USE OF CRITICAL DECISION METHOD (CDM) IN HEALTH SETTINGS: A REVIEW

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ABSTRACT

Critical Decision Method (CDM) is a useful knowledge elicitation technique in health settings. It has been used to understand the decision making processes of the experts under stressful or non-routine situations. The information elicited through CDM interviews is useful in identifying the important cues used by physicians and nurses in critical decision making situations. These cues help in developing training material and strategies for the novices. This is important for health professionals, specifically in Pakistani cultural context1, where informed and shared decision making is less practiced (low literacy rate), and doctors have to make most of the decisions at their own. Orienting nurses and doctors with the decision making process used by experts in critical situations would lead to the development of decision aid tools, which would potentially improve their decision making in critical situations. The present paper reviews the literature on successful use of CDM in different stressful situations in health-care and medical domains.

KEY WORDS

Cognitive Decision Method, Critical Decision Making, Experts and Novices

CRITICAL DECISION METHOD (CDM) AS TOOL FOR DOCTORS

One of the most powerful knowledge elicitation method for cognitive task analysis (CTA) practitioners is to probe actual incidents. People can tell us about all details, cues, background, influences, challenges and strategies that they used in any critical situation. These stories by experienced practitioners are the gateway to their expertise. This helps us know how and what an expert did in any critical and non-routine situation. Critical Decision Method is one important technique that helps learn from specific incident. Most recently, CTA methods have been applied to a wider range of knowledge domains[2] e.g. medicine, science, and engineering to understand the cognitive processes in critical or non-routine situations. Most importantly, these methods are more helpful in identifying areas of potential human decision making errors in critical situations. Furthermore, the information retrieved from these analysis can also be used to develop decision aid tools to improve the decision making process in these situations.

Physicians and nurses working in the Critical Care Units (CCUs) make decision in situations which quite often are stressful and critical. Understanding the decision making process under these critical situations is not only challenging but a very important task. The present paper reviews the literature available on the use of Critical Decision Methods[3], a type of Cognitive Task Analysis (CTA), in health-care settings. The primary focus here is to review the literature to document the use/utility of CTA methods in such settings; that is how it helps in understanding the key cognitive elements and decision making process of physicians and nurses. This paper also focuses on how the information elicited through CDM approach can be used in developing training tools and strategies for the novices.

CRITICAL DECISION METHOD (CDM)

CDM is a retrospective task analysis interview technique that applies a set of cognitive probes to actual non-routine incidents. It is a variation of the critical incident technique4 which was established by Klein Associates[3, 5]. The method has been used to elicit expert knowledge[3], their problem solving and decision strategies[6], the cues they are attending to[7-8], and for the situation assessment[8-9]. Results of CDM has been applied to build and evaluate the expert system and to identify the training needs of novices[8,10]. CDM research has helped defining the field of naturalistic decision making[8, 11]. The utility of the technique is more than any other interview technique, as it focuses on the non- routine cases[12]. Previous research has shown the utility and efficacy of CDM in the nursing profession[13]; significantly more information was elicited in CDM interviews than in non-CDM interviews.

CDM helps in understanding the decision making process in stressful situations

CCU environments are generally high stress and time sensitive, where the primary medical goal is to recover the patient's health quickly and safely as early as possible. Decision making is crucial in such environments. Several cognitive activities that members of the CCU were engaged in[14] were identified using CDM interviews and observations. They found Pattern recognition as a fundamental element of critical patient care expertise as members of the CCU teams were relying frequently on pattern recognition for their decisions making. Furthermore, the researchers identified two types of pattern recognitions - mental models and packets (unique patient specific mental models) - both were found highly context specific. For example the cue of blood pressure of 80/40 was found to be quite different for respiratory failure patient than the congestive heart failure patient. The research suggested that the patterns recognized by experts can be documented and used for training of the lesser-experienced physicians.

Level of thinking was found to be another important cognitive element used by experts in decisions making in CCU[14]. Experts were found more at strategic levels of thinking (goal oriented) whereas lesser-experienced were found thinking more at tactical levels (task oriented). Consistent with studies of fire ground command decision making, where they reported the differences in decision making strategies used by lesser-experienced and more-experienced fire ground commanders[15]. They found that both groups relied on recognition decisions however, the strategy used by more-experienced was more likely to deliberate the situation evaluation dimension as compared to option evaluation dimension used by the less-experienced. Another research examined critical decisions made by surgeons during laparoscopic surgery; the research elicited information on the bases of which surgeons made their decisions, the strategies they use for reaching their objectives, and the problems that novices encounter during this process[16]. Eight attending surgeons participated and the researchers concluded that complex decision making is required in laparoscopic environment and novices are inclined to errors in taking decisions. Further different strategies used by experts were also indicated. The information retrieved from the use of cognitive task analysis in this study is very useful for laparoscopic training.

CDM helps in identifying complex aspects of the task, thus helps in modifying or developing the new systems

CTA methods which include CDM are used successfully for designing systems, along with developing function allocation, team structure and training[17]. In fact, there is research evidence which demonstrate that, exploring the cognitive processes of experts through CTA methods can be used for developing more effective training materials as compared to the material developed through other techniques[18-20]. A modified version of CDM was developed and used to identify the challenging aspects of Intelligence Analyst's task[21]. The goal was to develop analytic models of the Intelligence Analyst, ultimately to be used to develop computational models of tasks performed by Intelligence Analyst. The most challenging aspects of the Intelligence Analyst's task identified through CDM were time pressure, high cognitive workload and difficult human judgments. There was an example of use of CDM in discovering the decision strategies used by experts in dynamic environments[22]. They analyzed the process of dispatching ambulance at the Ambulance Co-ordination Center Sydney, Australia. The researchers used CDM to identify the information portrayal requirements and the goal states and decision strategies involved in the ambulance dispatch process. The research observed the dispatch decisions to be highly in a context specific of the situation to satisfy the overriding goal; furthermore, the display information affected the decision strategies in these dynamic intentional environments. The utility of the CDM technique was very high in this example as they identified five important goal states through CDM that could be used in developing better display concepts.

Human performance can be improved in important dynamic decision making environments by presenting the information in a manner to support the decision strategies. Another example of effective use of these techniques was seen in the development of computerized diagnostic support as a tool of helping family physicians. In the development, this effective method was used to produce user decision requirements for the development of computerized diagnostic support which is a non-routine method in the medical field. Eight physicians were interviewed and the diagnostic task was analyzed by performing a hierarchical task analysis along with analyzing seventeen think aloud protocols of family physicians. The approach used by these researchers enabled them to propose interface design recommendations that go ahead of current generators of differential diagnosis, aiming at improvement of the performance of physicians along with the approval of resulting tool[23]. In another research CDM was used to develop a course in C-debugging in the environments of the Bell laboratories. The method gave a very elaborative picture of both the settings of the task along with debugging expertise in those settings[24]. Research also indicates that those interns in medical field who were given training established on the information elicited from experts using CTA methods showed higher levels of competence[25].

CDM helps in identifying the problems in the process

CDM approach was used to identify the problems during patient sign out[26]. They identified the problems in verbal and written communication between inpatient physicians during care transfer for hospitalized patients resulting in omitted contents in medications, laboratory tests or failure prone communication processes such as lack of face to face discussion. The findings were important as communication failures during patient sign out could lead to serious harm to the patient. Such minute and important information could only be elicited through CDM. Therefore, the CDM approach is really useful not only in identifying decision making processes but also in identifying the problem areas in the system or process.

CDM helps in identifying the important cues and latter developing cue inventories for training

In CDM approach, the critical incident accounts provide taxonomy of informational or diagnostic cues. The cues are derived from the experts with the use of deepening probes and other quarries, and not directly reported by the experts. Critical Cue Inventory was developed which consisted of the cues used by paramedics to recognize heart attack victims during and prior to their showing

standard symptoms[7,8]. The inventory included the cues such as changes in skin tone, eyes focus, skin temperature, breathing and mental state etc. The cue inventory has been used as a design for training materials to teach these perceptual discriminations to the novices. It was also reported how experts recognized the cues while making their decisions in diagnosing the patients in CCU[14]. The researchers emphasized that not only the recognition of the typical cues but also differentiating them on the basis of the context was very important. The cues being context specific might have different meanings for different type of problems and in different situations. Expert physicians recognize and differentiate between these cues using their expertise and experience, and novice can be trained using these cues to improve performance. Another cue Inventory developed from the reports of systematic infection provided by Neonatal Intensive Care (NICU) nurses[13]. The study supported the use of the CDM in eliciting knowledge from expert NICU nurses. The cues, indicators, and exemplars were extracted from CDM incident accounts to form a guide to early sepsis assessment in the NICU that contained information not available through any other research documents or experiments. The guide was evaluated and found to be very useful by all the evaluators[27].

Using CDM Incident accounts to Develop Narratives or Stories for training material

If it's not possible to develop cue inventories, then CDM incident account information can be written as narratives or stories for use as training materials. Researchers while using CDM interviews in identifying the cognitive elements of physicians in ICU found the need for creating a story as a means of communicating and maintaining a common mental model about the patient[14]. The author noticed the loss of important information in the transition of care from shift to shift in many circumstance. Increase in shift hand over errors indicated that critical elements of the patient's story were missing. Practitioners developed a framework of causal connection and a central theme that tied the different information of the patient's data together in a meaningful story. Thus communicating important information in terms of stories can be helpful in avoiding errors. In addition, stories in skill training could facilitate the trainee's recall of task instructions[8,28].

CONCLUSION

It is evident from the literature that CDM is an efficient method of uncovering cognitive elements of expert knowledge that might not be possible to elicit through routine cases. The difficult or non-routine incidents reported by experts produce a rich source of data about the important aspects of a problem, and situation; and efficient ways (expert way) of solving it. A novice could overlook or use these important aspects in less efficient way. Therefore, the data derived through CDM helps understanding the process of decision making, problem solving, and other cognitive aspects of the expert's behavior .Moreover, the data also helps in identifying training needs and developing training tools, such as Cue Inventories and narratives of the critical information in terms of stories. Also, in Pakistani cultural context, introducing training programs for novices in medical field, based on the information retrieved from CDM interviews would be a good beginning step towards better and more responsible decision making on their part. This paper will also promote awareness towards

the possibility of the use of such effective methods for elaborating cognitive aspects of individuals in medical field, which can then lead to many positive changes/improvements in decision making process in critical situations.

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