CANADIAN INCIDENT
ANALYSIS FRAMEWORK

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Three Human Factors Methods that can be Used in Incident Analysis

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N. THREE HUMAN FACTORS METHODS THAT CAN BE USED IN INCIDENT ANALYSIS

Various human factors methods can be employed in the analysis process to help answer the question, "How did it happen?" They range in complexity, time and resources, and expertise (in human factors) needed. All three methods (described below) assist in examining the human-system interaction in detail. With **cognitive walkthrough**, perhaps the easiest and most cost-effective method to employ, a participant is asked to "think out loud" while simulating the tasks that were involved in the incident. In a **heuristic evaluation**, an audit is carried out of the various parts of the systems (such as equipment, paper forms, computer systems) that were used in the tasks that were part of the incident. The audit is used to determine if human factors design principles were violated, and thus may be identified as possible contributing factors in the incident. Heuristic evaluation requires an understanding of human factors principles as they apply to different systems (e.g. computer systems). Finally, **usability testing** can be used, in which human-system interaction with equipment, paperwork, or processes are observed (similar to a simulation). Participants are asked to carry out a set of tasks in a simulated environment given the scenario in the incident. Some level of human factors training is needed in order to plan and execute usability tests, and to interpret the results. However, the information is extremely helpful and detailed because, if done correctly, the usability test examines how the human-system interaction occurs in the real world.

Cognitive Walkthrough

As noted above, this is perhaps the quickest to conduct and takes the least amount of time, resources and human factors expertise to complete, as compared to the two other methods discussed here. Cognitive walkthrough can be used to help identify contributing factors in the analysis phase, or it can be used to help assess the effectiveness of recommended actions. In either case, it is used to help discover the details of the cognitive and physical activities that took place (or may take place, in the case of evaluating a recommended action).

To carry out a cognitive walkthrough, recruit participants who are either representative of the person(s) involved in the incident (e.g. pharmacist or nurse) or the actual workers involved, to simulate the set of tasks surrounding the incident. Ask the participant to "think out loud" as they simulate, or walk through each step of that task. The key is that they verbalize what they are thinking as they are doing it. Throughout the simulation, it is helpful to ask prompting questions such as, "What were you looking to do at this point?", "What did you have to figure out?", "Where did you find the information you needed?", "What did you have to think about next?", "What made you think you needed to do that?", "How obvious was it to you?" or "How confident were you that you did it correctly?".

The success of a cognitive walkthrough is heavily dependent on:

- The participant feeling comfortable to express their thoughts without fear;
- The proper identification of the task or activities that participants will simulate (if the task is too narrowly defined, it will limit the amount of information you can find); and
- The facilitator of the cognitive walkthrough keeping their opinions to themself and not "leading" the participant (the facilitator should only tell the participant what task to perform, but NOT "how" they should perform the task, nor how they "should have" performed the task).

If possible, recruit between one and six people to participate in the walkthrough. It is best to have four to six participants because it will capture a wider cross section of the human-system interaction. However, one participant is better than none, and even one person will provide extremely rich information for the incident analysis.

At the end of the cognitive walkthrough, the person conducting the activity will have a more detailed understanding of the cognitive and physical activities that led to the incident and what aspects of the system may have failed to support these activities, and thus may have been contributing factors.

Alternately, if the cognitive walkthrough was conducted to evaluate proposed recommended action, the walkthrough will provide some insight into their effectiveness. It may also help to determine if the recommended action has created some unintended and undesirable consequences. For instance: Does it take additional unnecessary mental effort? Does it make the task overly complex or tedious? Does it create confusion or uncertainty? Does it create risk for other kinds of errors? Depending on the response to these questions, it may be necessary to modify or select an alternate recommended action to pursue (and possibly evaluate again using any of the three human factors methods described in this Appendix).

Heuristic Evaluation

This method requires some knowledge of human factors design principles and how to apply them to specific systems (e.g. computer systems). It may take approximately the same amount of time to conduct as the cognitive walkthrough, though possibly longer depending on complexity), and does not require participants or other special arrangements. This method can be useful in the analysis phase to help identify contributing factors, or to help evaluate recommended action before they are implemented.

In a heuristic evaluation, an audit of the system is performed to determine if human factors design principles are violated. The principles cover a wide range of issues related to whether the design of the system fits the task or human. The audit can identify where human-system interaction is negatively influenced.

The results of a heuristic evaluation can provide very detailed information about contributing factors and how they can be changed to improve the risk for errors. Also, the method can be used to help develop and design the recommended action.

Usability Testing

Among the three methods described here, usability testing likely takes the most time and resources. It also requires some expertise in human factors to plan, execute and analyze the results. However, simple usability tests can be performed that are not as time-and-resource consuming and can yield very helpful information about contributory factors, or about whether a recommended action is effective.

In a usability test, participants are recruited to carry out a specific task (or set of tasks). The test can be carried out in a simulated setting, or in some cases the actual work area. Then information related to how the task (or set of tasks) is executed is gathered, such as time on

task, number (and nature) of steps, or errors. This allows for observation of how the human-system interaction plays out, and where difficulties are encountered (contributing factors). A formal usability test may require anywhere from 20 to several hundred participants and take weeks, if not months of planning. However, for the purpose of gathering information for an incident analysis, a less formal approach can be taken and fewer participants recruited, because the aim is to gain a qualitative understanding of possible contributing factors. Four to six participants would be desirable, but even involving only one or two participants may yield helpful qualitative information for the incident analysis.

Similar to the other methods described, usability testing can be used for both identifying contributing factors as well as for evaluating the effectiveness of recommended actions.

Example of using human factors to guide an incident analysis:
When examining an incident in which a nurse incorrectly sets up a medical device, it is important to identify the contributing factors. An action such as "the nurse pushed the wrong button" is not a contributing factor; it is a factual description of what happened. The goal in the analysis is to determine how and why this happened. To approach this question using human factors, it is necessary to examine the equipment's user interface and look for design features that may have influenced this action. For instance, as part of a heuristic evaluation, questions you could ask include:

- Was the button close to the one they intended to push?
- Was it labeled in a manner that led them to believe that pushing that button was the correct action?
- Were the instructions that were displayed on the screen unclear as to what button they needed to push next?
- Was the button label inconsistent with the terminology used in the displayed instructions?
- Was the button grouped closely with other buttons that are typically used in the task the nurse was performing (leading her to believe that it was to be used in this task)?
- Was the button's appearance similar to (and possibly confusable with) other buttons?
- Were there other confusing features on the interface that may have caused a misunderstanding or confusion?

You could also look at materials that were involved in setting up the device. For instance, if an order form was used, you would examine its ease-of-use. Not only it's readability and legibility, but also, how it relates to the task of setting up the device. For instance:

- Does the nurse refer to the order form during device set-up?
- What information does the nurse use to help with the set-up?
- Is the information provided in a logical order that matches what they need to do with the device?
- Is the terminology used on the order form consistent with what's used on the device?
- Is there any information that may be confusing?
- Does the organization of the information on the order form match the flow of the task?

Next, one would explore the nature of the task and how that may have influenced the human-system interaction, for instance, time pressure, performing multiple tasks at once, complexity of the steps, and so forth. Also, the environment, work area layout, organizational context, team, and patient factors also may influence how work is carried out and thus may be the source of contributing factors. The guiding questions in ***Appendix G*** provide a starting point for examining the factors that may have played a role in the incident.

A cognitive walkthrough to observe nurses setting up the device will also provide information on aspects of the process that may be confusing or where information is not readily available, leading to interruptions in the process that may also lead to errors.