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Does CPOE Actually Disrupt Physicians-Nurses Communications?

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Abstract

This study addresses the question of the respective impact of organizational vs. technical environment variables on the collaborative 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. Participant observations, interviews and recording of the dialogs were performed in 4 hospitals functioning with either a CPOE or a Paper based system. The study (i) presents the identification and description of the communications' processes involving doctors-nurses face-to-face communications and the supports that mediate medication information and (ii) focuses on the amount of face-to-face communications depending on the organization of work and the technical system used. The analyses demonstrate that the organizational variables have a larger impact than the technical environment on the quality and quantity of the communications and cooperation activities.

Keywords:

Communication, Medical order entry system, Human activities, Work

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. The care of patients inevitably involves many different professionals, all needing to share patient information and discuss their management. 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 critical role of doctors-nurses face-to-face communications has been largely demonstrated [5-6]. The professionals actually prefer direct communications for gathering information, more particularly about the medications which is the category of information most frequently sought by the professionals [7]. Moreover, the role of poor communication in generating avoidable error and poor outcomes is now widely discussed [8]. 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.

Some studies have focused on the impact of the implementation of CPOE applications on communications. Enthusiastic implementations of new technologies do not always have the consequences expected of them: most of the studies find that the technical system deteriorates the communication and cooperation activities [9]. This is in part because human communication processes are shaped into a form dictated by the technological system. There are essential differences between what happens in an informal conversation and what happens in a formal information system transaction [10]. But above all, there is a large number of factors that might influence communication behaviors, including the nature of available communication infrastructure, the nature of the work undertaken and the practices that are routinely applied within the organization. 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.

The present study aims at highlighting the critical role of the organizational factors when implementing a CPOE application in the work situations. It analyzes the doctors-nurses communications during the medication prescribing-administration

process, according to both the organization of their work and their technical environment, CPOE vs. Paper. The study (i) presents the identification and description of the communications' processes involving doctors-nurses face-to-face communications and the supports that mediate medication information and (ii) focuses on the amount of face-to-face communications depending on the organization of work and the technical system used.

Context of the study

Sites of the Study

A paper-based situation study was undertaken in a 3000-bed capacity hospital referred to as H1, in three wards: Cardiology, Nephrology and Neurosurgery.

The CPOE situation study was undertaken in two different hospitals running the same IT system:

- a 550-bed hospital, H2 which had been running the CPOE for three years. The analyses were realized in two medical departments: cardiology / gastroenterology and infectious diseases,
- a 825-bed capacity academic hospital, H3 which had also installed the CPOE. The study took place in two pilot sites, the nephrology and immunology wards where the system had been in use for about 6 months.

Overview of the Medication Use Process in the European hospitals

According to national and local regulations, the tasks necessary to carry out the medication ordering and administration procedures are distributed across the physicians, the pharmacists and the nurses. All the physicians attend all the patients and so do the nurses and pharmacists. The physician is in charge of the therapeutic decision making and of ordering the meds. The nurse is not supposed to copy the physician's orders on any support except to validate the administration. She/he has to control the meds before administering them to the patient; she/he must validate the administration and eventually document any unexpected event. The pharmacist is in charge of controlling the prescription and of delivering the medications to the medical unit.

It must be noted that in the vast majority of European hospitals, unit-dose dispensing is limited to a small proportion of drugs. The products are globally dispensed in the wards (drugs for several patients and for several days), the nurses being in charge of storing them in the ward medications' locker. The nominative dispensing (drugs for a given patient for a given period of 24h to several days) has a particular organization with direct delivery of the medications to the nurses in the ward for the involved patient. These organizations of the dispensing necessitate a preparation phase from ward stock before the actual administration to patients. Nurses are in charge of this preparation.

We will describe in this paper some universal characteristics of the organisation for oral route meds and standard schedules.

Description of the two systems (paper-based and CPOE)

In the hospital setting, the therapeutic decision making and ordering tasks take mainly place during the medical rounds, where the physicians visit all the patients of the ward. With the paper-based system (H1), doctors perform the medical round using a wheel cart with the patients' medical files underneath. They write their medication orders on the medical orders' list which is structured with 3 columns dedicated respectively to the entry of the date of the order, its content, and the signature of the provider. Only new prescriptions or prescription changes are entered at each visit at the patient bedside. Nurses then organize the administration of oral routes medications. It is structured by the preparation of pill dispensers usually covering a 24 hours period. At some point in the 24 hours period (night shift, morning, evening), a nurse prepares the pill dispensers for all the patients of the ward. To perform it, the nurse can rely on the information contained in each patient's medication orders' list. She/he translates the prescription into suitable administration times and dosage forms according to their knowledge and the ward routines. During the 24h period covered by the pill dispensers, the physicians visit the patients and place new orders or modify the existing patients' treatments. These modifications require an update of the corresponding pill dispensers by the nurse. This update is executed as soon as the nurse gets a modified medication orders list. The pill dispensers may be stacked on a wheel cart or on a fixed support. Nurses perform "administration rounds" using the wheel cart with the pill dispensers on top and the patients' medical files underneath. During these rounds, the nurse administers the meds to the patient, validates the administration on the MAR (Medication Administration Record), and eventually documents any abnormality. This MAR presents the treatments on a summarized way with a temporal axis which permits to obtain, at a glance, a global, summarized view of the patients' current medication.

In the CPOE situations (H2 and H3) , a laptop on a wheel cart supports physicians order entry at bedside. The CPOE functions require two main screens to enter medication orders. Using the first one, the physician selects the proper drug. With the second one, the physician specifies the dosage. He has to enter the duration, the frequency and either a precise schedule or a global schedule (*e.g.* morning-noon-evening). The system then automatically updates the planning table and sets the specific timing for the administration depending on the organization of the ward (*i.e*. 7 am., 12 am., 6 pm.). For the display of the treatment, doctors get one screen which comes out in the form of a list of detailed orders structured with 5 columns dedicated respectively to the type of meds (oral route or injection), its detailed content, the date the administration should start and the date it should stop, and finally the status of the prescription (current, stopped or suspended). The orders and their exact time for administration appear on the nurses' care plan. As for the paper MAR, the treatments are summarized with a temporal axis which permits to obtain, at a glance, a global view of the patients' current medication. The modalities of the preparation are similar to the paper-based situations. The pill dispensers may be stacked on a wheel cart or on a

fixed support close by the laptop. If the administered drug is different from the prescribed drug, they have to document a "memo", *i.e.* a note for doctors which appears in the form of an exclamation mark in the doctors' screen.

Materials and Methods

HFE Methods

Five observers trained in naturalistic observation in complex settings conducted the observations. A first qualitative analysis of the medication ordering - administration process was undertaken. Naturalistic observation supported by handwritten time-stamped detailed field notes focused on (i) doctors-nurses' face-to-face communications about medication and (ii) interactions with the medication supports (MAR and Orders' List / paper-based and computerized). Interviews were performed with professionals to ensure a good understanding of the events and to eventually complete missing data.

In a second step, quantitative data were collected in the hospitals H1 and H2. For each ward, eight observations have been undertaken. Each observation period started with the arrival of the prescribing physician in the ward and ended with the administration of the meds to the patients. During each period, all the doctors-nurses communications about the care-providing for the inpatients were audio-taped.

Results

Face-to-face communications

The analysis amounted to 55 observations (lasting 3 to 8 hours) and 44 interviews. The observations highlight three main organizations of the doctors-nurses face-to-face communications (Table 1), thus whatever the system (CPOE or paper-based); organizations spontaneously described in the interviews by professionals.

1. The Common Round organization (CR): In the common round organization, the nurses' activities are organized so that they can participate systematically with physician to the medical rounds (one nurse or several nurses). Considering the entire prescription-administration process, the physicians-nurses face-to-face communications occur mainly during this dedicated time of the medical round. There are a two-way communications between physicians and nurses. Physician very often comment aloud their reasoning and therapeutic decision. Nurses summarize the patient's case, provide relevant information to the physicians and, sometimes, participate in the decision when they make suggestions for therapeutic changes. The very rare dialogs off the medical rounds happen only when there are unexpected changes in the situation, *e.g.* in the patient's status.

Table 1 – Percentages of the duration of doctors-nurses face-to-face communications per ward according to the communications' organization (Common Round, Briefing, Opportunistic Exchange) and the system (CPOE, paper-based).

			Scheduled		OE
			CR	B	
CPOE	H2	Card./Gastroent.	92 %	0%	8%
		Infectious disease	0%	89%	11%
	H3	Nephrology	0%	0%	100%
		Immunology	0%	0%	100%
Paper-based	H1	Neurosurgery	98 %	0%	2%
		Nephrology	0%	81%	19%
		Cardiology	0%	0%	100%

2. In the briefing organization (B), dedicated time slots are scheduled before and/or after the medical rounds where physicians and nurses participate in short daily meetings. These briefings are regularly planned at the same time so that doctors and nurses, or the extended clinical staff, can organize their activities to participate. All the patients' cases of the department are reviewed so that physicians and nurses are mutually aware of the patient's case and its evolution. The dialogs may influence the next decision making of the physicians during the medical round. Most often the briefings occur before the medical round and sometimes after, when physicians need notifying new therapeutic changes that have not been addressed during the first briefing. During the prescription-administration process, the doctors-nurses dialogs take mainly place during these dedicated times. During these two-way direct communications, nurses summarize the patient's case and physicians may comment. A few dialogs occur outside the briefing, *e.g.* when a change in the situation occurs (unexpected results, unexpected evolution in the patient's status, etc.).

3. In the opportunistic exchanges organization (OE) no dedicated time slot for physicians-nurses face-to-face communications is scheduled. Therefore, some brief dialogs occur sporadically when physicians or nurses can no longer perform their own activities with the only support of the patient record (paper or computerized): they are compelled to ask their colleague for more information. These informal communications are distributed throughout the time and the space. They are the last resources to compensate weaknesses of the systems (paper vs. computerized). Some of these brief verbal communications 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. But most of the communications are initiated by the nurses needing additional information to interpret unusual or modified therapeutic orders.

Medication supports

The table 2 presents the differences of each system, differences observed whatever the organization (CR, B or OE).

Table 2 – Differences in the interactions professionals / systems, depending on the type of system

Paper-based system	CPOE system
• New complementary exams or lab results can arrive anytime, professionals have then to constantly check their receipt, thus overloading the professionals • During information gathering in the patient medical record, loose sheets allow doctors to lay out all the necessary information and thus make easier the task • As the MAR is easily accessed at the patient bedside and well structured for information gathering about the current treatment, doctors systematically use it, thus making easier the information gathering • Doctors write their orders as they think them, writing orders into a paper-based system is easier/less restrictive than entering them into a CPOE system	• Alarms notify new complementary exams or lab results availability, thus efficiently guiding professionals • Finding out through the system all the necessary information is tedious (several windows and screens) and makes difficult the information gathering for doctors • To gather information about current treatment, doctors are constrained to use the order list which makes difficult the information gathering (while the MAR exists, it is not readily available to the physicians and thus is very little or not used) • The entering of unusual orders into the system is time consuming

The results show differences in the interactions between the professionals and the systems depending on the type of the system. One of the advantage of the CPOE over the paper one, is information can be updated in real time with the alarm's notifications which is a highly appreciated functionality by both professionals (doctors and nurses). However, the CPOE system fails (i) to provide ready access to a summarized view of the information and (ii) to support a rapid and easy entering of the orders.

The analyses show other differences in the use of each system, but only in one of the organizations, the OE organization (vs. CR and B) (Table 3). In this organization and for the paper-based situation, problems with notifications of changes also concern the medications changes. In the CPOE situations, in addition of being time consuming, the filling in of orders compels the doctor to enter information he doesn't usually deal with, *e.g.* the solvent of an infusion or the precise timing of medication administration, most of the time he prescribes with moments or frequencies, nurses being in charge of translating orders into suitable administration times.

Finally, none of the two systems, whether the paper-based or the CPOE, is able to efficiently support the doctors-nurses communications: in the paper-based conditions a nurse's workaround of the order list is observed and in the CPOE conditions, the "memo" functionality is not satisfying.

The results show an impact of the CPOE system on the doctors-nurses cooperative activities during the medication use process. The introduction of this type of system has the great advantage to give to the professionals an access to legible and updated information in real time as compared with a paper-based system. It has, however, some weaknesses all too frequent in currently available systems, *i.e.* the entering constraints and the failure to provide ready access to information overviews. But on looking closer, these are mainly ergonomics defects of the tool that can be easily solved and controlled.

Table 3 – Differences in the interactions professionals / systems for the Opportunistic Exchanges organization, depending on the type of system

OE/Paper-based	OE/CPOE
• The medical order list is also used by nurses to write some comments. • Doctors mainly prescribe medications during the medical round but also punctually at other times. Nurses are then stressed to miss a change in the treatment and constantly check for changes into the patients medical records • The handwriting of some doctors is illegible for nurses	• It happens that doctors miss a problem with the administration of a med (difference between what have been prescribed and administered). The "memo" is not sufficiently salient and intuitive, doctors consult it very rarely. • Some information that doctors are forced to enter can be confusing for them, *e.g.* they are not used to enter the solvent of an infusion. • The schedule of medications entered by doctors in the system is not always in accordance with nurses routines, nurses also change the timing to correspond to their rounds without checking with doctors which can be dangerous

Whatever the technical system, three main organizations (CR, B, OE) have been identified which features seem to have an impact on the coordination and communication processes. The CR and B organizations have scheduled face-to-face communications which allow each partner to take the time to understand the situation and adjust a common representation of the situation. On the contrary, the partners of the OE organization have no scheduled exchanges and interact mainly by mediated systems (CPOE vs. Paper-based) which turn out to be insufficient to support the exchanges between partners. The differences observed are the consequences of the lack of face-to-face communications; they are not observed in the other organizations (CR and B), whether with paper or CPOE.

Quantitative analysis of the face-to-face communications

The quantitative analyses amounted to approximately the same number of hours in the 5 different departments (from 36h58 to 40h05), meaning that there are no significant differences in the medication use process itself across those departments, F (4, 35) = 1.01, $p > .05$.

Table 4 - Durations of observations and dialogs according to the support of work and the organization.

System	Org.	Duration of observation	Duration of dialogs	Mean durations in minutes (SD)
Paper-based	OE	39h40	0h33	M = 4.12 (4.2)
	CR	37h33	13h10	M = 98.75 (12.2)
	B	40h05	2h15	M = 16.9 (3.3)
CPOE	CR	36h58	16h50	M = 126.25 (20.6)
	B	39h36	2h18	M = 17.25 (2.5)

As expected, there is a marked difference in the duration of the physicians-nurses dialogs according to the organization of their work (Common Rounds / Briefings / Opportunistic Exchanges) while there is no impact of the technical environment *i.e.* CPOE vs. paper-based, $\chi^2(1, N = 40) = 1.66$, $p > .05$. (cf. Table 4).

Discussion

This study addresses the question of the respective impact of organizational variables and technical environment variables on the collective aspects of healthcare work situations. The most important result of the study is the significant impact of the doctors-nurses communications organization in the teamwork. These results confirm the critical role of the face-to-face communications and of their modalities on the teamwork. For the time being the technical environment cannot support efficiently all the doctors-nurses communications. IT systems tend to acquire and present data in a mechanistic way, while conversations are characterized by the fluid and interactive notions of asking and telling, inquiring and explaining [10]. Also only a part of the communications could be replaced by information systems but not the entire communications activities. It is difficult to provide in a formal way all the information needs because they are context dependant. In routine situations, professionals share a common model of the task and so need to communicate less during an exchange. In contrast, in unusual situations a significant portion of the communication may need to be devoted to establishing a common representation of the situation. This means that during the face-to-face exchanges, partners may check with each other repeatedly throughout the exchanges that they indeed understand each other.

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 [8]. The great variety of communications' organizations within each hospital complicates the task. 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 findings of this study on the three organizations need to be generalized. The issue is to identify in the work situations the determinants of the collective activities. One of them is the scheduled of face-to-face communications' slots in the work organization, and also its modalities. Indeed, exchange during the medical round and the decision making process (CR) or rapidly in the nursing room (B) is quite different. In another study, we demonstrate that the quality and extent of nurses' knowledge about the therapeutic care plans and about the drugs management may vary greatly depending on the organization of the physicians-nurses communications [11]. For example, based on the analysis of nurses' activities and confrontation interviews, we could establish that a nurse participating in medical rounds (CR) presents an extended understanding of the medical characteristics of the pathology, an extended knowledge and understanding of the therapeutic care plans and of their underlying medical rationale and finally an extended knowledge of the particular patient's medical case.

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