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Informing the design of clinical decision support services for evaluation of children with minor blunt head trauma in the emergency department: A sociotechnical analysis

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ABSTRACT

Integration of clinical decision support services (CDSS) into electronic health records (EHRs) may be integral to widespread dissemination and use of clinical prediction rules in the emergency department (ED). However, the best way to design such services to maximize their usefulness in such a complex setting is poorly understood. We conducted a multi-site cross-sectional qualitative study whose aim was to describe the sociotechnical environment in the ED to inform the design of a CDSS intervention to implement the Pediatric Emergency Care Applied Research Network (PECARN) clinical prediction rules for children with minor blunt head trauma. Informed by a sociotechnical model consisting of eight dimensions, we conducted focus groups, individual interviews and workflow observations in 11 EDs, of which 5 were located in academic medical centers and 6 were in community hospitals. A total of 126 ED clinicians, information technology specialists, and administrators participated. We clustered data into 19 categories of sociotechnical factors through a process of thematic analysis and subsequently organized the categories into a sociotechnical matrix consisting of three high-level sociotechnical dimensions (workflow and communication, organizational factors, human factors) and three themes (interdisciplinary assessment processes, clinical practices related to prediction rules, EHR as a decision support tool). Design challenges that emerged from the analysis included the need to use structured data fields to support data capture and re-use while maintaining efficient care processes, supporting interdisciplinary communication, and facilitating family-clinician interaction for decision-making.

Abbreviations: CDSS, clinical decision support services; CT, computed tomography; ED, emergency department; TBI, traumatic brain injury.

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1. Introduction

Translating scientific knowledge into clinical practice is a challenge in any healthcare setting. The Agency for Healthcare Research and Quality (AHRQ) reports that it can take as long as two decades for new knowledge to become common practice [1]. As a result, Americans reportedly receive only about one-half of recommended care [2]. Clinical decision support services (CDSSs) are one strategy that may address this issue by enabling clinicians to use electronically-entered patient data to allow rapid access to scientific evidence at the time of clinical decision-making. Although CDSSs have been reported to reduce errors and improve quality of care, they have also been poorly accepted and sometimes associated with negative unintended consequences [3]. Informatics-based strategies for the design and development of CDSSs may enhance clinical integration and thus improve quality of care and mitigate unintended consequences [4–6].

The emergency department (ED) is a particularly challenging setting in which to implement CDSSs [7–9]. Although CDSSs may be an effective method to implement best available evidence, there is limited literature and considerable debate as to its potential effectiveness in improving outcomes in this setting [9–12]. With the goal of reducing unnecessary cranial computed tomography (CT) scans in children, the Pediatric Emergency Care Applied Research Network (PECARN) recently derived and validated two robust, clinical prediction rules that identify both younger and older children at very low risk for clinically-important traumatic brain injuries (TBI) following minor blunt head trauma for whom CT scans may safely be obviated [13].

The sociotechnical dimensions inherent in complex healthcare settings such as the ED influence the design features needed for a system that can successfully support evidence-based clinical decision-making [10]. These dimensions include institutional culture and goals, interdisciplinary workflow and communication, existing information systems and both local and external rules and regulations affecting clinical practice. Research examining the effectiveness of technology in various organizations has emphasized the importance of describing the details of these dimensions and their relationships prior to the introduction of new technologies. Failure to understand the interrelated nature of these dimensions can lead to solutions that support one while potentially harming another [3]. In healthcare settings, this is described as the unintended consequences of healthcare information technology (HIT) [14,15]. The complex sociotechnical facets of healthcare environments, while acknowledged to be inextricably connected, may be deconstructed in order to be examined and described prior to technology development. In any setting, these dimensions can be analyzed and their relationships described so that appropriate system features can be identified that address gaps while supporting existing positive structures. The objective of this study was to describe the sociotechnical environment in the ED setting to inform the design of a CDSS intervention to implement the PECARN TBI clinical prediction rules. In addition, we describe a modified sociotechnical model to reflect the unique requirements of the ED setting that could be used to inform the design of future CDSS interventions.

2. Materials and methods

2.1. Study design

We conducted a multi-site cross-sectional qualitative study (workflow observations, clinician focus groups, key stakeholder interviews), over a four-month period (November 2010–February 2011) prior to developing the CDSS intervention for implementation of the PECARN TBI prediction rules. Institutional Review Board approval was obtained at each site and informed consent was obtained from all study participants.

2.2. Research sites

All 11 sites participating in the study were part of either the PECARN or the Clinical Research in Emergency Services and Treatments (CREST) network [16,17]. Sites included three free-standing academic children's hospitals, two academic tertiary care centers and six community hospitals located across the United States. All six community hospitals were part of the Kaiser Permanente Health System in Northern California. All sites were using the same vendor provided electronic health record (EHR) in the ED (EPIC®, Madison, WI) although software versions varied across sites. Nursing documentation, physician documentation and computerized provider order entry (CPOE) were in use at each study site for at least one year prior to the study period.

2.3. Theoretical model

Exploring the complex interactions between the social and technical nature of healthcare work is recognized to be an important step in understanding the potential impact of a new technology [18]. This is often referred to as a sociotechnical analysis [5,18,19]. Sociotechnical approaches to understanding work processes are based on the notion that the social context of work is critically linked to the technical component and as a result, the two continuously influence and alter one another [19]. Although, there is no single, comprehensive sociotechnical theory or approach, there are a number of theoretical and conceptual models based on sociotechnical thinking that can be used to inform the design of suitable structures to support work practices in a given setting [18,20–22]. From the available models, we selected a model proposed by Sittig and Singh [5]. This model was developed based on an in-depth analysis of information technology implementation in healthcare settings and, therefore, we felt it would serve as an appropriate guide for the current study [5]. This model consists of eight-dimensions known to be important to the development of useful and safe IT in healthcare settings [5]. These dimensions include (1) hardware and software infrastructure; (2) clinical content; (3) human–computer interface; (4) people; (5) workflow and communication; (6) organizational policies, procedures and culture; (7) external rules and regulations; and (8) system measurement and monitoring [5]. These eight dimensions form a synthesized model that allows for their practical description while recognizing their complex, interrelated nature [5]. As was done for this project, each dimension can be described as it occurs within a particular healthcare setting. The existing connections among the dimensions can then be reviewed, allowing for an examination of the sociotechnical structures in place that influence the usefulness of a new technology.

We used the eight dimensions of the model to develop an open-ended guide for use in the focus groups and interviews. In addition, we used the model to guide observations of work processes with a focus on patterns of workflow and communication, as well as physical structures in each ED that would impact development and use of a CDSS intervention. The eight dimensions and their application to this project are described in the following paragraphs.

Hardware and software infrastructure includes a description of both the existing hardware and software in use as well as the structures in place that support the maintenance of hardware and updates to existing software [5]. This infrastructure includes IT personnel available to develop new software and support its use as well as the capabilities of available software to address