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Evaluating and Improving a Novel Toolkit for Implementation and Optimization of Lynch Syndrome Universal Tumor Screening

Tara M. Wolfinger
University of South Florida

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Evaluating and Improving a Novel Toolkit for Implementation and Optimization of Lynch Syndrome Universal Tumor Screening Programs

by

Tara M. Wolfinger

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Public Health with a concentration in Genetic Counseling Department of Global and Planetary Health College of Public Health University of South Florida

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March 17, 2022

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ABSTRACT

Individuals with Lynch syndrome (LS) have a hereditary predisposition to colorectal cancer (CRC), endometrial cancer (EC), and several additional cancer types. Universal tumor screening (UTS) is a systematic approach that increases identification of LS so affected individuals can benefit from targeted therapies and risk-reduction strategies to decrease cancer-related morbidity and mortality. Despite the known benefits of UTS, the practice is widely underutilized, likely due to the complexity of implementation and optimization. We developed a novel evidence-based toolkit to help institutions implement and optimize UTS programs. As part of an iterative evaluation process, we obtained feedback on the toolkit through interviews with two “Experts” who previously played a primary role in UTS implementation and four “Non-Experts” who had not been responsible for implementing UTS. All participants completed a survey after the interview to assess the acceptability and appropriateness of the toolkit using the Acceptability of Intervention Measure (AIM) and Intervention Appropriateness Measure (IAM). Constructive feedback from the “Experts” and “Non-Experts” was classified into one of three categories: “Content”, “Usability”, and “Visual Appeal”. The feedback was further classified into one of five categories to assist with the revision process: “Doing”, “Needs Discussion”, “Unsure”, “Not Doing”, “Mixed Feedback”. Participants’ survey responses to the AIM and IAM were averaged. The majority of feedback provided was constructive and most positive feedback came from “Non-Experts”. Most feedback from “Experts” related to content, while “Non-Experts” provided relatively equal amounts of feedback relating to content, usability, and visual appeal. Throughout and after the evaluation and revision process, 163 changes were made to the
toolkit. The toolkit was considered acceptable and appropriate by all participants with average AIM andIAM scores (on a scale of 1-5) of 4.33 and 4.25, respectively. Learning that the toolkit is acceptable and appropriate makes us more confident that it will be utilized to help with successful implementation and optimization of UTS programs that can reduce the cancer burden associated with LS.
INTRODUCTION

Lynch syndrome (LS) is the most common cause of hereditary colorectal cancer (CRC); approximately 1 out of every 35 individuals with CRC has LS (Hampel et al., 2008). Individuals with LS are born with a pathogenic germline mutation in one of four mismatch repair (MMR) genes: MLH1, MSH2, MSH6, PMS2 (EPCAM deletions). Dysfunction of any of these genes predisposes individuals to CRC, endometrial cancer (EC), and several additional cancer types including cancer of the ovaries, stomach, small bowel, pancreas, prostate, urothelial tract, and biliary tract (Bonadona et al., 2011). Individuals with LS have up to a 61% risk of developing CRC and 57% risk of developing EC in their lifetime, which are significantly higher than the general population risks of 4% and 3% for CRC and EC, respectively (Bonadona et al., 2011; Dominguez-Valentin et al., 2020; Møller et al., 2017, 2018; Ryan et al., 2017). The age of cancer onset is also significantly younger in individuals with LS in comparison to the general population (Bonadona et al., 2011).

Identifying individuals with LS can reduce cancer-related morbidity and mortality in numerous ways. Affected individuals can benefit from targeted therapies to better treat existing cancers and risk-reduction strategies, including screening and prophylactic surgery, to decrease the likelihood of future cancer development or increase the likelihood of detecting it at an earlier, more treatable stage (Fedda et al., 2020; Järvinen et al., 2000; Le et al., 2015; Natarajan et al., 2010). Identification of individuals with LS also allows for cascade testing and detection of at-risk family members who can also benefit from these risk-reduction and treatment strategies (Hampel et al., 2008).
Traditionally, prediction models based on family history and clinical diagnostic criteria have been used to decide which patients receive screening for LS. This selective screening (i.e., criterion-based screening) can fail to identify affected individuals (Hampel et al., 2008; Heald et al., 2013; Kastrinos et al., 2013; Pérez-Carbonell et al., 2012). It has been previously estimated that only 2% of individuals with LS are aware of their diagnosis (Hampel & Chapelle, 2011).

Fortunately, numerous diagnostic advances have been made to increase detection of individuals with LS, specifically the use of universal tumor screening (UTS). UTS consists of screening tumors of all newly diagnosed individuals with CRC or EC through immunohistochemistry (IHC) or microsatellite instability (MSI) testing to look for evidence of high microsatellite instability (MSI-high) or mismatch repair-deficiency (dMMR), which is characteristic of LS (Aaltonen et al., 1993). MSI-high or dMMR tumors can undergo further screening via MLH1 promotor hypermethylation analysis (for CRC or EC) or somatic BRAF V600E mutation analysis (for CRC) to rule out additional individuals who do not have LS. Individuals with absence of MLH1 promotor hypermethylation or absence of BRAF V600E are referred to genetic counseling for germline genetic testing to confirm or rule out a LS diagnosis (Yurgelun & Hampel, 2018). This systematic, universal approach allows for identification of LS cases that would be missed without routine screening (Hampel et al., 2008; Heald et al., 2013; Moreira et al., 2012; Watkins et al., 2017).

Although many institutions have implemented UTS for LS, the method is underutilized, leaving patients with LS undiagnosed and without access to risk-reduction and treatment opportunities (Beamer et al., 2012; Eriksson et al., 2019). Even at institutions where UTS programs exist, program structure and outcomes vary (Beamer et al., 2012; Cohen, 2014; Cragun et al., 2014; Heald et al., 2013; Hill et al., 2015; Mascarenhas et al., 2018; Mittal et al., 2020;
This variability is likely due to the complexity of UTS for LS and need for coordination by multiple individuals across multiple departments (Dicks et al., 2019; Rahm et al., 2018; Schneider et al., 2016).

Thankfully, efforts are being made to increase successful UTS implementation. The Lynch Syndrome Screening Network (LSSN) was formed to promote and facilitate LS UTS implementation through the provision of resources, protocols, and data. The Implementing Universal Lynch Syndrome Screening (IMPULSS) research study, funded by the National Cancer Institute, recently described, compared, and explained institutional variation in UTS with the aim of developing a toolkit to aid in successful implementation and optimization of LS UTS programs (Rahm et al., 2018). IMPULSS was guided by the Consolidated Framework for Implementation Research (CFIR), a theoretical framework consisting of constructs that influence implementation success by serving as barriers and facilitators to implementation, and information was obtained through interviews with healthcare systems at varied stages of implementing LS UTS programs (Damschroder et al., 2009; Rahm et al., 2018). This study describes the use of IMPULSS results in the systematic development, initial evaluation, and revision of the toolkit.
METHODS

Toolkit Development

*Initial Development*

The first and senior authors, in consultation with other IMPULSS researchers, developed a toolkit based on the results of IMPULSS to assist institutions in decision-making, planning, and optimization of LS UTS programs (Figure 1). At the time of tool development, the first author was a second-year genetic counseling graduate student and senior author was a licensed certified genetic counselor, genetic counseling program director, and Lynch Syndrome Screening Network (LSSN) Communications Director. Feedback was provided throughout the development process by the third author, a licensed certified genetic counselor and LSSN Board of Directors member, and fourth author, a licensed certified genetic counselor. The toolkit was created using Microsoft PowerPoint and was converted into a web-based interactive tool using iSpring 10.

![Implementing Universal Tumor Screening (UTS) for Lynch Syndrome](image)

**Figure 1.** Toolkit home page
Toolkit content was derived from IMPULSS study findings and information from the existing LSSN website. Several Consolidated Framework for Implementation Research (CFIR) constructs were addressed during development of the toolkit as shown in Table 1.

**Table 1.** Consolidated Framework for Implementation Research (CFIR) constructs addressed in toolkit with examples

<table>
<thead>
<tr>
<th>CFIR construct</th>
<th>Definition</th>
<th>How construct influenced toolkit development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evidence Strength &amp; Quality</td>
<td>Stakeholders’ perceptions of the quality and validity of evidence supporting the belief that the intervention will have desired outcomes. (<a href="#">Rycroft-Malone et al., 2002; Stetler, 2001</a>)</td>
<td>Content includes evidence of cost-effectiveness, ability of UTS to identify missed cases, benefits to patients, etc. with hyperlinks to reference articles.</td>
</tr>
<tr>
<td>Relative Advantage</td>
<td>Stakeholders’ perception of the advantage of implementing the intervention versus an alternative solution. (<a href="#">Gustafson et al., 2003</a>)</td>
<td>Content includes comparison of advantages/disadvantages of multiple LS identification approaches.</td>
</tr>
<tr>
<td>Cost</td>
<td>Costs of the intervention and costs associated with implementing the intervention including investment, supply, and opportunity costs. (<a href="#">Damschroder et al., 2009</a>)</td>
<td>Content includes a link to a customizable cost tool that will run the costs using different cost parameters.</td>
</tr>
<tr>
<td>Engaging</td>
<td>Attracting and involving appropriate individuals in the implementation and use of the intervention through a combined strategy of social marketing, education, role modeling, training, or other similar activities. (<a href="#">Damschroder et al., 2009</a>)</td>
<td>Content includes suggestions and resources for educating and engaging team members (e.g., discussing LS at tumor board meetings, holding conferences, etc.)</td>
</tr>
</tbody>
</table>
### Table 1 (Continued)

<table>
<thead>
<tr>
<th>CFIR construct</th>
<th>Definition</th>
<th>How construct influenced toolkit development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning</td>
<td>The degree to which a scheme or method of behavior and tasks for implementing an intervention are developed in advance, and the quality of those schemes or methods. (Damschroder et al., 2009)</td>
<td>Content includes detailed planning guides with steps to think through before implementation along with evidence-based suggestions that are anticipated to optimize implementation based on IMPULSS data and other prior research (Cragun et al., 2014; Heald et al., 2013).</td>
</tr>
<tr>
<td>Executing</td>
<td>Carrying out or accomplishing the implementation according to plan. (Damschroder et al., 2009)</td>
<td>Content includes suggestion about having a champion or designated person check to ensure the plan is being executed with consistency.</td>
</tr>
<tr>
<td>Reflecting &amp; Evaluating</td>
<td>Quantitative and qualitative feedback about the progress and quality of implementation accompanied with regular personal and team debriefing about progress and experience. (Damschroder et al., 2009)</td>
<td>Content includes detailed optimization planning guide with steps for quality assurance, sample spreadsheet to track expected case numbers, etc.</td>
</tr>
</tbody>
</table>

**IPDAS Evaluation**

Following initial development, the first and senior authors evaluated how well the International Patient Decision Aid Standards (IPDAS) Checklist could be applied to improve the toolkit since implementing UTS requires multiple decisions (e.g., which tumors to screen; which screening test to use; which reflex test to use; who receives and discloses screening results, when, and how; etc.). The IPDAS Checklist consists of 64 criteria developed to evaluate the
quality of patient decision aids. Criteria fall into one of three domains: “Content” (28 items), “Development Process” (29 items), and “Effectiveness” (7 items). The first and senior authors independently reviewed the toolkit and classified IPDAS criteria into one of four categories: “Met”, “Planning to Meet”, “N/A”, “Not Feasible/Salient”. Criteria classified into the “Met” category included those that were met by the version of the toolkit reviewed during the IPDAS evaluation. Criteria classified into the “Planning to Meet” category would be met through our user feedback evaluation process and/or could be met after revisions were made. Criteria classified into the “N/A” category were not applicable to organization-level decision-making. Criteria classified into the “Not Feasible/Salient” category required revisions that were not possible due to technical and/or time limitations, or required revisions that the first and senior authors agreed would not add significant value to the toolkit. First and senior authors slightly modified several criteria (e.g., changing the word “patients” to “users”) and substantially modified 3 criteria (i.e., changing, adding, or removing multiple words) to ensure relevance to the organization- rather than patient-level. The first and senior authors discussed discrepancies between classifications until consensus was achieved, and subsequently discussed how to implement toolkit modifications to meet criteria in the “Planning to Meet” category.

**IPDAS Evaluation Results**

Initially, 31 of 64 IPDAS Checklist criteria were met by the toolkit (Figure 2). Criteria met in the “Content” domain included: describes positive/negative features of options; compares probabilities using the same denominator, time-period, and scale; uses visual diagrams; allows for viewing of probabilities based on own situation. Criteria met in the “Development Process” domain included: provides references to evidence used; written at level that can be understood by the majority of the target group; describes quality of scientific evidence [including lack of
evidence]. Criteria met in the “Effectiveness” domain included helping users: recognize a decision needs to be made; know options and their features; understand that values affect the decision. Plans were made to meet 17 additional criteria through toolkit revisions and interviews (Table 2). Six criteria were deemed “not applicable” to the organization level, including: provides security for personal health information entered into the decision aid; helps patients become involved in preferred ways; uses stories that represent a range of positive and negative experiences. Ten criteria were considered “not feasible/salient”, including: reporting how often the decision aid is updated; showing the decision aid improves the match between the chosen option and the features that matter most to the informed user.

Figure 2. Results of toolkit evaluation using International Patient Decision Aid Standards (IPDAS) checklist criteria for each IPDAS domain
Table 2. Results of toolkit evaluation using International Patient Decision Aid Standards (IPDAS) checklist criteria and subsequent toolkit revisions

<table>
<thead>
<tr>
<th>IPDAS Domain</th>
<th>Number of IPDAS Criteria</th>
<th>Revisions made to the toolkit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Met</td>
<td>N/A</td>
</tr>
<tr>
<td>Content</td>
<td>19 (^a)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Development Process</td>
<td>9 (^a)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effectiveness</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>31</td>
<td>6</td>
</tr>
</tbody>
</table>

Note: (a) Modifications were made to criteria to ensure relevance to organizational- rather than patient-level.

User Feedback Evaluation

After evaluating the toolkit with the IPDAS Checklist and implementing revisions, the first and senior authors designed an additional evaluation to obtain feedback from users as part of
an iterative process to revise and improve the toolkit. Evaluating usability, acceptability, and appropriateness was essential because if the toolkit was not considered “easy to use” or “acceptable and appropriate” then institutions would be less likely to utilize it. This would ultimately hinder our long-term goal of increasing detection of individuals affected with LS and reducing cancer-related morbidity and mortality. The evaluation was submitted to the Institutional Review Board at the University of South Florida and determined to be an evaluation that was not under the purview of human subjects research.

**Participant Recruitment**

Participants who evaluated the toolkit consisted of health care professionals ages 18 and older who are, or could be, involved in UTS for LS. Individuals with varying levels of UTS knowledge and experience were recruited to obtain feedback from both the expert and potential-user perspectives. A convenience sample of individuals, who are involved to varying degrees in the LSSN, were approached to participate. Recruitment took place via email and continued throughout the iterative evaluation and revision process until six individuals were interviewed.

**Instrumentation**

A semi-structured interview guide was developed by the first and senior authors to obtain feedback and evaluate the extent to which the toolkit addressed specific CFIR constructs shown in Table 1. For example, prompts were included asking participants to speak to the evidence presented in the toolkit to obtain information about their perception of “Evidence Strength & Quality”. Questions were also included to prompt participants to share positive and constructive feedback on the content, usability, and visual appeal of the toolkit (Appendix 1).

A survey was developed in Qualtrics to evaluate the acceptability and appropriateness of the toolkit using the Acceptability of Intervention Measure (AIM) and Intervention
Acceptability was defined as the perception among implementation stakeholders that a given innovation is agreeable, palatable, or satisfactory. Appropriateness was defined as the perceived fit, relevance, or compatibility of the innovation for a given practice setting, provider, or consumer; and/or perceived fit of the innovation to address a particular issue or problem (Proctor et al., 2011). Each measure consists of four items with a Likert-style response scale ranging from “1 = Completely disagree” to “5 = Completely agree”.

**Procedures**

All interviews were arranged and conducted by the first author. Participants were sent an invite via Microsoft Teams prior to the interview date. At the time of the interview, participants and the first author joined the Microsoft Teams meeting link and verbal consent was obtained from the participants to record the interview. A link to the toolkit was sent to participants via the Microsoft Teams chat. Participants were asked to open the link, share their screen, and talk aloud as they reviewed the toolkit. The first author asked participants to navigate through the toolkit on their own while providing their verbal feedback and thoughts. The interviewer would sometimes ask participants at the end of the interview to navigate to sections they did not previously cover to obtain feedback. A semi-structured interview guide was used, and notes were taken by the first author throughout the interview. All participants viewed all sections of the toolkit. The first author sent participants the link to the AIM/IAM Qualtrics survey via the Microsoft Teams chat to complete anonymously after the interview.

**Data Analysis**

After the completion of interviews, the first author reviewed their notes and watched video recordings to confirm notes and add additional feedback that was not documented during
the interviews. Participants were divided into two groups based on their experience with implementing LS UTS programs: “Experts” who had played a primary role at implementing UTS previously and “Non-Experts” who had not been responsible for implementing UTS. Feedback from participants in both categories was compiled. Each piece of feedback was then classified into one of two categories: “Positive” or “Constructive”. Constructive feedback was further divided into three categories based on what it was in reference to: “Content”, “Usability”, “Visual Appeal” (Figure 3).

![Diagram of participant feedback classification process]

**Figure 3.** Outline of participant feedback classification process

After AIM/IAM survey completion, participants’ responses to the four-item AIM and four-item IAM were averaged. Higher average scores indicate greater acceptability and appropriateness; cut-off scores for interpretation are not available at this time (Weiner et al., 2017). AIM and IAM scores were then averaged across all participants to obtain overall average AIM and IAM scores ranging from 1 to 5.
Toolkit Revisions

After interviews, the first author reviewed participants’ constructive feedback and classified it into one of five categories: “Doing”, “Needs Discussion”, “Unsure”, “Not Doing”, “Mixed Feedback”. Items classified into the “Doing” category included feedback that the first author agreed with and felt confident incorporating independently. Items classified into the “Needs Discussion” category included feedback that the first author wanted to incorporate but needed to discuss how to do so with the senior author. Items classified into the “Unsure” category included feedback that the first author was uncertain about incorporating. Items in the “Not Doing” category included feedback that authors agreed were unnecessary or not possible to incorporate. Items in the “Mixed Feedback” category included feedback that differed from previous participant feedback. The first and second authors reviewed and discussed these classifications until consensus was reached. Agreed-upon revisions were made at various intervals throughout the evaluation as part of an iterative process, and items in the “Mixed Feedback” category were discussed at the following interview.
RESULTS

Participants

Participant demographic information is shown in Table 3. A total of six participants took part in the evaluation, including two genetic counseling graduate students and four genetic counselors. Two participants were classified as “Experts” and four participants were classified as “Non-Experts”. Participant interviews lasted between 60 and 120 minutes.

Table 3. Participant demographic information

<table>
<thead>
<tr>
<th>Participant #</th>
<th>Training</th>
<th>UTS Experience Level</th>
<th>Gender</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2nd year genetic counseling student</td>
<td>Non-Expert</td>
<td>Female</td>
</tr>
<tr>
<td>2</td>
<td>Genetic counselor</td>
<td>Expert</td>
<td>Female</td>
</tr>
<tr>
<td>3</td>
<td>Genetic counselor</td>
<td>Expert</td>
<td>Female</td>
</tr>
<tr>
<td>4</td>
<td>Genetic counselor</td>
<td>Non-Expert</td>
<td>Female</td>
</tr>
<tr>
<td>5</td>
<td>Epidemiologist</td>
<td>Non-Expert</td>
<td>Female</td>
</tr>
<tr>
<td>6</td>
<td>1st year genetic counseling student</td>
<td>Non-Expert</td>
<td>Female</td>
</tr>
</tbody>
</table>

User Feedback

Overall, most feedback provided was constructive and the majority of positive feedback came from “Non-Experts”. Positive feedback included the ability to view advantages/disadvantages side-by-side to compare options for decision-making (Figure 4), and the inclusion of UTS procedure flowcharts to outline the screening process (Figure 5). Multiple
participants also spoke positively about the quantity and quality of evidence presented throughout the toolkit, and the overall visual appeal. The majority of constructive feedback from “Experts” was in relation to content, whereas “Non-Experts” provided relatively equal amounts of feedback regarding content, visual appeal, and usability (Figure 6). “Experts” were more likely to suggest the addition of information (e.g., adding more detailed information on IHC procedures and MSI results), and “Non-Experts” were more likely to suggest the clarification of information (e.g., adding roll-overs). Overall themes amongst constructive feedback included changing language to avoid confusion, reducing the amount of text on pages, and simplifying navigation (Table 4). Examples of revisions made based on constructive feedback are shown in Figure 7 and Figure 8. In total, 163 changes were made to the toolkit throughout the iterative process.

Figure 4. Toolkit page comparing different systematic approaches to identify Lynch syndrome

Note: Multiple participants spoke positively about the variety of considerations presented and ability to view advantages and disadvantages of options side-by-side.
Figure 5. Toolkit page with universal tumor screening procedure flowchart for colorectal tumors undergoing IHC testing with *MLH1* promotor hypermethylation or *BRAF* V600E testing

*Note: Multiple participants spoke positively about the importance, utility, and visual appeal of the UTS procedure flowcharts.*

Figure 6. Proportion of constructive feedback related to content, usability, and visual appeal from “Experts” and “Non-Experts”
<table>
<thead>
<tr>
<th>Feedback Theme</th>
<th>Feedback Examples</th>
<th>Toolkit Revisions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change language to avoid confusion.</td>
<td>Participants said that using “positive” and “negative” in reference to IHC results may be confusing because “positive” could be misinterpreted as MMR proteins being present.</td>
<td>“Positive” and “negative” were replaced with “abnormal” and “normal” when referencing IHC results throughout the toolkit.</td>
</tr>
<tr>
<td></td>
<td>Participants said that using “reflex testing” to refer to testing that is performed immediately after an abnormal IHC or MSI result may be confusing because users may not be familiar with this term.</td>
<td>“Reflex testing” was replaced with “additional testing” throughout the toolkit, and a roll-over was added to explain that this additional testing is done immediately following an abnormal IHC or MSI result before referring for genetic counseling/testing.</td>
</tr>
<tr>
<td></td>
<td>Participants said that using the term “hypermethylation” in reference to \textit{MLH1} promotor hypermethylation may be confusing because there are numerous tests that can detect different types of hypermethylation.</td>
<td>“Hypermethylation” was replaced with “\textit{MLH1} promotor hypermethylation” throughout the toolkit.</td>
</tr>
<tr>
<td></td>
<td>Participants said that saying direct to germline testing is “not recommended” may be confusing because it is recommended for some individuals with CRC and EC.</td>
<td>Wording was changed from “not recommended” to “not recommended for \textit{all} patients with CRC and EC” to ensure it was clear that we were referring to a universal approach.</td>
</tr>
<tr>
<td>Feedback Theme</td>
<td>Feedback Examples</td>
<td>Toolkit Revisions</td>
</tr>
<tr>
<td>----------------</td>
<td>------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Reduce the amount of text on pages.</td>
<td>Participants said that listing a summary of each professional recommendation supporting UTS was overwhelming and repetitive.</td>
<td>Page was changed to include a single summary of recommendations with icons hyperlinked to each individual recommendation (Figure 7).</td>
</tr>
<tr>
<td></td>
<td>Participants said that the amount of text on planning guide pages was overwhelming.</td>
<td>Planning guides were changed to include questions only, requiring users to click on questions to view pages with answers/more information. PDF versions of planning guides with both questions and answers were added to the “printable documents” section (Figure 8).</td>
</tr>
<tr>
<td>Simplify navigation.</td>
<td>Originally, each planning guide question page had a “close” button that directed users back to the main planning guide page. Participants stated that it was confusing to return to the main page each time they finished with a question and that it was hard to remember which questions they had already reviewed.</td>
<td>“Close” buttons were replaced with “next” buttons that direct users to the next planning guide question rather than take them back to the main planning guide page (Figure 8).</td>
</tr>
<tr>
<td></td>
<td>Participants stated that it was difficult to find their way back to the home page while navigating the toolkit.</td>
<td>Home icons were added to the corner of the main toolkit pages and an instruction was added to make users aware of this feature (Figure 8).</td>
</tr>
<tr>
<td></td>
<td>Participants stated that it was confusing when the outline did not match the order of the pages in the presentation.</td>
<td>Direct to germline and tumor sequencing planning guides were moved from the “planning” to the “considering new approaches” section (Figure 9).</td>
</tr>
</tbody>
</table>
Figure 7. Toolkit page providing professional recommendations for which tumors should be screened for which patients before revisions (left) and after revisions (right).

Note: Page was revised to avoid repetition and reduce the amount of text. “Close” button was replaced with “next button to simplify navigation.

Figure 8. Toolkit page with universal tumor screening planning guide before revisions (left) and after revisions (right).

Note: Page was revised to include questions only rather than questions and answers to reduce amount of text. Home page icon was added to the top right corner to simplify navigation.
Figure 9. Toolkit page for users considering new approaches to identify Lynch syndrome

Note: Originally, planning guides for all 3 approaches (UTS, Direct to Germline, and Tumor Sequencing) were under the “Planning” section of the outline. Based on feedback, the Direct to Germline and Tumor Sequencing planning guides were moved under the “Considering New Approaches” section of the outline.

Survey Results

Overall, the average score for the Acceptability of Intervention Measure (AIM) was 4.33 out of 5 and the average score for the Intervention Appropriateness Measure (IAM) was 4.25 out of 5. Averages for each of the items are shown in Figures 10 and 11. No participants completely disagreed with any of the AIM or IAM items.
**Figure 10.** Average participant scores for each of the four-items from the Acceptability of Intervention Measure (AIM)

**Figure 11.** Average participant scores for each of the four-items from the Intervention Appropriateness Measure (IAM)
DISCUSSION

We developed and evaluated a novel toolkit to aid in implementation and optimization of Lynch syndrome (LS) universal tumor screening (UTS) programs and user feedback helped to improve the toolkit as part of an iterative process. We recruited both “Experts” (i.e., healthcare professionals who had played a primary role in implementing UTS previously) and “Non-Experts” (i.e., healthcare professionals who had not been responsible for UTS implementation) to participate in our evaluation because it has been shown that useful feedback can be obtained from both subject-matter experts and novices (Aebersold et al., 2018; Cho et al., 2006).

The majority of positive feedback in our evaluation was provided from “Non-Experts”, which aligns with previous study findings showing that subject-matter experts provide significantly fewer praise comments than non-experts (Cho et al., 2006). It has been proposed that an individual is more critical when they have a greater knowledge of the subject matter (Leki, 1995). This could be a possible explanation for the difference in positive and constructive feedback received from participants with varying levels of UTS knowledge and experience in our evaluation. Positive feedback included appreciating the quantity and quality of evidence provided throughout the toolkit, specifically the inclusion of professional guideline summaries. We were pleased to learn that participants positively perceived this content because lack of awareness of guidelines and lack of guideline clarity have been previously reported as barriers to successful UTS implementation (Dicks et al., 2019; Schneider et al., 2016).

Studies have shown that subject-matter experts and non-experts provide different types of constructive feedback, and our findings also support this notion (Aebersold et al., 2018; Cho et
We found that constructive feedback from “Experts” was primarily regarding the toolkit’s content, while “Non-Experts” provided relatively equal amounts of constructive feedback on the toolkit’s content, usability, and visual appeal. These findings support the inclusion of participants with varying levels of knowledge and experience in future evaluations to maximize feedback obtained.

Our survey found that average participant scores for the Acceptability of Intervention Measure (AIM) and Intervention Appropriateness Measure (IAM) were 4.33 out of 5 and 4.25 out of 5, respectively. Although cut-off scores for interpretation are not available at this time, higher average scores generally indicate greater acceptability and appropriateness (Weiner et al., 2017). Knagg et al., 2021 considered average AIM scores ≥ 4 to indicate high acceptability, whereas Chung et al., 2022 considered sum AIM or IAM scores ≥ 15 as acceptable or appropriate. As our participant scores would be considered acceptable and appropriate by the cut-offs used in both studies, we conclude that users with varying levels of UTS knowledge and experience find the toolkit to be both acceptable and appropriate. It should also be noted that participant scores were in reference to the toolkit version they reviewed at the time of evaluation, prior to any revisions; we hope that the 163 changes made to the toolkit, throughout the iterative process of editing the toolkit based on participant feedback, have further increased its acceptability and appropriateness. Given that lack of acceptability has been reported as a challenge to implementation, and appropriateness can potentially capture “pushback” to implementation, these findings have made us more confident that the toolkit will be utilized (Davis, 1993; Proctor et al., 2011).

A strength of our evaluation was the varying level of UTS knowledge and experience amongst our participants, but our exploratory evaluation was limited both by interviewing a
relatively limited convenience sample and the type of healthcare professionals from which we received feedback was nearly homogenous. A variety of team members can be involved in UTS (e.g., pathologists, oncologists, administrators, surgeons, nurses, genetic counselors, etc.) and our evaluation primarily included participants with backgrounds in genetic counseling. Dicks et al., 2019 found differences in UTS implementation barriers reported by pathologists and genetic counselors. Therefore, future evaluations of the toolkit should include participants from various healthcare roles to obtain additional feedback and ensure it is perceived as acceptable and appropriate by all types of potential-users.

To our knowledge, we are the first to develop a toolkit to aid in LS UTS implementation. UTS has the potential to increase detection of LS and subsequently reduce cancer-related morbidity and mortality, but the approach is widely underutilized and most institutions that have UTS programs are not fully optimized (Beamer et al., 2012; Cohen, 2014; Cragun et al., 2014; Hampel et al., 2008; Mittal et al., 2020; Watkins et al., 2017). Previously reported challenges to UTS implementation include lack of knowledge of LS and screening guidelines, lack of a clear champion to head implementation, uncertainties regarding cost, and complexity of implementation (Dicks et al., 2019; Schneider et al., 2016). Given that our toolkit contains information to address and overcome these various challenges, as well as evidence-based information regarding UTS program optimization, we hope its use will assist in two process outcomes: Firstly, to help increase successful implementation of new UTS programs; and secondly, to improve existing UTS programs by maximizing the detection of individuals with LS who can benefit from risk-reduction and treatment opportunities.
REFERENCES


Syngal, S. (2013). Comparison of the clinical prediction model PREMM1,2,6 and molecular testing for the systematic identification of Lynch syndrome in colorectal cancer. *Gut, 62*(2), 272–279. [https://doi.org/10.1136/gutjnl-2011-301265](https://doi.org/10.1136/gutjnl-2011-301265)


APPENDIX 1:

SEMI-STRUCTURED INTERVIEW GUIDE

Script: Is it okay if I record the interview? It will not be shared with anyone, it’s just for me to go back and verify my notes. Please click the link in the chat to open the toolkit and begin sharing your screen. First, we want you to look things over and share your immediate thoughts and reactions. Please say anything that comes to mind as you review it—any thoughts, both positive and constructive. After you review the materials and talk aloud about your thoughts, we will then ask you some additional questions.

- What were your first thoughts when looking at the materials?
- What are your thoughts on the visual appeal?
- What was easy or hard about navigation?
- Thoughts on the layout?
- Recommendations for changes you would like to see?
- How helpful or unhelpful was the content in making a case for why institutions should implement a UTS program?
  - Can you speak a little bit to the UTS evidence presented?
  - Can you speak a little bit about the advantages of UTS over other ways to identify patients with LS?
- What additional information do you think could be added or changed to help strengthen the case for implementation?
  - What additional evidence do you think would be valuable to add?
  - Any other benefits or advantages you can think of?
  - Anything that could be added to help address cost?
- What was helpful or unhelpful in explaining how to engage people in planning?
  - What information do you think could be added to help improve the section on engaging a team?
- What was helpful or unhelpful in explaining steps required?
- What information could be added to help improve the planning steps?
- What was helpful or unhelpful about explaining the steps to maximize success?
  - What information do you think could be added to help improve the steps to help maximize success?
- Liked how it layed out things that could go wrong then gave information on how to overcome

Key:
Evidence Strength & Quality
Relative Advantage
Cost
Planning
Engaging
Executing / Reflecting & Evaluating