

A Qualitative Analysis of Prescription Activity and Alert Usage in a Computerized Physician Order Entry System

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Abstract. Medical alerts in CPOE are overridden in most cases. The need for alerting systems that are better adapted to physicians' needs and work processes is recognized. Our study aims to shed some light on how medical alerts are used and how they are integrated in the work process. Work analysis and interviews resulted in a hierarchical task analysis of prescription during ward rounds at the University Hospitals of Geneva. The results indicate that non-modal medical alerts are appreciated as an "insurance" for drugs that are out of the routine set. In the case of drugs that are often prescribed, alerts are ignored as physicians feel comfortable prescribing them. Non-interrupting alerts do not cognitively overcharge physicians, but the question is how to display the numerous alerts so that they are easily accessible when needed. Further, inexperienced physicians lack a mental representation of what evaluations the system is doing with the prescriptions and when alerts are triggered. This may lead to lack of trust or overconfidence, both of them potentially harmful.

Keywords. CPOE, medical alert, task analysis, usability

1. Introduction

The aim of the present paper is to analyze the prescription behavior of physicians and their use of medical alerts with a homegrown computer physician order entry (CPOE) system with an integrated decision support system (DSS) at the University Hospitals of Geneva, a teaching hospital with 2000 beds and 15.000 electronic prescriptions a day. The scope of the study is limited to the use during ward rounds.

Research in other hospitals has shown that medical alerts have a low compliance rate [1] but nevertheless improve prescription behavior and patient safety [2]. It is generally agreed that alert systems have to be better adapted to the needs and work processes of prescribing physicians. If alerts would be better timed, more specific and

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displayed in a user-friendly way, they would act as an even more powerful decision support system than today.

The prescription activity with CPOE can be described in a top-down manner accessing job descriptions, hospital guidelines, medical guidelines and their implementation in the resulting CPOE. Conversely, in a human-centered approach, the activity can be constructed on physicians' representation of the information in the CPOE and how they handle the medical information in a real work context. As for medical alerts, there seems to be a discrepancy as the low compliance rate shows.

In order to study prescription activity, ethnographic work observations and interviews [3], work simulations [4] and focus groups [5] have been applied. A method to model the prescription process is cognitive task analysis. The result is a hierarchical representation of main tasks and the depending sub tasks. Researchers have used this technique to represent the drug administration process [6]. A similar method is MAD (Method of analytic task description) [7] which is used in the present study. The goal is to represent the physician's activity in order to make alerts better adapted to it.

2. Method

In a first step, 5 deputy heads of different divisions at University Hospitals of Geneva were questioned in semi-directive interviews. The aim was to get a wide range of requirements and a broad perspective on the alerting systems in their divisions. The scope was not limited to CPOE, but aimed to cover general use of alerts in the medical field. Two divisions have been selected for conducting further analysis: the division of cardiology in the department of internal medicine and the division of pediatric surgery in the department of adolescents and children. In each division, a ward round in the morning was accompanied to see how medical personnel act and communicate during prescription activity. Work procedures were observed and notes taken. The work itself was not interrupted as far as possible. When the moment seemed right emerging questions were asked according to the methodology of contextual inquiries.

Each deputy head of division selected a physician for further semi-directive interviews. In the case of cardiology it was an attending physician with 10 years of experience with CPOE and in the case of pediatric surgery an advanced resident with 2 years of experience with the CPOE. The interviews were always opened with the request "to recount a recent clinical case where an alert has been displayed". When narrations stopped or when something was unclear, further questions were asked to complete the view on the prescription process. In each of the services we interviewed 2 more residents, each with 8-14 month of experience with CPOE. The interviews took 20-40 minutes, were audio recorded and transcribed. The transcriptions were analyzed in order to identify the different activities in the prescription process and their temporal and causal relations. This data completed the findings provided by work analysis.

3. Results

3.1. Interviews with deputy heads of division

Alerts in CPOE are in general regarded as a good means to provide decision support, as the deputy head of division support projects which go further in this direction.

However, some brought up issues make the CPOE less utile. First, alerts once entered in the system can be outdated. The processes how to keep them up-to-date is not yet implemented (i.e., for patients who were carrier of methicillin-resistant staphylococcus aureus (MRSA) and who are now readmitted to the hospital). Another example is reminder alerts that should be given the last day of hospitalization (i.e., bacteriological tests), a day the system cannot forecast. This leads to an alert every day and therefore to a low compliance rate and alert fatigue. Some physicians criticize the authentication warnings when accessing patient records out of their responsibility. They are regarded as interruptive, intimidating and as a lack of trust in them. None of them complained about the amount of alerts and they agree that it is usually difficult to make alerts more specific given that the user range is very broad (medical specialties, experience and expertise).

Concerning usability issues, some deputy head of division are concerned with the quality of medical work by inexperienced physicians. They fear that novice physicians might use electronic prescribing as a poor substitute for thorough clinical analysis. According to them, residents depend too much on decision support systems. Another usability issue has been identified in the display of information. Some alerts are out of the visual focus region when using the system and thus leading to low response levels to the alerts. No one had the impression that there are superfluous alerts. However, some concerns were expressed that the number of alerts will soon overcharge the screen. Form usability was also mentioned as some interaction elements like pull down menus can lead easily to errors when choosing a wrong unit in drug prescription.

3.2. Work analysis

There are two situations where drugs are prescribed. In the first case, a physician is on a night or weekend shift and does the prescription alone. In most cases however, the physician is on a ward round together with other residents, nurses and in some cases with a deputy head of division and/or attending physicians who lead and supervise the prescription process. The decision making process in these cases is collaborative. Prescriptions and medical forms are entered by one designated resident after the visit of a patient or even at the end of the ward. The question arises what impact alerts have on the prescription process when they appear some time after having made the decision.

3.3. Interviews with attending physicians and residents

Only one of the interviewed physicians could recall a recent medical case where he was alerted during the prescription. Apparently, alerts like drug interaction alerts and dosage alerts do hardly lead to critical incidents which would be remembered. The alerts are rather seen as contextual information (coming from the drug compendium) for a drug or drug combination, which may also be ignored in favor of the division's own rules. The alerts were considered by nobody to be interruptive. This may be due to non-modal alerts (not interrupting the work process) and to the fact that drug prescription is never inhibited.

While the two more experienced physicians had a more detailed mental representation of what tests are conducted by the system and what alerts are triggered by these tests, the less experienced residents had only a fuzzy representation of what the system is testing. Indeed, when asked if they would expect an alert for a given use case, a typical answer was for example: "I don't know. You have to ask the

programmers of the system.” This issue was never stated as a problem in the interviews. Still, if this is the case, physicians will find it difficult to trust a system completely; if they do, they risk missing potential dangerous situations where there is no alert. Statements by residents, the deputy head of divisions, and research [8] indicate that they will not look for any, if the system is not warning them. Also, some express doubts on whether the system has up-to-date information (for instance for weight-based drug dosage alerts in pediatrics or drug interactions in cardiology where they often introduce new drugs).

Physicians were aware that they don’t pay attention anymore to alerts. Both visited divisions had a specialized drug set they prescribed very often. Drug alerts for their most common prescriptions were routine to them and the respective alerts were ignored. When asked whether they find them useful they responded that they were confident that they know the risks for the drugs in their medical domain, but they appreciate such an alert system for drugs they don’t prescribe often as for instance psychiatric or neurological drugs. None of them could report such a situation, but it does comfort them that the system would intervene. Both divisions used a limited set of about 5 drugs per patient, but they already find it difficult to understand the visualization of drug-drug interaction alerts where one drug has interactions with several others.

An important alerting mechanism stays the feedback of the nurses who are used to prescribe a set of common dosages, routes, and frequencies of prescription. In contrast to the CPOE, they are also aware for what diagnose the drug is prescribed for.

3.4. Task analysis

The method of analytic task description (MAD) resulted in the hierarchical tree as shown in Figure 1. The sticky-man symbol represents a physician-initiated task, a computer represents a computer-initiated task; the label “opt” describes an optional task. The relations between a task and its subtasks are “alternative”, “parallel”, “sequential”, or “no order”. This task representation may be used to create use cases and scenarios for prototype development and usability testing.

4. Discussion

The present study gives some insights in the prescription process with a CPOE and how alerts are handled. The main finding is that physicians appreciate alerts as insurance for situations they are not familiar with. Also, non-modal alerts are not overcharging the physicians, however attention should be paid on how to best visualize the ever growing number of alerts. Finally, as it is not visible to the physicians, they have in general no mental representation of what prescriptions the decision support system is checking. These issues have to be addressed in future research.

5. Conclusion

The present qualitative study offers a means to understand what causes lay beneath the low compliance towards alert systems and how to improve them. We will use the findings to develop a prototype for alert systems which will be further studied in

usability tests. The presented method may be easily adapted to other work contexts and research questions in the medical field.

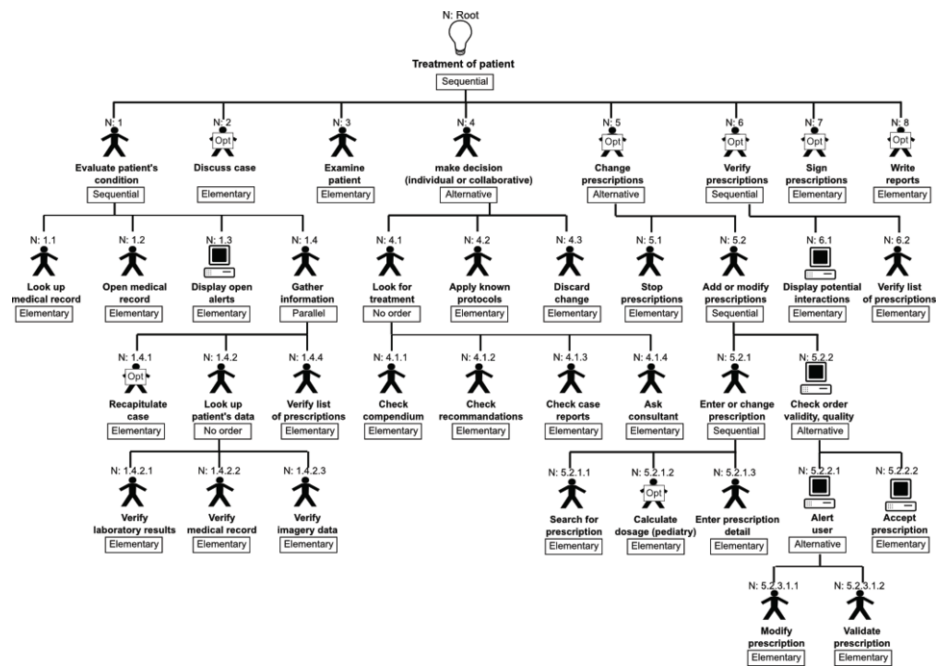


Figure 1. Analytic Method of Task description for prescription process during a ward round

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