Evaluating Inter-Professional Work Support by a Computerized Physician Order Entry (CPOE) System

Zahra NIAZKHANI, Habibollah PIRNEJAD, Antoinette de BONT, Jos AARTS

Institute of Health Policy and Management (iBMG), Erasmus University Medical Center, Rotterdam, the Netherlands

Abstract. Physician-centered design for computerized physician order entry (CPOE) systems overlooks the collaborative, multi-professional nature of medical work. We analyzed the compatibility of the conceptual model of inter-professional workflow underlying a CPOE system with real-life workflow in the medication ordering and administration process. We conducted twenty-three semi-structured interviews with key informant users and analyzed the handwritten documents and computerized printouts used in daily work in a Dutch academic medical center. The interview transcripts were analyzed on the basis of three conceptual themes in the inter-professional workflow: division of tasks, flow of information, and task coordination. The CPOE system fundamentally reorganized the existing work procedures of the three professional groups involved, mainly by reassigning tasks and by reallocation of areas of expertise. Although the system improved the flow of medication-related information from physicians to nurses or pharmacists, this flow was only in one direction; the system did not allow information transactions in the reverse direction. It also failed to coordinate the medication-related tasks of professionals from different disciplines. To maintain the necessary level of coordination, the professionals had been obliged to consider additional methods of communication, such as phone calls or face-to-face discussion. We identified several workflow integration issues after the implementation of a CPOE system. Our insights into these issues can help ensure that system design or redesign properly integrates all professional groups' tasks, information, and areas of expertise into those of the physicians. Only then can these systems support the actual inter-professional workflow in the medication process.

Keywords. Computerized physician order entry, workflow, collaboration

Introduction

Implementing computerized physician order entry (CPOE) systems has proved to be difficult [1]. This is mainly because the deployment of these systems may disrupt medical workflow, and possibly trigger resistance in users [2]. It has been shown that the workflow model embedded in these systems does not match actual workflow between professionals [3]. Gorman et al. criticized these systems for their linear,
sequential, and unidirectional model of care processes [4]. It has also been pointed out that a narrow focus only on physicians may overlook the collaborative, multi-professional nature of medical workflow, which involves not only physicians but also professionals such as nurses and pharmacists [5]. Despite these shortcomings, the literature to date has nonetheless paid little attention to how well the design of these systems takes account of the multi-professional and interdependent nature of medical workflow. Neither is it completely clear which aspects of inter-professional workflow are most affected by CPOE systems.

To analyze the compatibility of the workflow model underlying this system with real-life inter-professional workflow, we conducted a qualitative study of a computerized medication order entry system implemented in a Dutch hospital. For this purpose, we examined the role of the system in integrating the work of one professional group with that of others in the medication process. In particular, we were interested in identifying areas in inter-professional medication-related workflow which are either supported by the CPOE system or rendered difficult by it. The resulting insights can help designers and implementers to consider redesigning both systems and care processes, thereby creating a better fit between the system and the multi-professional nature of the medication process.

1. Conceptual Framework

Our study was inspired by Wears and Berg, who pointed out that “many of the difficulties do not result from bad parts of the systems but are inherent in the perspectives and theories of medical work (and the role of IT in this work)” on which these systems are founded [6]. Drawing upon studies of medical work carried out in the social sciences and in the field of computer-supported cooperative work, we identified three conceptual themes that were relevant to the workflow between professional groups using information systems: division of tasks, flow of information, and task coordination [7-9]. The medication ordering and administration process involves various professional groups whose tasks are extremely interdependent. Avoiding possible conflicts requires an effective division of labor that not only takes account of different professional groups’ work domains, but also coordinates them effectively [7].

While this calls for an accurate and timely flow of information between the groups [8], it is not sufficient, as the ad hoc nature of the medication process can cause medication plan to change frequently. Various professional groups therefore are required to coordinate their interrelated tasks and to ensure a shared understanding of the medication plan [9]. Figure 1 shows the relationship between these three concepts in our conceptual model.

Figure 1. A conceptual model for inter-professional workflow in the medication process
2. Methods and Materials

In 2001, a commercially available computerized medication order entry system (Medicatie/EVS) was implemented at Erasmus University Medical Center, an academic hospital in the Netherlands. Medicatie/EVS was chosen for implementation because it was compatible with the hospital’s existing information systems. When physicians use this system for order entry, nurses receive printed medication-order-labels, which they stick into a paper-based, patient medication administration record (MAR). Nurses use the system to request non-stock drugs from the pharmacy.

The first and the second authors conducted 23 semi-structured interviews with a sample of key informant users (i.e., 12 nurses, eight physicians, two pharmacists, and one pharmacy technician) between November 2006 and April 2007. The interviews were performed in the interviewee’s working environment where they could show us how they work with the system. The nurses and physicians interviewed were recruited from both internal and surgical specialties. During the interviews, we focused on the role of the system in integrating one group’s work with that of others. The interview transcripts were analyzed on the basis of the three themes discussed above. In addition, to examine their role in the workflow, we analysed handwritten documents (e.g., MAR), and system printouts (such as the patient medication overviews) used in daily work.

3. Results

The results are presented on the basis of the three themes. Per theme, we particularly focused on workflow between two or more professional groups.

3.1. Division of tasks

The CPOE system in our study fundamentally reorganized the existing work procedures, affecting the workflow between the three professional groups both advantageously and disadvantageously.

By forcing strict levels of authorization for executing tasks, the system reinforced professional boundaries. In some cases, this was perceived as beneficial. Nurses, for example, were no longer questioned about the changes in orders, as, in the new situation, changing medication orders were not considered part of a nurse’s responsibility. In other cases, however, this reorganization negatively affected workflow by reallocating areas of expertise and by reassigning tasks.

Although it removed order decryption and transcription tasks for nurses, the concept of physician order entry in this system enforced a central position for physicians. This meant that physicians were sometimes forced to decide on the details of orders beyond their areas of expertise. One physician, although generally satisfied with the system, noted: “When you have to put 10 prescriptions, then you have to check for all [details], [for example] let’s go to IV: IV wide, IV peripheral, IV central… or just IV; it doesn’t matter… these are very specialized.” (Feb. 2007)

In turn, this centralized decision-making violated nurses’ work domain: nurses experienced difficulties in implementing physicians’ detailed medication orders, particularly with regard to time and route of administration. For example, they often had to adjust the time of drug administration to fit in nursing work routines. Because
they had not been authorized to change medication orders using the system, nurses manually registered these adjustments on the order labels. This worked well only for available drugs in the ward stocks. However, problems arose when such adjustments required nurses to request drugs from the pharmacy. For instance, before the implementation of the CPOE, nurses could, on their own initiative, change a patient’s IV antibiotics to oral forms after three days of infusions. After the implementation, however, they had to wait for physicians to change the order in the system, because the pharmacy would reject the nurses’ drug requests in the absence of the electronic orders.

3.2. Flow of information

This system improved the flow of medication-related information from physicians to nurses and to the pharmacy. This was especially the case due to legible and complete, single medication orders and could save many call-backs to physicians. However, nurses received piles of order labels after physicians entered their orders into the system. This required nurses to sort the labels out per patient and put them into the right administration-records.

Sometimes, the uniform black and white structure of these labels caused nurses to mix them up for different patients. To ensure an accurate flow of information, nurses therefore had to ensure that they had the right medication labels for the right patients. For this purpose, the nightshift nurses were obliged to double-check each patient’s order labels with a medication overview printed out from the system.

Unfortunately, the improvement in information flow was only in one direction; the system did not allow information transactions in the reverse direction. Because nurses recorded medication-related information in the paper-based nursing records, the medication data became fragmented in the electronic and the paper-based systems. Similarly, because nurses and pharmacists were not allowed to input into the system, information flow from other professional groups to physicians through the system was inadequate. For instance, physicians had practically no easy access to the MAR, which was available in the nurses’ working station. To develop comprehensive, integrated patient medication information, this information therefore had to be communicated directly between physicians and nurses during the medical rounds.

Finally, the flow of information between nurses and the pharmacy was insufficient. To acquire the information they needed, both groups had to call each other.

3.3. Task coordination

The medication-related tasks among professionals were coordinated by other methods of communication and not only through the system. None of the professional groups actually counted on the system for this purpose. While phone calls played an important role in coordinating interdependent tasks between professionals from different services (such as physicians and pharmacists, or nurses and pharmacy technicians), physicians and nurses who worked closely together depended most on face-to-face communication.

In all the specialties interviewed, physicians and nurses discussed the overall medication plans in medical rounds, during which the majority of the decisions on changing medication plan were made. For reference, nurses often made notes on these decisions. Without these rounds, no shared understanding of the medication plan could be developed; both groups therefore depended on the discussions in these rounds.
If a change was necessary in the evening or night shifts, physicians would have to inform nurses directly. Relying merely on the system and on the printed labels to coordinate these changes was perceived as risky. In fact, if a medication order was lost among other papers, or if there was a printer failure, none of the nurses or physicians would realize on time. On the other hand, as one senior head nurse noted, when nurses received any new order label, they often contacted the prescribing physician: “…in such a case [a change in medication plan], physicians usually tell us; otherwise, if we see there is a controversy between the medication-label and our notes, then we [will] call physicians and ask for the reason”. (Jan. 2007)

Similarly, the procurement of non-stock drugs required nurses to take extra coordinative steps beyond the system. Because the system was not available at the bedside, physicians entered the orders in their offices later on. Due mainly to the time pressure caused by other clinical duties after their medical rounds (such as operations or outpatient visits), they often delayed entering their orders. As a result, nurses were able to send the electronic requests to the pharmacy only later during the day.

To notify the pharmacy technicians of new requests sent during the afternoon, nurses also had to call them personally, because, due to internal policy at the pharmacy, the technicians checked the electronic requests only twice a day: at 8 and 12 o’clock. In order to emphasize the necessity of drug delivery for the same day, this coordination redundancy –referred to almost by all the nurses interviewed– had become routine.

4. Discussion and conclusion

Our study revealed several workflow integration issues. Besides advantages such as legible and complete medication orders, which have resulted in overall satisfaction with the system implemented, we identified instances in which the system has inappropriately integrated professionals together by reassigning tasks and reallocating the areas of expertise. This system also caused patient medication-related information to become fragmented in both the paper records and in the electronic records, and also in different professional domains. Neither did the system support professional groups in the temporal coordination of tasks, nor in making sense of new changes in the medication plan. To integrate work, they frequently bypassed the system or added new steps (e.g., double-checking the orders) and extra coordinative tasks (e.g., phone calls).

Our study shows that the system challenged the effective integration of various professional groups’ work not only by reorganizing the areas of expertise, but also by reinforcing strict boundaries around professional domains. In fact, the workflow model underlying this system overlooked the overlaps that normally exist in practice. These findings are similar to those of other studies which have emphasized that CPOE systems may limit opportunities for decentralized decision-making in the medication process [10]. In our study, to compensate for such limitations, the professionals tried to bypass the system and to adjust the orders on the basis of their own work organization, although it was not easy to provide other parties with feedback on these adjustments. Even in a highly advanced CPOE system, a similar lack of effective integration has been found between nursing processes and the computerized system [11].

Negotiation between co-working professionals is critical to creating a shared sense of a care plan and to adjusting the work of one professional group with that of another. In our study case, these purposes were served by the medical rounds, which enabled physicians and nurses to negotiate their overall medication plans. Nevertheless, this
was unhelpful with regard to the details of orders and also to the changes which were made beyond rounds: as stated above, extra communication methods such as phone calls and face-to-face communication had to supplement the system. Similar coordination redundancies have been reported in another CPOE study [3].

With regard to inter-professional medication workflow, implementing a CPOE system is a double-edged sword. Our study not only contributes to a deeper understanding of the interdependent nature of medication-related tasks among professional groups working in the same or different services, it also identifies where the problems lie with the CPOE system implemented. Our findings are in accordance with the argument of Gorman et al [4], confirming that under this system the workflow among professional groups is indeed conceptualized as linear, stepwise and unidirectional; the flow runs mainly from physicians to the other professional groups. In our case, the system caused the physicians to dominate other groups, whose work became contingent on the timely and appropriate execution of physicians’ tasks. In order to fairly distribute the benefits of work efficiency, these systems should support real-time, ad hoc, and mutual relationships in the medication process. Nurses’ and pharmacists’ inputs into this process should also be considered. Only then can the system support actual inter-professional relationships in the medication process.

Acknowledgement

We gratefully acknowledge our interviewees. The first and the second authors were supported by training grants from Urmia University of Medical Sciences (Urmia, Iran).

References