Organizational vs. Technical Variables: Impact on the Collective Aspects of Healthcare Work Situations

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Abstract. This study addresses the question of the respective impact of organizational vs. technical environment variables on the collective aspects of healthcare work situations. It analyzes the physicians-nurses communications during the medication use process, according to both the organization of their work and their technical environment. It demonstrates that the organizational variables have a larger impact than the technical environment on the communications and cooperation activities.

Keywords. doctor-nurse communications, CPOE, organization, work situation design

1. Introduction

In many safety critical environments, technical automated systems prove efficient to reduce and prevent errors. In the healthcare domain, the medication use process has been extensively studied under the safety point of view and a huge amount of efforts has been made to support the implementation and adoption of Computerized Physician Order Entry (CPOE) systems to prevent medication errors [1]. Indeed, successfully implemented CPOEs prove efficient to achieve a significant reduction of Adverse Drug Events (ADE) [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. Therefore, organizational and technical variables have a large impact on their efficiency and reliability. The medication use process may be characterized as a complex distributed work situation: rather than existing in the mind of any particular individual, the cognition is distributed across the minds of the members of the clinical team and across physical media [4]. In this context, the communications between the healthcare professionals and the patterns of their interactions with the technical system supporting their work are critical. More particularly, the role of doctors-nurses face-to-face communications has been largely demonstrated [5]. Some studies stressed that

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problems with these communications are common causes of medical errors [6]. Some studies have focused on the impact of the implementation of CPOE applications on the communications between healthcare professionals. Most of them find that the introduction of these technical systems deteriorates the communication and cooperation activities [7]. But the technical environment might not be the most important determinant of the quality of professionals' communications. Doctor-Nurse cooperation and communications are also governed by the organization of their work. From previous studies in different hospitals and different departments [8], we could identify three main types of organizations regulating the physicians-nurses communications and cooperation activities.

The *briefings* constitute the most common organization. Before or/and after the medical rounds, physicians and nurses participate in short daily meetings during which they systematically review the patients' cases. These briefings may be supported or not by the reading of elements of the patient's medical record; they may be limited to the doctor and the nurse or extended to the clinical staff.

The *common rounds* organization has the nurse(s) participate in the medical rounds with the physicians. During the rounds, the patients' records are read and documented. The participation may be limited to the trio doctor-nurse-patient, or include other member of the clinical staff.

A third organization appears sporadically which is characterized by *opportunistic exchanges*. No time-slot is dedicated to doctor-nurse oral exchanges and communications are mainly written and asynchronous.

Within this general framework, the present study analyzes the physicians-nurses 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}.

2. Methods

2.1. Context of the Study

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. The analyses were realized in two medical departments: cardiology/gastroenterology and infectious disease presenting two different organizations, B and CR. At the time of the study, there was no site combining the CPOE and Opportunistic Exchanges organization.

2.2. Activity Analysis

For each department, eight systematic observations were realized starting with the arrival of the physician in the ward and ending with the preparation-administration of the meds to the patients. They were supported by handwritten time-stamped detailed field notes and focused on (i) physicians and nurses' tasks in the medication process, (ii) physicians-nurses' dialogs about medication which were audio-taped and (iii) interactions with patient records. Semi-structured interviews of target users were realized.

309

2.3. Physicians-Nurses Dialogs' Analysis

The coding method of DAMSL (Dialog Act Markup in Several Layers) [9] 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. Activity Analysis

The eight observations amounted to approximately the same number of hours in the 5 different departments (from 36h58 to 40h05), meaning that there are not significant differences in the medication use process itself across those departments. The medical rounds are usually shorter (faster) in Surgery departments than in Medical departments, which accounts for the 3h40mn difference observed between the paper-based CR and the CPOE-CR conditions. But the most striking result is the marked difference in the duration of the physicians-nurses dialogs according to the organization of their work (CR/B/OE) while there is no impact of the technical environment (cf., Table 1).

In the *Common Rounds* organization, all the dialogs occur during the medical rounds and most of them involve the prescribing physician and the nurses. No other medication-related Dr-Nurse communication is observed outside the medical rounds. The oral exchanges occurring during the medical round provide both the physicians 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 *Briefings* organization, most of the dialogs occur during the briefings, involving mainly the prescribing physician and the nurse. A few dialogs occur outside the briefing, e.g. when the physician needs notifying a new therapeutic change that has not been addressed during the briefing. In the paper environment, the physician notifies the modification directly to the nurse in charge of the preparation or update of the pills dispensers. In the CPOE situation, the system ensures this notification to the nurse for each patient.

All the *Opportunistic Exchanges* 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.

| Technical environment | Organization | Department | Duration of observations | Duration of dialogs |
|--------------------------|----------------------------|---------------------------------|-----------------------------|---------------------|
| Paper-based | Common Rounds | Neurosurgery | 37h33 | 13h10 |
| Paper-based | Briefings | Nephrology | 40h05 | 2h15 |
| Paper-based | Opportunistic Exchanges | Cardiology | 39h40 | 0h33 |
| CPOE | Common Rounds | Cardiology/ Gastroenterology | 36h58 | 16h50 |
| CPOE | Briefings | Infectious disease | 39h36 | 2h18 |

 Table 1. Durations of observations and dialogs according to the support of work (CPOE or paper-based) and the organization of the collective work (CR, B, OE)

3.2. Physicians-Nurses Dialogs' Analysis

The detailed analysis of the content of the dialogs confirms the global results issued from the analysis of dialogs' durations, showing different patterns of communications depending on the organization of the collective work (cf., Figure 1). Again, there are no differences between the CPOE and the paper-based situation within each organization. For the main organizations (CR and B), the introduction of the CPOE system does not modified 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 physicians 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 Rounds the professionals exchange a lot about the patient while they discuss the recent relevant information to support the therapeutic decision. They take the opportunity of the common rounds to negotiate the care plans together. During the *Briefings*, the utterances are mainly dedicated to transmit information, mainly about the patient. The short *Opportunistic Exchanges* aim essentially at obtaining the minimal mandatory information about the patient status or the care-providing to be able to perform one's activities.

4. Discussion and Conclusion

This work addresses the question of the respective impact of organizational variables vs. technical environment variables on the collective aspects of healthcare work

situations. It demonstrates that the organizational variables have a larger impact than the technical environment on the quantity and content of physicians-nurses communications and cooperation activities. 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. This does not mean that the introduction of a new IT system like a CPOE does not impact the collective aspects of the work situation. More detailed analyses of the content of the doctor-nurse dialogs (which are not presented here due to lack of space) identify different patterns of interactions between the human professionals and their technical environment depending on the nature of the system they work with (paper or CPOE). When working with a CPOE both physicians and nurses rely on the system for the notification of changes in the medication orders, while this information is also transmitted orally in the paper-based environment. It is therefore important that further researches in this domain take into account simultaneously both organizational and technical variables.

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. Qualitative observations demonstrate that there exists a great variety of organizations within each hospital. These various organizations have a major impact on the collective characteristics of the work systems. It would be interesting to provide the hospitals with a framework or an observation grid supporting the organizational characterization of their various departments before the introduction of a new IT system. The present study provides some interesting elements to be included in such a tool.

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