Awareness-Based Scheduling in a Home Care Clinical Information System

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ABSTRACT

In home care, workers from different disciplines treat patients in their homes. However, workers who treat a shared patient are mobile and rarely see each other face-to-face, so it is difficult for them to maintain awareness of others' activities. In this paper, we discuss one aspect of these information limitations by considering how limited awareness of others' schedules influences work patterns in home care. We identify and discuss several problems that arise from incomplete information about others' schedules. We examine design approaches for supporting mutual awareness of others' schedules by presenting Mohoc, a point-of-care clinical information system for workers in Saskatoon District Health, and the results of a 2½-month field trial we carried out with the system.

INTRODUCTION

Home care workers spend most of their time in the community treating patients in their homes. Many home care patients receive services from several disciplines, but because these workers are mobile and rarely see each other face-to-face, it is difficult for them to communicate and share information[1,2]. As a result, workers often have limited knowledge about the activities others undertake with shared patients, even though those activities can have relevance to their own treatments.

In this paper, we consider the role played by worker awareness in the delivery of home care services in a local health district (SDH). Awareness[3,4] is a worker's knowledge of others on the treatment team and their activities with a shared patient. In SDH, several problems are caused by limited awareness of others' work activities[5]; in this paper, we will focus specifically on how limited awareness of others' schedules influences work patterns.

In SDH, workers set their own schedules and keep unpredictable office hours. Workers record their schedules on paper, but these are not shared with other clinicians, so they have a limited awareness of others' schedules. From field observations and interviews in SDH, we identified three problems that are caused by limited access to this information: schedule conflicts, difficulties coordinating services, and difficulties initiating synchronous communication.

To address these problems (and other issues related to collaboration and information sharing in home care [5]), we developed Mohoc, a point-of-care (POC) clinical information system (CIS) for home care that operates on laptops with wireless cellular modems (see Figure 1). Mohoc supports clinical documentation, scheduling, treatment planning, and explicit communication with other treatment team members. In this paper, we will discuss the features that support scheduling, which we will refer to as scheduling tools.

The Mohoc scheduling tools attempt to improve workers' awareness of others by making information about schedules and treatments available to workers who share common patients. Due to the mobility, autonomy, and wide distribution of workers in home care, these scheduling tools were a challenging design problem. The system supports the scheduling practices currently seen in SDH, but it also distributes the information across the network so that it is available to others. This information is presented to workers through representations in the user interface. These representations are integrated with the tools that users use to carry out current work activities, so that they can consider others' activities while they carry out their own work.

In this paper, we report some of our findings from a 2½ month field trial we carried out where a team of home care workers in SDH used Mohoc to support the delivery of care to a shared patient. In particular, we will discuss how the scheduling tools influenced work patterns during the field trial, and how an awareness-based approach was useful in avoiding schedule conflicts, facilitating synchronous communication, and coordinating services. Our main conclusion is that awareness of schedule information is important for effective service delivery in home care, and that awareness-based scheduling should be a part of home care clinical information systems.

SETTING

We have been working with clinicians and administrators in the Home Care department at Saskatoon District Health (SDH), a health district in Saskatchewan, Canada, for the past two years as part of an ongoing project to develop point-of-care information systems for home care clinicians. The functional unit for managing a community-based patient's care in SDH is a treatment team—a group of workers who separately travel to a patient's home and deliver a range of services to that patient. Treatment teams can be made up of workers from several clinical disciplines, including occupational therapists, physical therapists, social workers, nurses, case managers, and home health aides. Since each worker treats multiple patients during a workday (usually 6-15 depending on the discipline), and since teams are formed around patients, each worker is a member of multiple teams.

The mobility and distribution of workers in home care limits collaboration and information sharing between

team members. The unpredictability seen in community-based work makes it difficult for workers to maintain an awareness of others' locations, availabilities, and schedules, and this can make communication difficult. Workers rarely see each other face-to-face, and usually only communicate with each other intermittently. In spite of the infrequent nature of collaboration, however, workers are still interested in others' activities, but the difficulty inherent in communicating and sharing information means that they often have limited awareness of others.

SCHEDULING PROBLEMS

The work practices seen in SDH make it difficult for workers to know others' schedules. Currently, home care workers set their own daily schedules, including their own office hours. Workers' schedules are unpredictable, and it is difficult for others to anticipate where they will be at any given time. Workers fill out daily schedule cards that specify the times when patients will be visited on that day, and the specific services that will be provided during each visit. Copies of these cards are left with the clerical staff in the office, but the cards are not shared with other community-based clinical staff.

This lack of information about others' schedules gives rise to a three problems: schedule conflicts, difficulties coordinating services, and difficulties initiating synchronous communication.

Schedule conflicts. Since a patient can receive several different services over the course of a day, more than one worker may inadvertently schedule a visit with a patient at the same time. When these conflicts occur, one worker may be forced to sit and wait in the patient's home until the other worker finishes their treatment. These conflicts usually force workers to rearrange their schedule to accommodate the delay, and decrease workers' productivity.

Difficulties coordinating services. Home care workers usually have limited information about the services that others provide to a shared patient, and this can make it difficult for them to coordinate treatments. Workers often need to coordinate services on a per-visit basis, and to do this they need to know when other treatments occur and the specific services that are provided. This coordination needs to occur for four reasons. First, workers may want to avoid visiting a patient shortly after a specific type of service has been delivered. For example, some disciplines may not want to visit a patient after a physical therapist has carried out gait training with him or her, since the patient may be fatigued. Second, some services are closely aligned, and treatments may be needlessly replicated. For example, occupational and physical therapy may both include upper extremity exercises in their daily

treatments and be unaware of the overlap. Third, some combinations of treatments may be counterproductive or contraindicated. For example, if an occupational therapist is attempting to teach a patient to dress his or her lower body, it is counterproductive for the home health aide to dress the patient without encouraging their participation. Fourth, dependencies may exist between two services, and workers may need to link their visit with the visit of another worker. For example, some disciplines may prefer to visit a patient with Parkinson's disease after the nurse has given him or her their medication.

Difficulties initiating synchronous communication. In home care, lack of schedule information makes it difficult for workers to know when others are available for synchronous communication. Since schedules are unknown, workers cannot anticipate when others are busy treating patients or when they are in the office and available for face-to-face meetings and phone calls. Even though a mobile phone can be a valuable asset in home care, some treatments cannot be interrupted to receive a call (e.g. wound care), and some workers report being uncomfortable taking calls in the presence of patients and their families.

METHODS

Our initial work focused on understanding the workers, organizational structures, and work activities that are part of home care delivery in SDH. We carried out three rounds of interviews (1-1½ hours each) where we interviewed a member of each clinical home care discipline. In addition, we spent approximately 60 hours carrying out field observations to develop a detailed understanding of day-to-day work activities.

These observations guided the development of early prototypes of Mohoc. We carried out ongoing prototype reviews with home care clinicians to refine our designs. Once we felt that we had adequately validated our approach, we implemented the design as a mobile clinical information system.

We carried out a 2½-month field trial of Mohoc with a team of six home care workers from different disciplines. During the field trial, each worker carried a laptop with a wireless cellular network card. The treatment team used the application to support the treatment activities that they provided to a shared patient. Workers used the application to schedule visits, establish treatment plans, document treatments, and to explicitly collaborate with each other. During the field trial, we carried out two further rounds of interviews, and we met with each participant for approximately 1½ hours per round. Upon completion of the field trial, we analyzed transcripts, system logs, and the private and shared workspaces that workers utilized within the application during the trial.

SCHEDULING TOOLS IN MOHOC

We designed Mohoc to support common autonomous work activities that are seen in all major disciplines that deliver home care services in SDH. Our design approach was to support existing home care work activities, but to do so in a way that fosters mutual awareness of others' activities with shared patients.

Mohoc's scheduling tools were designed to address the scheduling problems outlined above by improving awareness – by making information about schedules and treatments available to workers who share common patients. We embed this shared information into the scheduling tools, so when workers carry out their autonomous work activities, they can better consider the activities of other workers.

Mohoc supports current scheduling activities, which include: specifying appointments with a given patient; specifying the services that will be delivered during a given appointment; and modifying time, date, duration, and services. Workers can create and modify appointments using a drag and drop interface (see Figure 1). For example, to create an appointment, a worker specifies an appointment by selecting a patient in the caseload region at the top of the screen (A on Figure 1) and dragging the patient's rectangle to the schedule region at the bottom of the screen (B). When a new appointment is created, a popup window appears and allows workers to specify the services that they will deliver during that appointment (C). The information entered through these features is then automatically pushed out through the network so that it is available to other workers.

This information about others' schedules and treatments is displayed at the user interface level in the scheduling tools. It is shown using representations that convey information, but do not constrain workers' abilities to carry out their own work activities. These representations allow workers to:

- View others' appointments with a shared patient
- Identify scheduling overlaps with others who visit a shared patient
- View the services that will be delivered by other workers during visits

When a worker selects a patient in the caseload region of the screen, all appointments that others have made with that patient are shown in the worker's schedule as transparent overlays. This can be seen in Figure 1, where Jeff Dyck is selected in the caseload region of the screen (A). The tiles that are shown more prominently represent the appointments that have been made by the worker that is using the system (B). The overlays that represent others' appointments with John Doe are also visible. For example, on Thursday at 1:15, an appointment that was set by Buchanan, a physical therapist, is shown (E).

The system also helps workers identify schedule conflicts with other workers. This can be seen in Figure 1 (D), where an appointment that was set by the worker that is using the system overlaps with an appointment set by Geddie, an occupational therapist. In the user interface, the timeslot where the collision occurs is flagged in red, so that workers can resolve the overlap if it is a problem.

Finally, Mohoc provides a view of all appointments that have been set with a given patient. This view is shown in Figure 2, and it displays all appointments that have been set with a patient, and the services that will be provided during those appointments.
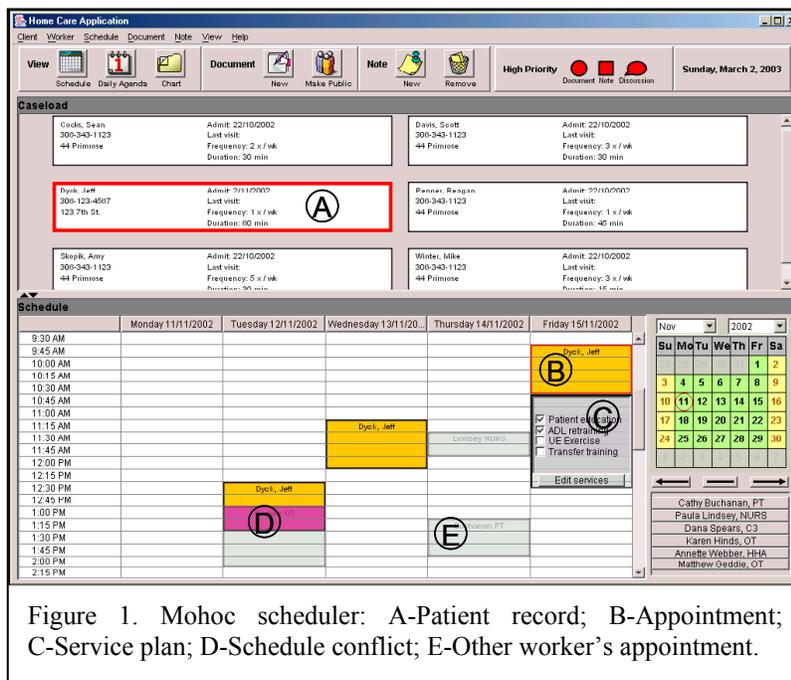

Figure 1. Mohoc scheduler: A-Patient record; B-Appointment; C-Service plan; D-Schedule conflict; E-Other worker's appointment.
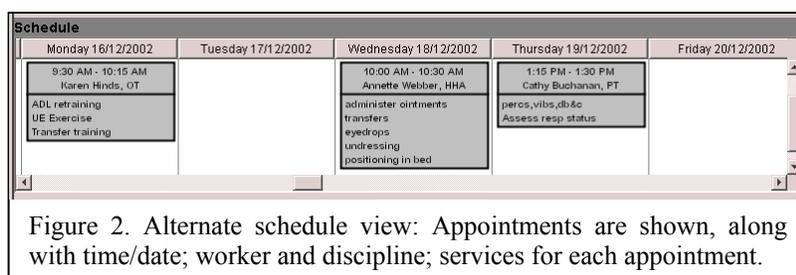

Figure 2. Alternate schedule view: Appointments are shown, along with time/date; worker and discipline; services for each appointment.

RESULTS

When we introduced Mohoc during the field trial, we saw effects on work patterns. We believe that the findings indicate the promise of the awareness-based approach. In the following sections we consider the impact made by the Mohoc scheduling tools on the three scheduling problems we identified earlier: schedule conflicts, service coordination, and synchronous communication.

Avoiding schedule conflicts

In Mohoc workers can see others' appointments with shared patients when they set their own appointments (e.g. Figure 1, E). This allows workers to selectively avoid the appointments times of others. When a schedule conflict does occur, the system flags the time block where the overlap occurs by turning it bright red so that workers can resolve it, or ignore it if the overlap is desirable (Figure 1, D). This method recognizes the scheduling autonomy of home care workers, and does not presume to enforce rules about scheduling (such as preventing overlaps).

In the field trial, Mohoc did appear to increase awareness of others' schedules, and an analysis of system logs did not show any evidence of schedule conflicts during the 2½ months. During interviews, workers confirmed that this approach helped them avoid conflicts during the trial. Workers stated that the information available in the system was particularly valuable since the patient received services from a large number of disciplines (five), all with different treatment frequencies and varying treatment times. Because of this, the risk for scheduling conflicts between the workers treating the patient was high, and conflicts were common prior to the introduction of the system. Additionally, several workers stated that since they had more information about others' appointments, they felt free to revise treatment times since they had enough information to avoid collisions. This approach afforded them extra flexibility, which they felt was a valuable asset given the unpredictability of community-based care.

Coordinating services

Mohoc embeds information about the services that are provided during appointments and shares that information with others. Figure 1 (C) shows a popup that allows the specification of services that will be provided to the patient during an appointment, and the information is passed on to other workers who treat that patient. Workers can access a view of all appointments that workers have set with a given patient, and that displays the services that are provided during the appointments (see Figure 2).

During the field trial, workers used the information provided by the Mohoc schedule to augment their autonomous work practices. First, when a notable service event was seen in the schedule, workers would reference any documents in the shared document repository that had been created to describe that visit. Second, workers reported that this information allowed them to maintain a much better picture of what was happening with the patient, and, in a general sense, were better able to consider their role in providing services to the patient.

Workers also reported more specific instances of coordination that occurred as the result of the introduction of Mohoc. In one instance, the occupational therapist, who often saw the patient early in the morning, wanted to guarantee that the patient was awake and out of bed before she visited. She was able to make use of information available in the scheduling tools to guarantee that the home health aide had the patient up and dressed prior to visiting. In a separate instance, the nurse and the physical therapist carefully monitored the services that were provided by the other since they were both providing treatments focused on improving the patient's respiratory status.

Facilitating synchronous communication

Mohoc's schedule information also helps workers keep track of others' locations and availabilities, simplifying the initiation of synchronous communication. This is accomplished using the techniques discussed above – by showing appointment and treatment information integrated into the CIS.

By tracking appointments with patients (Figure 1, B and E) and services provided during appointments (Figure 1C; Figure 2), Mohoc helps workers determine when others are available for phone calls and meetings. Availability can often be determined by knowing the treatments that workers provide during each visit, and workers can determine whether or not certain services limit a worker's availability. For example, a home health aide who visits a patient to do meal preparation can probably receive a phone call, but if the home health aide is bathing the patient, they probably cannot.

During the field trial, workers used the functions that were provided in the Mohoc scheduling tools to help facilitate synchronous communication. For example, an occupational therapist (OT) reports that she wanted to train a home health aide on how to use a ceiling lift system that had been installed for the patient. The OT utilized the schedule tool to determine when the home health aide would be in the patient's home, and dropped by during that time. Without this information, the OT would have been forced to expend significant extra effort to arrange the meeting.

Findings from the field trial suggest that we could have done more to facilitate synchronous communication. In the current version of Mohoc, we did not represent

office times on the schedule, but instead only handled appointments with patients. Workers report that information about office hours would have been valuable, since this represents a point when others can contact them.

DISCUSSION

Maintaining awareness of others' activities is a central part of group collaboration[3], and the idea of mutual awareness is not new in clinical information systems. In fact, mutual awareness is one of the main benefits of EHR's, since access to others' clinical documents can increase workers' knowledge of others' observations, activities, and the outcome of those activities[6].

However, while traditional access to a shared document repository is valuable, this information is generally not commonly embedded in tools that support specific work practices, and workers have to read through considerable text to find information that is relevant to them. Therefore, the traditional approach only provides partial solutions to many of the collaborative difficulties in home care, namely scheduling, information dissemination, information retrieval, short-term treatment coordination, and long-term treatment planning[5].

Our experiences with home care teams suggest that awareness-based scheduling information in particular is an underutilized resource for clinical information systems. Our work shows that improving awareness of others' schedules can help workers deal with common problems seen in home care delivery. The approach of gathering information from normal individual work, and then sharing it with other members of the team, is one that recognizes the tradition of autonomy in community-based work and minimizes the additional effort required to help others maintain awareness. Our field trial validates the usefulness of this approach—workers did not feel that they were forced to do extra work to support mutual awareness of others' schedules within the treatment team, since they were performing the work activities that they normally carried out anyway, albeit with CIS support.

The second part of our design strategy involves the integration of awareness into the user interface. We embed visualizations of others' activities into tools that support normal individual work, so that workers can gather awareness information while they carry out their daily work activities. For example, in Mohoc, when a worker creates an appointment with a patient, the appointments of all other workers who treat that patient are superimposed over the worker's schedule (Figure 1, E). This display changes to reflect the treatment team for each active patient.

CONCLUSION

In home care, workers are mobile and rarely see each other face-to-face, so it is hard for them to maintain awareness of others' activities. In this paper, we explored three problems caused by lack of information about others' schedules: schedule conflicts, difficulties coordinating services, and difficulties initiating synchronous communication.

We presented results of a field trial we carried out with Mohoc, a POC CIS that supports common home care tasks, and provides functions to help workers deal with schedule problems. The main design approach in Mohoc is to gather, distribute, and visualize awareness information about worker activities and schedules into the normal tools used in the CIS. During the field trial, workers were able to maintain awareness of others' schedules and treatment activities, with minimal additional effort.

Mohoc integrates other types of awareness information into other system features, also with good results. The success of the awareness-based approach argues for consideration of scheduling information and other kinds of awareness in other clinical information systems, particularly for systems designed to support workers who are distributed but still need to manage interdependencies, as is the case in home care.

We are currently revising Mohoc to incorporate several improvements suggested by the field trial findings. In the future, we plan a larger trial of the system.

ACKNOWLEDGMENTS

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