Cognitively Authentic Training for Medical Team Coordination and Decision Making

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ABSTRACT

The number of medical errors that occur each year is staggering. When the details of these errors are investigated, it is often discovered that there are a variety of factors and people that contributed to the poor decision – not just one single person or procedure. Many of these errors could be mitigated by improving communication and coordination among the medical staff.

Klein Associates was hired by a large urban hospital in Minneapolis, MN to develop training for their Emergency Department staff. Based upon data gathered through Team Cognitive Task Analysis interviews with MDs, RNs, and EMTs, we developed a training exercise to help improve coordination and decision making in their unit. The exercise consists of two components - a paper-and-pencil triage exercise and an electronic Decision Making Exercise (DMX) - in which staff members are required to make rapid decisions about treatment based upon realistic patient descriptions. The exercise focuses on understanding the roles and functions of emergency department team members, making explicit the expectations of team members on the unit, and learning the standard treatment methods for common cases in the emergency department. The exercise was developed to be low cost, but to have high cognitive authenticity – i.e., evoking the same reasoning and decision-making processes that would be used daily in an actual emergency department.

Initial evaluations with two teams of nurses and physicians at the hospital indicated improvement in the ability to deal with common emergency team problems associated with scope of practice, alignment of expectations, and utilization of resources. With a design capability that allows the trainer to easily modify the patient descriptions and physical layout, this training can be implemented across healthcare facilities, targeting the specific challenges of those facilities.

ABOUT THE AUTHORS

David W. Klinger is a Senior Research Associate at Klein Associates. Mr. Klinger has led or participated in many projects concerned with team interaction. Mr. Klinger was a member of the technical teams that developed the Advanced Team Decision Making model and the model for distributed team performance. He is an experienced observer of teams in both natural settings and simulated environments. He has worked with control room crews at various nuclear power plants as well as led projects to improve team performance for the Emergency Response Organizations within nuclear plants. His team projects also include work with Uninhabited Combat Air Vehicle operators, U. S. Army Peacekeeping Efforts in the Balkans, SONAR submarine teams, U.S. Air Force Weapons Directors Onboard AWACS Aircraft, and U.S. Marine Corps Command Posts. Mr. Klinger holds a B.S. in Psychology from Wright State University, Dayton, OH.

Anna McHugh is a research associate at Klein Associates**,** specializing in uncovering the nature of human cognition and skilled performance in a variety of applied domains. She recently led an effort for the Centers for Medicaid and Medicare Services (CMS) to identify the principal cognitive challenges facing long-term care facility

surveyors and to develop associated training recommendations. As follow-on to this well-received study, she and her team developed a training script and participated as panel members in a satellite training broadcast on surveyor decision making for CMS's continuing education program. During her time at Klein Associates, she has used Cognitive Task Analysis methods and naturalistic observation to study decision making in additional domains ranging from military operations other than war (OOTW), to Army small unit leadership, to multinational coalitions. Mrs. McHugh holds a M.S. in Industrial-Organizational and Human Factors Psychology from Wright State University, Dayton, OH, and an B.A. in Psychology and Spanish from Denison University, Granville, OH. She is a member of the American Psychological Association (APA) and the American Psychological Society (APS).

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INTRODUCTION

The patient had been on the operating table for an hour. Doctors had made an incision in her groin, punctured an artery, threaded in a tube, and snaked it up into her heart. Now they were stimulating her heart electronically to test for abnormal rhythms. In an adjacent room, a phone rings. It is the patient's doctor inquiring about the status of the operation. When informed of the current situation, he asks "what are you doing with my patient? There is nothing wrong with her heart".[1]

It seems all too frequent that we hear about a life-threatening mistake made by a competent physician or nurse as they attempt to either restore life to a dying patient or improve the quality of life of a nearly healthy one. Obviously, the costs of these mistakes cannot be calculated. The loss of loved ones, the impact on individuals who are economically dependent on those who are lost, and the emotional toll on loved ones are only a few of the costs associated with these types of medical errors. But how do these errors happen? And what can be done to prevent, or at least reduce the frequency of such errors?

We believe that in order to remedy the problem, we must first fully understand the problem in all its complexity. We must understand how these high-stress teams and organizations operate. We must identify the key decision-making challenges and the team requirements in medical organizations. That is, we must understand how decisions are made, how tasks are distributed, and how team members share information and coordinate resources. Only then can we develop effective decision-support systems, improved organizational structures, and training interventions that assist medical professionals in managing the cognitive requirements and teamwork challenges inherent in their work.

This report documents a project in which we took on the challenge of understanding the cognitive and team-based landscape of a medical unit. We were hired by a large urban hospital[2] to assist in improving the performance in their Emergency Department (ED). This hospital was seeing a steady increase in presentations (a term used to denote patients arriving at the ED), while financial constraints were forcing them to decrease the size of their ED staff. The hospital's concern was obvious and their dedication to trying to understand the nature of potential future problems should be applauded. They were not waiting until they "lost" a patient to investigate their process. They were being proactive.

During the course of the project, we conducted 16 in-depth interviews with the ED staff and their trainers. For countless hours, we observed the ED teams in action. We watched them as they performed triage on individual patients, followed them from patient room to patient room, listened in as they conferred about patients' conditions, and watched them as they conducted shift-change briefings. These interviews and observations were part of a cognitive task analysis (CTA) process (For reviews of CTA, see Schraagen, Chipman, & Shalin (2000) and Cooke (1994)). The goal of a CTA is to understand the decisions, judgments, shifts in situation awareness, and information needs of those performing their job.

In collaboration with members of the hospital's patient safety division, we performed analysis on the CTA data. Our goal was to pinpoint areas where they could improve safety in the ED without dramatically increasing costs or adding personnel. We conducted multiple data analysis sessions in which we identified key areas for improvement. Several interventions were recommended to address the challenges and areas of concern that were identified. Some of the recommendations, such as a structural redesign of the ED itself, carried a high price tag. The hospital, however, was most interested in interventions that would have high impact, with relatively low cost of development and implementation. One of the key

[1] http://www.vaccinationnews.com. Oops, Wrong Patient: Journal Takes on Medical Mistakes.
[2] Work was performed at Abbott Northwest Hospital.

recommendations endorsed by the hospital administration was an online training tool to be used by all staff - both new and seasoned. The staff at Klein Associates developed this tool and evaluated it with the hospital staff. The evaluation, though small in scope, provided us with positive feedback regarding the effectiveness of the training tool.

In the remainder of this paper, we will describe the Cognitive Task Analysis (CTA) methods that were used to develop the content of the training for the ED team. CTA methods serve as a foundation for developing training that has high *cognitive fidelity*. That is, it evokes the same reasoning and decision making processes that are required on the job. Following a description of the methods used to develop training content, we will discuss the key findings and describe how the findings were transitioned into the training tool. Finally, we will describe an initial evaluation of the tool with the hospital's ED.

METHOD

Frequently post-hoc investigations into adverse events include the development of a timeline and the identification of events that transpired within that timeline. In the medical field, this type of investigation is certainly widespread. Following an adverse or unexpected event of some kind, individuals are asked to recount their perception of the experience. The goal is to understand the *events* themselves – i.e., what happened, when did it happen, and who was involved. But generally, there is little attention given to understanding the *cognition* associated with that event. Little attention is given to what decisions were made, what cues or factors they were considering in the decision-making process, who or where they were getting the information from, and what they were uncertain about at the time of the decision. Yet, it is the decisions people make that differentiate patient safety from jeopardy.

Only recently have Cognitive Task Analysis (CTA) methods been developed for identifying cognitive task demands. CTA enables us to identify the often tacit cognitive skills possessed by experts within a particular domain. CTA is the process of understanding the cognitive complexities of a task. It provides a set of tools for eliciting and representing general and specific knowledge pertaining to a particular activity. The CTA allows us to go beyond procedural knowledge and the behavior aspects of work in an ED. The purpose is to get "inside the head" of individuals, and to try to understand the "cognitive map" that guides their decision making process. Data acquired through CTA techniques helps to provide a framework for information system and training developers to address human thought processes explicitly and to incorporate them as an integral part of the final training product (Jonassen, Tessmer, & Hannum, 1999; Miller, Phillips, Battaglia, Wiggins, Baxter, Mills, et al., 2003; Phillips, McCloskey, McDermott, Wiggins, Battaglia, & Klein, 2001).

Employing CTA with the ED team enabled us to understand many of the cognitive aspects involved in the judgment, decision-making, problem-solving, and team coordination skills that are so critical in the uncertain and dynamic ED environment. This information could then be used to inform training that is *cognitively authentic* – i.e., training that invokes the same mental processes that would be used in performance of the task (Ross, Halterman, Pierce, & Ross, 1998; Ross & Pierce, 2000)

In order to help us understand the complexities of tasks within the ED, we conducted a total of 16 CTA interviews with members of the ED team. The two types of CTA methods we utilized included the Critical Decision Method and the Knowledge Audit, which are described below.

Critical Decision Method

CDM is one particular type of CTA technique used to gain insight into the decision making process employed during a particular event. CDM interviews, based upon Flanagan's (1954) critical incident technique, are organized around the account of a specific incident. The incident must be the participant's own. That is, it must come from his/her own lived experience. The specific episode carries context with it and reveals how particular aspects and events in the environment impel the decision maker to action (Hoffman, Crandall, & Shadbolt, 1998.) A CDM interview requires an initial step, that of guiding the participant to recall and recount a relevant incident. Once that step has been accomplished, the interviewer conducts three information-gathering sweeps through the incident. These sweeps are: timeline verification and decision point identification, to structure and organize the account into ordered segments; progressive deepening, to develop a comprehensive, detailed and context-specific account of the incident from the perspective of the decision maker; and what-if queries, in which the decision maker discusses the incident in terms of potential errors and expert-novice differences. A CDM interview allows the interviewer to elicit goals, options that were generated, cues that were utilized, factors

that influenced the decision(s), and strategies that were used to make decisions (Hoffman et al., 1998). CDM interviews can be conducted for individual tasks or team tasks. Team CDM requires that team members discuss the same incident, although each interview is conducted separately (Klinger & Thordsen, 1998). Typical CDM interviews are two-hour sessions.

We conducted an initial round of team CDM interviews with five members of the ED team. The incident used as a basis for the interviews was a recent shift that the Klein Associates research team had observed. During the interview, the interviewee was asked to describe the array of patients for which he/she was responsible at various times during the shift. This method provided us with valuable information around patient – nurse – physician communications and coordination. We quickly learned that coordination within the nurse – physician dyad was an area where we should focus our attention. Within these five interviews, we probed and deepened around this communication/coordination area to see where problems typically arise and how they are resolved, if at all.

Team Knowledge Audit

Our second round of interviews used the Knowledge Audit. The Knowledge Audit is an Applied CTA methodology, intended for use in situations where the luxury of large amounts of time to spend with the interviewee does not exist (Hutton & Militello, 1996). The Knowledge Audit is utilized to aid researchers in eliciting details and examples of cognitive requirements necessary to perform a particular task. The types of information that can be obtained from a Knowledge Audit include cognitive challenge-faced in a task, information about cues and strategies used to make decisions, and information regarding why particular tasks are challenging.

During the Knowledge Audit interviews we probed for information about how information flows through the ED, how various communication devices, such as patient folders and patient communication boards, are utilized to make decisions, and we probed into the issues involved with patient flow in and out of the ED. For example, different physicians have differing criteria for sending a patient home or admitting them to the main hospital. We probed into specific patient cases to learn how nurses learn various physician tendencies and how they work around them. We also began to probe the issues regarding nurse tendencies (such as their propensity to take on too many or too few patients) and the issue surrounding the use of nurses who are not employed by the hospital but are brought in on an "as needed" basis when the hospital is short-staffed.

Naturalistic Observation

Interspersed throughout the interviews, we conducted naturalistic observations within the ED. All told, we observed more than 100 hours. We selected various times in the day (and week) to observe. Patients who "present" at noon are often quite different than those who "present" at 2 AM. We needed to see the full range of patients, staff, and workload issues. We were particularly sensitive to patient thresholds for individual nurses and how information is shared across nurses, physicians, and other staff within and outside the ED, as well as how that information is used to make decisions.

ANALYSIS, FINDINGS, & RECOMMENDATIONS

A decision requirements analysis and a thematic analysis were used to determine the specific training needs of the ED staff and to guide the development of the training tool. The first step in the decision requirements analysis involved identifying the critical decisions made by the various staff members. To accomplish this, each member of the research team conducted several sweeps through the interview and observation notes for decision points. Following the identification of critical decisions, we developed a decision requirements inventory for those decisions deemed most critical by the ED staff. For each decision point, we identified the cues, strategies, information requirements, coordination issues, and potential errors for each decision. For example, when performing triage, why did the nurse assign that patient to that particular room? How was that information captured and shared? What resources were available to the nurse as he/she tried to balance the workload of the staff with the needs of the patient? Also, each room in the ED has different equipment signatures. How did the nurse decide to use one of the more equipped rooms that are typically used for more severe patients for a less severe patient? What information did the nurse need that he/she simply did not have? The decisions identified were used as focus points or for creating training.

The findings from the thematic analysis and decision requirements analysis tended to cluster into five overarching categories, which will be described below:

1) Scope of Practice. This category of findings encompasses challenges associated with understanding roles and functions of the staff within the ED. When roles and functions are not clearly defined, it can lead to difficulty in anticipating the actions of team members, leading to lapses in coordination and errors in decision making in the ED. Examples of some of the confusions that were uncovered in the CTA study with respect to roles and functions included uncertainty surrounding where the nurse role ends and the physician's role begins. For example, when is it appropriate for the nurse to make a diagnosis and proceed with an intervention? Also encompassed within this category are challenges related to differing expectations about functions of the various ED staff. We uncovered conflicting expectations surrounding the level of room preparation expected to be done by a nurse. For example, expectations about what equipment or tools the nurse should pull based upon a particular diagnosis were not directly aligned between nurses and physicians of the ED.

2) Geography. A second category of challenges in the ED that was uncovered through CTA related to the geography of the ED. This category of challenges encompasses issues ranging from the overall layout of the ED to the location of information sources (such as patient files and information-filled whiteboards).

3) Patient Flow Decisions. The third category of findings encompasses decisions made by the ED team with respect to the flow of patients within the unit. The CTA study uncovered challenges with decisions surrounding issues such as when it is appropriate to move an ED patient to the hall and admit another patient into that room. This, like other critical decisions regarding patient flow, is not a straightforward one. It involves the consideration of a variety of factors that are not always obvious to members of the ED team, particularly less experienced team members.

4) Administrative Functions. During many of the interviews, we were told about perceptions of the ED staff toward such wide-ranging topics as current training, yearly review process, promotion criteria, etc. Though this was not a major focus of our effort, we felt it important to relay this information, as it has a direct impact on morale and subsequent decision making.

5) External Factors. The final category of findings from the CTA study encompasses decisions related to factors that are not internal to the ED, but that nonetheless have a critical impact on the ED. This category includes the occupancy in the hospital as a whole, current staffing issues outside of the ED (nurses in the main hospital had recently been on strike), the competency of the emergency medical teams to bring in appropriate patients for this ED with sufficient information regarding patient condition, and so on.

Recommendations

Following the identification of areas of need, we developed a series of recommendations to address those needs. One of the primary recommendations included the development of an online training tool for use by all staff members. To develop this tool, we selected the appropriate need areas that could be addressed using this training medium. In conjunction with the hospital staff, we selected the following areas as targets for our training tool: scope of practice, patient flow decisions, and external factors.

TRANSITIONING FINDINGS INTO A TRAINING TOOL

The hospital administration wanted a training tool that was accessible via the internet, available 24 hours a day, and that could be accessed by multiple staff members at any one time. Thus, we employed a training method and a collaborative software toolset we had used previously in the development of a training system for Stability and Support Operations (SASO) with the U.S. Army.

Decision Making Exercises

Our goal was to provide a versatile tool that could be used to address the aforementioned need areas and provide the trainees with experience in making decisions related to these areas. If a trainer wanted to bring in a set of new nurses and provide them with practice in making decisions associated with new patients and triage, the tool would support this. If the trainer wanted to bring in experienced nurses and physicians to work through the development of standard procedures for various types of patients, this could easily be accomplished as well.

The training method chosen to address these needs was the development of on-line decision-making exercises (DMXs) that were of high cognitive fidelity and that challenged participants in the kinds of judgments and assessments required in the ED. The key feature of these DMXs is that they are low-physical fidelity, high-cognitive fidelity exercises that can be developed and iterated more quickly and less expensively than high-fidelity simulations.

The platform for the DMXs, called Web4M, is an online collaboration software platform that features a shared whiteboard and communication amongst players and a facilitator via a chat feature. Web4M provides a great deal of flexibility and allows multiple users to access the training software.

Previous experience with DMXs has shown that maximum effectiveness is gained when there is a facilitator who has relevant domain experience and instructional skill. The facilitator has a key role in leading discussion following the DMX. Discussions can include how and why certain decisions were made, confusions about roles and functions, and similar experiences they have faced in real life. This is often where much of the learning occurs.

At the time of our work with the hospital, there was a full-time trainer on staff. This person was a member of our data analysis team, so she was intimately familiar with the needs of the staff. This training tool was developed specifically for her use. As she made assessments of staff needs, the tool would provide her a medium for necessary, real-time training.

Given the wide-ranging areas for application of the tool, a modular tool was developed. At the heart of the training tool is an overhead representation of the ED. A triage nurse is presented with a series of patient descriptions that are representative of the types of complaints patients have when they present themselves to this particular ED. Also, these descriptions contain the information a triage nurse would have following an initial evaluation in the ED waiting/triage area. The triage nurse then assigns patients to rooms. It is left to the discretion of the facilitator to determine how many patients are already present in the ED when these descriptions are given to the triage nurse. Also, the facilitator decides when ED nurses are brought into the exercise to begin making assessment about priorities, etc.

The following describes an example of how the training tool was used. The participants, including nurses and physicians, were presented with the DMX, and they were allowed to move through the exercise at their own pace and direction. They were asked to evaluate each patient individually and assign priorities. They grouped patients based on an acuity estimate (how much attention this patient would need from the staff), not necessarily the criticality of the complaint. That is, in a few cases, certain more seriously ill patients require less attention than some less seriously ill ones. This can be a factor of the technology in the room, the age of the patient, and the physical condition of the patient. Following this evaluation of priority, each group began developing strategies for how to handle each case. It was here that critical information exchanges occurred. These discussions were clearly centered on the "Roles and Functions" category discussed earlier in this paper.

In addition to the DMX, another technique was included in the training tool. This technique, called the Situation Awareness Calibration, includes the use of five questions to stimulate discussion. Those questions range from "What is the most critical patient right now" and "What are you doing about that patient" to "What will the ED look like in two hours?" The use of these questions stimulates discussion among the ED team members regarding patient care and patient safety and helps the staff to move to a more fruitful discussion about how to work with various types of patients in the future.

EVALUATION OF TRAINING TOOL

Several evaluation plans were developed to obtain quantitative data regarding the effectiveness of the training tool. Each of those formal evaluation plans was discarded, for a wide variety of reasons. Those reasons ranged from the staff's concern that some members were receiving better training and would therefore receive better yearly reviews, to the Chief of Staff of the ED's desire to implement the training immediately. Due to these practical constraints, we were limited to asking evaluation questions of the participants as they completed the training. Furthermore, the hospital began using the training tool even before we were made aware of this. We were not present for the first two implementations of the tool, nor was any usable data collected from the participants.

In short, our evaluation plan was overcome by the desire of the staff to being using the tool. Multiple conversations with several of the ED staff resulted in positive feedback regarding the tool, and its impact following the training, as well as the anticipated use of the tool to train new employees. It is our belief that the tool provides the staff with a method to discuss real-world patient situations in non real-world time. That is, they can talk at length about how to handle a critical patient. Staff feedback has suggested that this training resulted in more focused, better coordinated, and more efficient decision making and care when new patients present to the ED. The staff is able to predict the actions of others and make appropriate decisions, and they better understand their own roles and functions. It is also the belief of the researchers that the training

tools provide a common language for the staff to use talk about process. In the past, process discussions were avoided, as individuals took those conversations as personal attacks. Now, the discussion is not about personality, but about process.

CONCLUSIONS

Financial constraints at many large hospitals have resulted in a reduction in staff at the same time that patient loads are increasing. Recent research regarding the impact of reduced staffing on mortality rates (e.g., Ramlall, 2004) suggests that there is a correlation: mortality rates increase as staffing is reduced. It is critical that organizations facing these constraints develop better training - both initial an ongoing - that addresses the process of patient care, the coordination of resources, and the critical decisions faced by the ED team.

Our application of CTA techniques provided the necessary information for the development of a training tool to address the issues around process and patient safety. It provided a solid foundation for developing training content that is cognitively authentic, and that provides the ED staff with practice in the same decisions and team coordination that is required on the job. The use of on-line DMXs provides a low-cost, easily accessible, and easily tailorable option for training the key cognitive and team-related challenges faced in the ED.

Although the evaluation did not take the course we had planned due to the hospital's desire to quickly implement a training system, feedback from the ED staff suggests that this tool does provide the much needed training and support for team coordination and decision making that is critical within the ED.

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