounting and finance qualifications. We champion opportunity, diversity and integrity, and our long traditions are complemented by modern thinking, backed by a diverse, global membership. By promoting our global standards, and supporting our members wherever they work, we aim to meet the current and future needs of international business.

www.accaglobal.com

CISCO

Corporate Overview

Cisco Systems, Inc. is the worldwide leader in networking for the internet. Today, networks are an essential part of business, education, government and home communications, and Cisco Internet Protocol-based (IP) networking solutions are the foundation of these networks.

Cisco hardware, software, and service offerings are used to create Internet solutions that allow individuals, companies, and countries to increase productivity, improve customer 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. At Cisco, our 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 72,935 people.

Cisco is committed to innovation and research and development is a core component of our corporate culture. Cisco spends nearly \$5.3 billion a year in R&D, making us one of the top R&D spenders in the world.

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

For ongoing news, please go to

<http://newsroom.cisco.com>.

NERVECENTRE

Nervecentre is a pioneer in providing workforce management solutions into healthcare. Based in the UK, Nervecentre focuses entirely upon healthcare customers, delivering innovative solutions and supporting consultancy to help hospitals deliver measurable and tangible improvements in patient safety and staff productivity. Nervecentre's unique products provide the business intelligence behind the process change implemented at Nottingham University Hospital. It assists in the allocation of activities to appropriately skilled specialists by helping the nurse understand who is available, and by automating the communication with the specialist.

In addition to providing a comprehensive Hospital At Night solution, the Nervecentre approach and products can reduce delays, improve safety and improve productivity in many areas of the hospital including activity management for specialists during the day, portering and estates, reducing delays for stroke services, nurse call, and staff safety.

www.nervecentresoftware.com

NOTTINGHAM UNIVERSITY HOSPITALS NHS TRUST

Area	46.325 hectares
Population served	2.5m
Budget	€992m
Staff	13,000 (11,000 FTEs)
Wards	87 (48 at QMC Hospital Campus and 39 at City Hospital Campus)
Beds	1,700

Formed in 2006, we are now one of the biggest and busiest acute Trusts in England, employing 13,000 staff. We provide services to over 2.5 million residents of Nottingham and its surrounding communities. We also provide specialist services to a further 3-4 million people from neighbouring counties each year.

The Trust is made up of Queen's Medical Centre, Nottingham City Hospital and Ropewalk House.

- Queen's Medical Centre – our emergency care site (where our Emergency Department is located)
- Nottingham City Hospital – where our Cancer Centre and Heart Centres are based and where we focus on planned care and the care of patients with long-term conditions
- Ropewalk House – where we provide a range of outpatient services, including hearing services.

We have achieved national and international reputation for many of our specialist services, including stroke, renal, neurosciences, cancer services and trauma. QMC is home to the Nottingham Children's Hospital.

The Trust has an annual income of €992m, 87 wards and circa 1,700 beds.

We have a clear vision of what we want to achieve as a Trust – we are determined to be the best acute teaching Trust in the country by 2016. By the best, we mean that the Trust's services and departments must be in the top three compared with peers in the country.

We will measure this in six areas: clinical outcomes, patient experience, staff satisfaction, teaching and training, research and development and value for money.

To achieve these objectives the Trust needed to improve productivity by making major changes to working practices. Due to the sheer size of the organisation the management team realised that this could only be achieved through the significant underpinning of the day-to-day work of the Trust with new technologies.

A review undertaken by Cisco¹³, one of the world's leading networking solutions manufacturers, found that existing processes and infrastructures were not of an adequate standard to support the Trust's strategic objectives.¹⁴ The resulting report:

- described slow and inaccurate information processes with ad hoc growth leading to duplicate information systems holding inconsistent data
- identified 'the significant... risk to clinical service delivery from a growing reliance on information provided through ageing and increasingly unreliable technology'
- noted that staff were using outdated stand-alone equipment that led to duplicate data entry
- found that integration across departments was rare, leading to multiple patient data entry and limited knowledge of bed status
- highlighted the minimal system integration across the two sites.

The report recommended that the Trust adopt a more strategic approach to information and communication technology (ICT) investment that would improve cost efficiency and help transform NUH into a centre of excellence. It proposed that the Trust fit a medical grade network to provide both wired and WiFi network foundation and architectures that would enable all communication, including advanced clinical applications and biomedical devices, to operate in a protected, interactive, resilient and responsive environment.

A fundamental element of this would be telephony services, provided by both fixed and portable handsets, with the portable units utilising the WiFi network. The portable phones could be used for internal calls throughout the hospital at no operational cost, and offered a range of 'smart' messaging options, including automatic updates from clinical systems, and the ability to provide the location and work status of users.

Following on from this review the Trust agreed a significant investment with NextiraOne (Cisco's delivery partner) which, in addition to the supporting infrastructure, incorporated leading health technologies including:

- *Wireless data access* to give staff access to information systems at the point of care;
- *Wireless telephony, unified communications and presence* to show real-time availability of staff and to enable staff to be contacted wherever they are in the hospital;
- *Cisco Unified Application Environment*, a messaging system linking ED to Pathology and Radiology systems for notifying when results are ready and patients ready for collection from x-ray; and
- *Radio Frequency Identity (RFID) and tracking* to enable geographic location of equipment.

Due to the size of the change programme it was decided to stage the ICT implementation over a period of 18 months, starting in July 2009. It was agreed that the emergency department (ED) should be first to go live for two reasons: first because the department is geographically distinct so it was easier to deploy the new technologies here than across multiple areas of the Trust; and second, and perhaps more importantly, because ED, as the 'front door' to the hospital, is key to managing the flow of patients through the hospital.

The introduction of the new technology is, however, just one thread of the change programme being introduced at NUH. The Trust was one of only two sites chosen nationally to pilot the NHS Institute for Innovation and Improvement's *Releasing Time to Care Productive Ward Programme*¹⁵. The programme focuses on the introduction of lean processes and the elimination of inefficient working practices to give nursing staff the time they need to spend on direct patient care.

Running alongside this work is the Trust-wide improvement programme Better For You which also focuses on lean working practices. While the new system was being designed, therefore, the Trust began the complex task of completely reviewing working practices across the hospital with the aim of synthesising the service redesign agenda with the new technology to deliver caring, safe and thoughtful care to patients.

Having taken the decision to make a significant investment in both new processes and new technologies the Trust was committed to assessing the benefits.

In 2010, ACCA was asked to assess the preliminary effects of the new ICT system on the Emergency Department. The report, published a few months after the new collaboration technology had been successfully introduced to the emergency department, in March 2010, described the significant improvements that were already evident including:

- a reduction in the patient journey time of 23% for adult patients and 33% for paediatric patients
- an increase in productivity of doctors treating minor injury patients equating to a potential time saving of over seven hours per day or one doctor per year
- cost containment that will allow a full return on investment in the new technology to be realised in just 14 months.

This second report continues the ICT assessment process but the focus this time is very different. It describes the impact that Nervecentre, a tool designed to address communication gaps, clinical governance and performance management, has had on out of hours service provision.

13. www.cisco.com

14. Internet Business Solutions Group connected hospital study **Report on Findings on Nottingham University Hospitals** April 2006

15. www.institute.nhs.uk/quality_and_value/productivity_series/the_productive_series.html

Implementation timeline

February 2006

initial discussions with Cisco and programme of staff interviews

April 2006

Cisco report produced

October 2006

Outline Business case completed

April 2007

Procurement process commenced

December 2007

Approval to proceed by Trust Board

January 2008

Contract awarded to NextiraOne

April 2008

Detailed infrastructure design phase undertaken

November 2008

Core infrastructure installation commenced

July 2009

Installation commenced in ED

October 2010

Roll out of Nervecentre to H@N co-ordinators in City Hospital Campus

December 2010

Roll out of ward forms to initial wards, CSWs supplied with mobile handsets

January 2011

Roll out of ward forms to all wards in City, Nervecentre provided to H@N co-ordinators in QMC Hospital Campus

February 2011

Mobile handsets provided to all H@N doctors, Cius tablets provided to H@N co-ordinators

Appendix B

BACKGROUND – THE ENGLISH HEALTHCARE SYSTEM

The infrastructure of the English healthcare system is based around a primary and secondary care service model with GPs acting as the gatekeepers to secondary care services. The system is publicly funded through taxation and, with the exception of some dental, optical and dispensing services, offers free care at the point of delivery.

The English healthcare system (NHS) covers all English citizens and had total expenditure of €130bn in 2009/10.

The administration of the NHS varies in each part of the UK. The structure in England is currently under review but at the time of writing it operates at four different levels:

- Department of Health
- Strategic Health Authorities
- Primary Care Trusts
- NHS Trusts

Department of Health

The Department of Health defines and oversees the overall direction of the NHS and sets the standards for service delivery. It is accountable to both the government and the public.

The Department has three strategic objectives¹⁶:

- Better health and well-being for all: helping people stay healthy and well; empowering people to live independently; and tackling health inequalities.
- Better care for all: the best possible health and social care that offers safe and effective care, when and where people need it; and empowering people in their choices.
- Better value for all: delivering affordable, efficient and sustainable services; contributing to the wider economy and the nation

Strategic Health Authorities

For the purposes of the delivery of healthcare, England is sub-divided into 10 distinct regions. Responsibility for overseeing the delivery of healthcare in each region lies with a Strategic Health Authority (SHA). SHAs monitor the performance of NHS Trusts and PCTs within their region and ensure residents have equitable access to quality health care.

Primary Care Trusts (PCTs)

Primary Care Trusts (PCTs) are the organisations responsible for commissioning hospital, community and primary care services. Between them, they control over 80% of the NHS budget.

Primary care is the first port of call for most people when they develop a health problem, usually via a visit to their general practitioner (GP) or family doctor.

NHS Trusts / NHS Foundation Trusts

The provision of hospital care, mental health services and ambulances is undertaken by NHS Trusts. These organisations receive most of their income through providing services to PCTs.

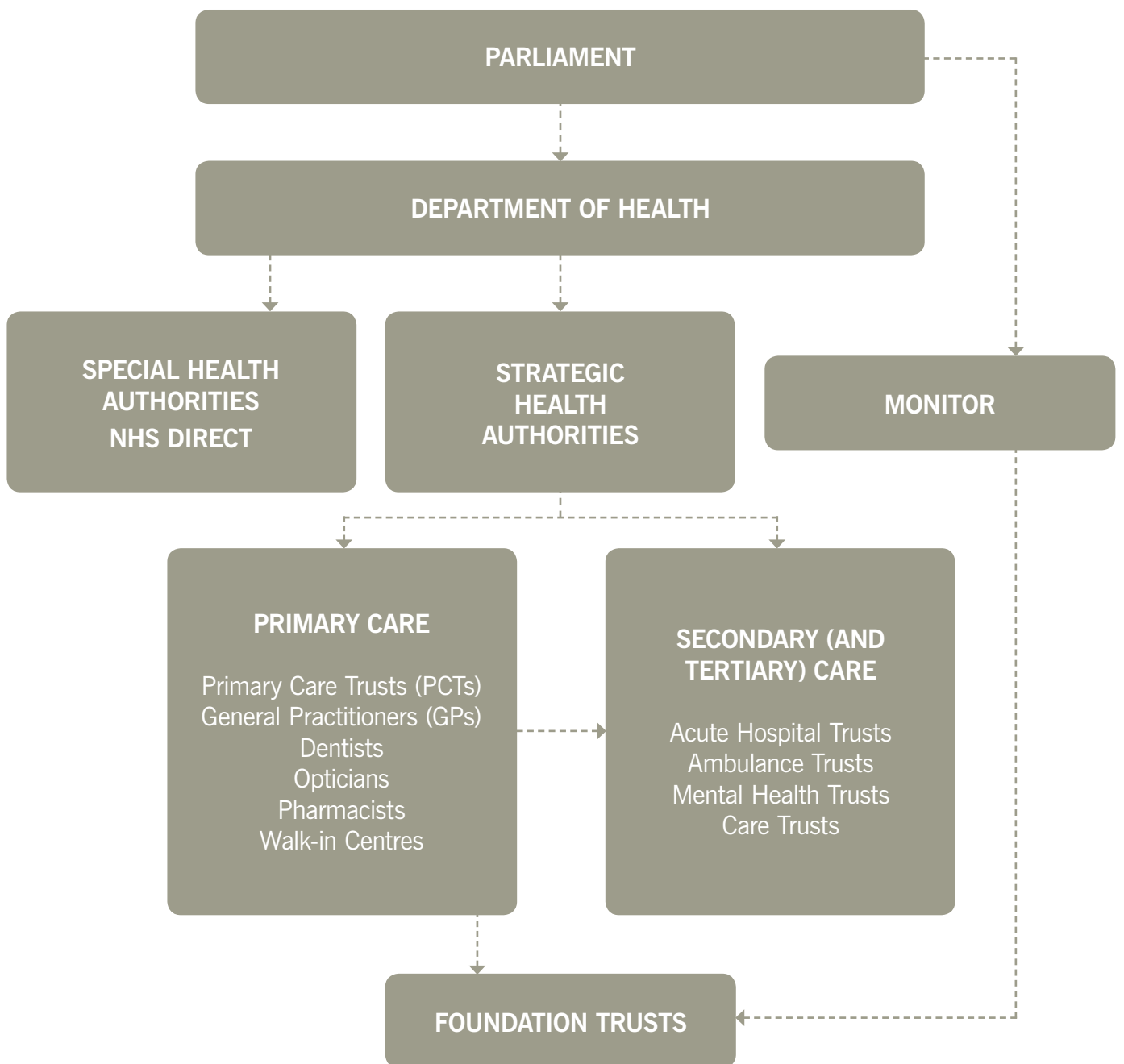
NHS Trusts which have passed a rigorous assessment process are granted Foundation Trust status. Unlike other NHS Trusts, these organisations are performance managed by Monitor, an organisation that reports directly to the Secretary of State.

Foundation Trusts:

In the longer term the government expects all NHS trusts to apply for and to achieve NHS FT status. NHS FTs:

- have greater operational freedom
- can retain their surpluses and borrow to invest in new and improved services for patients
- are accountable to their local communities, to their commissioners and to Parliament.

16. www.dh.gov.uk/en/Aboutus/HowDHworks/DH_4105906



Appendix C

Nottingham University Hospitals NHS Trust's Medical Grade Network and Cius tablet device

In 2006, NUH and Cisco undertook a wide-reaching study of business processes at the Trust, and concluded that 'connecting' healthcare would enhance patient safety, improve clinical outcomes, reduce the length of hospital stay, minimise administrative costs and increase revenues. Such benefits would be achieved by considering organisation, process and technology together, across functional and geographic boundaries, to develop efficient 'care pathways' - and to deliver information to the point of care at the time of need.

To help the reader of this report, we have prepared a brief overview of the benefits of the Medical Grade Network (MGN) as deployed in Nottingham, together with a brief overview of Cius, the first of which was delivered to NUH in early 2011. Since the Cius fits into Cisco's Unified Communications portfolio, information on the device can be found below.

Although, at component level, the deployment is highly complex, the benefits are described in terms of eight attributes; (1) converged IP networks, (2) communications, collaboration and messaging, (3) the application environment, (4) video, (5) mobility solutions, (6) intelligent building technology, (7) data centre and (8) information and service assurance.

In order to ensure that technology can effectively address the requirements of delivering modern healthcare, 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 EU and beyond, each designed to ensure the strategic linkage of business to technology. Cisco has published a number of detailed documents describing the approach. For the healthcare sector, the current documentation can be found at www.cisco.com/en/US/docs/solutions/Verticals/Healthcare/MGN_wireless_adg.html www.cisco-nab.com/

The rationale for a network-centric architecture is clear: the network delivers applications to the user, and is the prerequisite for any data-exchange. It provides collaboration, virtualisation and personalisation, ensuring the use of reliable, accurate, current and consistent patient and business information. This is the foundation for a connected health ecosystem. Cisco terms this fundamental tenet 'The Network as the Platform'.

Converged IP Networks

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.

NUH now considers its network in that same way, as the single conduit for all business and clinical services; its IP network is critical infrastructure, essential for service delivery. As a consequence, the leadership team for ICT at NUH embarked upon a two-pronged strategy: to transform its own approach to service provision, and to shift how IT was perceived and managed by the Trust as a whole. The first change was operational, requiring total adherence to the IT Infrastructure Library (ITIL) model across

the team, and for all processes. The second was cultural; the requirement was to have IT seen to serve the Trust, enabling rather than attempting to impose change. The solution was to make the hospital-wide Service Improvement Board responsible for managing and prioritising the whole IT programme of work. This has ensured congruence of purpose between business priorities and IT service delivery.

Communications, Collaboration and Messaging

Rich-media communications, collaboration and messaging tools are the main element of the applications whose benefits are examined in this study and which complement the mobile and video environments described below.

One of the first communication systems to benefit from convergence onto the IP network was telephony (Unified Communications). The last 10 years have seen wholesale transformation of telephony services from TDM (Time Division Multiplex) to IP. Unified Communications offers huge advantage over old world systems, with orders of magnitude more intelligence and integration being offered. Simply put, Unified Communications offers a wide range of communication options, enabling more communication more simply and more successfully than before.

In this report, reference is made to two different WiFi enabled communications devices. The H@N coordinator uses Cius, while the doctors use 7925 series phones. As with many organisations, data security and integrity is a primary concern for NUH. The Cius offers enterprise level security features, including media encryption, device authentication, and network security on both wired and wireless networks. It also extends the full range of productivity innovations, including voice and video-enabled telephony services offered by the Communications Manager platform to all Cius users.

By using the Open Source Android Operating System, Cius can utilise solutions available from the rapidly expanding Android developer community for building business-class productivity applications and also allows customers to develop their own custom applications. The 7925 is a device designed specifically for healthcare environments, which, in addition to offering full Unified Communications capabilities, offers an hermetically sealed, IP54 rated form factor which protects against dust, liquids, and moist wipes. It also features a ruggedised industrial design, compliant with military 810F standard, and a rubber casing to shield the phone from damage caused by drops and shocks. Extensive details for both devices can be found at:

www.cisco.com/go/cius

www.cisco.com/en/US/products/ps9900/index.html

These solutions allow staff to work from any location without downgrading levels of contact with colleagues. Key tools within this category include instant messaging, voicemail, video and web conferencing. These tools are well established within the private sector and have been instrumental in allowing mobile network environments to deliver transformational changes in working practice.

Telepresence and healthpresence allow very high quality video conferencing – HD video, directional CD quality sound, and no perceptible delay – to support executive and clinical contact. These tools – particularly when combined with effective collaboration tools - are the key to providing a 'face to face' equivalent experience.

The Application Environment

Applications currently used by NUH 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 medical grade network provides an environment which is available (no single point of failure), scalable and secure, allowing interactions between all users and systems to occur seamlessly.

Video

Video is a key asset in NUH where 'showing rather than telling' is so powerful – for CT scans, for a patient's clinical symptoms, for training, for remote observation of patient behaviour and for richer information sharing between different clinical disciplines.

As seen on the internet, video is now easily supported on correctly-designed IP networks. Video offers great potential for transforming and improving clinical and operational efficacy:

- It can deliver live or stored e-learning material
- It can deliver messages and other information to staff and patients within Trust buildings using digital media/signage
- It can allow traditional audio-only telephony to be superseded by much richer video telephony
- It can enable video and rich-media conferencing between clinical teams
- It can help reduce travel, providing benefits in terms of cost, time and environmental impact.

Mobility Solutions

Mobile working is increasingly important in NUH.

Mobility solutions provide a key to improved productivity and effectiveness for hospital and community-based staff. They also enable solutions that help to identify and use key resources. Mobility solutions are very widely deployed and early concerns around safety and security have been addressed – in some part by regulatory compliance. Today wireless is robust, fast and is secured to transport patient-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.

Wireless networking allows for location-independent working, for example within hospitals where it can be a key enabler for initiatives such as the productive ward. RFID based asset tracking offers very strong business and economic benefits. Wireless tags allow key assets to be located and tracked for security, for routine maintenance and for improved utilisation of those assets.

Remote access and teleworker solutions allow staff to work from home or when out in the community. This offers considerable benefits both to employers in terms of increased staff efficiency and effectiveness, and to staff who can potentially achieve a better work / life balance. While working from home is a benefit for many it can be essential for those who are carers, are long term sick, or have child care responsibilities. Provision of mobility solutions should be seen by an employer as a means of fostering staff inclusion, and of retaining key staff members who might otherwise not be able to continue in work.

Intelligent building technology

Connected Real Estate is the industry term for utilising the IP network to improve the function and efficiency of buildings and their environs.

Connected Real Estate calls for all essential building services – building and energy management, heating and ventilation, security and access control – to be run on the network. Once again, the network becomes a key business asset, but importantly adds reliability and reduces complexity, duplication and cost.

Data Centre

The increased reliance on ICT by healthcare providers focuses attention on the environment – the data centre - where applications, information and services are located.

In the past data centres were simply a repository for servers and storage, but today data centres are built to exacting standards of dependable power, advanced cooling and high security. They also employ virtualisation and dynamic provisioning to allow operational changes to applications and services to be made in a timely manner, with no impact on users.

These new technologies include:

- Virtualisation – so that all data centre infrastructure need not be dedicated to particular applications, and can be made available on demand to meet new needs. This can also reduce the ICT estate, hence having a positive impact on power usage and carbon impact.
- Dynamic provisioning – so that software tools can allow virtual infrastructure, servers and storage to be dynamically provisioned on demand to meet changing business requirements

Information and Service Assurance

As previously discussed, NUH ICT services are now treated in the same way as 'Critical National Infrastructure'.

That is, 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 proactive security provision along the end to end path between user and data centre. Some of the principal concerns addressed are:

- Governance – particularly in respect of 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 – 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.

The MGN deployment considered all of these areas to maximise the ability of technology to deliver on assurance policies.

Appendix D

Nervecentre Overview

Nervecentre is a Healthcare Workforce Management application that provides the business intelligence behind the process change implemented at Nottingham University Hospital. It assists in the allocation of activities to appropriately skilled specialists by helping the nurse understand who is available, and by automating the communication with the specialist.

By integrating tightly into the Cisco wireless network and mobile telephony systems, Nervecentre understands which staff are present in the hospital and where they are, and can communicate with those staff. This in itself is a huge leap forward as most ward staff in larger hospitals have limited visibility of the rotas and location of consultants and specialists outside their direct teams.

Nervecentre is not specifically a H@N solution, though it is very well suited to the Hospital At Night process. Rather it provides a reusable solution for removing internal delay in hospital processes, informing staff of important hospital events, and helping management to understand productivity and staffing requirements.

The capabilities of Nervecentre can be considered as three discrete but complementary functions:

Event notification

At the most basic level, Nervecentre notifies staff of important hospital events. These can include test results, schedule changes, changes in patient status, or emergencies. Nervecentre can provide assurance that notifications are delivered and acknowledged or take follow-up alternative action if the message is not acknowledged. This removes the need for staff to chase information and results, allowing them to focus on providing care.

Task and process management

Building upon event notification, Nervecentre manages hospital tasks and processes, whether they are clinical, housekeeping or administrative. It manages the location, availability and skills of staff and uses this information to control the assignment, governance and completion of tasks or processes.

Removing the effort of assigning tasks from the ward staff, and ensuring the most appropriate specialist receives the task, can drive significant delays from hospital processes as well as improving patient care and staff satisfaction.

Workforce management

Nervecentre tracks which staff have what skills, and also which staff are available or busy at any time. This allows Nervecentre to provide a sophisticated level of reporting into the capacity of any given specialisation along with the demand on that specialisation.

The productivity of wards and departments can be compared and trends can be analysed, allowing the productivity of specialist areas to be managed on a hospital-wide basis.

By managing all staff with a given skill set as a virtual team shared across the hospital, significant improvements in productivity and performance can be achieved.

Appendix E

Next steps service roadmap

Hospital at Night was chosen as a lead project to demonstrate that collaboration and mobile technology can drive improvements, and there were many reasons behind this decision. For example, it provides a high volume of activity with which to exercise the technology adoption. Also the working practice of Hospital at Night teams is a good fit for automation as they share a small number of highly skilled staff across a large area, making communication challenging.

However, the technology and process change deployed is not specific to Hospital at Night. It provides reusable functionality that can be applied to many different processes to drive improvements in workforce productivity and reduce internal communication delays across the hospital.

Following the successful roll-out of the Hospital at Night project across the City Hospital Campus and QMC Hospital Campus, the same Nervecentre and Cisco technology is being reapplied to support process change right across the hospital. Reapplying strategically selected technology across multiple projects increases the return on investment from that technology and lowers operational costs.

The following sections describe the areas within the hospital that have been identified by NUH as areas that provide opportunities for improvement. These are at various stages of deployment. No auditing of the benefits of these additional services was performed as part of this study, and this service roadmap is included to provide a more rounded and comprehensive understanding of the strategic direction NUH is taking.

Hospital at Night further improvements

This report focuses upon the first phase of deployment for Hospital at Night, which replaced manual, paper processes with automation and mobile devices. In the second phase the service will be extended to further improve productivity and align to other strategic initiatives within NUH.

For example, integration with other hospital systems will allow test results and other work requests out of hours to feed directly into the Hospital at Night team, removing the need for staff to act as the linkage between systems.

Nurse call

A small number of wards within Nottingham University Hospital are private rooms, which do not provide a good line of sight between the nurses' workstation and the patient rooms. In these instances, the existing nurse call system that generates an audible alert leads to several issues.

First, on hearing the nurse call alert, the nurse must walk to the nurses' workstation to see which patient is requesting assistance. This in itself adds a few minutes to the process. More importantly, without knowing which patient is requesting assistance it is not obvious which nurse should respond to the alert. Finally, it is impossible for a nurse to distinguish between routine requests and urgent requests.

This loss of ownership and lack of visibility of the priority can lead to significant delays in response, as the nurses are not able to easily decide whether to respond or not.

The introduction of the collaboration technology will send information including the patient's name, room number, and current location direct to the nurse's mobile device. Having the patient information will allow the nurses to decide who should respond, addressing the ownership problem that is causing much of the delay.

A single button-press on the phone will allow the nurse to speak to the patient without the patient moving, allowing the nurse to quickly determine if this is a routine or urgent request.

For emergency situations, an emergency button will be placed on each telephone across the ward which will automatically allow a patient or member of staff to broadcast their voice in real-time to every nurse in the ward, enabling a call for immediate help where required.

Stroke services

When an ambulance calls to indicate the arrival of a suspected stroke victim, the hospital works against a tight timescale to line up the appropriate resources to diagnose and treat the patient. The target is to treat a stroke patient within one hour of the onset of the stroke to prevent disability.

The nurse receiving the call must contact a stroke consultant to see the patient on arrival at the hospital. Should the consultant believe thrombolysis might be necessary, a CT scan needs to be organised. When the results of the CT scan are available, the consultant needs to be made aware of the results to determine if thrombolytic drugs should be administered.

Each of these steps has the potential to introduce delay into the process, especially when reliant upon pagers as the basic means of communicating between staff. If 10 minutes of delay is introduced in each of these steps the total delay will be in excess of 30 minutes, which is very significant when compared with the one hour target.

A stroke process will be configured within the Nervecentre application to handle this sequence of events, and remove as much communication delay as possible. Upon receiving the call from the ambulance, a nurse will enter the details of the patient, which will automatically be forwarded to a consultant and the CT scan facility. Governance around this communication will be automated to ensure delays are minimal. Should a CT scan be required, the consultant will be made aware as soon as the test results are available.

Maternity and suspected child abduction

Suspected child abductions are thankfully very rare. However, the infrequency of incidents leads to a problem in ensuring staff are aware of the hospital process that must be followed. Turnover of staff and agency staff exacerbate this problem, making it very difficult to ensure the appropriate process is adhered to.

This problem will be addressed by providing concise instructions to specific personnel when a suspected child abduction incident occurs. A nurse calling an emergency phone number when there is a suspected abduction will trigger the event. This will kick off a series of communications to key staff, and the communication will inform the staff exactly what is expected of them. This could include instructing security staff to cover exits.

By automating the process we can remove the training and governance issues as well as providing a safer service.

Coordination of hospital specialists

Certain specialist services that are normally organised by ward staff, such as physiotherapy or anaesthetists, have similar characteristics to the Hospital at Night process.

These services can be coordinated in the same way as the Hospital at Night activities, using the mobile devices to offer tasks to specialists based upon their location and ability. This will provide similar benefits to the Hospital at Night programme, removing the need for ward staff to spend time chasing specialists, removing delays to the treatment of patients, and providing improved visibility of the productivity of the specialist teams.

Porter and estates services

There are many similarities between the Hospital at Night process and the allocation of activities to porters and estates services. The collaboration technology can equally be applied to these services to reduce delays with the services and increase productivity.

Improvements in porter services can improve efficiency of many areas of the hospital such as theatre and patient discharge. Nervecentre will provide visibility into the productivity of porters to hospital management, and transparency of porter requests to ward staff.

