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Using a sociotechnical framework to understand adaptations in health IT implementation

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This paper is dedicated to Dr. Ben-Tzion Karsh.

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ABSTRACT

Purpose: When barcode medication administration (BCMA) is implemented nurses are required to integrate not only a new set of procedures or artifacts into everyday work, but also an orientation to medication safety itself that is sometimes at odds with their own. This paper describes how the nurses' orientation (the Practice Frame) can collide with the orientation that is represented by the technology and its implementation (the System Frame), resulting in adaptations at the individual and organization levels.
Methods: The paper draws on two qualitative research studies that examined the implementation of BCMA in inpatient settings using observation and ethnographic fieldwork, content analysis of email communications, and interviews with healthcare professionals.
Results: Two frames of reference are described: the System Frame and the Practice Frame. We found collisions of these frames that prompted adaptations at the individual and organization levels. The System Frame was less integrated and flexible than the Practice Frame, less able to account for all of the dimensions of everyday patient care to which medication administration is tied.
Conclusion: Collisions in frames during implementation of new technology result in adaptations at the individual and organization level that can have a variety of effects. We found adaptations to be a means of evolving both the work routines and the technology. Understanding the frames of clinical workers when new technology is being designed and implemented can inform changes to technology or organizational structure and policy that can preclude unproductive or unsafe adaptations.

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1. Introduction

The topics of health information technology (IT) design and implementation provide a canvas onto which engineers, clinicians, administrators and politicians paint a variety of idealized states of clinical practice and patient engagement. Health IT is said to have the potential to improve the safety and effectiveness of care [1–4]. However, it is known that the implementation of health IT can introduce new risks into the environment of care as a result of design failures [5], implementation failures [6] and unintended consequences [7].

At the institutional level, management decisions to implement IT-based patient safety innovations are influenced by a variety of factors: financial considerations, marketing efforts of vendors, individual and shared experiences of leaders (e.g., clinical and/or management experience, education, and personal experiences with the health system), and subjective and shared ideas about what constitutes safe practice. Once the decision to implement the IT system has been made, various interest groups such as vendors, management, IT staff and users may have very different ideas about which safety-related problems need to be solved and the best strategies for solving them. The result is a myriad of software features, rollout decisions, infrastructure decisions, organizational structures, use practices and other factors converging to transform the sociotechnical system in ways that vary across clinical units.

Optimally, the convergence of these various perspectives, or *frames of reference*, can result in mutual learning and increased safety and effectiveness. In a less optimal scenario, there is a collision in priorities or understandings of practice that goes unresolved, leaving end-users, groups and organizations to adapt to fulfill individual goals [5,8,9]. For example, when some hospitals' new health IT systems collide unfavorably with pre-existing workflow, clinicians are known to adapt by persisting in the use of paper artifacts [10–13]. These adaptations may improve or compromise quality and safety and, by virtue of being adaptations, constitute unintended consequences. With this paper, we use empirical research from 2 studies of the implementation of barcode medication administration (BCMA) to explore the collisions of the frame of reference for medication safety that was codified in the BCMA system with the frame held by practicing nurses. We examine adaptations used by individuals and organizations as a result of the collisions. With these analyses we aim to complement the sociotechnical frameworks that have been applied to health IT [14–21] by contributing insights into some fundamental reasons for adaptations and exploring the potential value of adaptations.

2. Background

2.1. Patient safety IT implementation research

Numerous health IT systems have been put forth as potentially valuable patient safety solutions, including BCMA, clinical decision support (CDS) and computerized provider order entry (CPOE). There is evidence of these systems alternately improving patient safety [22–27] and being the source of potential harm to patients [5,6,28,29], suggesting that health IT outcomes depend on contextual issues such as implementation design [30–38]. Research on unintended consequences has focused on patient safety IT, and has shown a lack of realistic representations of clinical work in tool design and implementation [7,8,39–41].

2.2. Frames

At the core of the problem revealed by unintended consequences is the existence of multiple frames of reference regarding clinical work. A technology developer may think of clinical work in terms that can be represented in a computer program. A manager may think about aspects of work that can be influenced by management practices, policies or the allocation of resources. A clinician or other health care worker may have a more "situated" [43] perspective on clinical work, where a myriad of factors such as the clinical environment, the patient and family, their training experiences, and surprises "in the moment" converge in the doing and describing of their work. These different perspectives have been characterized as frames [44], orienting frames [45], schema [46], and interpretive schemes [47]. All of these constructs refer to shared conceptual resources that actors use to make sense of complex, ambiguous social and technical information. In contrast to the technological frames literature that examines frames of orientation to technological artifacts [48–50], we examine frames of orientation to the *work of medication management and medication safety*.

There are a variety of communities, or stakeholders, involved in the implementation of a BCMA system, ranging from vendors to clinical and technological management to bedside nurses. We use the term "System Frame" as a way of considering the system's functionality and implementation as representative of the cumulative assumptions, decisions, priorities and perceived possibilities for problem-solving of the vendor, developers and implementation decision-makers. The "Practice Frame" is a similar aggregation of the bedside nurse's perspective, as documented through observations and interviews. The Practice Frame may indirectly include the patient's perspective via the nurse's role as an advocate. In this paper we examine the conflicts or "collisions" between the System Frame and the Practice Frame and the resultant adaptations by both nurses and management.

2.3. Adaptations

In the context of health IT, adaptations are dynamic responses by human actors to the technology as well as the evolution and persistence of these responses over time. Adaptations include augmenting the technology and changing work practices to accommodate the technology [51,52]. Workarounds comprise a specific type of adaptation that is a widely reported unintended consequence of health IT implementation [5,28]. In the case of workarounds, a new way of working is devised as a way to remove an impediment or problem [53]. Studies have documented numerous workarounds related to BCMA use [53], including affixing patient identification barcodes to locations other than the patient in an effort to speed the scanning process [5,28] or not scanning the medication or patient

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