Appendix E. User Interface Testing

APPENDIX E:User Interface Testing

User interface testing included three components:

1. Entering demographic data and completing questionnaires to provide the information needed for the predictive models.
2. Interpreting predictive model results through data displays including:
    a. Data Table - Identifying current pain and function scale results and identifying predicted pain and function outcomes with surgical or nonsurgical treatment.
    b. Bar Charts – Understanding the meaning of scales, identifying current and predicted outcomes, and understanding uncertainty.
    c. Combined pain and function plot – Understanding the meaning of a data point, identifying current and predicted outcomes, and comprehending the concept of uncertainty around the predictions.
3. Determining user understanding of the predictive models, mathematical equipoise and clinical trial randomization through case-based discussions.

Usability testing included a “think aloud” protocol and usability testing script. The former involved asking users to accomplish a series of tasks including completing questionnaires and describing their interpretation of the predicted outcomes. This allowed us to understand participants’ thoughts as they used the application and to identify aspects of the tool that were unclear. Any questions or problems were noted to improve future versions of the application. The latter allowed determination of users’ understanding and interpretation of the current and predicted outcome results page .

The usability testing was conducted in two stages. Both versions of the Usability Testing Plan are provided on the following pages.

Version 1- Usability and Cognitive Testing Plan

This version of the usability testing plan was used for the initial testing conducted with a diverse group of research institute staff and members of our patient and clinician stakeholder panels.

Introduction: Imagine that you (or someone you know) has knee osteoarthritis and is contemplating different options, including surgical and nonsurgical treatments. Now imagine that your clinician asks you to complete these questions in advance of the appointment [or possibly, you will complete the questions together with your clinician during that appointment]. Next, you and your clinician are going to make some decisions about the next steps for how to treat your knee osteoarthritis.

Please complete this online questionnaire, which will take about 15 minutes. We expect the total time will be about 1 hour for both completing the questionnaire and answering some questions about using this application.

Note: When you see the term "physical function," it refers to how your health affects your ability to perform activities that you might do during a typical day.

Part 1: Questionnaire Usability: Please follow the prompts and instructions on the screen. The bar at the top will show your progress, and you can use the arrows to go backwards and forwards. Some of the pages require you to scroll down. You need to complete all of the questions on a page before you can go onto the next page. If you have any questions while completing the forms, please ask me. I will record your questions, so we can improve future versions of this questionnaire. Please think aloud while you complete the questionnaire.

A. If you need help on this page, what would you do?

Part 2: Usability of Numeric Predictions: The predictive model built into the application used information that you entered to calculate the current level of knee pain and physical functioning. It also calculated four predictions about the level of knee pain and physical functioning at 1 year. [This includes knee pain without surgery, knee pain with surgery, physical function without surgery, and physical function with surgery].

[The patient is directed to the screen displaying the bar graphs for current and predicted pain and function with and without surgical treatment.]

A. Expectations

Physical Function:

I have a few questions before we look at all of your results. *[Research Assistant turns the computer away and writes out the current scores on a piece of paper along with the scale and later the predicted scores.]*

- What bothers you more knee pain or physical function? *[Ask about whichever one bothers the patient more first.]*
- Your current physical function score is __ on a scale of 0 to 100 where 0 is poor function and 100 is excellent function.
- In a year, would you expect your physical function ***with usual care*** to be higher or lower than your current physical function?
- What activities would you hope to be able to do after a year of usual care?
- If you were to have **knee replacement surgery**, would you expect your physical function to be higher or lower in a year?
- What activities would you hope to be able to do a year after knee replacement surgery?

Knee Pain:

- Your current knee pain score is ___ on a scale of 0 to 100 where 0 is no pain and 100 is extreme pain. In a year, would you expect your knee pain ***with usual care*** to be higher or lower than your current knee pain? If you were to have knee replacement surgery, would you expect your knee pain to be higher or lower in a year than your current knee pain?

B. Usability of Graphical Depiction of Predictions

Interpret the Bar graphs and Legend:

- Just looking at the bar graph for current pain, where on the bar graph would knee pain be worse?
- Where would it be better?
- Would your friends (or the people that you know) understand where severe knee pain and where mild knee pain are on the graph?
- **Brief description of uncertainty:** Just like with a weather forecast, there is some uncertainty for any prediction. When you hear that there is a 60% chance of showers, you know there is some uncertainty around that number. The most likely prediction (the average) is shown by the height of the color in the bar. 95 out of 100 people who answered like you would have knee pain predictions within the colored area. Please take a look at this graph.

  [On the top next to the pain tab, click on the function tab.]
- On the current function graph, where on the graph would physical function be worse?
- On the current function graph, where on the graph would physical function be better?
- Would your friends (or the people that you know) understand where poor function and where excellent function are on the graph?
- What does the colored area around the value marked in the bar graph mean to you?
- Does it convey anything to you about uncertainty or error?
- *[If the user does not think that the colored area conveys uncertainty, then ask this question.]* If the colored area around the value in the bar graph does not convey uncertainty, what would convey uncertainty to you for this bar chart?
- Given the bar graphs, do they help you interpret the results? *[We will show the bar graph for pain and the bar graph for function separately.]*

Interpreting combine pain and function plot:

- [The *Research Assistant first moves to the Combined Knee Pain and Function Graph, and walks through the different layers that we can add on the graph, using the text below*.]
- The purple star on this graph displays your current pain level with your current physical function level.
- The blue diamond shows the predictions for your knee pain and physical function at one year with usual care. Just like the line on the bar graph, the blue colored cloud represents the uncertainty around the predictions for knee pain and physical function at one year with usual care.
- The green circle shows your predicted knee pain and physical function for one year after knee replacement. Just like the line on the bar graph, the green colored cloud represents the uncertainty around the knee pain and physical function prediction one year after knee replacement surgery.
- **Brief description of uncertainty:** There is some uncertainty for any (model) prediction. If we give you a prediction of 32, there is some probability that the actual outcome will be higher or lower than that. On the graph, we are showing knee pain and physical function predicted together. 9 out of 10 people like you would fall within the colored area around the prediction. Please take a look at this diagram/graph.
- The overlap between the dotted blue and green clouds shows that some people with either usual care or knee replacement have the same predicted knee pain and physical function outcomes.
- If the current value (purple star) is within the blue dotted cloud around the usual care prediction, then this means that there is a chance that with usual care after one year this individual will still be at the same level of knee pain and physical function.
- Can you point to your current level of pain and function?
- Where is your prediction if you do have surgery?
- Where is your prediction if you have usual care?

- What are your likely outcomes if you do have surgery? Would you get better, worse, or do about the same?
- Given the uncertainty oval, how confident are you about that?
- *[If the current score is within the uncertainty shape, ask this question.]* What does it mean that your current score is within the dashed shape? *[We are looking for an articulation of whether the graph is unclear and whether more explanation is needed. E.g. Can the user realize that his/her current score is in the surgical circle? Perhaps, it could come out that the scores would be no better off with surgery.]*
- What are your likely outcomes if you do not have surgery? Would you get better, worse, or do about the same?
- Given the uncertainty shape, how confident are you about that?
- *[If the current score is within the uncertainty circle, ask this question.]* What does it mean that your current score is within the dashed shape? *[We are looking for an articulation of whether the graph is unclear and whether more explanation is needed. E.g. Can the user realize that his/her current score is in the surgical circle? Perhaps, it could come out that the scores would be no better off with surgery.]*
- How do you interpret the colored shape around the prediction?
- How do you interpret the colored shape around the prediction?
- *[Researcher points outside of the shape.]* Is this a likely outcome? *[No, would be the correct answer. It is possible but not likely.]*
- You picked the (surgical/nonsurgical) treatment option before, would you still choose (surgery/ nonsurgical treatment)? OR (You were not sure which treatment option that you would chose before, are you still undecided?)

C. Current Score

Function:

- *[Please look at the table on the left and tell me]* what is your current physical function score?

- Would you say that your current score suggests your physical function is excellent, very good, good, fair, or poor?

Pain:

- What is your current knee pain score?
- Would you say that your knee pain score suggests that your knee pain is none, mild, moderate, severe, or extreme?

B. Predicted Scores

Physical function:

- What is your predicted 1-year physical function score with usual care?
- What is your predicted 1-year physical function score *with* surgery?
- Compared to your current physical function score, would you say that you would be better, worse, or the same in your physical functioning in one year with usual care?
- Compared to your current physical function score, would you say that you would be better, worse, or the same in your physical functioning in one year *with* surgery?

Knee Pain:

- What is your predicted 1-year knee pain score with usual care?
- What is your predicted 1-year knee pain score *with* surgery?
- Compared to your current knee pain score, would you say that your knee pain would be better-off, worse-off, or the same with usual care?
- Compared to your current knee pain score, would you say that your knee pain would be better-off, worse-off, or the same *with* surgery?

Interpretation:

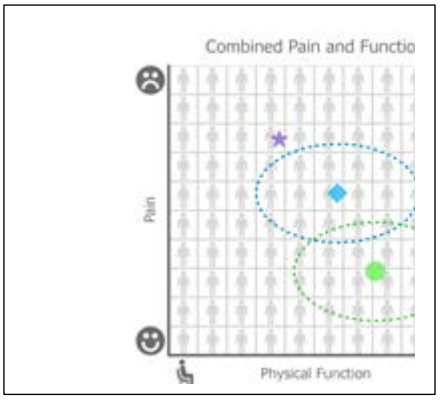
- Based on this information about surgical or nonsurgical treatment options, does one option look better than the other for improving knee pain?
- Does one option look better than the other for improving your physical function?
- Is the improvement what you would have expected?

- Which treatment option would you chose given all four predictions?
- What do you understand about the improvement that makes you select it?

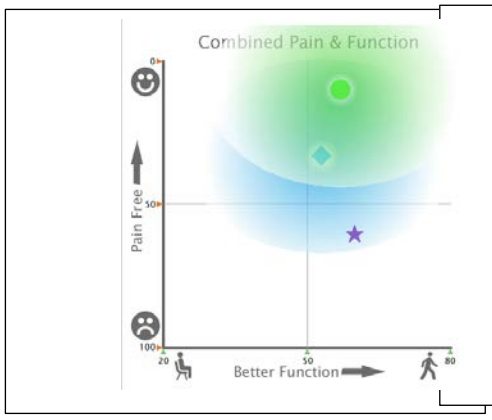
[The patient is directed to the screen displaying the bar graphs of pain and function.]

Part 3: Equipoise

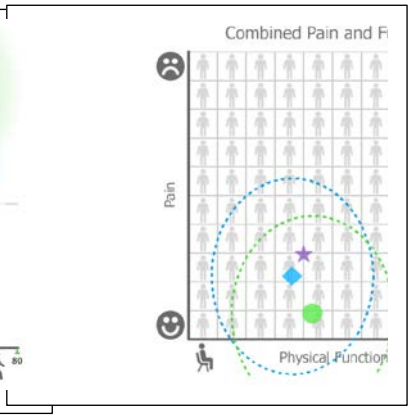
1. **Please look at the three scenarios below depicted from the results page.**
   - Let's imagine that a clinician is telling you about a research study with two options (surgical or nonsurgical treatment of knee OA). If you choose to participate in the study, you will be randomized to the surgical or nonsurgical treatment with equal chances of each treatment being the one you receive.
   - Looking at figure 1, would you choose randomization?
   - Looking at figure 2, would you choose randomization?
   - Looking at figure 3, would you choose randomization?
   - What's the amount of overlap that suggests your future pain and function will be about the same with or without surgery?



Small Overlap



Moderate Overlap



Large Overlap

Additional possible questions to add about the knee pain and physical function graphs to test for understanding:

Order:

- Does the order of Knee Pain results, then Physical Function results, and ultimately the results with Knee Pain and Physical Function together provide a logical and helpful organization of the information?

Concluding Questions:

- If you were unable to make a decision about treatment options after viewing this tool, what further information would you need?
- Did this questionnaire aid your decision making process in choosing between nonsurgical and surgical treatment for knee OA?
- Are there any other parts of this results page that you found unclear or confusing that you have not already mentioned?
- Are there any further changes that you would recommend for this questionnaire?

Version Two - Usability and Cognitive Testing Plan

This version of the usability testing plan was used for the final testing conducted with patients in the Rheumatology, Orthopedic and Primary care clinics.

Introduction:

Imagine that you (or someone you know) has knee osteoarthritis and is contemplating different options, including surgical and nonsurgical treatments. Now imagine that your clinician asks you to complete these questions in advance of the appointment [or possibly, you will complete the questions together with your clinician during that appointment]. Next, you and your clinician are going to make some decisions about the next steps for how to treat your knee osteoarthritis.

Note: When you see the term "physical function," it refers to how your health affects your ability to perform activities that you might do during a typical day.

Part 1: Questionnaire Usability

Please follow the prompts and instructions on the screen. The bar at the top will show your progress, and you can use the arrows to go backwards and forwards. Some of the pages require you to scroll down. You need to complete all of the questions on a page before you can go onto the next page. If you have any questions while completing the forms, please ask me. I will record your questions, so we can improve future versions of this questionnaire.

Part 2: Usability of Graphical Depiction of Predictions

Interpret the Bar graphs and Legend

- Tell me what you think this is telling you.
- What does the colored area around the value marked in the bar graph mean to you?
- *(Based on the information displayed, what does this tell you about the level of knee pain at one year with usual care and with knee replacement?)*
- *(Based on the information displayed, what does this tell you about the level of physical function at one year with usual care and with knee replacement?)*

Interpreting combined pain and function plots:

- What does this tell you?
- *(Based on the information displayed, what does this tell you about the outcomes at one year with usual care and with knee replacement?)*
- What are your likely outcomes if you do have surgery? Would you get better, worse, or do about the same?
- Given the uncertainty oval, how confident are you about that?
- What are your likely outcomes if you do not have surgery? Would you get better, worse, or do about the same?
- *(Based on the information displayed, what does this tell you about the outcomes at one year with usual care and with knee replacement?)*
- Given the uncertainty shape, how confident are you about that?
- How do you interpret the colored shape around the prediction?

Concluding Questions:

- Are there any other parts of this results page that you found unclear or confusing that you have not already mentioned?
- *Only ask if the patient is eligible for randomization as determined by the model with the orange bar in the application itself.* Imagine that there was a research study in which you were eligible to participate. The study is testing two different treatments for knee osteoarthritis; nonsurgical treatment or knee replacement. Considering that the model predicts that you would benefit from either knee replacement surgery or nonsurgical treatment, would you be willing to be randomized to a study in which you would have equal chances of you being assigned to either total knee replacement or to nonsurgical treatment? If no, why not? If yes, why would you choose to participate?