Usability Study of a Covid 19 Point of Care Testing Device

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Usability studies are indicated when there is a need to understand how a technology performs from the point of view of the person utilizing the technology. These studies can help a clinical informaticist (CI) determine an educational strategy and identify pitfalls associated the technology being examined. The system selected for this usability study is the Abbott ID Now Covid-19 point of care test (POCT). The Abbott ID Now POCT device was chosen as, due to the 2020 global pandemic, this technology had to be quickly deployed at multiple locations only two months after the pandemic "lockdown". This was necessary despite very limited training resources. Moreover, the end users being trained were medical assistants with trade-school educations.

The Abbot ID Now POCT process requires multiple steps and must be learned quickly. At the time of implementation three issues were identified. First, users unfamiliar with the devices often experiences challenges with several of the steps in the POCT, which led to test failures. The second major concern was the device's vulnerability to contamination (Hahn et al., 2021). Finally, the system did not interface with the EHR. This interoperability was confounded by the fact that the EHR had yet to interface with the Department of Public Health (DPH), which meant that users had to document the results of the assay in the EHR, and then report positive findings to the DPH.

The purpose of this study is to understand the effectiveness of the device using the current educational materials and prompts provided, the efficiency of use, and the user experience (UX) with the device (McNeill, 2023). Utilizing cognitive walkthrough, a CI can discover ways to address the test failure issue which will be an aim of the study. Another goal will be to examine the contamination issue and determine if there are workflow interventions which can reduce the likelihood of device inoculation by soiled hands. There is no question that the interoperability issue will be problematic, but to determine how to prioritize this issue, timing of how long it takes to double chart results will be captured in the cognitive walkthrough.

According to InfoTek Solutions (2022), usability study constraints often include the time it takes to develop a usability study, and challenges with isolating the causes of identified issues. Cost is always a concern when trying to determine the most applicable usability study given the technology (McGonigle & Mastrian, 2021). The biggest constraint in the usability study for the Abbott ID Now is time. In ambulatory facilities that are part of a large organization, point of care devices must be rolled out to multiple sites simultaneously, and educational resources are often limited to whatever came with the devices.

The issue of usability relates to the human computer interface (HCI) framework in that the goals of usability studies parallel the models put forth regarding the designing of interfaces. HCI frameworks, such as Ammenwerth's FITT model, espouse that designs should be a match for the needs of the user, the tasks being completed, and the technology available (McGonigle & Mastrian, 2021). O'Brien et al. (2008) discussed how an HCI framework could help guide the development of a human's intuitive interactions with technology. Through lenient teaching and positive feedback, users can be taught to guess with greater accuracy, a positive outcome of utilizing the HCI framework. O'Brien et al. (2008) explained that designers could use the HCI framework to subtly "guide the guessing process", which would promote learning.

As the point of the HCI framework is to design an intuitive product, the project leader of the usability study would ideally have experience with UX analysis. McNeill (2023) admitted that there is flexibility in choosing a lead with UX, bet recommended finding participants representative of device end users. Some caveats aside, five participants should be sufficient to vet an expansive enough list of identified issues (Usability.gov., n.d.). The idea of finding participants that can experientially related to end users is also consistent with the HCI framework, as participants that share similar work experiences with end users are likely to come to similar intuitive decisions when trying to navigate technological system.

The dependent variables for the Abbott ID Now metrics should include the time it takes to process and document a test, the success rate, the reported ease of use, and contamination precautions. Measuring these elements will be the primary goal of the study. The independent variables will be adjustments and improvements to the training materials that come with the Abbott ID Now devices, improvements to device

video prompts, and the creation of an interface between the device and the EHR. As an interface between the EHR and the DPH is underway, that issue will be tabled.

Controls will limit the participants to those that are trained medical assistants, and those that have at least six months of experience working with point of care testing. The methods of control utilized will be through the development and distribution of screening questions, so that participants that are not medical assistants, or do not have at least six months of point of care testing experience, can be eliminated from the study. As the goal of this usability test is to examine user experience with a new but complex point of care test, a cognitive walkthrough will be an appropriate, cost-effective evaluation method.

The cognitive walkthrough is a usability test which allows participants to maneuver through tasks to explore an interface. According to the Interactive Design Foundation (n.d.) this type of study is quick, inexpensive, and helpful in understanding if the UX is a positive one. McGonigle and Mastrian (2021) highlighted a cognitive walkthrough's ability to identify the ease with which a system can be learned. This is an attractive notion as the Abbott ID Now has built-in video displays that prompt users to perform specific tasks. Despite the video illustrations, users have run into the two main system issues alluded to in the introduction: difficulty performing certain tasks crucial to testing success, and challenges with keeping the device free from user contamination.

To perform this study, the CI will use the educational materials provided with the Abbott ID Now devices and examine the POCT tasks. Using the task directions, the CI will create a list of commands that will be used to guide the participants. As the assessor, the CI will come up with questions pertinent to understanding the UX (Interaction Design Foundation, n.d.). Questions will include: 1) Did the participant navigate through the visual programming prompts by selecting the correct responses? 2) Did the participant struggle with the timing of tasks, or were they inclined to jump ahead of the task despite the pace illustrated in the display video? 3) Did the participant successfully insert testing cartridges into the device as illustrated in the display video? 4) Did the participant successfully complete the test, achieving a valid result at the end?

Salazar (2022) identified that an ideal setting for a cognitive walkthrough would be a workshop. Once the workshop is ready, the CI will gather five Abbott ID Now devices, and varied personal protective equipment (PPE). The five participants will be allowed to review the educational material provided with each device for one hour but will not be allowed to ask the CI any questions. The CI will ask the participants to dawn appropriate PPE. The CI will note items that should have been chosen but were not. The informaticist will read the instructions for the first task, again noting responses. The process will progress until the end of the final task. Just as the CI will assess the performance of each participant's completion of all tasks, he or she will observe the doffing of PPE and look for practices that could lead to device contamination.

Because users need a device that is easy to operate, the ability of the CI to amend device video prompts will allow users to perform tasks with less effort and less training. As the tasks must be completed as quickly as possible, actions that cause test failures must be identified through usability testing. The CI will record qualitative data in an organized fashion. Information learned in the usability test can be organized using data capture software like REDCap, which is capable of exporting data for later analysis (S. Ehler, personal communication, June 6, 2023). If there is a great deal of data captured, thematic analysis using coding can be used to evaluate the exportable data (Rosala, 2022).

In keeping with HCI framework, the questions the CI asks, and the assessment of tasks, will let the CI know what video prompts built into the device are lacking. It will also allow the CI to understand the limit of the video prompts and determine what adjuncts to the provided educational material are needed. By creating amendments to video prompts that reduce test failures, the CI contributes to a design that is a match for the task. By amending video prompts, the CI contributes to a design that is a match for the technology available. If participants have no difficulty navigating through the visual programming prompts, no amendments will be needed for that area of education. If participants struggle with timing by jumping ahead, video prompts will be amended to include a reminder to move at the same rate as the video prompt.

If the participants fail to insert specimen cartridges into testing cartridges properly, the CI will know that the amount of force needed to complete the task is not sufficiently explained by the video

prompt, and additional information will be added to that prompt. If the participant fails to achieve a valid result at the end, the CI will ask the participant to repeat the POCT. The CI will monitor closely for cartridge cover removal without spillage, failures in cartridge insertion timing, sample mixing timeout issues, and selection of the correct control; the participant should select a negative swab to perform a negative control test, and a positive swab to perform a positive control test. Understanding the causes of test failures will help the CI create educational content that is built into the device's video prompts, reducing end user frustration and improving the UX.

When assessing for PPE donning and doffing, the CI will make adjustments to the PPE guide as needed to correct: 1) Failure to remove contaminated glove and put on a new glove after mixing the sample in the solution well of the specimen receiver, 2) Failure to contain the specimen swab within the solution well, making sure the swab doesn't contact any other part of the device or its components, 3) Failure to remove the cartridges without spilling the contents of the specimen receiver on or near the device. In analyzing infection prevention techniques, the CI can discover participant errors that could lead to device contamination, which could result in a frustrating run of false positives, harming the UX.

Conclusion

This paper explored the process of planning and conducting a usability study of the Abbott ID Now Covid-19 POCT. The POCT device identified had three issues the informaticist was aware of that required assessment. The video prompts guiding the POCT tasks did not sufficiently prevent test failures, or user-driven device contamination. Also, there was no interoperability between the POCT and the EHR. A cognitive walkthrough was used to perform the usability study. This paper outlined steps taken by the CI once testing data was gathered. The cognitive walkthrough, using five participants with experiential relevance to end users, allowed the CI to understand the point of view of the people utilizing the technology, determine device pitfalls, and adjust the design to improve the UX. The usability study will allow solution generation aligned with HCI framework, assuring that design modifications of the device's video prompts are a match for the needs of the users, the tasks being completed, and the technology available.

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