

Interpreting Laboratory Results with Complementary Health Information: A Human Factors Perspective

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Abstract. The desire to access personal and high-quality health information electronically is increasing, not only in Canada, but globally. With the advent of the COVID - 19 pandemic the desire and demand for telemedicine and timely access to personal health data such as online laboratory (lab) results has increased substantially. This study examines citizens' perspectives of being provided with high-quality information about a specific lab test (i.e., potassium) in the same display as a trend graph. Therefore, the objective of this study is to test how participants managed this additional information about the context of the test, understood, and applied it. The researchers analyzed the responses of semi-structured interviews with Canadian participants ($N=24$) using conventional content analysis. This paper examined four themes related to providing complementary information concurrently with lab results in the same display: 1) Benefits of Collocated Information, 2) Information Overload, 3) Misinterpretation, 4) Confusion. This study provided examples of some of the difficulties that the participants faced accessing their lab values online, while navigating and discerning complimentary high-quality health information available in their patient portal.

Keywords. Personal health record, delivering health information and knowledge to the public, consumer perspective, clinical information systems, usability testing

1. Introduction

The desire to access personal and high-quality health information electronically is becoming more prominent not only in Canada, but globally [1-3]. The COVID - 19 pandemic further motivated the desire and demand for telemedicine and timely access to personal health data such as online laboratory (lab) results [4,5]. Consequently, patient portals (i.e., personal health records [6]) are increasingly being viewed as technological resources that can assist citizens (e.g., caregivers, patients) in managing disease and diagnostic testing [7]. Given this increase in access to personal health information, citizens often need to complement raw clinical data presented in patient portals by seeking information elsewhere (e.g., searching the internet) [3]. However, the resources they use may not be evidence-based or clinically sound [3].

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Due to the heterogeneous nature of patient portals (e.g., varied naming conventions and information displays [6]) considerations to human factors, must be made to ensure positive interactions and that these systems add value and facilitate understanding and action whilst avoiding confusion and misinterpretation. Specifically, “human factors principles in communication processes are fundamental to what is designed, how it is designed, how it is used, and how the designed system influences subsequent communication among users of the system” [8]. Thus, each information display should be designed to support a particular task or series of tasks including integral functions to the information display such as learning or communication and decision-making [8]. It is therefore imperative that information displays and accessibility leverage what is known about human information processing, cognitive abilities, and limitations [8,9]. In this study, we explored how Canadian citizens might use a lab results display example from a patient portal. Importantly, we complemented a typical graph of lab values for a particular test (i.e., potassium) commonly used in Canada with high-quality information from Testing.com (formerly Lab Tests Online) [10]. Testing.com, established in 2001 in the United States, “is a ‘peer-reviewed, non-commercial, patient-centered’ resource where patients and their relatives and caregivers can learn about the tests used to screen for, diagnose, and manage disease” [7]. Therefore, the objective of this study was to test how participants managed this additional information about the context of the test, understood, and applied it.

2. Methods

This study is a compliment to a broader investigative research series examining participants’ experiences with online lab results as well as their ability to use and understand different display formats [11-14]. The University of Victoria’s Human Research Ethics Board approved this study. Participants were recruited using an online forum and compensated \$25 Canadian for their time. The focus of this study was to explore the impact of complementing a graph of lab result data for one type of test (i.e., potassium) with high-quality information contextualizing this test. In the display for this study, the most recent potassium value was slightly higher than the reference range. Specifically, the most recent potassium value was 5.3 (reference range 3.5-5.2). Complementary information from Testing.com for potassium was placed below the graph (e.g., Why get tested? When to get tested? What is being tested? How is the test used? What does the test result mean?) [10]. One of the leading ambulatory lab testing organizations in Canada is currently using this approach. While looking at this display, participants were asked to pretend these were their results and 1) think aloud and walk through how they would use these results; 2) identify if there were any results outside the reference ranges; 3) describe what they would do next based on these results; 4) describe what they liked and disliked about the display; and 5) how they would improve the display.

The researchers used a conventional content analysis approach to analyze segments specific to display examples, gleaned from semi-structured interviews [15]. That is, labels for codes, reflective of key thoughts and themes, were generated directly from the transcribed interview scripts [15]. For brevity, this paper will only examine the themes related to providing this complementary information concurrently with lab results in the same display.

3. Results

We interviewed 24 participants. Most (20) participants belonged to age categories ranging from 24 to 64 years old. One participant identified as a man and all the rest identified as women. All participants primarily spoke English at home and had minimally completed high school education. Most (23) had gone on to complete certificate(s) or degree(s) in post-secondary institutions.

Four primary themes emerged from this analysis: 1) Benefits of Collocated Information (i.e., perceived positive aspects associated with the availability of high-quality information in the same display as lab results), 2) Information Overload (i.e., when there is too much information to cognitively process at once), 3) Misinterpretation (i.e., when a person believes they understand something but in fact they are incorrect), 4) Confusion (i.e., a situation where a person does not understand the information or what they should do next). Nearly all participants made comments belonging to each of these four themes. In terms of comment frequency, participants mentioned the Benefits of Collocated Information most often, followed by Information Overload, Misinterpretation, and finally Confusion (Figure 1).

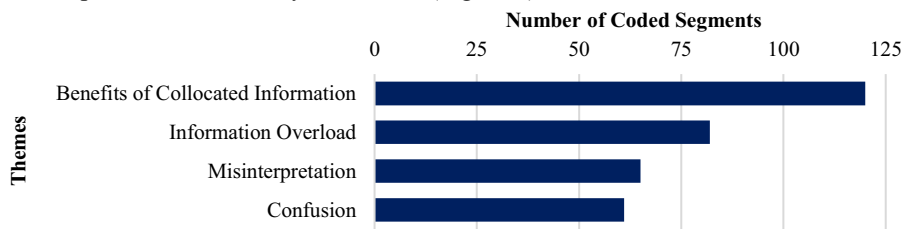


Figure 1. Frequency of data coded for each theme. *Note:* participants could be counted more than once if they spoke about a theme multiple times.

Participants generated interesting comments in all four themes. Examples of illustrative quotes from the semi-structured interviews categorized thematically to depict some of the experiences faced by the participants in interpreting their lab results with complimentary information can be found in Table 1.

Table 1. Table of participant quotes illustrating identified themes.

Theme	Illustrative Quote
Benefits of Collocated Information	Participant 14: “Yeah, I would go to Google...but having it here. It's like a reputable source of information that's based on like, your country's practices and like, yeah, it's nice that it's there. Because this is typically the information that I would be looking for.”
Information Overload	Participant 2: “I mean, that's overall...too much information for the lay person because, it can create a lot of stress...That's like, great, information for students and healthcare practitioners. But I think too much for.. the everyday user.”
Confusion	Participant 17: “I'm looking at the testing may be done when you have this...or that. Now, if, if nothing like that's been mentioned to me, that would be a bit panicking of oh, my doctor sending this because he thinks I had kidney disease. But we haven't talked about that. What does that mean?...”
Misinterpretation	Participant 6: “What are some good dietary sources of potassium? Oh, that's great. So with this information, I would know how to I would make sure to try to incorporate that into my diet.”

4. Discussion

This study provided a clear example of the perceived benefits and interpretative challenges faced by Canadian citizens in accessing their lab values online. Undoubtedly, participants appreciated access to high-quality complementary health information in the same display as values for the specific lab test. Yet, perhaps the most worrisome of our findings is that participants frequently misinterpreted the information. For example, two participants discussed eating more bananas or otherwise increasing their dietary potassium, when the most recent lab result was above the reference range. Two participants in this small sample indicated that misinterpretation could be quite problematic and giving people information that is poorly designed may have adverse consequences. This could be attributed to the complementary information only supplying content about causes and treatments of *low* potassium (i.e., hypokalemia), despite the example value illustrating slightly elevated potassium levels. That is, information about *high* potassium (i.e., hyperkalemia) would have been more relevant, but it was not included in these values. Thus, responses indicated that this information has shortcomings related to understandability, simplicity, and personalization.

The conventional approach to content analysis is limited in theory development and description of lived experiences [15]. Further, the sampling and analysis procedures can often render theoretical and relationships between concepts difficult to deduce from the findings [14]. However, the authors established credibility through debriefing and careful analysis of and discussion of the interview transcripts [15]. Lastly, as this was a pilot study, the sample size ($N=24$) was small and therefore participants responses may not be reflective of the true diversity of the Canadian population. However, even in this small study, with participants who mostly had advanced educational credentials (i.e., lower likelihoods of low health literacy) and accessed their online lab results often, we observed that misinterpretation occurred frequently.

The motivation behind collocated high-quality information with lab test results is good: streamline the process so that people need not look elsewhere for explanations about lab tests and run the risk of using poor quality information. However, as this study showed, there may still be unintended consequences of high-quality information that could increase demands on the health care system. For example, people who become more confused about what to do next, may schedule appointments with their health care providers despite their values being only slightly out of range. Worse, people may actually do the opposite of what they should do but believing they are acting on this information accurately, such as increase their dietary potassium when their results are already high.

5. Conclusions

Considerations for system design, information design, and cognitive processing abilities are necessary for citizen-centred health information systems. In compliment to studies such as this one, tools such as the Flow of Cognitive Processing Model [9] and journey mapping techniques [13,16-19] could succinctly provide insight into these user experience (UX) design issues. This could lead to providing more personalized content to citizens that is catered to their information needs and health literacy levels. Future work should explore participants understanding, misunderstanding, and their intentions for next steps with larger sample sizes and incorporate these findings into their journeys more holistically.

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