Clinical Decision Making by Emergency Room Physicians and Residents

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INTRODUCTION

Clinical decision-making is a complex process that is reliant on accurate and timely information. Clinicians are dependent (or should be dependent) on massive amounts of information and knowledge to make decisions that are in the best interest of the patient. Increasingly, information technology (IT) solutions are being used as a knowledge transfer mechanism to ensure that clinicians have access to appropriate knowledge sources to support and facilitate medical decision-making. One particular class of IT in which the medical community is showing increased interest is clinical decision support systems (CDSSs).

CDSS is "any program designed to help healthcare professionals make clinical decisions" (Musen, Shahar & Shortliffe, 2001). Decision models used in CDSS, especially those providing patient management and diagnostic advice, are normally based on expert knowledge, either discovered from past data or elicited from medical books or practice guidelines. The quality of any patient-specific CDSS is reliant on the quality of the underlying decision model(s). These models have to reflect clinical expertise, which implies that clinicians using such systems have to provide values for the CDSS input variables that can be correctly elicited only with an appropriate level of expertise. That is, only experienced clinicians will be able to provide CDSS input variables in a reliable and comprehensive manner, while inexperienced clinicians will be forced to gather information and make assessments for activities that they may lack the clinical acumen to do accurately. This may diminish the usefulness of the CDSS and

the validity of the advice generated by the system, and lead to the rejection of the system by novice clinicians as forcing them to evaluate a patient in a way in which they are not accustomed.

CDSS users can be categorized using the classical taxonomy of novice or expert decision-makers. Differences between these two classes of decision-makers have been widely documented in the decision-making and medical literature. In complex domains such as medicine, it typically takes 10 years of training before one can be considered an expert (Prietula & Simon, 1989). Over time, experts develop a capability to systematize information and to form complex networks of knowledge that is stored in long-term memory (Arocha, Wang & Patel, 2005; Prietula & Simon, 1989). Novices lack these knowledge networks, and thus, when faced with new informational cues, they need to produce more hypotheses than experts (Kushniruk, 2001) and are unable to filter out irrelevant cues (Patel, Arocha & Kaufman, 1994), thus taking a longer time to make their decisions.

The purpose of this chapter is to explore how two classes of CDSS users representing different levels of expertise consider expert-generated CDSS inputs in their clinical decision-making. In this study, staff physicians are considered expert decision-makers and residents are considered novice decision-makers. Our study is based on the empirical results of a clinical trial of a CDSS that was developed for helping with triage decisions of pediatric abdominal pain in an emergency department (ED) (Farion, Michalowski, Slowinski, Wilk & Rubin, 2004). On the basis of collected data and other established literature on expert/novice deci-

sion-making, we evaluate differences between these two groups of CDSS users and draw more general conclusions for supporting clinical decision-making with technology.

The research question we seek to answer is:

What importance do residents and staff physicians place on expert-generated CDSS input variables in making their clinical decisions?

This chapter is organized as follows. First, background about the Mobile Emergency Triage (MET) CDSS is presented, along with an explanation of the input variables that are used by the system. Next, descriptions of the sample and data collection procedures are provided, along with the analysis techniques used. This is followed by a discussion of the results, future trends in CDSS design, and a conclusion.

BACKGROUND

The MET system was designed and developed to support ED physicians in making triage decisions about children with abdominal pain. The MET system consists of a server that interfaces with a hospital's electronic patient record system using the HL7 protocol and a client that resides on a PDA. The client facilitates the collection of clinical data during examination by physicians and also supplies a triage support function. The client is used directly at the point of care.

The MET client provides a series of interfaces to collect 11 out of 13 input variables shown in Table 1 that are used by the abdominal pain triaging algorithm (the remaining two variables, gender and age, are extracted automatically from the electronic patient record system). The collected data get transferred to the server for persistent storage and usage in the electronic patient record system. Discretizations for numerical input variables were based on medical practice, and the triage decision-making model was developed using retrospective chart analysis and knowledge discovery techniques based on rough set theory (Pawlak, 1991; Slowinski, 1995). The decision model is represented as decision rules that are easy to comprehend and interpret by physicians, and therefore are well accepted in clinical practice.

Based on the values of the input variables, the client uses the rule-based decision model to offer a suggested triage decision, which can be one of the following three options:

Table 1. Abdominal pain triaging input variables

Input Variable Name and Description	Possible Values
Age	number, discretized to 0-6, >= 7 years
Gender	male, female
Duration of pain	number, discretized to <=24 hrs, 1-7 and >7 days
Site of maximal pain	right lower quadrant (RLQ), lower abdomen, other
Type of maximal pain	continuous, other
Vomiting	yes, no
Previous visits in the ED for abdominal pain during the last 48 hours (irrespective of site)	yes, no
Temperature	number, discretized to <37, 37-39, >= 39 Celsius
Site of maximal tenderness	RLQ, lower abdomen, other
Localized guarding: localized muscle sustained contraction noted when palpating the abdomen	absent, present
Rebound tenderness: pain felt at site of maximal tenderness, produced by altering intra-abdominal pressure	absent, present
Shifting of pain	absent, present
WBC (white blood cells)	number, discretized to <=4000, 4000-12000, >=12000

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