WORK SYSTEM ANALYSIS OF HOME NURSING CARE
AND IMPLICATIONS FOR MEDICATION ERRORS

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The purpose of this study was to examine the context of the provision of home nursing care for patients with congestive heart failure. A modified macroergonomic analysis and design work system analysis was undertaken in two phases with fourteen nurse participants: I) field observations of eight nurses for the collection of data on work elements and II) follow-up telephone interviews with six home care nurses. Open-ended questions were asked after the observations to identify clinical knowledge, policies, and procedures that influenced care decisions and practices. The telephone interviews focused on four different aspects of home health care delivery and were conducted using semi-structured questions. Results of the observations were translated into flowcharts and a summary report. The baseline findings described aspects of home medication management and its relevance to safety, quality of care, communication, and self-management.

INTRODUCTION

Congestive Heart Failure (CHF) has been described as “an emerging epidemic” among older Americans (Bennett, Cordes, Westmoreland, Castro, & Donnelly, 2000). CHF is a chronic, fatal disease affecting approximately 4.9 million American adults, with 550,000 new cases identified annually (American Heart Association, 2002). In addition, the cost of CHF in the U.S. was recently estimated at $27.9 billion. Deaths from CHF increased 35.3 percent from 1992 to 2002 (American Heart Association, 2005). The condition threatens longevity as well as quality of life. Management of CHF often includes pharmacological interventions, fluid and nutritional restrictions, and recommendations for lifestyle modifications.

From 1979 to 2002 the number of CHF inpatients discharged from hospitals increased 157 percent (American Heart Association, 2005). In place of inpatient care, CHF patients are more frequently being cared for in their homes using self-management supported by home health services. This change does have potential benefits, as patients are inclined to stay at home if the outcomes of home treatment are equivalent to those of hospitalization (Fried, van Doorn, Tinetti, & Drickamer, 1998). A variety of multidisciplinary interventions targeted at improving patient outcomes have been demonstrated to be effective, and are increasingly being delivered in the home. As a result of the site of care moving to their homes, patients are required to assume greater responsibility for managing their treatment regimens, symptoms, and referrals to professional home care services when deemed necessary. A major goal of home care nursing is to educate and enable patients to manage this complex disease and treatment regimens.

To facilitate patient self-management, attention has been focused on technologies that may assist home care nurses in managing and transferring management skills to CHF patients. To this end, this project, known as HeartCare II, was designed to provide information and communication resources, self-management tools and medical records access to patients in their homes via the Internet. Because patients benefit from access to Internet-based health information and communication resources (Brennan et al., 2001; Brennan, Moore, & Smyth, 1995; Brennan, Ripich, & Moore, 1991; Gustafson et al., 1999), the HeartCare project will
integrate a Consumer Health Informatics (CHI) application with formal clinical services (home care nursing).

However, experiences within and outside of health care have revealed that success is greater when the information system is designed mindful of key aspects of the work processes that the technology is intended to support (Berg, 1999; Carayon & Karsh, 2000; Karsh, 2004; Karsh & Holden, 2005). Effective information technology implementation necessitates consideration of the range of actors involved, the workflow to be supported, and the context in which the technology is placed. In this project, we set out to systematically examine the actors and the context of home care of patients with CHF to best integrate the HeartCare suite of services. This data will be used for the next phases of our study in which an information technology is designed and tested among home health nurses and CHF patients. We report here only on our baseline findings describing the nature of work for home care nurses caring for CHF patients, and focus on a part of the process involving medication management. We chose to focus on this for a number of reasons. First, research has shown that the majority of older home care patients take five or more prescription medications, often in ways that deviate from prescribed regimens, putting them at risk for adverse drug events (Ellenbecker, Frazier, & Verney, 2004; Meredith et al., 2001). Second, technological solutions have been recommended for dealing with home care problems related to medication management (Ellenbecker et al., 2004), and so data from this study may contribute to the design of functional requirements for such a technology, including the one being designed for the experimental phase of the HeartCare project.

METHOD

Designs and Procedures

Participating institutions granted IRB approval. A modified macroergonomic analysis and design work system analysis (Hallock, Alper, & Karsh, 2003; Hendrick & Kleiner, 2001) was undertaken in two phases: I) field observations to collect information about the work elements and II) telephone interviews with home care nurses to gather more information about nurses’ work. Two trained researchers observed the home health care nurses caring for patients with CHF. The researchers were non-participant observers, recording the information about the course and steps of the caring process on a notepad during observations. Nine open-ended questions were asked after the nurse and researchers left the patients’ homes to identify clinical knowledge, policies, and procedures that guided nurses’ actions and to clarify the observations. Questions were asked outside the patients’ homes to avoid any interference with the process of care delivery.

The telephone interviews were conducted using semi-structured questions in order to increase the depth and breadth of the information obtained about the processes of care delivery. The open-ended questions addressed four different aspects of home health care delivery: need for information, nurse-patient communication, self-monitoring, and medical records access. With nurses’ consent, these interviews were audiotaped to promote accuracy.

Sampling and Subjects

Nurse participants were recruited from a large home care agency affiliated with a major not-for-profit health care system in a metropolitan area in a Midwest state of the US. Thirty-six nurses from this agency volunteered to participate; based on availability 14 were involved in this study. Eight participated in field observations and six in telephone interviews. Nurses were contacted by phone and asked to allow two trained researchers to ride along with her or him. Patient and nurse informational sheets were sent by email or fax to nurses prior to the day of observation and phone interview.

Data Analysis and Validation

Two industrial engineering researchers (CO and A-SG) created separate workflow diagrams for each of the eight nurses they observed. They then synthesized the individual diagrams into a single composite. Next, they worked with one of the study investigators (BK) and a nursing researcher (GC), who has 10 years of experience in research on CHI applications and 5 years clinical background in providing acute care to patients with CHF, to ensure all details were included, coherent, and accurate. This iterative process involved scrutinizing the workflow diagram, looking for gaps in the process, going back to the observation and interview data and then refining the composite diagram. This process lasted several months. For validation, two nursing researchers, one who has almost 30 years experience in the care of cardiac patients and health outcomes research (LB), and the other who has 12 years of experience as a clinical nurse specialist and manager at the home care agency involved in this study (MS), then studied and corrected the information in the composite flowchart. In addition to the flowchart, responses from each of the post observation face-to-face discussions and the phone interviews were transcribed into a summary report. The nurses who validated the composite flowchart also validated the summary report. Other members of the
health care organization in the study were consulted for clarifications as needed.

RESULTS

One hundred and sixty-seven steps and 48 decision points were identified in the analyzed process, starting from when a nurse obtained her or his schedule and ending when the nurse left the patient’s home. Major processes identified included scheduling the visit, confirming the visit, and providing care to the patients. Because of the size, detail and complexity of the work studied, and also because of the importance of medication management for averting medication errors and adverse drug events, this paper only includes the results that describe the creation of the electronic medication profile (see Figure 1), which is the electronic medication list that the nurse creates for him or herself and the patients.

Interview data revealed that virtually all patients were discharged from the hospital with prescriptions and a complex medication regimen to follow. Through observations and interviews, it was discovered that only a small proportion of patients received a medication list to take home. This document is a complete list of all medications patients are instructed to take including drug name, dosage, frequency, and recommended times. As mentioned by a home care nurse, “If the patients just came out from the hospital and if I’m lucky, they would
have a complete list of medications that is written out at their discharge”.

On the admission to home care services, the home care nurse required the information contained in a medication list for documenting the medication profile into the computerized documentation system and for helping the patient to establish a medication schedule. Without the medication list, nurses had to rely on a patient’s or family member’s report of instructions received, inspection of medication bottles in the patient’s home, and searches of transfer documents to construct the medication profile. Nurses explained that the accuracy of this list was especially important because the medication profile served a critical role in ensuring that family members or patients correctly administered medications and nursing staff monitored the correct medications. As expressed by another home care nurse during the phone interview, “A medication list is extremely helpful for providing care, but we don’t often receive these ...”.

If nurses were still in doubt about the correct medication regimen, they would attempt to contact the intake coordinator, the pharmacist, or the discharge physician for clarification of the information. As described by one home care nurse, “It has happened that the patient did not have a medication list during admission. I used whatever I could use for creating the medication list, such as the bottles. I tried to call the doctor the same day for clarifying the information ....”. However, observation and interview data showed that nurses faced difficulty getting in touch with the patient’s physician or the pharmacist directly or immediately during home visits, thus delaying the completion of this important aspect of home care. One nurse was observed leaving a message on a voice mail system and waiting for a call back.

**DISCUSSION**

The goal of this phase of the HeartCare project was to analyze the workflow of home care nurses caring for patients with CHF. This work system analysis allowed the researchers to identify steps and decisions in the process which could lead to errors, and in particular, medication errors. Due to the fact that nearly one-third of home care patients are at risk for a potential medication problem (Meredith et al., 2001), it is imperative to focus on medication errors in home care settings.

The timely availability of a complete and accurate medication list can have a significant impact on safety, quality of care, and patient self-management. The process for creating the medication profile was observed to be fraught with safety hazards because (a) medication lists were not always available, (b) if lists were present they could be incomplete, and (c) multiple information handoffs occur between patients, nurses, and other clinicians. As stated, evidence shows that home care patients are in fact at great risk for adverse events from medication errors (Ellenbecker et al., 2004; Meredith et al., 2001). As most of the patients with CHF receiving home health care services are elderly and elderly are more fragile, they may have increased vulnerability to adverse effects from medication errors. As such, it is critical to prevent medication errors from happening to home health care patients.

We observed that nurses were frequently challenged to create an accurate medication profile because patients were typically without a medication list, and the methods used to create a medication profile all had potential for introducing medication errors. Even though nurses were encouraged to contact the intake coordinator, the discharge physician, or the pharmacist to minimize the confusion of the information, hazards remained as nurses could still make data entry mistakes when entering the collected medication data into the home services computerized medication profile. Because there was no immediate validation of its accuracy, incorrect information entered into the computerized medication profile could lead to patients omitting required medications, taking medications at the wrong time, taking the wrong medication, or taking the wrong doses. This is because nurses educate patients about taking their medications as prescribed according to the medication profile in the computer or from the medication list. Patient’s knowledge about their regimen is thus inaccurate if nurses deliver the wrong instructions due to the information inaccuracy. The consequences of incorrect medication use can include patient harm and need for repeat hospitalization, or even death.

There are a number of potential hazard reduction strategies for dealing with the observed problems. One strategy is to design a method for improving the communication between the physicians who discharge the patients, the pharmacists who have the copy of the medication list, acute care nurses who make the referral to home care, the intake coordinator who should be able to retrieve the patient’s discharge medication and other information, the home health nurses who subsequently care for the patients, and the patient who needs to take the medications. A well-designed information technology could contribute to the solution by facilitating the sharing of an electronic medication list among the stakeholders in the system. In the next phases of the HeartCare study, we will in fact test whether such an information technology can improve nursing care practices and patient outcomes in an intervention trial. Subsequent to implementing the technology, additional
work system analyses will be conducted to examine how the provision of care and patient self-management is affected.

This study had a number of important limitations that may limit the generalizability and validity of the results. First, only eight nurses were observed and six interviews were conducted, although conducting such analyses with low numbers of participants is common because of the time involved and scheduling conflicts. Second, participants were not randomly selected, thus they may not be representative of other home care nurses (and their patients may not have represented other patients with CHF). To partially address these concerns, we had a highly experienced nurse review the results to assess their validity.

ACKNOWLEDGMENTS

This research was supported by a grant from the National Library of Medicine (Grant# LM 6249). The authors thank the reviewers for their valuable comments on this paper. The order of the fourth to the tenth co-authors was determined by alphabetical order.

REFERENCES


