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# Unintended transformations of clinical relations with a computerized physician order entry system

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## ABSTRACT

A socio-technical approach was used to study the qualitative effects of deploying a medication computerized physician order entry system (CPOE with no decision support) at two internal medical wards in a hospital in Denmark. Our results show spatial and temporal transformations of core acts and relations in medication work, i.e. of the intended use of the system inscribed in hardware and software, in the relations of care between doctors and patients, of collaboration between doctors and nurses, and prospectively of the patients' trajectories when readmitted to hospital or another health care institution, reusing data from the system. This study throws light on problems of continuity of patient care paths, patient-related and IT-system-related error handling and time spent on core activities—when ubiquitous IT is used locally in a real physical setting with specific traditions of performing or 'doing medication'. The paper argues for the project organization to support the local collaboration and renegotiation of time and place of enacting medication with CPOE, as well as set up feedback for maturation of the software for future clinical use.

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## 1. Introduction

This study pays special attention to the technique and role of a computerized order entry system (CPOE) in the work processes of medication at two wards of internal medicine in a middle-sized Danish hospital. From the view of health care management, "the cockpit crew" [1], CPOE systems are expected to reduce errors and medical costs, give better quality and continuity of care and improve cooperation between health care professionals [2]. The aim of the qualitative study presented here, though, is to bring in the view of the "fire brigade" [1], the clinicians responsible for the medication outcome, and to support their articulation of experiences as the primary users of the system. These articulations might, in spite of their local, qualitative origin, be of interest to other implementers and developers of CPOE systems, as learning on

design, change management and the nature of clinical work [3,4] seem to be the imperative of improving information systems in health care. Classen et al. state that evaluation of CPOE installation in individual organizations is more pressing than ever [5, p. 51]. "All organizations will need to perform ongoing evaluation of their CPOE applications and their electronic health record (EHR) if the potential benefits of these technologies are to be actually realized" [6, p. 53]. Georgiou et al. concluded that further research is needed, especially as "(f)ew data are available regarding the impact of CPOE on patient outcomes" [6, p. 514]. Pragmatic discussions on health care improvements from CPOE call for more attention to detail and appropriate support to clinicians' workflow [7]. The following ethnographic study illuminates usability and utility problems of clinicians interacting with CPOE in real life settings.

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### 1.1. Background

The theoretical background is socio-technical understanding of work processes, which basically means that work processes do not take place automatically, controlled more or less by either the technologies at hand or the professionals in place. Instead, technological artefacts and human actors are closely intertwined, and will be analyzed accordingly. Medication processes include a variety of persons and techniques, from patients, physicians, doctors' rounds, writing tools, note books, etc. They are also termed 'actants', as they all – humans as well as techniques – contribute to the production or 'enactment' of medication as an ongoing activity in concrete temporal and material settings [8,9].

## 2. Materials and method

The *object of study* is the medication process with a CPOE system in two Danish internal medical wards. Qualitative methods have been used for in-depth analysis of 48 h observation, six semi-structured interviews with primary users (two physicians and four nurses) and an analysis of the user interface and of other documents. Based on the observations, three use scenarios for central events in the medication process were constructed. The *actants* were among others drugs, physicians, nurses and the CPOE system. The CPOE system, at this stage of development, is only handling the "bookkeeping" of medication. It is not offering any decision support, and is developed by a professional vendor (Systematic Software Inc., Aarhus, DK) in close cooperation with the responsible Health Maintenance Organization (HMO) (Aarhus County, DK), who have supplied clinicians to the development project. At the time of the study, the CPOE had been in use for 8 months in the participating hospital wards, replacing a paper medication scheme, called MOS. Other actants were the pharmacy system (electronic Danish Physicians Desk Reference (PDR)), handbooks on medication, PC tables, other staff groups and techniques.

### 2.1. The medication process

Medication (treatment with drugs) in hospital settings can be understood as a process that begins with the patient's diagnosis and ends, at best, when the patient is discharged from hospital or is no longer in need of the drug. This overall *programme of action for carrying out medication* consists of a minimum of seven subprogrammes of actions that are essential for medication to take place [10]:

1. The indication of treatment.
2. 'Prescription', i.e. the choice of treatment and the patient's consent hereof.
3. 'Order', i.e. entry of clinical choice of treatment into the CPOE system.
4. 'Dispensing', i.e. the drug is made ready for consumption.
5. 'Administration', i.e. the patient is given the drug.
6. 'Assessment' of the drug's effect on the patient.
7. Considerations on how to precede, i.e. whether to continue or withdraw the drug.

These *subprogrammes of medication* are elementary, core events in medication work. They are continuously repeated, with ongoing adjustments within a 24 h rhythm, 365 days a year. Danish clinicians commonly understand the *goals of the subprogrammes* as 'the five right': the right drug, to the right patient, at the right time, in the right dose, in the right way (e.g. orally or intravenously). Any deviation from these goals is considered to be an error of medication.

Apart from being used for drug orders (3), the CPOE was an active part in the subprogrammes of prescription (2), dispensing (4) and continuity of treatment (7). The observations were condensed, verified by users and generalized in the construction of *three use scenarios* that confirmed transformation in vital elements of health care: (a) in the doctor's relation to the patient and other techniques (especially a clumsy PC table and stationary dictaphone for the patient record), (b) in the doctors' and nurses' coordination work, and (c) in the possibilities of the patient's further trajectory and future medication care path.

## 3. Results

The following shows how the CPOE system participates in the transformation of three central relations for enacting right medication, i.e. between doctor and patient treatment when prescribing and ordering drugs, between doctor and nurse and their collaboration around ordering and decisions on proper dosage for the patient, and in the coordination between hospital and future situations of treatment. These transformations point to unintended consequences that cannot alone, though, be reduced to either the system or social factors but are in many ways sensible outcomes of concrete situations of interaction. The use scenarios showed that the system's success or failure in use could not be assessed isolated from the environment in which it participates. The social culture and the materiality of space and things challenge the use of the CPOE system.

### 3.1. Transformation of prescription (2) and drug order (3) on doctor's rounds

On doctor's rounds 'a detour' [6] or work around occurred in making prescriptions and entering orders in the system. This was due to long walking distances between the patients' beds and the stationary dictaphone in the hallway for making prescriptions in the patient's medical record and subsequently, a clumsy PC table with the otherwise portable CPOE (Fig. 1). The doctor would therefore memorize three or four patients at a time before (s)he would, first, dictate the patients' diagnoses, indications and prescriptions for the patients' records and then enter the drug orders in the system. In other words, the space and distance between hospital beds, PC tables and a stationary dictaphone decide what is accessed, when, in what order and how. The CPOE may be, therefore, technically ubiquitous in the sense that it provides users with global access to patients' medication across hospital wards and other health care institutions in the county. Though in its local use other actants such as the stationary dictaphone, the clumsy mobile PC table (Fig. 1), the endurance of the laptop computers and the

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