

Organizational Considerations for the Implementation of a Computerized Physician Order Entry

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Abstract. Several studies stressed that the introduction of CPOE applications deteriorates the doctor-nurse communication. But there are many factors that might influence communication behaviors, as for example the way these communications are organized. The present study aims at showing that the impact of a CPOE system on the cooperative activities can be controlled given that a good understanding of the cooperative workflows support the implementation. By analyzing the doctors-nurses communications during the medication use process, the study demonstrates that the technical system has no impact on the cooperative activities within a given organization. CPOE does not induce differences in the dialogs' durations and contents.

Keywords. Organizations, Medical Order Entry System, Communication, Human Factors, Socio-technical system.

Introduction

In the healthcare domain, the medication use process has been studied under the safety point of view and successful implementation of Computerized Physician Order Entry (CPOE) systems prove efficient to achieve a significant reduction of Adverse Drug Events (ADE) [1-2]. However, sociotechnical or human factors qualitative studies repeatedly uncover unexpected and unintended negative effects of CPOE systems [3]. In the hospital setting, the work situations are inherently collaborative. The medication use process may be characterized as a complex distributed work situation: the information is distributed across the minds of the members of the clinical team and across physical media [4]. In this context, the critical role of doctors-nurses face-to-face communications has been demonstrated [5-6]. Moreover, some studies stress that problems with these communications are common causes of medical errors [7]. Since the responsibility of doctors and nurses are complementary rather than overlapping, a complete, coherent, and updated knowledge of the patient status requires a direct two-way information flow among team partners.

The impact of the introduction of CPOE applications on doctors-nurses communications has been demonstrated: the technical system seems to deteriorate the

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communication and cooperative activities [8-9]. For instance, the destructive effect of the switch from synchronous to asynchronous communications has been highlighted [10-11], leaving nurses out of the ordering loop [12] and impairing synchronization and feed-backs mechanisms [8]. The present study aims at showing that this impact of a CPOE system on cooperative activities can be controlled given that a good understanding of the cooperative workflows support the implementation. We think one of the problems is that implementations of CPOE systems are mainly technology-driven without particular attention to the doctors-nurses cooperation and communications processes. Highly cooperative work, such as the medication use process, inevitably generates differences in the structure and organization of the communicative processes. These different communications' organizations impact the quality and reliability of the cooperative activities. Although most of the information in the clinical workplace is acquired and presented in a face-to-face manner, very little work has been done to understand the communications dynamics and requirements [13].

The aim of this paper is to show that the potentially negative impact of the technical system on the cooperative processes can be neutralized if particular attention is given to the work organizational factors during implementations. The study was undertaken in two hospitals functioning with different systems of work, a CPOE system and a paper-based one, to analyze the CPOE impact on cooperative activities. As we have participated to the implementation of the concerned CPOE, we could give recommendations to take into account the particular features of the doctors-nurses face-to-face communications. Especially, we stressed the importance to keep the nurse in the ordering loop and to preserve also the common rounds when they already exist. To do so, enough laptops were installed in the departments so that doctors and nurses can each have their own screen with the relevant information during the medical round.

From previous studies in different hospitals and wards, we could identify that the doctors-nurses face-to-face communications during the medication use process are mainly based on three work organizations [14], strengthened by other observations in Denmark. The *common rounds* organization has the nurses' activities organized so that they can systematically participate with doctor to the medical rounds. In the *briefing* organization, dedicated time slots are scheduled before and/or after the medical rounds where doctors and nurses participate in short daily meetings. Then doctors perform medical rounds. These briefings are regularly planned at the same time so that doctors and nurses can organize their activities to participate. A third organization appears sporadically which is characterized by *opportunistic exchanges*. No time-slot is dedicated to doctor-nurse face-to-face exchanges and communications are mainly written and asynchronous. Within this general framework, the present study analyzes the doctors-nurses face-to-face communications during the medication prescribing-preparation-administration process, according to both the organization of their work: {Briefings-B; Common Rounds-CR; Opportunistic Exchanges-OE} and their technical environment {CPOE; Paper-based}.

1. Sites of the study

This study was part of the work of a French PhD thesis, thus explaining the analyses were undertaken in two French hospitals. The paper-based observation site is the University Hospital of Lille. The analyses were realized in three departments: Cardiology, Nephrology and Neurosurgery presenting the three different organizations

(B, CR and OE). The CPOE observation site is the Denain Public Hospital which had been running the CPOE for three years. The analyses were realized in two medical departments: cardiology/gastroenterology and infectious disease presenting two different organizations, Briefing and Common Round. At the time of the study, there was no site combining the CPOE and Opportunistic Exchanges organization.

Even if the specialities are different, the departments can be considered as belonging to a similar type: (i) the medication prescribing-preparation-administration process is similar, (ii) the number of medications per day and per patient is comparable ($F(4, 472) = 0.7, p > .05$) and (iii) the pathologies attended are comparable in terms of mean number of days' care (Annual figures, lasting 5 to 6.4 days), the severity of patient's state can also be considered as similar.

It must be noted that in European hospital settings, the physician is in charge of the therapeutic decision making and of ordering the meds. The nurse has no medication ordering rights except for a small number of usual drugs (*i.e.* standard painkillers) and only if a written protocol exists in the department. The nurse must validate the administration and eventually document any unexpected event. All the physicians attend all the patients and so do the nurses.

2. Methods

2.1. Quantitative analysis: the dialogs' duration

For each department, eight systematic observations were undertaken starting with the arrival of the physician in the ward and ending with the preparation-administration of the meds to the patients. This observation window covers the entire medication cycle, *i.e.* prescription ordering – administration and its documentation. During each period, all the doctors-nurses communications about the care-providing for the inpatients were audio-taped. Semi-structured interviews of target users were carried out.

2.2. Qualitative analysis: the dialogs' contents

The coding method of DAMSL (Dialog Act Markup in Several Layers) [15] was used to analyze the communications. The dialogs were divided to obtain "utterances" which reflect the intentions of the transmitter. A third of the data of one department was coded by two analysts to calculate a kappa to test the reliability of the coding. For illustration purpose, we present in this paper the results for the dimension "semantic content" of the utterances ($\kappa = 0,78$). Three main contents were highlighted by our data: (i) the patient which refers to the variables characterizing the patient *e.g.* pathology, clinical signs, physiological data, etc.; (ii) the care-providing which refers to the variables characterizing the interventions on the patient *e.g.* therapeutic order, biological order, surgery, etc. and (iii) the logistics which refers to the variables characterizing the organizational, technical and human resources and constrains, *e.g.* the availability of meds in the ward.

3. Results

3.1. Quantitative analysis: the dialogs' duration

The quantitative analyses amounted to approximately the same number of hours in the 5 different departments (from 36h58 to 40h05) (see Table 1), meaning that there are no significant differences in the medication use process itself across those departments, $F(4, 35) = 1.01$, $p > .05$. As expected, there is a marked difference in the duration of the physicians-nurses dialogs according to the organization of their work (CR / B / OE). But the most striking result is there is no significant difference depending on the technical environment, *i.e.* CPOE vs. paper-based, $\chi^2(1, N = 40) = 1.66$, $p > .05$.

Table 1. Total durations of the doctors-nurses dialogs depending on the system (CPOE, Paper-based) and the communications' organization (CR, B, OE) / Mean duration in minutes (SD).

System	Communications' organization		
	CR	B	OE
CPOE	16h50 / M = 126.25 (20.6)	2h18 / M = 17.25 (2.5)	
Paper-based	13h10 / M = 98.75 (12.2)	2h15 / M = 16.9 (3.3)	0h33 / M = 4.12 (4.2)

The duration of the communications in the Common Round organization is 6 to 8 times higher than in the Briefing organization and is up to 28 times higher than in the Opportunistic Exchanges organization. In the two Common Round organization (CPOE and Paper-based), all the dialogs occur during the medical rounds and most of them involve the prescribing doctor and the nurses. The partners take the time to understand the situation, they elaborate or adjust a shared understanding of the situation. Moreover, the overhearing by nurses of the doctors-doctors and doctor-patient dialogs allow them to take advantage of the medical expertise. Very few other medication-related doctor-nurse communications, if any, is observed outside the medical rounds. The face-to-face exchanges occurring during the medical round provide both the doctors and the nurses enough information to go on with their own activities, with the only support of the patient record, be it paper-based or CPOE.

In the two Briefing organizations (CPOE and Paper-based), most of the dialogs occur during briefings before the medical round. All the patients' cases of the department are reviewed so that physicians and nurses are mutually aware of the patient's cases and their evolution. The dialogs may influence the next decision making of the physicians during the medical round. When physicians need notifying new therapeutic changes that have not been addressed during the first briefing, a second very short briefing occur just after the medical round. A few dialogs occur outside these briefings, mainly when a change in the situation occurs (unexpected results, unexpected evolution in the patient's status, etc.).

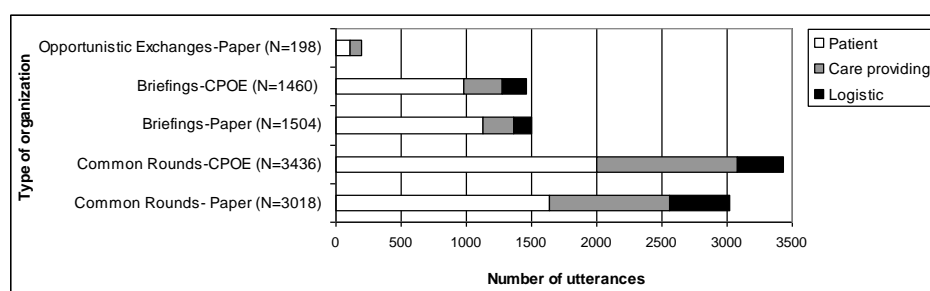
In the Opportunistic Exchanges organization, the dialogs occur when the physician or the nurse can no longer perform their own activities with the only support of the patient record: the information they need is not readily available, and they are constrained to ask their colleague. Many of these brief exchanges are initiated by the nurses needing additional information to interpret unusual therapeutic orders. If the physician is not available when the nurse needs additional information, she has to perform her activity with incomplete knowledge which can prove dangerous. Some of these brief dialogs are initiated by physicians. They interrupt the medical round to fetch

complementary information about the patient, *e.g.* “does he sleep well?” or “How much does he piss?”. The information they need is not readily available whatever the technical system.

3.2. Qualitative analysis: the dialogs’ contents

The qualitative analysis of the content of the dialogs confirms the global results issued from the analysis of dialogs’ durations, showing no differences between the CPOE and the paper-based situation within each organization, $\chi^2(2, N = 7942) = 8.5, p > .01$, (cf. Figure 1). For the main organizations (Common Round and Briefing), the introduction of the CPOE system does not modify the content of the oral exchanges or the proportion of these contents in the dialogs.

Figure 1: Distribution of the number of utterances emitted by doctors and nurses according to the 5 conditions (CR-paper; CR-CPOE; B-paper; B-CPOE; OE-paper) and the content of the communications (Patient, Care-providing, Logistic).



Globally, during the Common Round the professionals exchange a lot about the patient while they discuss the recent relevant information to support the therapeutic decision. They take the opportunity to negotiate the care plans together. During the Briefing, the utterances are mainly dedicated to transmit information about the patient. The short exchanges in the Opportunistic Exchanges condition aim essentially at obtaining the minimal mandatory information about the patient status or the care-providing to be able to perform one’s activities.

5. Discussion

This study addresses the question of the impact of technical variables on the collective aspects of healthcare work situations. It demonstrates that the technical system has no impact on the cooperative activities within a given organization. If the organizational factors are controlled, CPOE does not induce differences in the dialogs’ durations and contents and also does not seem to deteriorate the doctors-nurses communications. Although a condition is missing in the study (OE/CPOE), previous observations in other hospitals in such a condition suggest that the results would be similar, *e.g.* very few dialogs occur between doctors and nurses and mainly to obtain information to act.

With these new insights, the organizational variables could be interpreted as confounding factors distorting the results reported in the literature. The impact studies showing that technical systems weaken the doctors-nurses communications did not consider the organizational factors for the interpretation of their outcomes. Effectively,

it seems the introduction of a CPOE in a work environment induces particular communications' organizations when no attention is given to the organisational factors. Especially, the implementation of a CPOE can unexpectedly lead to a shift from an efficient existing organization to a weaker one, *e.g.* Common Round or Briefing to Opportunistic Exchanges (synchronous to asynchronous). This change of organization explains better than the technical system itself that doctors-nurses communications were damaged.

On a more pragmatic level, this study confirms that it is important to consider the entire work system when introducing a new technology such as an IT application. Although supporting more effective communication practices may have great impact on the collective activities, there remain enormous gaps in our broad understanding of the role of communication in health care delivery. The great variety of communications' organizations within each hospital complicates the task. The findings of this study on the three organizations need to be generalized. The issue is to identify in the work situations what shapes the collective activities. One critical feature is the scheduled (or not) of face-to-face communications' slots in the work organization, and also its modalities.

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