12-3-2014

Customising doctor-nurse communications

Brian Cusack
Auckland University of Technology

Dave Parry
Auckland University of Technology

DOI: 10.4225/75/57981f9831b43
3rd Australian eHealth Informatics and Security Conference. Held on the 1-3 December, 2014 at Edith Cowan University, Joondalup Campus, Perth, Western Australia.

CUSTOMISING DOCTOR-NURSE COMMUNICATIONS

Brian Cusack[1], Dave Parry[2]
[1,2]Auckland University of Technology
[1]brian.cusack@aut.ac.nz, [2]dave.parry@aut.ac.nz;

Abstract

Doctor-Nurse communications are critical for patient safety and workflow effectiveness. Our research question was: What further improvements can be made to current communication systems? A variety of mobile and land based communication systems have been used and experimented with. In the study, the pager was found to be most common and more recent attempts to provide broadband capability with systems such as the iBeep. We built an alternative information system using Android phones and a software application that was customised by feedback from the medical professionals. The trial in five wards with 22 doctors and 170 nurses over one month showed marked improvement in the end users' perception of technologies to help their work. Customising the Doctor-Nurse communication channel with role based communication applications, smart phone capabilities enhanced the efficiency, safety, and effectiveness of a time challenged work force. Nurses found they could provide more information and that it was easier to portray how unwell a patient is. Doctors found they were better able to prioritise their time and that urgent tasks were more apparent for immediate action. Each effect had beneficial work impacts.

Keywords
Communications, Doctor-Nurse, Customisation, Effectiveness, Patient Safety.

INTRODUCTION

Systems to improve information management and information flows between nurses and doctors are critical in the path of patient safety and hospital service effectiveness. The natural ratio of numbers between nurses and doctors determines a potential bottleneck for messages and an interface in which serious problems can occur (Coiera & Tombs, 1998). The structural consistency of information and the frequency of messages are two determinants that are shown to affect the effectiveness of decision-makers (Westbrook, Ampt, Kearney, & Rob, 2008). In the pressures of medical service delivery, other matters such as attention deficit, interruptions, and priority calls affect the performance of actions in response to communications. The house officer's role in the hospital system is a pivotal role in the evaluation and management of medical problems on a ward. The doctors who perform this role experience wide fluxutions in demand as the ratio of doctors to nurses varies cross a working day and in relation to the variation in urgency for patient medical requirements. The role was selected for our study as it is a 24 x 7 role that is heavily supported by communication technologies and is critically central to service delivery.

Previous studies have shown that doctors require filters in information to determine priorities, to create evaluation time, and to manage information congestion (Coiera & Tombs, 1998; Patel, Reilly, Old, Naden, & Child, 2006; Liang, Day, Orr, & Warren, 2011). Policy solutions are often implemented that reduce the frequency of nurse – doctor messaging. Such solutions make information more manageable but fail to address key questions regarding the structures and styles of information a doctor requires, the minimal conditions under which a doctor may make safe decisions, the type of resources required for better information processing, and what technological solutions are already available to improve the outcomes from a work-flow bottleneck. Answers to these questions address concerns regarding potentials for greater effectiveness, reduction in mishandled cases, improved nurse - doctor communication confidence, and enhanced House Officer performance satisfaction.

Current hospital communication technologies provide a baseline from which to assess technology solution improvement for nurse – doctor communications. The alphanumeric pager was implemented as an improvement on synchronous telephone communications. The pager system permitted remote and asynchronous communications but carried little information and had few controls for prioritisation of urgency and message frequency. Similarly, text messaging and voice communications using mobile phones have been implemented, including broadband connections for rich media. The shortcomings of the innovations have been service and fit requirements. In many hospitals cell and other wireless signals vary in intensity within buildings challenging continuity in services. Other issues have also arisen with battery life, software refresh rates, disruptive interfaces and screens, and the interruption to normal workflows. Our experiment implemented a prototype smart phone system for nurse – doctor communications that was designed to overcome the technical issues found in previous services and with an interface designed from nurse – doctor consultation. The results show that further significant performance gains can be made from better balancing the synchronised communications of nurses with the asynchronous responses from doctors. Consistent technical service coupled with the doctor's customised information structure requirement improved accuracy, confidence and service times. This paper reviews the background literature, describes a research methodology, and discusses the findings.

BACKGROUND

Hospital medicine can be characterised as a complex team-based activity with a requirement for a high level of accurate, timely and reliable communication. Junior physicians have been observed to spend over a third of their time performing professional communication activities (Westbrook, Ampt, Kearney, & Rob, 2008). Up until recently, pager-based systems have been widely seen as the most cost-efficient method of communication in terms of time-critical tasks. However, pager systems have long been known to be extremely inefficient (Coiera & Tombs, 1998; Haroon, Yasin, Ecked, & Walker, 2010) in terms of missed pages, multiple pages required to get a response and incorrect paging. Adding text messages to a pager system has not been shown to be effective in terms of increasing satisfaction or efficiency (Liang, Day, Orr, & Warren, 2011). More recent work (Patel, Reilly, Old, Naden, & Child, 2006) has shown that only 30% of pages were both appropriate and required immediate action. There has been considerable interest in the use of electronic systems based around computer-supported cooperative work (CSCW) models (Pratt, Reddy, McDonald, Tarczy-Hornoch, & Gennari, 2004). In CSCW a distinction is made between synchronous and asynchronous communication modes. EMR systems can be thought of as asynchronous communication tool, and telephones and pagers as "synchronous" communication.

There has been shown to be a strong preference for synchronous communication methods in hospital practice (Edwards, Fitzpatrick, Augustine, Trzebucki, Cheng, Presseau, Mersmann, Heckman, & Kachnowski, 2009). However, synchronous communication is likely to be interruptive and interruptions have been shown to increase errors in medication administration by nurses (Westbrook, Woods, Rob, Dunsmuir, & Day, 2010) and lead to "interrupt –driven" behaviour by emergency room physicians (Chisholm, Collison, Nelson, & Cordell, 2000). Apart from the temporal relationship between communication types, there is also a distinction between structured and unstructured communication. Work in clinical handovers (Porteous, Stewart-Wynne, Connolly, & Crommelin, 2009) and operating theatres (Lingard, 2008) reiterates the need for structured communication that reduces the likelihood of misunderstand or mis-priortisation of work requests. Work that is both urgent and potentially open to miscommunication requires both structure and synchronicity.

Table 1: Examples of modes of communication

	Asynchronous	Synchronous
Structured	CPOE	ISoBAr Handover
Unstructured	Free-text notes	Voice conversations, Paging

Outside the hospital SMS messages are used extensively, but despite the apparent simplicity and asynchronous nature of the medium, conversations via SMS may become complex and take longer than voice communication (Laursen, 2005) due to the need to confirm messages. Smartphone communication including voice, email and SMS are used as an alternative to the official pager system (Haroon, et al., 2010) and in small-scale studies these have been shown to be effective and efficient (Ortega, Taksali, Smart, & Baumgaertner, 2009). However, a larger study of, commercially available smartphones evaluated for hospital use was less positive (Wu, Morra, Quan, Lai, Zanjani, Abrams, & Rossos, 2010). The availability of email alongside voice communication was seen to be helpful but there were concerns about increased interruption and a reduction in the perceived barriers to contacting physicians. In terms of asynchronous communication methods, CPOE systems are known to have an influence on communication methods (Aarts, Ash, & Berg, 2007) especially between professional groups, but this is not always the case.

METHODS

The aim of the research was to make a more effective communication system. The approach was pragmatic and the steps were broken down into a systematic order. First, to listen to the professionals and to understand what issues, problems and solutions they saw as related to the Doctor-Nurse communication Information Systems (IS) and the work implications. Then to analyse their concerns and produce a thematic analysis to resolve requirements for IS improvement. Followed by building a prototype system, implement it in a hospital trial and to evaluate the impact. No one traditional IS development theory encapsulated all of what we wanted to achieve so it was decided to take some of the principles from systems analysis and design, some from prototyping methods and some of the principles from Soft Systems methodology and put these together as a research framework. Consequently, our method was more objective driven than theory based and the outcomes pragmatic in the sense that these would be situational measurements. The design was in phases and had feedback loops but was largely forward propagations where the outputs of one phase fed the next. For the purpose of investigation, the project stopped after the evaluation phase but it could equally be continued for further rounds of evaluation, system improvement, and implementation (Figure 1).

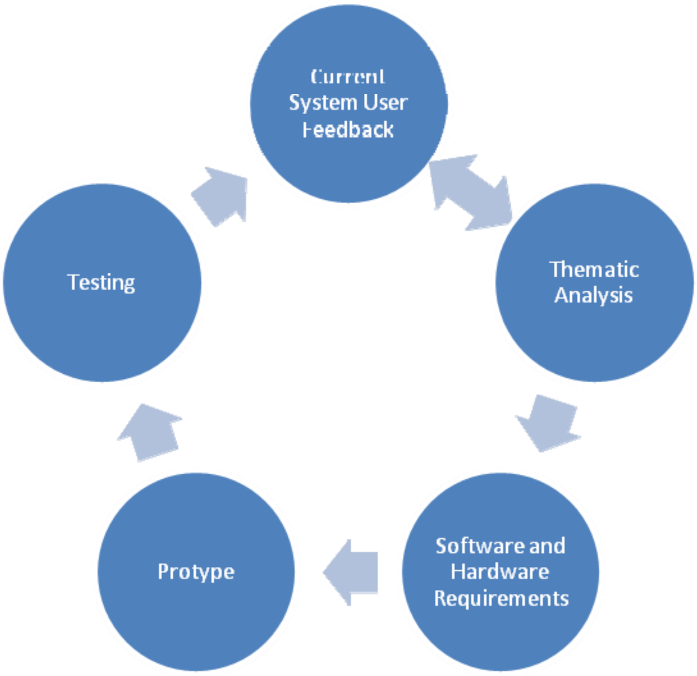

Figure 1. Research Phases

The thematic analysis delivered a range of software and hardware requirements that the professionals generally communicated as negatives about the current pager and iBeep systems they had used in the hospital. Then we took these negatives through the feedback loop and asked them to describe the ideal system for communications. Much rich data and detail was gained as to not only what to fix but also what to make an enhanced system look like and how it should perform. One of the clear messages was that the IS had to be robust in the workplace and fit for purposes. The concept of robust included both software and hardware requirement for the overall IS. In the area of hardware things like size, weight, battery-life, ease of access, pouch holders, signal strength, interoperability, and durability (ie. What happens if the mobile device is dropped or immersed in water or other chemicals) were all raised as critical. For the software the content, the styling, the refresh rate, the navigation, the security, the policies, the simplicity, error correction and functionality were all raised as concerns. Importantly the professionals required the GPS tracking to be turned off so they could not be tracked but welcomed time stamping to verify actions. These requirements were then formalised into software and hardware developments. The hardware (Androids) was selected and customised to fit the workplace. The software was also and customised according to the professional's requirements. In this way, the research evaluation was to review a fully customised IS for medical professionals.

The fifth phase of the research was to test the system in a hospital. This proved difficult, as the professionals were happy to provide information on the situation with the current IS and the ideal improvements but any prototype trials would be disruptive to workflow. Discussions with hospital management provided three general wards, a cardiac ward and a short stay ward for the trial. The ethics and disclosures permission processes were also completed. The target group was to be House Surgeons and in the high messaging time of after hours. The positioning of the study captured the critical communications bottleneck when there would be fewer doctors available and in a time zone when many of the communications would be done by mobile communications. For the hospital it also minimised disruption but maximised the opportunity to assess enhancements for the IS. Consequently, the actual trial had 22 doctors, 170 nurses and was run over one calendar month of 28 days. The data was to be of two types: that which was purely human perception and that that was from the IS log files detailing every communication. The data was to be collected from interviews, an online survey, documents and the system logs. Each element of the design provided critical data type for understanding the impact of a customised service. One of the aims of the research was to improve reliability and confidence in the receipt of messages. Simple receipting can improve workflows by each party knowing the responsibility has been discharged correctly.

RESULTS

The prototype system was implemented with 30 minutes training for each participant. The trial ran for 28 days in 5 wards of a large inner city hospital. The system was in place for 520 hours with 22 doctors, 170 nurses and 452 patients. The prototype replaced the on-call pager for the Med C call house-officer after-hours and there were no faults in the 1316 pages sent and received. The log data was categorised into 11 statistics plus a further 8 categories for medical class identification. The 11 statistics were create time, receive time, read time, complete time, receipt time, read time, total message completion time, sender, receiver, patient hash code, and message content. Analysis of statistics showed a number of observations. Significantly, more information was being sent to doctors, with 93% of pages including more information than standard text pages (100 characters), ranging from 84 to 532 characters, with an average character count of 166. Unlike with pre-existing paging systems, all pages included each patient's full name, NHI, age, gender, and bed number, as well as the nurse's name, ward and extension number (Figure 2).

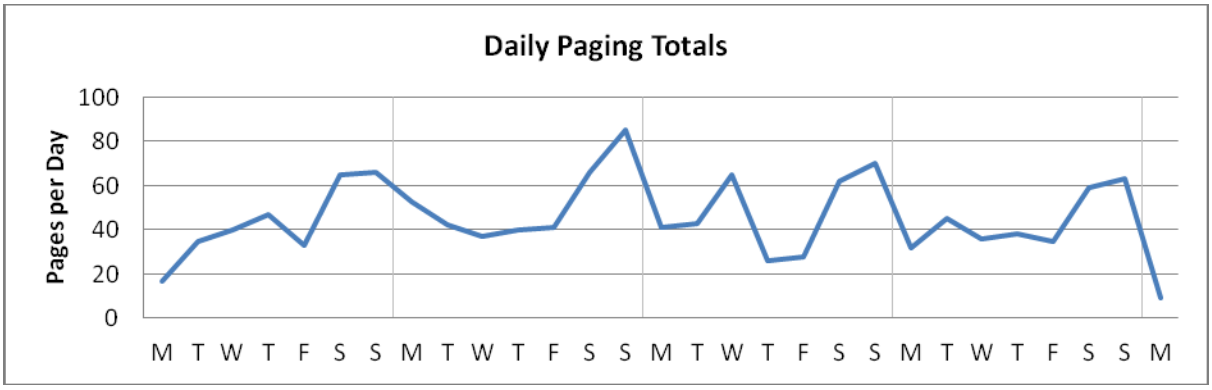

Figure 2: Daily Message Volumes

The most commonly requested tasks (Figure 3) were for patient reviews (not otherwise specified), non-specific medication requests, and for review of abnormal observations. 67 pages were sent regarding Warfarin prescriptions, and 68 IV lines were requested, with as many as 5 in one shift. These statistics are commented on in the Discussion section as they show a variation that would not usually be expected. In addition, analysis of time stamps showed that most of these requests happened after shift changes and staff rotation.

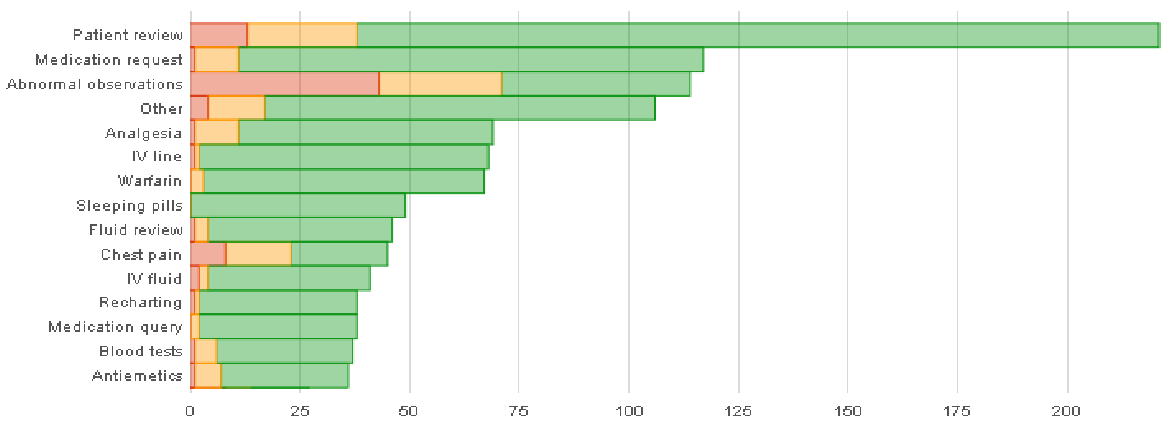

Figure 3: Message Content by Number

Page acknowledgement was rapid, with most pages acknowledged by 20 seconds; and 84% by 1 minute. Acknowledgement information could be seen on the wards in less than 2 seconds (Figure 4).

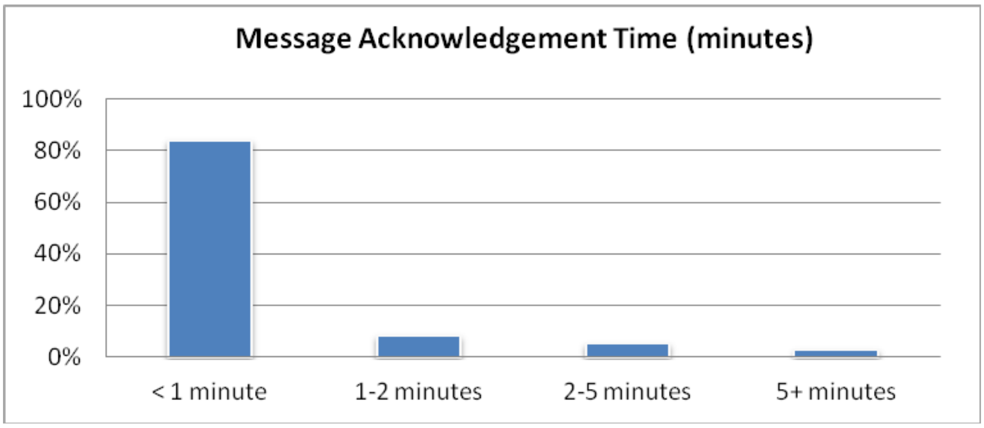

Figure 4: Message acknowledgement times

Battery life was an average pager lifetime of 23 hours, easily covering both evening and night shifts with one battery. There were no technical failures in the 520 hours of use and the signal had sufficient consistency for continuous service and bandwidth for each message payload.

To collect soft data interviews were made of the participants (who volunteered as per the ethics approval), documents collected and an online survey made available for feedback. All doctors and nurses participating in the trial were asked to fill out an anonymised online survey and this had a response rate of 45% for nurses and 77% for Doctors. No attempt was made to chase up people or inquire as to why there were not 100% returns. Our actions were in keeping with the ethics approval and the disclosures and conduct agreements. The percentages calculated expressed the positive response divided by the number of responses. The feedback from nursing and medical staff involved in the trial indicated that clear benefits in terms of communication, safety, and workflow were found. Key benefits from the Nurse's perspective have been the ability to send more clinical information, and the immediate feedback received when their messages are delivered and read. Doctors have been able to receive comprehensive and pre-prioritized pages with minimal interruption, and then respond to those pages remotely while being able to organise their workload more efficiently (Figure 5).

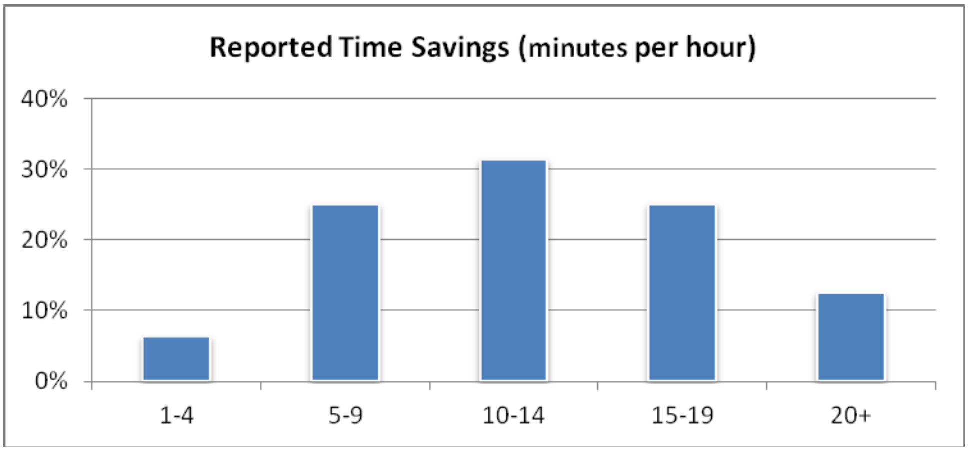

Figure 5: Reported timesaving

98% of respondents found the prototype easy to use, and with 98% reporting that the training supplied was sufficient to use the IS confidently. 92% of doctors and nurses reported timesaving with. Doctors reported an average of 10-15 minutes out of every hour saved, with some reporting savings of over 20 minutes per hour. The stability of the system coupled with the immediate receipting and acknowledgement features provided a trust factor so that participants (Nurses and Doctors) had the confidence that once a message had been sent it was in the work system and it would be acted upon. No time was wasted in follow up or clarification. 96% of nurses agreed that there was less need to send repeat pages about the same issue, with repeat paging decreasing to less than 1% in the final week of the trial. 100% of pages were acknowledged by doctors, with doctors and wards choosing to update or send a text reply in 24% of cases. 13% (173) of all tasks were handed over to night or weekend doctors, with 100% of doctors surveyed finding it easier to accurately handover tasks. The number of tasks sent per shift varied widely, from 10 to 44, with an average of 20. Weekend mornings and day shift handovers were the busiest in this trial, with an average of 28 pages per shift and a higher proportion of semi-urgent and urgent pages. Weekend nights were the quietest, with an average of 15 pages.

Survey results and interview data suggest that timesavings were converted into faster response times, faster completion of tasks, and more time spent with unwell patients. 94% of nurses found that doctors got back to them quicker with the prototype, and 90% of nurses found that ward tasks were completed quicker. 94% of doctors reported that the prototype allowed them to respond faster to urgent calls, and 76% reported they were completing all of their tasks faster. 94% of doctors reported a better ability to prioritize tasks, and 88% reported high workloads being more easily managed. 100% of all survey respondents commented on the reliability. Pre-existing paging systems had no record of successful message delivery. Our prototype recorded all messages sent during the trial as delivered, acknowledged, and completed. Standard pagers require tasks to be written to paper. 71% of doctors reported that when using text pagers tasks can be easily lost or forgotten, whereas with the prototype this reduced to 0%.

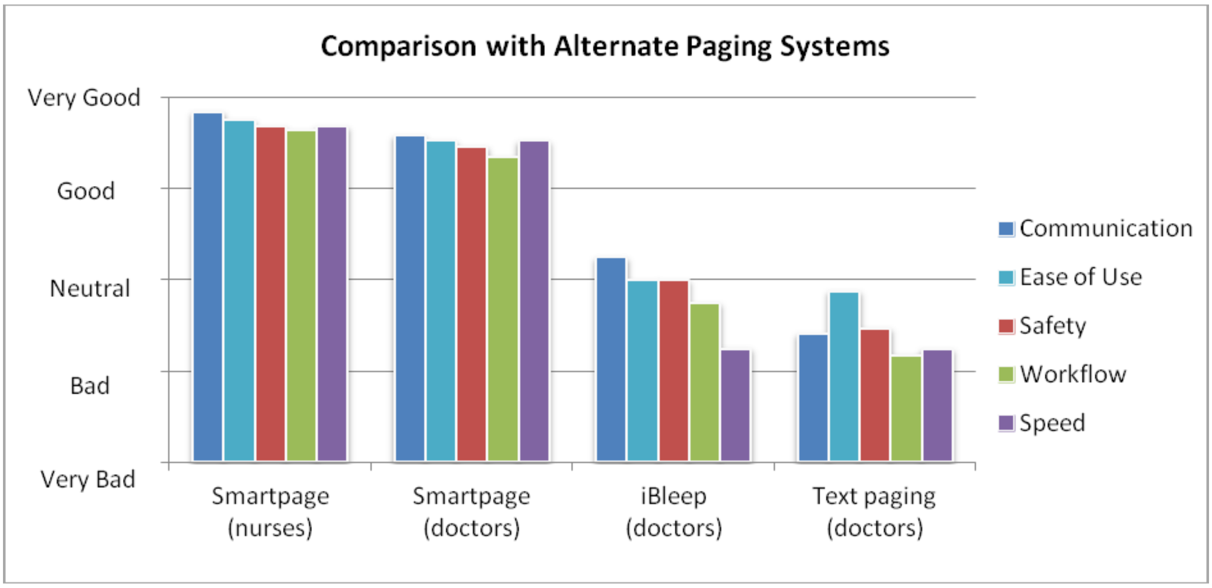

Figure 6: Comparison of IS based on Perception

The purpose of our study was to improve an IS and to report ways of doing this. Consequently, the participants were asked to comment upon the prototype (called "Smartpage" for the trial) in relation to their perception of previous hopes and experiences with the two other communication systems being used in the hospital. Both nurses and Doctors found the customised prototype to perform better on each of the five key performance indicators (Figure 6). 100% of nurses found that the prototype allowed them to provide more information compared to existing paging systems, and 100% agreed that it was easier to portray how unwell a patient is. 94% of doctors found that the pages they received were easier to understand, and 94% found that the urgency of pages were more apparent. 100% of nurses found the ability to know when pages are received or read very or extremely important. 94% of doctors found the ability to reply back very or extremely useful, with 86% of nurses reporting that they knew more about when doctors were attending their patients. 95% of nurses found that they had faster responses and 95% of doctors found that they were able to attend urgent tasks quicker than before. 100% of doctors found that there were fewer repeat pages and 59% found the prototype caused less interruption when compared to standard paging systems. 94% of doctors ranked the prototype as their No 1 preferred paging system, with one doctor preferring a cell phone. 100% of all doctors and nurses surveyed preferred prototype to the pre-existing paging system and 100% agreed that they would like to continue using it (Figure 6).

The trial data demonstrates that significantly more information was being sent to doctors, and they were reading it. Unlike with pre-existing paging systems, all pages included each patient's full name, NHI, age, gender, and bed number, as well as the nurse's name, ward and extension number. Observations were entered for 16% of pages, and for 70% of all pages triaged as urgent. 100% of doctors found the inclusion of observations and NEWS to be important, with 100% of nurses reporting that the prototype allowed them to better convey how unwell their patients were. 98% of pages kept their initial triage, indicating that nurse and NEWS- based triage was appropriate. The concept of NEWS was that either additional information would help decision-making or it would provide updates on situations. Medical staff carry a genuine concern for their patients' wellbeing and because they had discharge the responsibility for care it did not mean they had stopped thinking about the case. NEWS meant a doctor or a nurse could post an update on a patient without requesting action. The NEWS posting would be available for the teams of staff. The service reduced messaging and stress levels with more available quality information. The use of the service is shown in Figure 7.

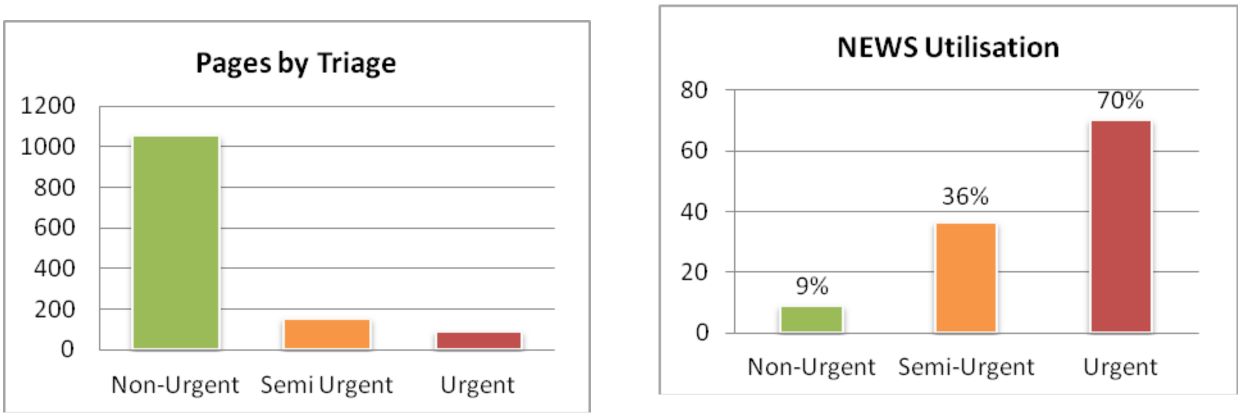

Figure 7: Rich Media and Updates

DISCUSSION

Without formal experimental testing procedures it is impossible to assess, independently, the material impact of a new IS. In this study, we relied on participant's perception of matters in order to evaluate the impact of the new system. We did not and could not control many variables such as the many moderating variables and the novelty factor of the trial – that was viewed by some as a type of "peoples' revolution" to reclaim workplace control of technologies. It can be argued that there is insufficient evidence to prefer one system to another when qualitative data is a large part of the assessment. On the matters of usage, task categorisation, and acknowledgement times, there is no dispute. These measures came from the IS log files and are factually recorded for analysis. However, at the least it can be counter argued that in the participant's perception the prototype provided the types of improvements they were requiring. In their responses, the new system was better than the old. They also said how it was better and why it was better. These matters of perception have a wider impact in the utilisation of technology. Soft variables such as confidence, motivation, and success orientation contribute to a more fluid and productive work environment. On the hard matters such as adequate battery life, sufficient signal strength, receipting for sent messages received, read receipts, and turn-around time; material evidence was available to suggest these problems had been fixed in the prototype. The concerns also have a bearing on patient safety. The figures showed that the IS system did not break down, the participants had continuous service over the 28 day trial, refresh rates were consistently timed to be quick, pages were not lost, pages did not have to be resent or alternative communications systems used, and the response times Nurse-Doctor-Nurse were recorded. The factual and circumstantial evidence suggests that the prototype provided a number of improvements that the professional users expected of an effective information system.

The information logged of each communication provided an audit trail and a repository for data mining. These data are valuable for financial and safety checks, and for managers involved in strategic planning. The loadings of staff and the critical points where excessive demands come over any week are clearly visible and can be projected on to continuous MIS reports. Also at times where work loadings are minimal staff can be moved to other tasks or contracts arranged to minimise budget impacts. On the matter of safety the records over the trial period showed mistakes occur at shift change over times and unusual quantities of drugs being used. Such matters can quickly be addressed by changing procedures and pinpointing the circumstances surrounding aberrations. The accuracy of the prototype system (ie. it had no service downtime that staff would have worked around) assured significant patterns were visible and trustworthy for decision-making. These data have business value for early warning systems, budgeting, and safety checks.

The way our research proceeds can be argued to be getting the answer before the question is formed. We deliberately went to the potential users of the IS and built a new IS based on their requirements. The outstanding irritations and the problems seen and experienced in the current system by the users were known before we started building. Our build specifically addressed these issues in every respect. We did not invent new hardware or software but simply made current opportunities work better for the people who were to use it. The innovation was to make the hardware fit for purpose and the software effective for the business requirements. This is a simple pragmatic demonstration of things that work and not a scientific method or a study requiring independence for judgement. The value of such development is in incremental improvements that generalise across a system from the hard count data to the soft perceptions that people express opinions from. As continuous improvement, the pragmatic methods have potential to adapt and change to fit the evolving requirements of technologies and the people using them. Customising IS is expensive but it is one way to bring organisational performance improvements. In our case, the timesaving better-used resources, the confidence the users had in the IT services performance reduced messaging, the customised information format carried useful meaning, and the accumulated data allowed managers to audit and safety check.

CONCLUSION

The messaging bottleneck between nurses and doctors has been widely studied and identified as an area for improvement. This study shows that the implementation of a trial prototype IS that had been developed from the participating professional's requirements contributed significant performance improvements in the work place. Customising software for the work environment from the requirements of those who are to use the IS delivered a solution to many of the outstanding issues influencing effective service delivery. Measureable performance improvement was recorded. These improvements translate into cost savings, better safety, and greater service delivery with the same resources.

ACKNOWLEDGEMENT

Dr Adian Gill is acknowledged for the data collection, data presentation and the inspiration for this paper.

REFERENCES

Aarts, J., Ash, J. & Berg, M. (2007). Extending the understanding of computerized physician order entry: Implications for professional collaboration, workflow and quality of care. *International Journal of Medical Informatics, 76*(Supp 1), S4-S13.

Chisholm, E., Collison, D., Nelson, R., & Cordell, W. (2000). Emergency department workplace interruptions are emergency physicians "interrupt-driven" and "multitasking"?, *Academic Emergency Medicine, 7*(11), 1239-1243.

Coiera, T., & Tombs, V. (1998). Communication behaviours in a hospital setting: an observational study. *British Medical Journal, 316*(7132), 673-676.

Edwards, L., Fitzpatrick, S., Augustine, A., Trzebucki, S., Cheng, C., Presseau, C., Mersmann, B., Heckman, B., & Kachnowski, S. (2009). Synchronous communication facilitates interruptive workflow for attending physicians and nurses in clinical settings. *International Journal of Medical Informatics, 78*(9), 629-637.

Haroon, F. Yasin, R. Eckel, F., & Walker, M. (2010). Perceptions and attitudes of hospital staff toward paging system and the use of mobile phones. *International Journal of Technology Assessment in Health Care, 26*(4), 377-381.

Laursen, D. (2005). Please reply! The replying norm in adolescent SMS communication. In *The inside text*, ed: Springer, pp. 53-73.

Liang, K. Day, M. Orr, T., & Warren, J. (2011). Insights from an iBleep trial: Understanding the implications. *Health Care and Informatics Review Online, 15*, 13-22.

Lingard L (2008). Evaluation of a preoperative checklist and team briefing among surgeons, nurses, and anesthesiologists to reduce failures in communication. *Archives of Surgery, 143*(1), 12-17.

Ortega, S. Taksali, R. Smart, R., & Baumgaertner, M. (2009). Direct cellular vs. indirect pager communication during orthopaedic surgical procedures: A prospective study. *Technology and Health Care, 17*(2), 149-157.

Patel, K. Reilly, A. Old, G. Naden, R., & Child, S. (2006). Appropriate use of pagers in a New Zealand tertiary hospital. *Journal of the New Zealand Medical Association, 119*(1231), U1912.

Porteous, E. Stewart-Wynne, M. Connolly, M., & Crommelin, P. (2009). iSoBAR-a concept and handover checklist: the National Clinical Handover Initiative. *Med J Aust., 190*(11 Suppl), SS152-6.

Pratt, M. C. Reddy, D. W. McDonald, P. Tarczy-Hornoch, P., & Gennari, J. (2004). Incorporating ideas from computer-supported cooperative work. *Journal of Biomedical Informatics, 37*(2), 128-137.

Westbrook, A. Ampt, L. Kearney, L., & Rob, M. (2008). All in a day's work: an observational study to quantify how and with whom doctors on hospital wards spend their time. *Medical Journal of Australia, 188*(9), 506-509.

Westbrook, A., Woods, M., Rob, W., Dunsmuir, T., & Day, R. (2010). Association of interruptions with an increased risk and severity of medication administration errors. *Arch Intern Med, 170*(8), 683-690.

Wu, R., Morra, D., Quan, S., Lai, S., Zanjani, H. Abrams, H., & Rossos, P. (2010). The use of smartphones for clinical communication on internal medicine wards. *J Hosp Med, 5*(9), 553-559.