Usability And Impact Of A Mobile Information And Communication Technology Device At An Academic Hospital

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Abstract

Communication problems among health care workers may engender medical errors. Theoretically, Mobile Information and Communication Technologies (MICTs) could reduce medical errors by improving communication within a health care setting; in practice however, evaluating the impact of MICTs has been problematic. A simple and effective approach to determining the patterns and effects of use of MICTs lies in the review MICTs' logs. Such a review may yield supplementary validation to the findings of traditional usability studies. We conducted electronically a traditional usability survey of a MICT device manufactured by Vocera Communications System and reviewed the log of its usage. We also reviewed the log generated the COMLinx- Nurse Call Management System. Thirdly we performed a social network analysis of the users of the Vocera device. Staff using the device were predominantly nurses. They were highly satisfied with its ease of operation even though battery life and system availability were problematic. Those using the device registered more visits to patient room. Key adoption influencers were identified.

Introduction

Communication problems among health care workers play a significant role in the genesis of medical errors [1-3], and, to some, the solution should be sought in the cognitive and engineering sciences rather than medicine [4, 5]. In a retrospective review of 14,000 in-hospital deaths in Australia, communication error was determined to be the leading cause of death, in fact twice as frequent as errors caused by inadequate clinical skills. Also in another study, communication problems between physicians and nurses accounted for 37% of errors in an intensive care unit [6].

The context of an academic hospital requires an effective, clear, unambiguous and synchronous communication system to address the demands of a complex communication-intense environment where activities of patient care, medical research and academic activities intermingle. Typically, clinicians navigate many sites from wards, clinics, diagnostic and therapeutic centers to class rooms while they need to maintain constant communication with each other, patients, support staff and patients' families.

Significant advances in voice recognition, wireless technology, connectivity, and identity management have enabled the design of smart communications devices, upon which clinicians depend. Devices built on the convergence of these technologies are gaining adoption in hospital settings. It has been suggested, albeit with scant evidence, that they may have a significant impact on medical care. Theoretically indeed, they hold the promise of improving communication within a health care setting [7, 8]; in practice however, health care organizations have struggled to evaluate the impact of MICTs [9].

Vocera is a wearable hands-free communications system using an existing wireless local area network (WLAN) to support instant mobile voice communications and messaging [10]. The system has been implemented in a number of acute care hospitals across the nation, including St Agnes Hospital in Baltimore[11]. The system is deployed in eight functional units at our academic hospital. We sought to evaluate its usage. Specifically, the goals of this assessment were to: (1) document current usage of Vocera and related problems, (2) identify the determinants of its optimal use and (3) provide recommendations for future deployment.

The study focused on two intervention units: a medicine unit and a surgical unit. In addition, two control wards were examined. The study included a usability survey, the analysis of log file data generated by Vocera System and Nurse Call Management System (NCMS) and, social networking analysis.

Methods

Setting: The site for this study was a 995-bed academic medical center with approximately 46,000 discharges a year. Two intervention units were selected: a medicine ward with a bed capacity of 25 and staffed by 44 nurses (N1); a surgery ward with 20 beds and 38 nurses at the time of the study (N2).

Two other units O1 and O2, functionally comparable to the intervention units were included as controls. These did not use the Vocera system.

The device: The Vocera Communications System is manufactured by Vocera Communications Inc. and is built on the convergence of three technologies: wireless LAN, VoIP, and speech recognition software. It uses an 802.11b wireless network to enable instant synchronous communications between staff members. The system itself has two main components: the Vocera Communications Server Software and a Vocera Communications Badge. This badge is a small, wearable device, weighing less than two ounces that permits quick, one-button voice access to other users on the system, or connects to outside phones through PBX integration. This communication "badge" contains a speaker, microphone, and an LCD display for caller ID or text messaging. The accompanying server software utilizes user-neutral speech recognition and users can call other users by name, role, group, or location

Usability survey: We designed a survey consisting of 24 questions, constructed in Survey Monkey®. The survey included basic demographical information, work conditions, usage of Vocera and satisfaction with select aspects of the device as well as work environment. The survey instrument, exempted by the IRB, was pilot-tested, and released to nursing staff from May 12 trough June 15, 2006.

Vocera logs: We examined the log files of communications generated by the Vocera server for ninety days. All calls attempted and made were reviewed. All inbound and outbound calls were examined for volume, patterns, and quality.

COMLinx-NCMS Logs: We evaluated time motion data collected from the COMLinx-Nurse Call Manager System (NCMS) in an effort to quantify the impact of Vocera on the clinical setting. The NCMS is a comprehensive clinical communications system that includes an infrared staff locator and tracking module.

Social network analysis: Coeira has posited that the value of any particular information technology can be determined only with reference to the social context in which it is used and, more precisely, with reference to those who use it [12, 13]. Social networking techniques are useful in assessing the dynamics of communication, particularly in understanding the diffusion and adoption of MICTs. We analyzed patterns of communication on the Vocera system using VisuaLyzer® 1.2 (MDLogix) .

RESULTS

Usability Survey: Overall, the survey response rate was good (49%) but varied between the intervention units (54%) and the control units (15%). Respondents were preponderantly nurses or nurse assistants (84%) and female (85.2%). The intervention units (N1 & N2),expressed moderate to high level of satisfaction with the device (84%) (Table 1), particularly its ease of use and features such as "hands free". Control units (O1 & O2) indicated a high interest in the device whose use they have observed (envy factor).

Two features, battery life and system availability, were problematic for users (Table 2). Many features were simply not known to the users: headset, playback, call waiting or outside dialing capability, underscoring possibly insufficient training.

Features Most Satisfied With	
Hands free	97% (34)
Size and weight	86% (31)
Login	78% (28)
Do not disturb mode	69% (25)
Dialing internal extension	63% (22)

Table 1: Convenieent features

Features Least Satisfied With	
Battery life	68% (24)
Calling and receiving call	60% (20)

Table 2: Inconvenient Features

Patterns of interpersonal communication were similar in all units whether staff were engaged in "direct patient care" or "non direct patient care" tasks. Typically, interpersonal communication occurred within a professional category.

Vocera Logs: Overall, 11,303 monthly calls were attempted on the system, on average. Of these, 61.4 % were successfully completed (hit). The heaviest use of the system occurred between 2:00 pm and 5:00 pm. The average duration of call was 19.2 seconds. Users attempted 2.3 calls a day, on average. However, there were "super-users" who placed as many as 21 calls a day.

COMLinx-NCMS logs: The data was collected over

a five week period starting in April of 2006. More than 200,000 data points were collected on 36 clinicians performing comparable functions. The data was organized and parsed into weekly segments. We found that on average, the number of patient visits by a nurse in N1 was more than twice that of O1.

The number of sensors that a nurse passed through in the course of a week was a third less for the Vocera group. This finding suggests that Vocera nurses followed a more direct route to reach patients.

Vocera usage appeared to be positively correlated with the number of visits by nurses to patients' rooms (Figure 1).

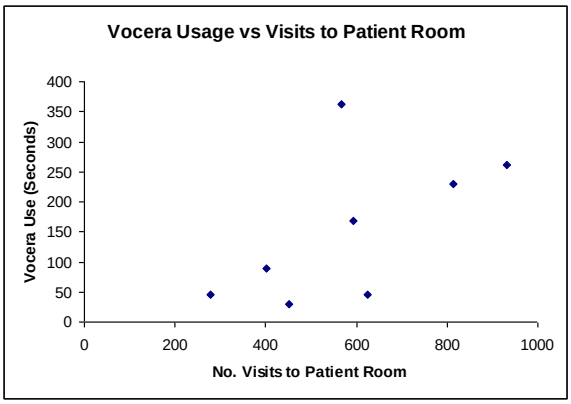

Figure 1: Vocera Time of use and Room Visits

Social network analysis: The data on patterns of communication from our subjective usability survey were inconclusive. The Vocera logs provided an objective source of data. In order to discern any general trend in communication and elucidate factors that may promote a successful adoption of MICTs such as Vocera, we examined these data by using the VisuaLyzer® 1.2, for volume and patterns of communications on N1 for a representative twenty four hour period. The analysis revealed six (6) core and twenty seven (27) peripheral nodes. Three (3) opinion leaders emerged as being points of the most intense communication activities in the network (H, I, J). Although they were not nurse managers or supervisors, these leaders tended to have been on the job slightly longer than the rest of the network: (7.2 years) as compared to (6.9 years). Besides requiring abbreviated training on the system (15 minutes or less), and expressing the highest level of satisfaction with the system (100% very satisfied) as determined through the usability survey, no other characteristic distinguished the opinion leaders from the rest.

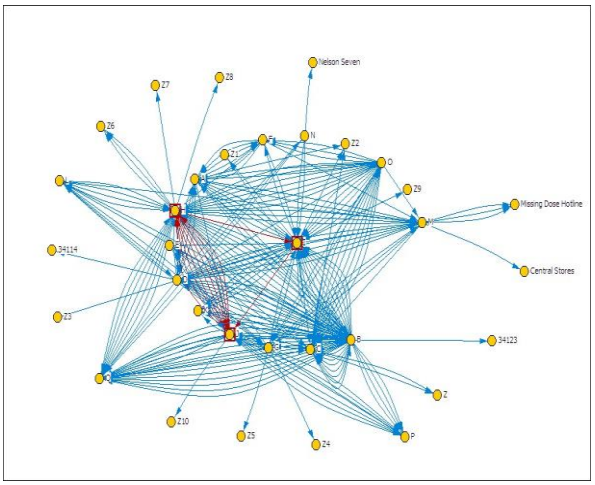

Figure 2. Communication Patterns on N7

DISCUSSSION

Bad communication compromises medical care, as much as any other social enterprise. The link between communication problems and adverse events in health care merits a greater scientific scrutiny. Both technology and the social paradigms of communication are relevant considerations. Parker and Coeira believe that MICTs can play a crucial role in improving patient safety and preventing errors [14]. Using these technologies, health care workers can achieve instantaneous contact with colleagues, when needed, and remain connected to their organizations and patients. This in turn, could lead to a better care management. There are however issues associated MICTs. Synchronous systems such as mobile telephones are disruptive of work flow. On the other hand, asynchronous technologies such as pagers, intercoms and similar devices are patently inefficient for many reasons. For example, the vocal quality and clarity of overhead pagers are problematic and their noise level, obtrusive. Our study showed that the clinical staff were sufficiently concerned about "annoying" nature of overhead paging.

We have identified performance issues with the system. The most serious of these was the availability: the system connected successfully only 64.1% of the times. Also, the battery life was brief enough to raise concern about a wider and sustained adoption. Nevertheless, the satisfaction level with the system was remarkably high, in spite of these shortcomings.

The NCMS provided us with an opportunity to study time and motion, a challenging topic to assess. There is general agreement that the benefits from a good time/motion study are immense, in terms of rational

and efficient workflow design. The traditional methodology for a time/motion study involves creative direct observation and requires considerable time and resources [15]. Whereas, the data collected and stored by the hospital COMLinx tracking system, offered objective, unobtrusive, inexpensive, retrospective time/motion analysis, without undue Hawthorne effect.

Social network analysis is aptly suitable for identifying enablers of successful communication technology adoption as well as impediments to adoption. Vocera is a technological tool, but its usage is subject to the predicates of human behavior and social organization. The VisuaLyzer® tool permitted an important insight into that aspect Vocera usability by revealing the communication patterns among users.

Conclusion

MICT's could improve patient management and reduce errors by providing efficient communication among care team. Assessment of their effectiveness is difficult. A simple examination of usage logs along with social network analysis can supplement traditional usability studies in providing an insight into usage, satisfaction and adoption. The techniques enabled us to evaluate Vocera.

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