Usability Evaluation of a Computerized Behavioral Intervention for Diabetes Management

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Samina Abidi[1], Michael Vallis[2], Syed Sibte R. Abidi[3], Helena Piccinini-Vallis[4], Syed A. Imran[5]

[1]Medical Informatics Program, Faculty of Medicine, Dalhousie University

[2]NSHA Behavior Change Institute, Halifax NS

[3]NICHE Research Group, Faculty of Computer Science, Dalhousie University

[4]QEII Health Sciences Center, Halifax, NS

[5]Division of Endocrinology and Metabolism, Dalhousie University

Problem Description and Rationale

- Effective Diabetes Management depends on positive behavior of an individual
- Primary Care Diabetes Management in Canada
  - By FP and Certified Diabetes Educators (CDE) [nurses /dieticians qualified by the CDA] in Diabetes Management Centers (DMC)
- Behavior Change Institute (BCI) at NSHA offers provider training and support in helping pt. in behavior modification and self-management
- Lack of access to psychosocial resources within diabetes medical services
  - Family Physicians and Diabetes Educators are not well equipped to manage behavior change in individuals with low motivation
- Provider related issues
  - Perception of own role and competence to behavior modification
  - Lack of intensive competency based training programs
- Patient related issues
  - 70% of individuals living with diabetes do not have access to specialized care

Research Objectives

- To implement **DWISE –Diabetes Web-Centric Information & Support Environment**
  - That translate and integrate Diabetes clinical guidelines and behavior change models in an e-Health platform
    - To support family physicians and diabetes educators in achieving self-efficacy to deliver behavioral interventions to the patients with diabetes
    - To engage patients to modify harmful behaviors and self-manage their condition
- To assess how well **DWISE** meets the functional goals, usability needs and content suitability requirements for providers (FP & CDE) and patients

Solution Approach: DWISE Framework

HbA1C <7

Diabetes not controlled

DWISE Framework

DWISE Web-based Provider Tool

Integrate CPG and Behaviour change models

Assist PCP in offering medical advice and behaviour change strategies

DWISE Web-based Patient Tool

Integrate self-management materials and Behaviour change models

Engage patients by enacting the behaviour change strategies

DWISE Mobile Patient Diary

Assist in goal-setting, self-monitoring and provide feedback

DWISE is Grounded in theory

Knowledge Content

1. Behavior Change Models
   - i. SCT - an individual's self-efficacy expectations and perceived capabilities to perform self-care
   - ii. Readiness to change assessment
   - iii. Decisional balance

2. CDA CPG

Knowledge translation method

Healthcare Knowledge Management

i. Integrated ontology based knowledge model that form the backbone of the DWISE

ii. Used OWL - endowed with declarative semantics

iii. Allows the association of natural language descriptions with formal statements, thereby allowing human and machine readability

Research Methodology

- DWISE Implementation using a knowledge management approach
  - Behavior change knowledge identification & synthesis
  - Readiness assessment and self-management strategy development
  - Knowledge Modeling –DWISE ontology engineering
  - Implementation of Web-based tool for provider and patient
  - Implementation of Mobile app for patient

- DWISE Evaluation
  - Provider Tool evaluation with providers
  - Patient Tool evaluation with patients
  - A focus group study with both patients and providers

Knowledge Identification &

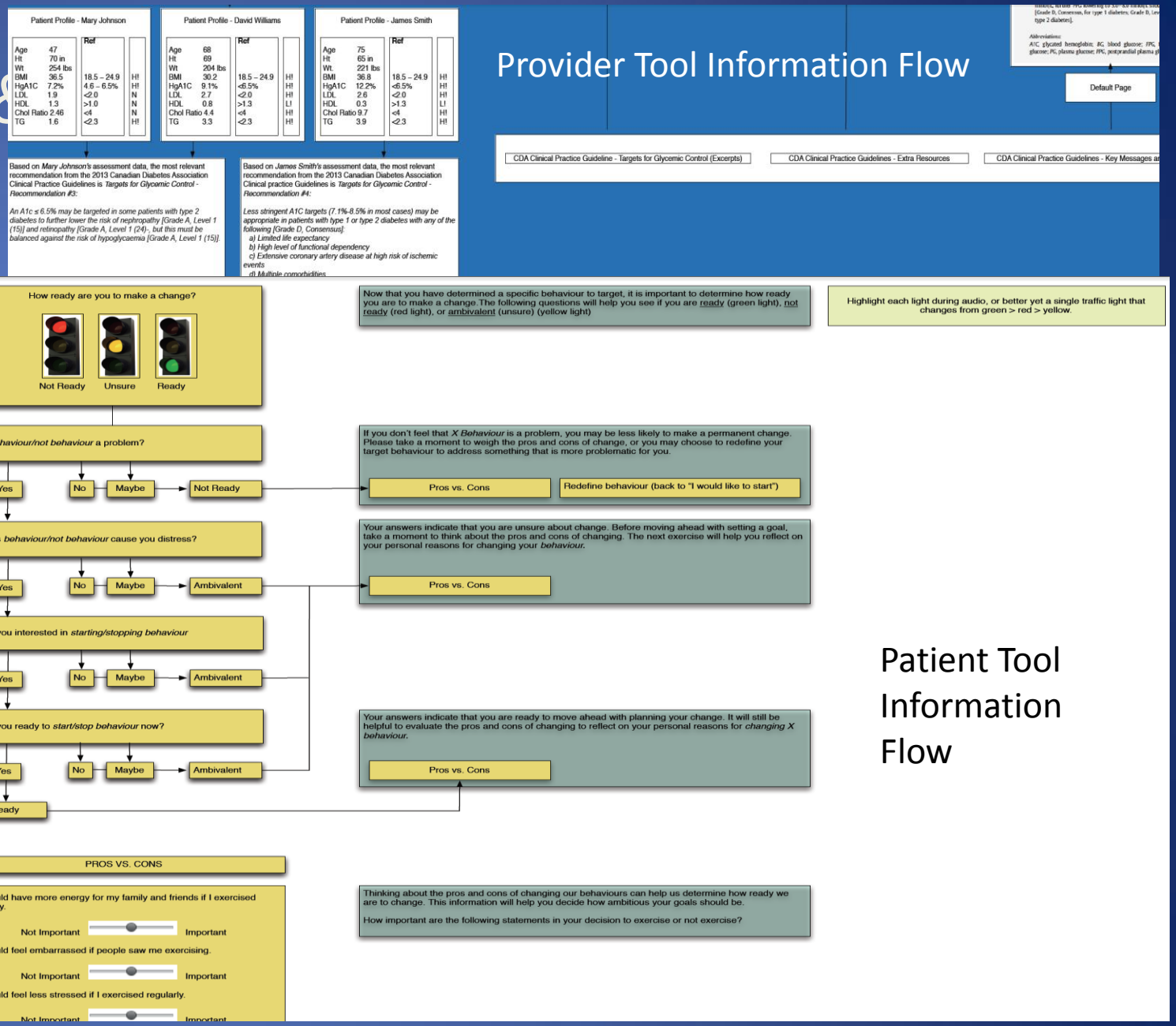
- Recommendation from 2012 Canadian Diabetes Assoc. CPG

- Behavior Models
  - Readiness Assessment in terms of Not Ready, Ambivalent and Ready
  - Decisional Balance when not ready or ambivalent
    - Provider - to evaluate pros and cons to recommending a patient target A1C based on CPG
    - Patient – to evaluate pros and cons to changing behaviors
  - Self-efficacy assessment

- Barriers to behavior change

- Personalized behavior change support materials and strategies for providers and patients

- SMART Goal setting support for patients via app (Interactive patient diary)

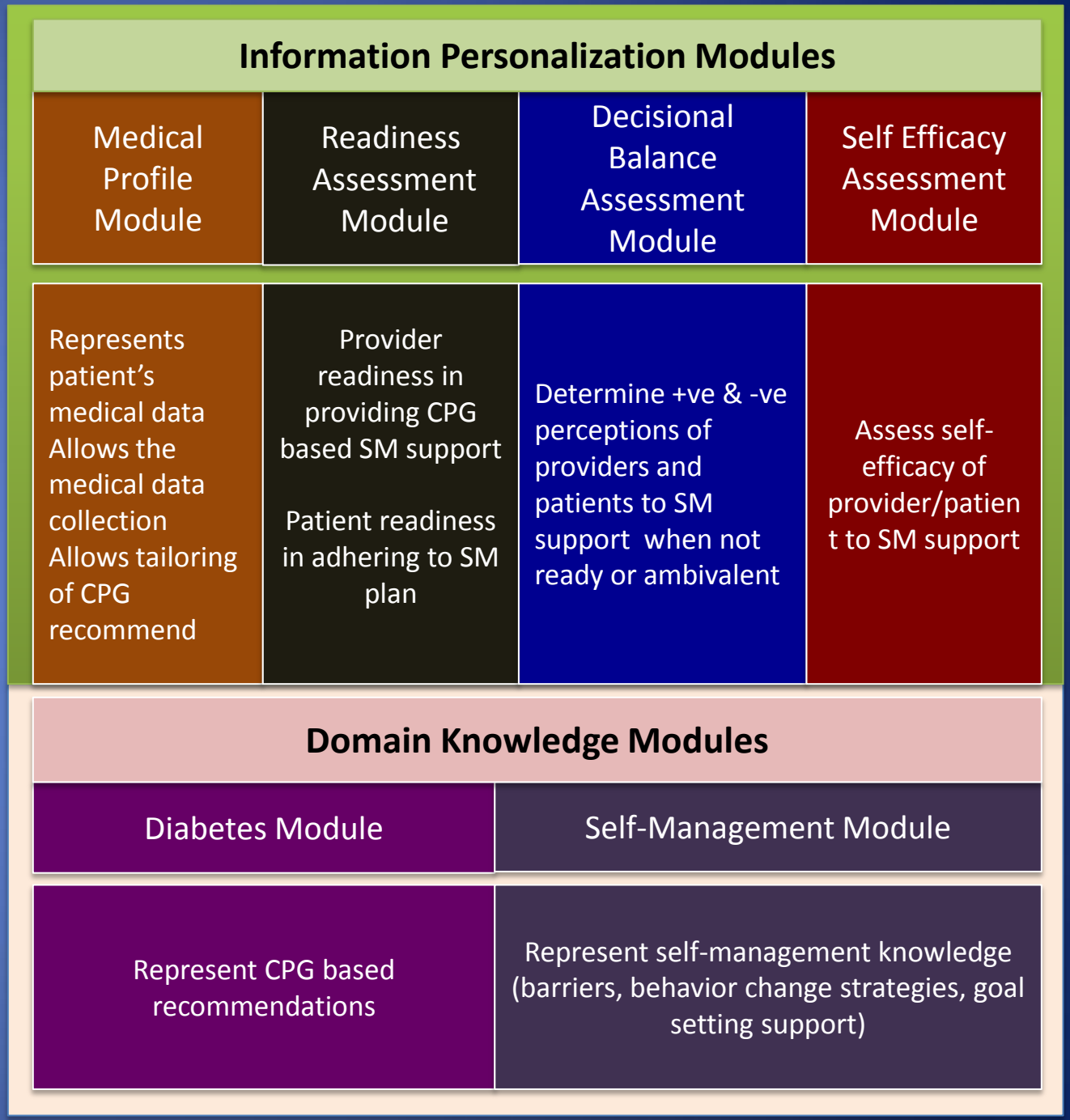


Patient Tool Information Flow

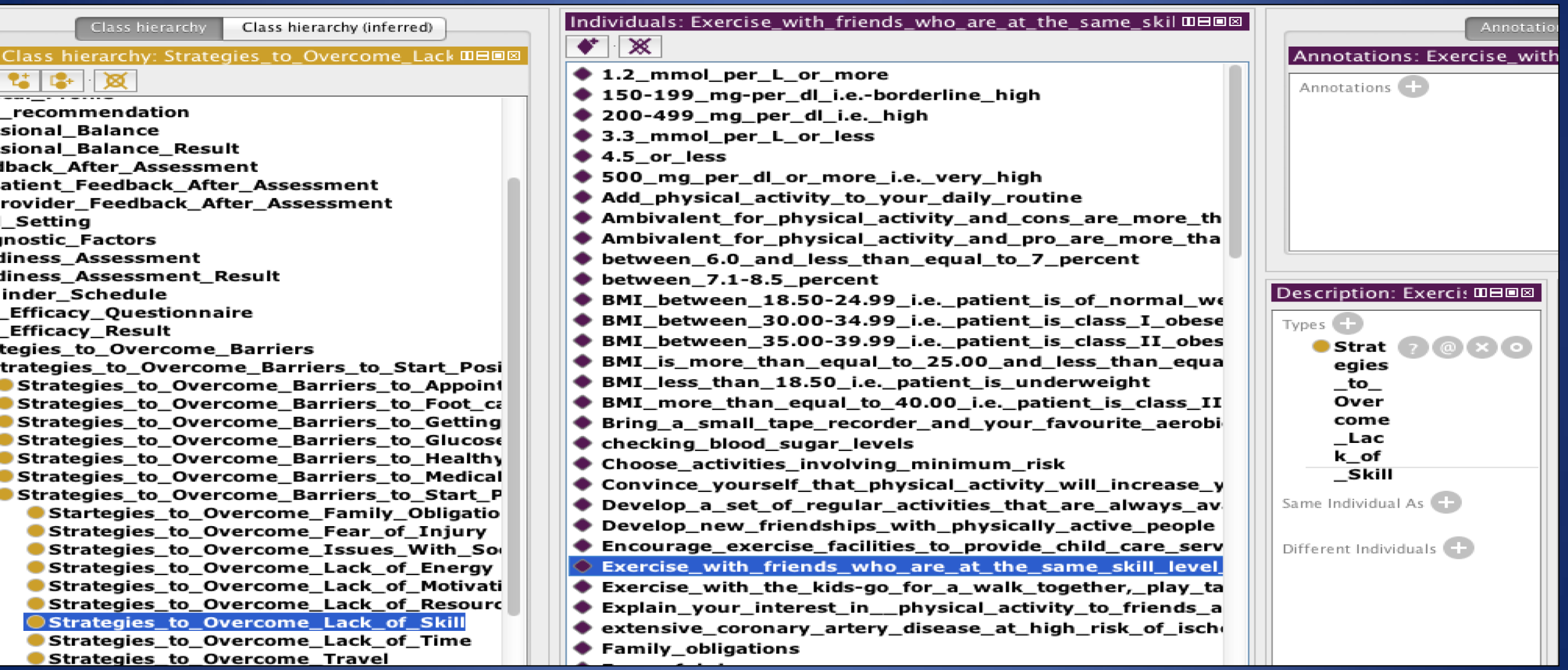
Identified logic in acc. to BCI workings and organize knowledge as such for provider and patient tool

Ontology Engineering

- Used Protégé 4.3.0 using OWL
- Ontology Modularization Approach
  - Smaller ontological modules
  - Self-contained and representative of a specific domain area
    - The modules are loosely coupled with as little interaction
    - Have definite relationships with other modules
  - Advantages
    - To handle cognitive burden of representation of multiple knowledge sources
    - Scalability
    - Reusability
    - Ontology Evaluation



Knowledge Modeling → ONTOLOGY Based Behavior Change Model



D-WISE

Readiness Assessment | CPG Evidence | Pros and Cons | Self-Efficacy Assessment | Self-Management Support | Behaviour Support

1) Do you consider it a problem that James Smith's A1c is >8.5%?

Yes No Maybe

Your Progress:

- ➤ Readiness Assessment
- Target Pros and Cons
- Evidence
- CPG Pros and Cons

D-WISE

Readiness Assessment | CPG Evidence | Pros and Cons | Self-Efficacy Assessment | Self-Management Support | Behaviour Support

- Determining the Target Behaviour
- Behaviour Change Support
- Building a Change Based Relationship
- Getting to the Behaviour
- Assessing Readiness
- Not Ready (RED LIGHT)
- Ambivalent (YELLOW LIGHT)
- Ready (GREEN LIGHT)
- Motivational Interviewing
- SMART Goals

Next

Determining the Target Behaviour

Determining which behaviour will best suit the clinical practice guideline recommendation depends on many things. Some recommendations may have more obvious behaviours associated with them and some may rely on your clinical judgement. The patient's profile and past behaviour will also play a large role in your decision of what area to target.

Below are some suggested behaviours for you to target with your patients that D-WISE will support.

You can select an area for your patient to focus on and they will use D-WISE to define their specific goals. You can then confirm that their goals are appropriate and their use of D-WISE will begin.

If you choose to have a conversation with your patient about the most appropriate target behaviour, you can refer to this resource on Getting to the Behaviour.

- Medication Adherence
- Blood Glucose Monitoring
- Nutrition
- Physical Activity
- Stress Management
- Emotions Management
- Sleep
- Smoking

Your Progress:

- ✓ Readiness Assessment
- Target Pros and Cons
- Evidence
- CPG Pros and Cons
- ✓ Self-Efficacy Assessment
- ➤ Behaviour Support

Patient Profile - James Smith

Age	71	-	-
Height	65in	-	-
Weight	221lb	-	-
BMI	36.8	18.5 - 24.9	H!
A1C	12.2	< 8.5%	H!
LDL	2.6	< 2.0	H!
HDL	0.3	> 1.3	L!
Chol Ratio	9.7	< 4	H!
TG	3.9	< 1.5	H!

Thinking about the pros and cons of changing our behaviours (or staying the same) can help us determine how ready we are to change. How important are the followi
opinions in your decision to exercise or not exercise? Click here if you would like more information on the benefits of physical activity.

D-WISE

Patient Support Setup Unit

Goal:

jogging

Introduction | S - Specific | M - Measurable | A - Action Oriented | R - Realistic | T - Timely

Now that you have an action-oriented goal, make it *specific*

- Is anybody else involved?
- Where will the action take place?
- When will you do it?
- Why do you want to achieve this goal?
- How will you reach this goal?

Now that you have had time to consider your level of readiness, pros and cons, and barriers to change, please answer the following questions:

How confident are you that you can start jogging?

Not Confident — Very Confident

How confident are you that jogging will improve your diabetes control?

Not Confident — Very Confident

Setting Schedule

Introduction
Getting to the Behaviour
Readiness Assessment
Pros vs. Cons
Identify Barriers
Goal Setting
Confidence/Conviction Questi
Scheduling
Summary

Regular exercise would help me have a more positive outlook on life.

Disagree — Agree

Exercise puts an extra burden on my significant other.

Disagree — Agree

DWISE Usability Evaluation

- To assess how well DWISE meets the functional goals, usability needs and content suitability requirements:
  - How easy it is to use DWISE?
  - How clear, understandable, useful and helpful is the information content in DWISE for the providers/patient?
  - Can we establish baseline user satisfaction and recommendation levels of system functionalities, interface and content

- To receive end-user feedback to identify potential areas of modifications to improve content, interface design and general ease of use
  - What are potential usability problems?
  - What are issues about the organization and comprehension of the information content ?

Study Design

- 2 mixed method usability studies with providers (Provider Study) and patients (Patient Study)
  - Sample size (10 providers and 11 patients)
- Quantitative: Questionnaires
  - Background/demographic Questionnaire
  - Post Study Questionnaires
    - 5 point Likert scale (1=strongly disagree to 5 strongly agree)
    - 4 themes
      - Learnability, i.e. How easy it is to learn and use DWISE (6 items)
      - Screen design, layout and navigation (8 items)
      - Content helpfulness, usefulness and understandability (8 items)
      - Overall satisfaction and recommendation (5 items)
- Qualitative: Think aloud protocol
  - **Provider Study**: Provided with 3 case scenarios in order to test them in DWISE
  - **Patient Study**: Provided with a standard behavioral recommendation i.e. physical activity that they have hypothetically agreed on with their FP/CDE.
  - Participants are encouraged to think aloud
    - Verbally express their thoughts about DWISE during interactions
  - Computer screen activity and audio recorded (QuickTme Player) to create TAP

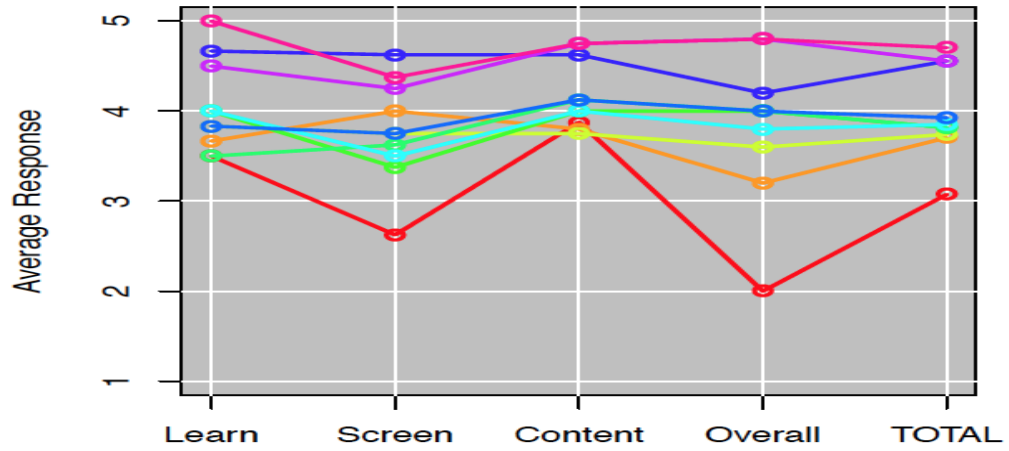
Background Information

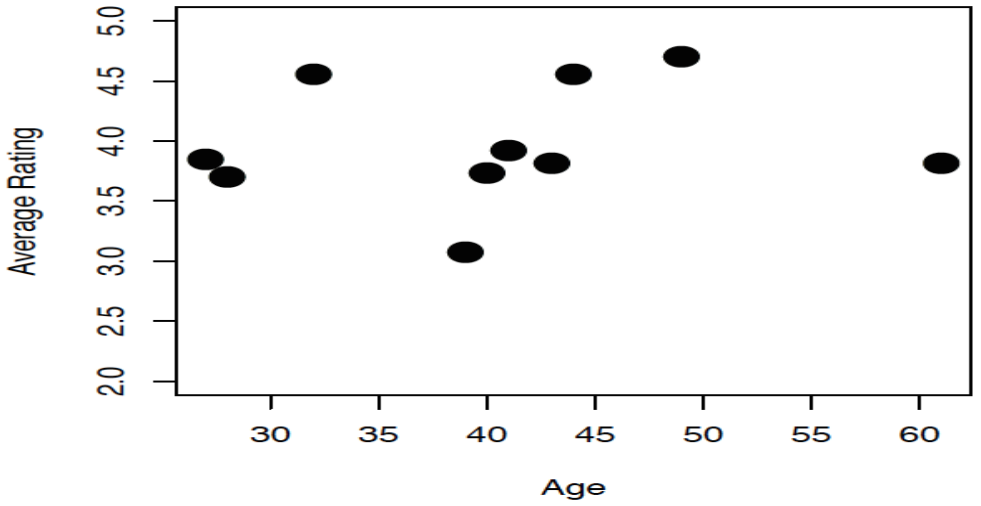
- **10 Providers** – 5 FP & 5 CDE, 9F & 1M
- Mean years of Practice: 11.9 years
- Comfortable with computers, Use EMR in practice , use of CDSS is variable
- Half have no BC training in past but use of BC strategies for patients

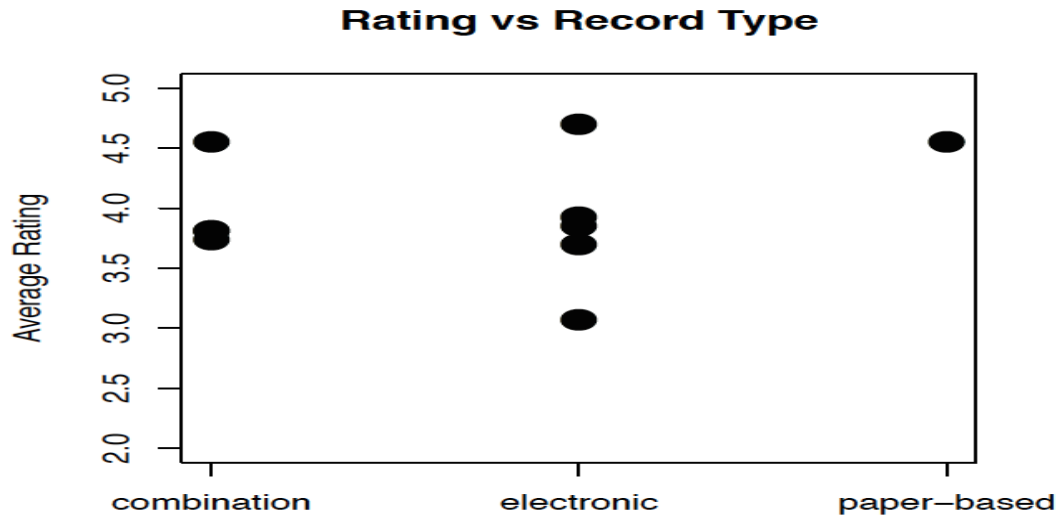
Item	Options	No. of Responses	%
Current Medical Record	Combination	4	40%
	Electronic	5	50%
	Paper-based	1	10%
Any decision support capabilities if electronic?	No	6	60%
	Yes	1	10%
	Unsure	3	30%
Seek CPG to aid patient care	No	1	10%
	Yes	9	90%
Seek patient care information online	No	0	0%
	Yes	10	100%
Comfort when using computers in general	Very comfortable	7	70%
	Moderately comfortable	3	30%
	Neither comfortable nor uncomfortable	0	0%
	Moderately uncomfortable	0	0%
	Very uncomfortable	0	0%
Frequency of Internet usage	Several times a day	10	100%
	Daily	0	0%
	Weekly	0	0%
	Monthly	0	0%
	Less than monthly or not at all	0	0%
Exposure to behaviour change training in the past	No	5	50%
	Yes	5	50%
If so, comfort in implementing behaviour change strategies in practice	Very confident	1	11%
	Moderately confident	4	44%
	Neither confident not unconfident	1	11%
	Moderately unconfident	2	22%
	Not at all confident	1	11%

- **11 Patients** – 10F & 1M
- Age: 24-64 years, median: 52 years, mostly urban
- Probably more educated then general population & quite comfortable with computers
- Most have received some BC support from variable sources

Item	Options	No. of Responses	%
Education	High School or Equivalent	1	9%
	Post Secondary degree	8	73%
	Graduate Degree	2	18%
Employment	Employed for wages	5	45%
	Unemployed	1	9%
	Retired	2	18%
	Unable to Work	2	18%
	Other	1	9%
Income	Under $10K	2	18%
	$10K-$20K	2	18%
	$30K-$40K	1	9%
	$40K-$50K	2	18%
	$50K-$75K	1	9%
	$100K-$150K	3	27%
Location	Urban	10	91%
	Suburban	1	9%
	Rural	0	0
Use of computers	Very Comfortable	5	45%
	Moderately Comfortable	4	36%
	Neither Comfortable Nor Uncomfortable	2	18%
Use of Internet for personal use	Daily	5	45%
	More Than Once Per Day	6	55%
Use of Internet to seek health information	Yes	10	91%
	No	1	9%
Received past behaviour change support to manage diabetes	Yes	9	82%
	No	2	18%
Behaviour change support provided by	CDE, Psychologist, Diabetes Clinic & Web-based support	1	9%
	Family physician, CDE, & Diabetes Clinic	1	9%
	Family physician, CDE, Diabetes Clinic & psychologists	1	9%
	Family Physician, Nurse, CDE & Psychologist	3	27%
	Family Physician; Nurse, CDE, Psychologist, Diabetes Clinic & Other (Hearts in Motion)	1	9%
	Family physician & Psychologist	1	9%
	Family Physician, Psychologist & Diabetes Clinic	1	9%
	Psychologist	1	9%
	Other (Bariatric Surgery Team)	1	9%
Confidence in using behaviour change strategies to manage diabetes when faced with barriers	Moderately unconfident	1	9%
	Neither confident nor unconfident	3	27%
	Moderately confident	3	27%
	Very confident	4	26%







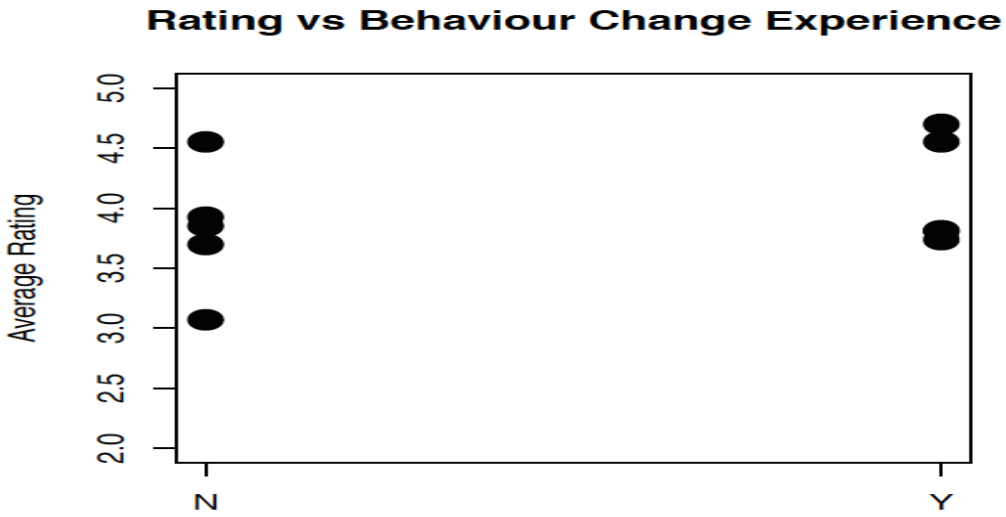


Figure 2: Individual ratings (top left), then comparing TOTAL score to the demographics

Table 3: Content. The average score was 4.18

Table 4: Overall. The average score was 3.84

re was 3.7875

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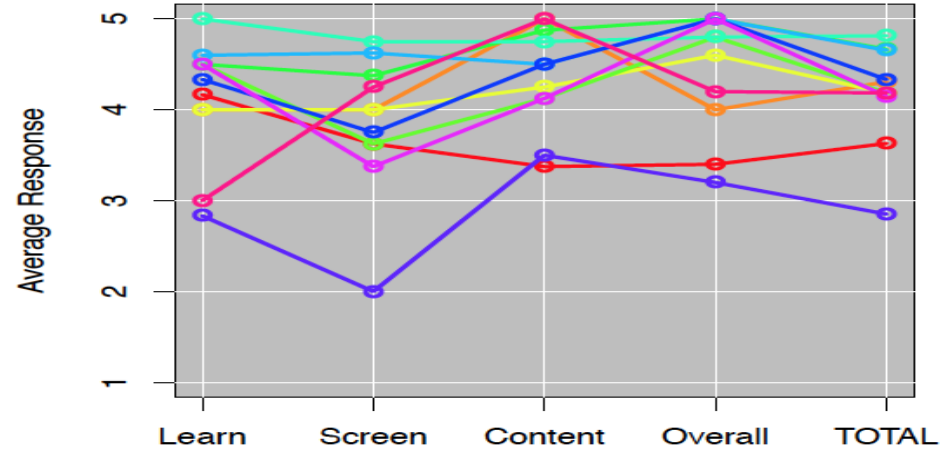

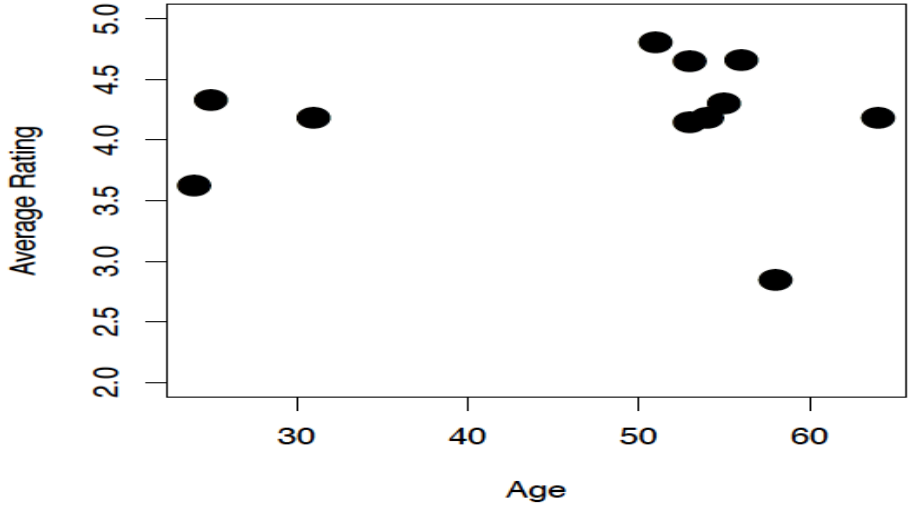

Table 1

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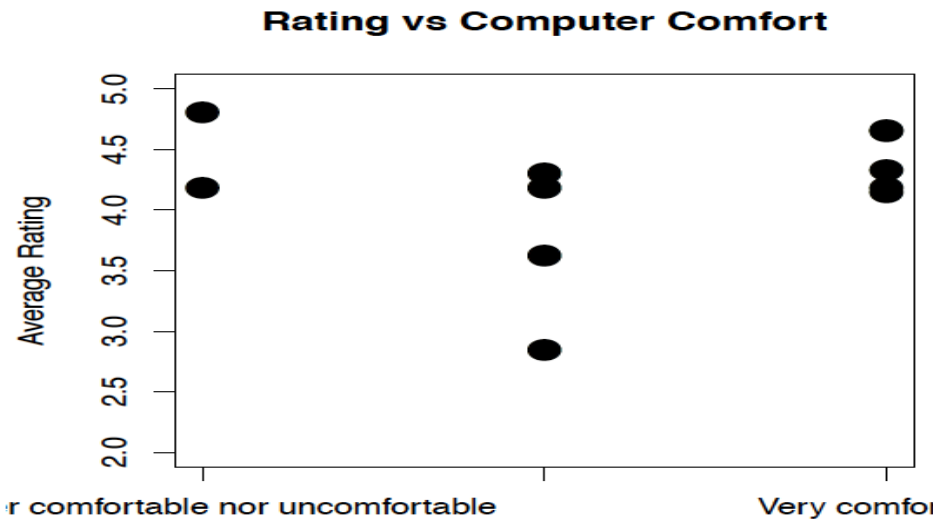

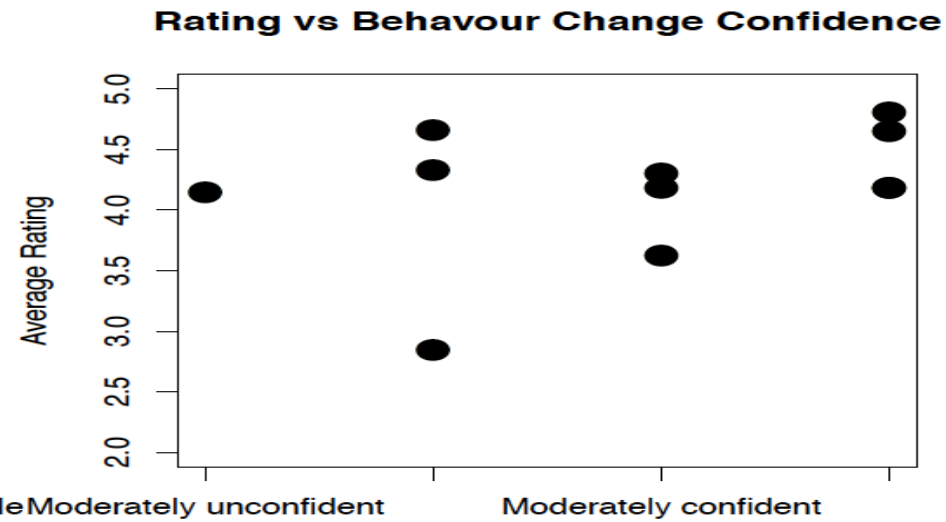

Table

Figure 2: Individual ratings (top left), then comparing TOTAL score to the demographics

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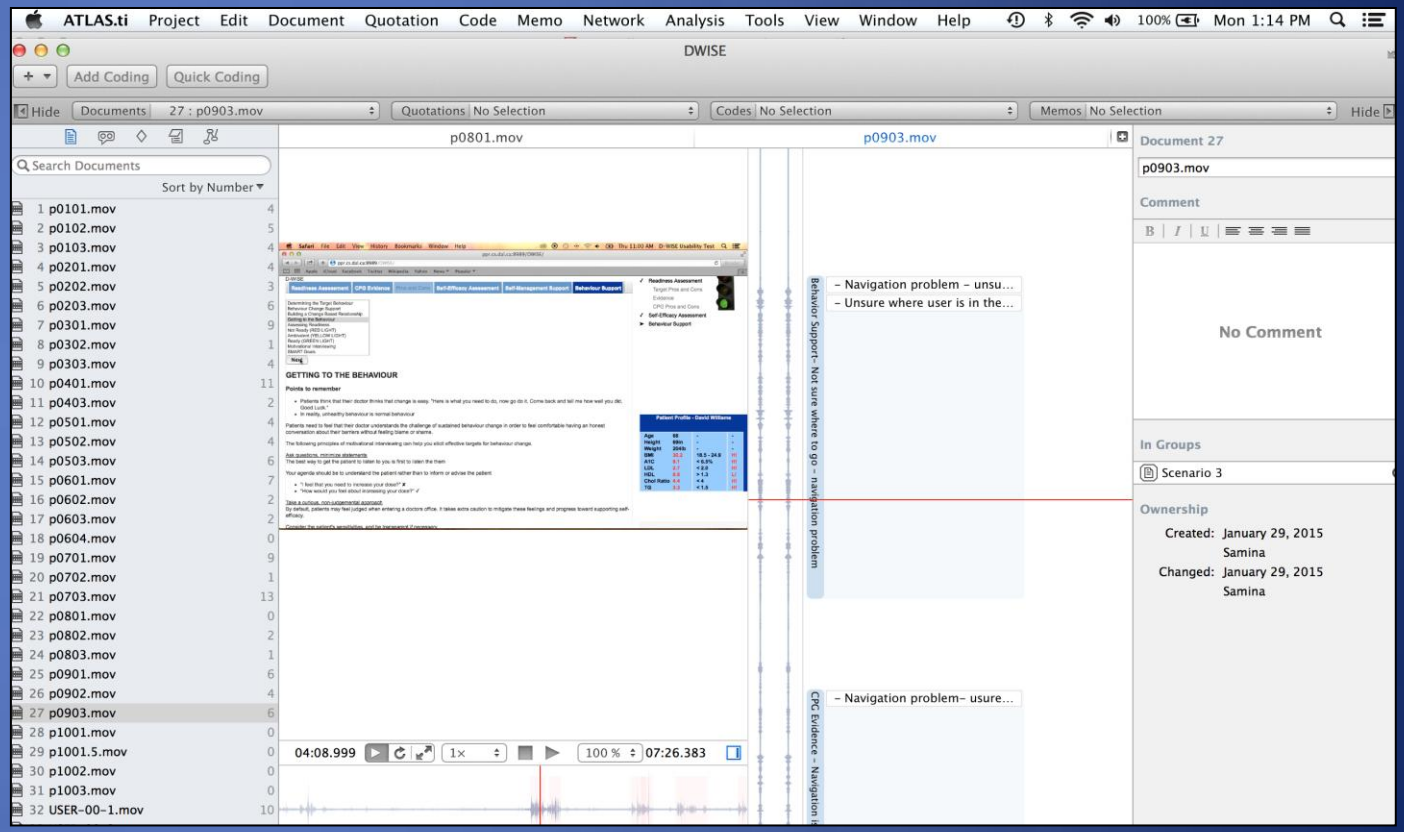
Qualitative Data Analysis

- Recorded screen activity and audio for all participants
  - 30 PCP TAP (3X10) & 11 patient TAP
  - Used AtlasTi Software
    - Allow direct selection of quotations and direct application of codes
    - Unit of Analysis- Quotations
- Performed thematic coding
  - Open coding (tentative labels for chunks of data)
  - Axial coding (identifying relationships among the open codes)



Qualitative Analysis of screen activity and audio Recording using Atlas Ti

Qualitative Results: Provider Tool

Name	
- Need more patient information for pros and cons	19
- Need more patient information for readiness assessment	11
- Behaviour change Information presenation and formatting issue	7
- Pros and cons statement confusing	6
- Need more patient information for self-efficacy assessment	5
- Self-efficacy statements must be more clear - how confident are you...	5
- CPG evidence shown is not relevant to issue at hand - lack of information personalization	4
- Difficulty in using sliding bars - pros and cons	4
+ Patient data display helpful	3
- Behaviour Change support statements unclear	3
- Pros and cons too wordy	3
- Too much information in behaviour change support content	3
- Too much scrolling required in behaviour change support page	3
- Behaviour change support information not personlized enough	2
- Disagree with readiness assessment result. Recomm is not acc. to GL based on patient data	2
- Inconsistent language use - Decisional balance vs. Pros and cons	2
- Navigation problem when selecting self-managment support vs. behaviour change support	2
- Navigation problem- usure when trying to get back to pros and cons after looking at CPG evidence	2
- Pros statement grammar mistake	2
- Scripted questions about targeting behavoiur to be asked to patients are too wordy	2
- Spelling mistake-Self Efficacy assessment	2
- Target behaviour resource links not active	2
+ Agree with CPG related statements in pros and cons	1
+ Agrees with text related to change based relationship	1
+ CPG evidence readily available	1
+ Finds interesting-results of her sef-efficacy assessment	1
+ Like abstract about TTM article and link to full article	1
+ Like BC support esp. building a changed based relationship	1
+ Like define a specfic behaviour information	1
+ Like name - DWISE	1
+ Like recommendation based on pros and cons	1

30 provider TAP yielded 31 open codes based on usability issues

Most critical codes include:

'Need more patient information for pros and cons' - grounded in 19 quotations &

'Need more information for readiness assessment' - grounded in 11 quotations

'Behavior change information and presentation' - grounded in 7 quotations

One such quotation is

"What would be really cool is that my answers in previous sections like self-efficacy questionnaire will tailor some of this information...that will be most beneficial instead of having to go through all of this...and this is way too much to process".

Qualitative Results: Provider Tool

17 – Axial Categories of Usability Issues emerged from open codes

Code Group	
Content presentation, formatting and readability	6
Difficult to learn	1
Improve practice overtime	1
Inadequate information/context for decision making	5
Lack of consistency and standards	3
Lack of content suitability and scope	6
Lack of content understandibility	3
Lack of relevancy or personalization of content	2
Lack of user guidance	1
Meaning of the labels is unclear	1
Navigation problems and lack of flexibility	8
Overall use of the system	1
Problems with lack of or inactive linkages in content	7
Recall rather than recognition	1
Reliability of content	7
Screen layout and features	5
Text quality- grammar and spellings	5
17 Group(s)	

Name	
- Behaviour change Information presenation and formatting issue	7
- Pros and cons too wordy	3
- Too much information in behaviour change support content	3
- Scripted questions about targeting behavoiur to be asked to patients are too wordy	2
- confused if same questions in 2nd Readiness assessment	1
- Self-efficacy result too wordy-time consuming to read	1
Result: 6 of 78 Code(s)	

The axial category ‘Content Presentation, Formatting and Readability’ comprises of 6 codes. ‘Behavior change information presentation and formatting issue’ is one of the 6 codes within this category and it was grounded in 7 different quotations.

Qualitative Results: Patient Tool

Name	
- Unsure of goal setting data entry field	11
- Sliding bar problems	7
- Problems with scrolling	6
- Barrier statement confusing	3
- Missed data input field for the behaviour to be started or stopped	3
- Use of 2 negatives in readiness assessment	3
- Clicks a box containing text	2
- Problems going back and forth	2
- Unsure about number of startegies to be chosen to overcome a barri...	2
- Barriers not directly related to physical activity	1
- Cannot change time once schedule is set	1
- Data input field for behaviour that is to be started or stopped not clear	1
- Font too small	1
- Goal scheduling questions does not match	1
- Goal setting entry field too small	1
- Some strategies are open and visible and others are not	1
- Specify text messages when scheduling reminders	1

11 Patient TAP yielded 17 open codes
based on usability issues

Most critical codes include:

'Unsure of goal setting data entry field' which was grounded in 11 quotations,

'Sliding bar problems' grounded in 7 quotations

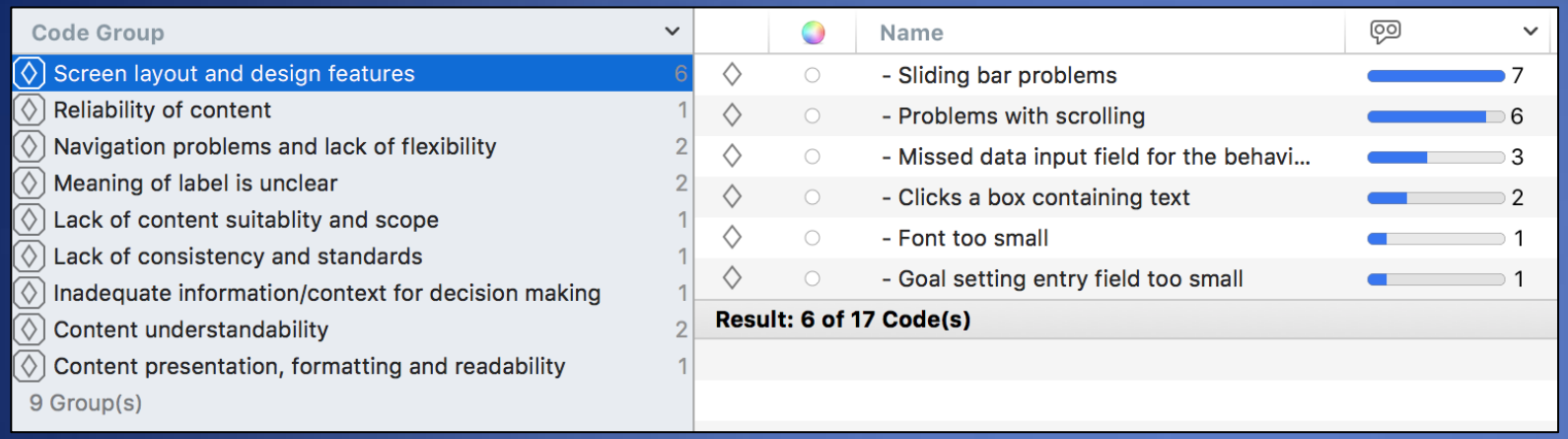
'Problems with scrolling' grounded in 6 quotations

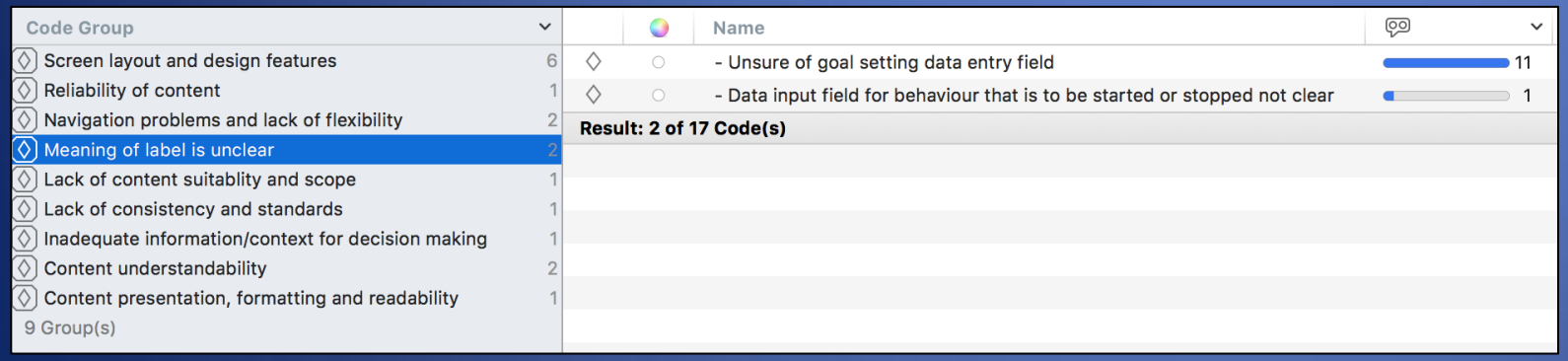
An exemplar quotation in which the code 'unsure of goal setting data entry field' is grounded in is as flows:

"I have entered my goal and now it is asking me to be specific…so it should be already some where…"

Qualitative Results: Patient Tool

9 – Axial Categories of Usability Issues emerged from open codes





'Screen layout and design features' contained 6 codes
One of the code 'Sliding bar problem' is grounded in 7 quotations

'Navigation Problems and Lack of Flexibility',
'Meaning of Label Unclear' &
'Content Understandability'
contain two open codes each

Focus group study with both providers and patients

- Objectives:
  - To engage patients and providers together,
    - To identify barriers and facilitators to the use DWISE for diabetes related behavior change support
    - To discuss the potential for its use in their interactions
    - To understand potential impact of DWISE on patient-provider communication and relationship when providing behavior change support to patients with diabetes
  - We are analyzing the focus group data and the results will be presented in future

Future Work & Conclusions

- An innovative approach that combines clinical guidelines and behavior change model
- An novel knowledge-centric approach to develop a high-level behavior change knowledge model
  - Scalable to include new knowledge about other chronic diseases
  - Flexible to apply to different behavior change programs
  - Agile to be deployed in web-based and mobile applications
  - Integratable to connect with other knowledge resources
- Demonstrated the potential of applying knowledge management and e-Health technologies for behavior change and chronic disease management
- Has been vigorously tested for its usability, functionality and acceptance through a series of usability studies
- Provider tool:
  - Most problems: navigation of the tool, and the presentation, formatting, understandability and suitability of the content in the tool
- Patient tool:
  - Most Problems: screen layout and design features, understandability of the content, clarity of the labels used and navigation across the tool

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THANK YOU

samina.abidi@dal.ca

NICHE Research Group
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