The Institute for Safe Medication Practices Canada (ISMP Canada) is an independent national not-for-profit agency established for the collection and analysis of medication error reports and the development of recommendations for the enhancement of patient safety.

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Usability Testing in Proactive Risk Assessments

Success in conducting a prospective analysis, such as a failure mode and effects analysis (FMEA), is contingent upon identifying risks or "accidents waiting to happen". A previous bulletin introduced a human factors engineering method called *cognitive walkthrough* and described how such a method can be included in an FMEA.[1] The current bulletin discusses a complementary method known as *usability testing*, which can be employed to identify risks, evaluate interventions designed to mitigate risks, and identify potential unintended consequences.[2] ISMP Canada uses both of these methods in conducting its analyses of medication incidents.

What Is Usability Testing?

Usability testing is a method whereby end-users participate in evaluating a product or process (a "system"). This method allows observation of how end-users will interact with the system and measurement of how well the system fulfills its intended purpose.

In a typical usability test, an end-user is asked to complete a task or set of tasks with the system in question (e.g., a new process or device) while specific performance variables are measured. These performance measures quantify the ease or difficulty with which the end-user can operate or use the system, and hence the risk of error. Examples of variables that might be measured include the time required to complete a certain task, the number of steps in the process, the number of steps that cause confusion, the number and nature of errors made by users, and any deterioration in competence after periods of non-use. User feedback can also be gathered to augment the usability measures.

The results of usability testing can complement the information gathered during cognitive walkthrough. Unlike the more qualitative findings from a cognitive walkthrough, usability testing yields quantitative data for evaluating or comparing systems (or the interventions designed to mitigate risks).

Why Conduct Usability Testing?

The goal of usability testing is to identify aspects of a system that may lead to inefficiency, high mental or physical workload, and errors. Usability testing supports the identification of potential risks (e.g., failure modes) and their likely causes. During a prospective analysis (e.g., an FMEA), information from usability testing can further the team's understanding of the system from the practitioner's perspective. Unlike interviews and brainstorming, which are inherently subjective and can be biased by preference or opinion, usability testing is based on observation and measurement of actual human performance and is therefore an objective method of collecting information about potential risks.

When and Where Should Usability Testing be Conducted?

Usability testing can be conducted as part of any risk analysis or evaluation process. It is a helpful addition to the planning of process changes and can be applied to written instructions (e.g., policies and procedures) or to equipment and devices (e.g., infusion pumps) before procurement or implementation. Usability testing can also be used iteratively. In other words, improvements to the system are repeatedly tested with usability testing. It is an essential tool for any team wanting to understand the potential for errors, to learn about practitioners' frustrations with a particular system, and to identify any mismatches or conflicts with current work processes.

Any healthcare setting, from acute care to home care, can benefit from usability testing. ISMP Canada has employed usability testing in a variety of projects, including both prospective and retrospective risk assessments, to gain an in-depth understanding of the potential for errors. Two projects in particular illustrate the value of usability testing in risk assessment.

In one project, usability testing was applied to evaluate the risks associated with carrying out 2 methods of independent double checks. The usability tests examined how the steps in each double-check method might impose a mental burden on the practitioner, which helped to understand how errors might occur. The results highlighted unanticipated problems with each method and provided insight into the design requirements needed to support the 2 types of independent double check.[3]

In the second project, usability testing was conducted to evaluate the potential for errors with an infusion pump that had been involved in a fatal error related to a chemotherapy infusion. This usability test was part of a retrospective (root cause) analysis. In a typical root cause analysis, the analysis team, including practitioners with detailed knowledge, helps in determining the most likely contributing factors on the basis of known facts and expert opinion. In this case, usability testing was also employed. During the testing, the same error was observed as had occurred during the fatal

incident, which gave investigators the opportunity to directly observe and understand contributing factors related to the device.[4]

Who Can Facilitate a Usability Test?

Any individual, even someone without extensive human factors training, can conduct a simple usability test, which might consist of measuring the number of errors made or the time required to complete a task. However, evaluation of an intricate system will usually entail more complex testing, such as concurrent observation of more than one participant. Alternatively, it may be desirable to evaluate the process or device in great detail. In these situations, the expertise and guidance of a human factors expert is beneficial.

Similar to the requirements for cognitive walkthrough, the person facilitating usability testing or acting as the test director should be someone who will not influence the participant's performance during the test. The aim is to observe "actual" performance, rather than "ideal" performance. The facilitator should be impartial and should not have a vested interest in the process, task, or device under review, so that participants can perform their tasks without fear of criticism.

Who Should Act as Participants?

Participants should be representative end-users who typically use (or will be expected to use) the device or carry out the task. The usability testing is intended to help uncover problems that an end-user might encounter or errors that could occur. It is often important to recruit at least 2 types of participants: those who are highly experienced with the system or device being evaluated and those who are new to it. Another type of participant that may be important to consider is an end-user who uses the device or process infrequently.

How Should a Usability Test be Conducted?

Step 1: Gather Information

Obtain a general understanding of the process or task, the people performing it, and the typical work environment. This can be done by conducting field observations and interviews or undertaking a cognitive walkthrough to gain information that will inform the focus of the usability test. Whenever possible, create a diagram of each step of the process or device operation (a process often referred to by human factors engineers as the "task analysis").

Step 2: Develop a Test Plan

(a) Identify the participants (end-users). Use the information gathered in Step 1 to identify the end-users. Consider involving end-users with a variety of characteristics (e.g., different professions, different levels of experience, different goals, different physical abilities, different frequency of use of the process or device). A small usability test might involve 4 to 6 participants.

(b) Identify the task to be performed. The target task, also based on information gathered in Step 1, is the set of activities that each participant will perform. Tasks selected for evaluation are typically those that carry a high risk or those that are performed frequently. The task could consist of carrying out a specific part of a process or setting up a device for a specific purpose.

(c) Create the scenario. The scenario represents the context for the task and should also be based on the information gathered in Step 1. The scenario might specify the events that transpire before the task begins, the amount of training provided, the tools to be used, the people or information available to the participant during execution of the task, and the nature of the work environment (e.g., noisy, dim lighting, multiple concurrent tasks, time pressure).

(d) Identify the environment of use. Use of a simulation centre, with a mock-up of the typical work area, is ideal. However, if such a setting is not available, usability testing can be conducted in a location that is fairly representative of the work environment in question, so long as the test can be completed without interruptions or distractions. (Although interruptions and distractions are sometimes part of the real-life scenario, their presence is not recommended for inexperienced facilitators, because inclusion of these features in usability testing requires careful planning and orchestration.) Any additional materials or tools that would typically accompany the task being evaluated should be available to participants.

(e) Specify performance measures and methods of data capture. Performance measures and methods of collecting the data must be determined before testing begins. A usability test typically involves measuring the time required to complete a task and the number of errors that occur. Other measures might include training time (e.g., how many trials are needed to achieve competence), the number of steps involved, the perceived mental workload (using a well-accepted survey such as the NASA task load index[5]), the number of times participants refer to the user's manual, and user satisfaction. Capturing measurement data generally requires additional equipment (e.g., video cameras, screen-capture software, or custom spreadsheets) and sometimes even additional people.

Step 3: Conduct a Pilot Test

No matter how much planning has gone into a usability test, a pilot test (or test run) is needed to ensure that testing runs smoothly. Facilitators often find that portions of the test plan, such as data capture, need to be refined. Pilot testing helps the facilitator to work out any problems before running the actual usability test.

Step 4: Revise the Test Plan

Issues identified during the pilot test must be rectified before the usability test is conducted. Once the test plan has been revised, another pilot test should be run, to ensure that all issues have been addressed.

Step 5: Conduct the Usability Test

Once participants have been recruited, the pilot tests have been completed, and the test plan has been refined, the usability testing can be conducted.

Step 6: Assimilate the Information

The results of the usability test will give rich insights into the system being evaluated, including identification of typical errors, some of the conditions that make such errors more likely, and the specific aspects of the process or task leading to these potential errors. In situations where 2 processes or devices are being compared, usability testing can help the team to understand the relative risks associated with each. In instances where a usability test is being conducted to improve an existing process or product, usability testing can generate an in-depth understanding of the improvements needed. Furthermore, if testing is conducted iteratively (i.e., repeatedly) after each stepwise improvement, decisions and improvements can be based on objective data, which improves the chance that the intervention or process improvements will be effective.

Conclusion

Usability testing is a powerful method for identifying risks. This type of testing evaluates processes or devices with the help of actual end-users. This approach can yield quantifiable and objective data on how intuitive a system is to use and thus how error-prone it may be. In-depth information can be obtained about a process, device, or system to help enhance the team's understanding of where risks exist and how they can be mitigated before patients experience any harm.

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Eliminating Harmful Medication Errors at Transitions: Medication Reconciliation—A National Priority

Reducing medication-related errors is a priority for advancing safe, high-quality health care in Canada. In early November 2012, Accreditation Canada, the Canadian Institute for Health Information, the Canadian Patient Safety Institute (CPSI), and the Institute for Safe Medication Practices Canada (ISMP Canada) released a report entitled *Medication Reconciliation in Canada: Raising the Bar* which describes an important approach to reducing such errors.

Medication reconciliation is the formal process of identifying a complete and accurate list of the medications that a particular patient is taking and then using that list to ensure that the patient continues to receive appropriate medications at each transition of care. This new report identifies populations at high risk of experiencing medication-related errors and effective approaches to medication reconciliation, as well as the challenges of, trends in, and advances toward ensuring that drug-related errors are avoided.

The following are some of the insights included in the report:

- One quarter of seniors have 3 or more chronic conditions, many of which must be treated with multiple medications. These seniors are at higher risk of adverse events related to medication use and unplanned visits to emergency departments and hospitals.
- Of the 288 health care organizations surveyed by Accreditation Canada in 2011, only 60% had a process for medication reconciliation at admission, and only 50% had a process for medication reconciliation at transfer or discharge.
- Medication reconciliation practices showed the highest improvement from 2010 to 2011, yet this aspect of care continues to represent one of the greatest challenges to overall patient safety.
- The National Medication Reconciliation Strategy, co-led by CPSI and ISMP Canada, supports the development of a curriculum for health care practitioners, and has created tools, resources, and technology supports, including medication checklists, an interactive web-based map of innovative medication reconciliation resources by region, and a mobile app to help patients better manage their own medications.

More information about medication reconciliation is available from ISMP Canada at www.ismp-canada.org/medrec

The full report is available from ISMP Canada in both English[1] and French[2]

[1] www.ismp-canada.org/download/MedRec/20121101MedRecCanadaENG.pdf
[2] www.ismp-canada.org/download/MedRec/20121101MedRecCanadaFRE.pdf

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ISMP Canada is a national voluntary medication incident and 'near miss' reporting program founded for the purpose of sharing the learning experiences from medication errors. Implementation of preventative strategies and system safeguards to decrease the risk for error-induced injury and thereby promote medication safety in healthcare is our collaborative goal.

Medication Incidents (including near misses) can be reported to ISMP Canada:
(i) through the website: http://www.ismp-canada.org/err_report.htm or (ii) by phone: 416-733-3131 or toll free: 1-866-544-7672.

ISMP Canada can also be contacted by e-mail: cmirps@ismp-canada.org. ISMP Canada guarantees confidentiality and security of information received, and respects the wishes of the reporter as to the level of detail to be included in publications.

A Key Partner in the Canadian Medication Incident Reporting and Prevention System